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IRWO

TECHNICAL SPECIFICATIONS FOR INTERNAL AND EXTERNAL ELECTRIFICATION WORKS AS APPLICABLE IN

भारतीय रेल कल्याण संगठन
INDIAN RAILWAY WELFARE ORGANISATION

SEPTEMBER, 2016

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Price Rs. 500/-

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भारतीय रेल कल्याण संगठन

PREFACE

In IRWO so far the Technical Specifications for Electrical Works were printed in tender documents and contract agreement making them bulky and resulting in consumption of large number of pages. Sometimes, the Technical Specifications for the same type of works varied from contract to contract also.

Now, endeavor has been made to standardize the technical Specifications for different types of electrical works. viz. Internal Electrification works, External Electrification works, D.G. Sets, Package type Substation and Lifts/Elevators. This will be uniformly applicable to al the electrical tenders and contract agreements. List of approved manufacturers for electrical/mechanical items for internal and external electrification works have also been standardized for all future contract agreements. Guidance to prepare this document has been taken from general Specification for electrical Works prepared by CPWD.

The standard Technical specifications for all type of electrical works has been printed in a single booklet which is a priced document and anyone can purchase it from IRWO's office on payment of prescribed charges. This will also be available on IRWO's website which will be a small contribution in the direction of 'Digital India'.

All General Managers, Chief Project Managers, Site Engineers, Project Engineers, Design Engineers and Manager/Finance shall keep a copy of this document in their personal custody. This document has been prepared with due diligence. If any discrepancy is noticed, the same may be brought to the notice of the undersigned so that appropriate action can be taken to rectify the same.

Place: New Delhi
Dated: 01-08-2016

(DEEPAK KRISHAN)
MANAGING DIRECTOR

SECTION -1

TECHNICAL SPECICATIONS FOR EXTERNAL ELECTRIFICATION WORKS

NOTE : TECHNICAL SPECIFICATIONS AS DETAILED BELOW ARE GENERAL IN NATURE AND WILL BE APPLICABLE WHERE EVER REQUIRED BASED ON SCOPE OF WORK, BOQ AND DRAWINGS.

The Electrical Installation shall be carried out in accordance with the provisions of National Electrical Code . It shall also be in conformity with regulations and requirements of the Local Electricity Supply Authority.

i) CONTRACTOR'S DRAWINGS :-

- **Manufacturers' Drawings:** - The CONTRACTOR shall provide manufacturer's drawings, where applicable, or when requested by the IRWO / ENGINEER-IN-CHARGE. The manufacturer's drawings shall clearly, show all dimensions, details, specifications connections/ joints etc.

- **Approval of Drawings :-**

  All drawings prepared by the CONTRACTOR shall be submitted at the appropriate time to the ENGINEER-IN-CHARGE /IRWO by the CONTRACTOR .IRWO shall check and approve these drawings in a reasonable time and issue them to the CONTRACTOR as "Approved for Construction". Such approval shall however not relieve the CONTRACTOR of responsibility for any discrepancies, errors or omissions in their submittals.

  The works shall be carried out in accordance with the Electrical Drawings to be issued by IRWO / ENGINEER-IN-CHARGE as "Approved FOR CONSTRUCTION".

ii) BAR CHART FOR EXECUTION OF WORK :-

The Contractor shall submit within one week of the acceptance of the tender, a BAR Chart to ENGINEER-IN-CHARGE, which shall indicate the planning for the execution of the entire work under the contract within the stipulated time given for completion. This shall be scrutinized by the ENGINEER-IN-CHARGE. The mutually agreed BAR CHART shall be binding on the Contractor for progress of the work & for completion by the due date.

The Contractor shall during the entire tenure of site work, provide accurate monthly reviews of BAR-CHART showing work targets & completed works for discussions with the IRWO.

Contractor's shall maintain a register of daily deployment of Electrician, Skilled/Unskilled Labour etc. on various activities and get it signed from Engineer-In-Charge on daily basis and shall produce before the IRWO as and when asked for.

iii) As Built Drawings and Maintenance Instruction Manuals:-

- The CONTRACTOR shall provide to the ENGINEER-IN-CHARGE / IRWO prior to the time of completion of the works as Built Drawings and Maintenance Instruction Manuals for all the equipments within the scope of work. On completion of any relevant works the CONTRACTOR shall prepare two sets of "As Built" drawings of such works for their approval by Engineer-In-Charge. These drawings shall be a complete record of the works showing the positions and dimensions of all elements executed within the CONTRACTOR's scope of work.

- After approval by the ENGINEER-IN-CHARGE the CONTRACTOR shall forward to the IRWO four copies of the approved "AS BUILT DRAWINGS" & Working and Maintenance Instructions Manuals and four prints and one reproducible copy of each drawing. Drawings files on compact disc (CD) shall also be forwarded.

iv) **QUALITY OF MATERIALS & GENERAL STANDARDS OF WORK :-**

The CONTRACTOR under this contract commits himself to use first class materials and assumes full responsibility for the quality of all materials incorporated or brought for incorporation in the work. The work shall be executed in accordance with the best Engineering practice and as per directions of ENGINEER-IN-CHARGE.

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TECHNICAL SPECIFICATIONS FOR EXTERNAL ELECTRIFICATION WORK WITH CONVENTIONAL OIL FILLED, OUTDOOR TYPE TRANSFORMERS

1.0 RING MAIN UNIT (11 KV)

1.1 GENERAL

The design, manufacture, supply, erection, testing & commissioning of the 11KV, 3 Phase, 3 wire outdoor Extensible Network Ring Main Unit comprising of the following:-

(i) 2 Nos. 630Amp Line Load Break disconnector Switches.

(ii) 1 No 630 Amp Feeder VCB / SF6 Circuit Breaker with self powered over current and earth fault relay with IDMT curves instantaneous setting and testing port.

(iii) Operation - The Ring Main Unit shall be suitable for Outdoor installation with the following levels of ingress protection.

a. Insulating medium envelope not less than IP -65

b. RMU exterior housing not less than IP -54 (Main Door shut)

c. RMU exterior housing not less than IP-41 (Main Door Open).

1.2 CODES AND STANDARDS

The RMU shall comply with the latest requirements/ standards as per applicable IS / BS / IEC specifications.

1.3 SYSTEM PARAMETERS:

The RMU shall be capable of withstanding the following

Network	Three phases - Three wires
Rated Voltage	12kV
Service Voltage	11kV
System Frequency	50 Hz
Lightning Impulse withstand Voltage • Phase to phase, phase to earth • Across the isolating distance	 75 kV 110 kV

Power Frequency withstand voltage	28 kV rms - 1 min
Rated Normal Current • Incomer Load Break Switch • Feeder Circuit-breaker	 630 A 630 A (As per drawing)
Rated Short time current withstand (3 sec)	20 kA
Rated Short circuit making capacity of line switches and earthing switches	52.5 kA peak at Rated Voltage
Number of operations at rated short circuit current on line switches, earthing switches and Circuit Breakers	5 closing operations
Rated load interrupting current • Incomer Load Break Switch	 630 A rms
Rated cable charging interrupting current • Incomer Load Break Switch	 30 A
Rated magnetizing interrupting current • Incomer Load Break Switch	 16 A

1.4 DIELECTRIC MEDIUM :-

SF6 gas is the preferred dielectric medium for MV RMUs. SF6 gas used for the filling of the RMU shall be in accordance with IEC 376.

1.5 EARTHING OF METALLIC PARTS :-

There shall be continuity between the metallic parts of the switchboard and cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of people.

The substation frames shall be connected to the main earth bus bar without dismantling any bus bars.

1.6 EARTHING OF THE MAIN CIRCUIT :-

The cables shall be earthed by an earthing switch with short-circuit making capacity, in compliance with the latest IEC standard. The earthing switch can only be operated when the switch is open.

The earthing switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast-acting mechanism, independent of operator action.

The moving contacts of the earthing switch shall be visible in the closed position through transparent covers.

Mechanical interlocking systems shall prevent access to the operating shaft to avoid all operator errors such as closing the earthing switch when the switch is closed.

1.7 **INCOMER LOAD BREAK SWITCHES :-**

They shall be maintenance-free, with breaking in low pressure SF6 gas. The position of the power contacts and earthing contacts shall be clearly visible on the front of the switchboard. The position indicator shall provide positive contact indication in accordance with latest IEC standard. In addition, manufacturer shall prove reliability of indication in accordance with latest IEC standard.

The switches shall be of the "increased operating frequency" in accordance with latest IEC standard. They shall have 3 positions, open-disconnected, closed and earthed, and will be constructed in such a way that natural interlocking prevents unauthorized operations.

The switches and circuit breaker shall be inside cast resin enclosure and inspected in the factory.

Manual opening and closing will be driven by a fast-acting mechanism, independent of operator action.

Each switch can be fitted with an electrical operating mechanism in a specially reserved location, without any modification of the operating mechanism and without de-energizing the switchboard.

The switch and earthing switch operating mechanism shall have a mechanical endurance of at least 1000 operations as per IS.

1.8 **CABLE END BOXES :-**

The Cable end boxes at each of the two ring switches suitable for 3 core, 185 sq.mm. 11KV XLPE cable approaching from below and fitted with frilled gland plates.

The tee off circuit breakers shall be fitted with an additional cable box and gland plate suitable for 3 core, 185 sq.mm. 11KV XLPE cable.

1.9 **CABLE CLAMP :-**

A non Ferro-magnetic cable clamp arrangement must be provided for all network cables terminated on the RMU.

1.10 **PADLOCKING FACILITIES :-**

The circuit breakers and earthing switches can be locked in the open or closed position by 1 to 3 padlocks 6 to 8mm in diameter.

1.11 **VOLTAGE INDICATOR LAMPS AND PHASE COMPARATORS :-**

Each function shall be equipped with a voltage indicator box on the front of the device to indicate whether or not there is voltage in the cables. The capacitive dividers will supply low voltage power to the lamps.

Three inlets can be used to check the synchronization of phases.

This device shall be in compliance with latest IEC standard.

1.12 **SAFETY OF PEOPLE :-**

Any accidental overpressure inside the sealed chamber will be limited by the opening of a pressure limiting device in the rear part of the enclosure. Gas will be released to the rear of the switchboard away from the operator. Manufacturer shall provide type test report to prove compliance with the latest IEC standards

1.13 **OPERATING LEVER :-**

An anti-reflex mechanism on the operating lever shall prevent any attempts to reopen immediately after closing of the switch or earthing switch.

All manual operations will be carried out on the front of the switchboard.

The effort exerted on the lever by the operator should not be more than 250 N for the switch and 250 N for the circuit breaker.

1.14 **FRONT PLATE :-**

The front plate shall have an IP2XC degree of protection. The front shall include a clear mimic diagram which indicates the different functions.

The position indicators shall give a true reflection of the position of the main contacts. They shall be clearly visible to the operator.

The lever operating direction shall be clearly indicated in the mimic diagram.

The manufacturer's plate shall include the switchboard's main electrical characteristics.

1.15 **CABLE INSULATION TESTING :-**

It must be possible to test the core or the sheath insulation of the network cables while the RMU remains energized at rated voltage. It shall be preferable to carry out the phase by phase testing through a built-in facility without necessity to have an access to cable compartment.

2.0 **11KV VACUUM CIRCUIT BREAKER FOR RMU :-**

2.1 **GENERAL :-**

Vacuum Circuit Breaker shall be incorporated in H.T. Panel wherever specified. VCB's shall conform to latest IEC 298 and 694 IS 3427, BS 5227 and VDE 0670, part 6 as well as the regulations mentioned therein. VCB's shall be suitable for operation on 11KV, 3 phase, 50Hz, AC supply.

2.2 **TYPE AND CONSTRUCTION :-**

2.2.1 The metal clad panel shall be fully extensible and compartmentalised to give.

a. Circuit Breaker Compartment

b. Busbar Compartment

c. CT and Cable Compartment

2.2.2 The compartments shall be safe to touch and compartments thus formed shall be dust proof & vermin proof. A separate metering chamber for fixing the necessary instrumentation metering and protective equipment shall be mounted on the top and bottom of the panel at the front.

2.2.3 The VCB shall consist of three air insulated poles incorporating mechanism of interrupters. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalised aluminium oxide. The contacts shall be of chromium copper and butt shaped.

2.2.4 Vacuum circuit breaker shall be mounted on truck or a carriage mechanism. In case of truck mechanism, the breaker shall be on a trolley while in a carriage mechanism, shall be separate door and it shall be possible to perform all operations with front door closed. The drawout carriage shall have two position for the circuit breaker viz isolated/test & service position. Busbars shall be insulated type made of high conductivity copper supported on cast epoxy monobloc designed to withstand full short circuit currents and shall be provided all along the length of the H.T. board.

2.2.5 It shall be horizontal isolation, horizontal drawout type, fully interlocked, with dust and vermin proof construction, suitable for indoor installation. The panel shall be supplied with the manufacturer's test certificates.

2.2.6 Certificates with date of manufacture and shall be complete in all respects as per details in the schedule of quantities. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognised phosphating process and shall then be given powder coating (Electostatic) paint of manufacturer's standard shade.

2.2.7 The switchgear constructions shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panel shall be specially designed to withstand these. Pressure relief flaps shall be provided for safely venting out gases produced inside the high voltage compartment, busbar compartment and termination compartment. These flaps shall be vented upwards and cannot be opened from outside. These relief flaps shall be of such construction as not to permit ingress of dust/water in harmful quantities under normal

working conditions. Enclosure shall be constructed with sheet steel of atleast 2.0 mm thickness. It shall have a rigid, smooth, leveled, flawless finish.

2.2.8 Total height of the H.T. Panel board shall be 2700mm approximately and width 620mm (approx.). On the incoming breaker panel, a 200VA burden and Class I accuracy potential transformer $11KV/\sqrt{3}/110V/\sqrt{3}$ with LT fuses shall be provided. These shall be three single phase PTs cast resin insulated type. Adequate space at the rear of the panel shall be provided for termination of power & control cables. The panel shall be provided with suitable terminating arrangement for termination of cables.

2.2.9 The making contact arms (upper & lower) of the circuit breaker shall be encased in polyprolene tubes. Penetration type bushings shall be provided in the busbars & cable compartment for the fixed contacts.

2.2.10 Safety shutters shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the carriage is moved to Isolated/Disconnected position. The shutters shall move automatically with the movement of the drawout carriage. It shall, however, be possible to open the shutters of busbars side and cable side individually.

2.2.11 Mechanically operated circuit breaker auxiliary switches of minimum 5 NO + 5 NC ways, shall be provided for control and indication purposes. Control wiring shall be done by using 1.5 sq.mm, 1.1KV grade stranded copper PVC insulated cable. All control fuses shall be HRC link type.

2.2.12 Terminal blocks shall be clamp type suitable for connection of only 2 wires per terminal and shall be 650 V grade. The L.T. control circuit shall be routine tested to withstand 2.0KV for one minute.

2.2.13 Busbar compartment shall be provided at the rear. Electrolytic copper busbars shall be of rectangular cross section and insulated. Busbars shall be supported properly by cast epoxy resin insulators so as to withstand thermal and dynamic stresses during system short circuits. Busbars shall be provided with necessary colour coding for phases indication. The busbars shall be designed to withstand a temperature rise of 60 deg. C above and ambient temperature of 45 deg. C.

2.3 **BUSBAR AND INSULATORS** :-

2.3.1 All busbars and jumper connections shall be of electrolytic copper conforming to relevant IS standards. They shall be adequately supported on epoxy insulators to withstands electrical and mechanical stresses due to specified short circuit currents. Busbar cross sect[illegible] be uniform throughout the length of switch board.

2.3.2 Contact surface at all joints shall be properly cleaned and No-oxide grease applied to ensure an efficient and trouble free connections. All bolted joints shall have necessary washers for maintaining adequate contact pressure. All connection hardware shall have high corrosion resistance.

2.3.3 Busbar insulators shall be of track-resistance, high strength, non-hygroscopic, non-combustible type & shall be suitable to withstand stresses due to over voltages and short circuit current. Busbar shall be supported on the insulator such that the conductor expansion and contraction

are allowed without straining the insulators. The temperatures of the busbars and all other equipments, when carrying the rated of relevant Indian Standards. duly considering the specified ambient temperature.

2.4 **EARTHING AND PROTECTIVE EARTHING** :-

Copper earthing bus shall be provided. It shall be bolted/ welded to the frame work of each panel. The earth bus shall have sufficient cross section to withstand fault currents to earth without exceeding the allowable temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting Owner's earthing conductors and earth bus shall run inside at the back of the panel for entire length. Facilities shall be provided for integral earthing of busbars & feeder circuit.

2.5 **METERING AND PROTECTION** :-

The VCB Panel Board shall be provided with epoxy resin current transformers for metering and protection. The CT's shall conform in all respects to IS 2705-1964 Part-I, II and III. These shall have accuracy class of 1.0 for metering of 5P10 for protection. Potential transformers shall be epoxy cast resin type & conform to specifications of IS : 3156-1965 Part-I, II & III and shall be class-1. Ammeter and voltmeter to be installed on panel shall be of moving iron type or digital type. Electronic type digital energy analyser having parameter of KW, KWH power factor, frequency etc. with 30 days memory shall be provided. All meters shall be tested for 2000V for 1 minute and shall be 96mm square pattern, flush mounting type with necessary selector switches. Necessary indicating lamps of low voltage type with built in resistors or LED type shall be provided (maximum wattage 2.5W).

2.6 **OPERATING MECHANISM** :-

Vacuum Circuit Breaker shall be equipped with motorised spring charge. These operating mechanisms shall be of the stored energy type. In the closed state of the breaker, the energy stored in the springs shall be suitable for O-C-O duty.

2.7 **INTERLOCKING AND SAFETY ARRANGEMENT** :-

Vacuum Circuit Breaker shall be provided with the following safety and interlocking arrangements:

i. The drawout carriage cannot be moved from either test/disconnected to service position or vice versa, when the circuit breaker is 'On'.

ii. The circuit breaker cannot be switched 'ON' when the carriage is in any position between test & service position.

iii. The front door of the panel cannot be opened when the breaker is in service position or in an intermediated position.

iv. The low voltage plug & socket cannot be disconnected in any position except test/isolated position.

v. The door cannot be closed unless the LV plug has been fitted.

vi. It shall be possible to mechanically close and trip the circuit breaker through push buttons with the circuit breaker in service position and the door closed.

vii. Individual explosion vents shall be provided for breaker, busbar, cable chambers on the top of the panel to let out the gases under pressure generated during an unlikely event of a fault inside the panel.

viii. Circuit Breaker & sheet metal enclosure shall be fully earthed.

ix. Self locking shutters shall be provided which close automatically and shall be interlocked with the movement of the drawout carriage mechanism.

2.8 **RATING :-**

The rating of the vacuum circuit breaker shall be as per the drawings and schedule of quantities. The rated/breaking capacity of the breaker shall be 350 MVA (18.37 KA RMS) at 11 KV. The rated making capacity shall be as per the relevant standards.

2.9 **ACCESSORIES :-**

Circuit Breakers shall be provided with the following accessories.

i. Auxiliary Switch with minimum 5 NO+ 5 NC auxiliary contacts.

ii. Tripping Coil

iii. Mechanical Operation Counter

iv. Spring Charging Handle

2.10 **ADDITIONAL ACCESSORIES :-**

The loose items to be supplied with the 11KV VCB Panel Board shall comprise of the following :

a. Instruction Book.

b. Maintenance Manual.

c. Reaching in/out handle.

d. Handle for spring charging mechanism.

e. Foundation bolts.

f. Busbar Earthing / Earthing Trolley .

2.11 **MOUNTING :-**

Vacuum Circuit Breakers shall be mounted as per manufacturers standard practice.

2.12 **AUXILIARY SUPPLY :-**

a. The tripping shall be at 110 Volt D.C. through a power pack unit. Each breaker shall have separate power pack.

2.13 **TESTS :-**

FACTORY TESTS :-

The circuit breakers panel shall be subjected to routine tests at manufacturers works in accordance with the details specified in the relevant IS specifications. These shall however necessarily comprise of the following.

a. Power frequency voltage test on the main power circuit.

b. Verification of the correct wiring/Functional Test.

c. Dielectric test at 1.5KV on the control circuit. Apart form above, the vendor shall submit the routine test certificates for the following equipment.

   i. Circuit Breakers

   ii. Current Transformers

   iii. Voltage Transformers

The vendor shall submit the type test certificate for following alongwith the offer.

a. Temperature rise test.

b. Impulse & power frequency voltage test

c. Short time current test on circuit breaker.

2.14 **SITE TEST :-**

GENERAL :-

1. Verification for completion of equipment, physical damage/ deformities.
2. Alignment of panel, interconnection of busbars & tightness of bolts & connection etc.
3. Interconnection of panel earth busbar with plant earthing grid.
4. Inter panel wiring between transport sections.
5. Cleaniness of insulators and general Cleaniness of panel to remove traces of dust, water etc.

CIRCUIT BREAKER & PANEL :-

1. Check for free movement of circuit breaker, lubrication of moving part & other parts as per manufacturers manual.
2. Manual/Electrical operations of the breaker and Functional test as per drawings.
3. Meggar before the Hi Pot test.
4. H.T. Test - Hi Pot test (Power frequency withstand test for one minute at 28KV RMS). At site Hi Pot test is carried out at 80% of 28KV RMS value.
5. Meggar after the Hi Pot test.
6. CT/PT ratio/polarity primary injection test.
7. Secondary injection test on relays to practical characteristics.

2.15 These tests as per the clauses above will be witnessed by the owner/consultant at the works for which necessary information has to be given in advance to the owner/ consultant.

3.0 11 KV/ LT OVERHEAD DISTRIBUTION SYSTEM :-

3.1 11 KV DOUBLE POLE STRUCTURE :-

3.2 SCOPE:-

This specification covers the requirement for installation testing and commissioning of over head distribution lines up to and including 11 KV service connection and the materials used there in. Also this section lays down the general requirement and specifications of Double Pole (DP) Structure. General scope of work shall include supply, fabrication, erection, testing and commissioning of two pole structures as per standards and complete with foundation material, which includes gang operated isolators, cross arms, drop out fuses, lighting arrestors, stain type insulators, flexible jumpers, outdoor type cable end terminations, meter box etc. all steel structures shall be rigid in construction and complete with G.I. anti climbing device etc. to the satisfaction of the owner and/or its representative. The location of structure shall be decided in consultation with owner and local Electricity distribution agency in such a way that it will not obstruct in the future extension of the building and at the same time required length of H.V. cables should also be minimum from structure of H.V. switchgear sub-station.

3.3 STEEL TUBULAR POLES :-

The main vertical girders (poles) shall confirm to IS 2713-1980 (part II) and shall be swaged and welded type as specified and shall be in three sections with base plate welded at the bottom and pole cap at the top.

3.4 ERECTION OF POLES:-

The pole shall be fixed in cement concrete foundation in ground with a cement concrete mixture of 1:3:6 (1 cement: 3 coarse sand: 6 graded stone aggregate of 20mm minimum size) about 1800mm depth for sound stability. A base plate of 300mm x 300mm x 12.5mm shall be welded at the bottom of vertical members before grouting the same in cement concrete.

All metal supports and Pole of overhead lines and metallic fittings attached there to shall be permanently and efficiently earthed and for this purpose a continuous earth wire shall be run and in case of Rail poles all insulator brackets, cross arms, stays and all other metallic fittings shall be bonded to the continuous earth wire. Isolators shall be supported by horizontal cross members of minimum 100 x 50 mm MS channels. Spacing between poles for 2 poles structure shall be 4500 mm. minimum 50 x 50 x 6mm MS angle shall be used for cross bracings of two pole structures, as per drawing and item of work.

All structures shall be painted with two coats of aluminium paint over a base coat of red oxide primer. Before applying primer coat, the metal surface shall be thoroughly cleaned and degreased to remove mill scale, rust, and grease and dirt.

Vertical members of the structure shall be of minimum 150mm x 75mm heavy gauge M.S. (I) section of 9.6 m in length. Erected pole shall be encased to 700 x 700 x 1500 concrete block below ground. Red enameled danger/caution plate of approved type shall be provided on each structure.

Horizontal members of the structure for mounting the lighting arrestor, air break switch, dropout fuses and cable joints shall be provided with not less than 100mm x 50mm x 5mm MS channels.

Necessary cross bracing shall be provided with not less than 50mm x 50mm x 5mm MS angle iron members.

The vertical and horizontal members shall be in single piece i.e., welded joints in between the members are not allowed.

3.4.1 **Anti-climbing device :-**

Necessary arrangement for preventing unauthorized persons from ascending any of the supports carrying H.V. lines without the aid of a ladder or special appliances shall be made as directed by the Engineer-in-Charge. Unless otherwise specified, barbed wire conforming to IS-278- 1969 having 4 point barbs spaced 75:12mm apart and weighing 108/125 cm/mtr shall be wrapped helically with a pitch of 75mm around the limb of the support and tide firmly commencing from a height of 3.5 mtr and upto a height of 5 or 6 mtr as directed by the Engineer-in-Charge.

All bolts, nuts and washers for complete work should be of hot dip G.I. Isolator shall be supported by horizontal cross member of minimum 100 x 50 mm MS channels. All structures shall be painted with two coats of aluminium paint over a base coat of red oxide primer. Before applying primer coat, the metal surface shall be thoroughly cleaned and degreased to remove scale rust, grease and dust.

3.4.2 **Outdoor Cable End Termination:-** The outdoor cable end termination shall be resin cast complete with mould spacers etc. as required. The end termination shall be supported on the 2 pole structure with the help of necessary clamps. The termination shall be suitable for the cable mentioned in the schedule of quantities. The manufacturers instruction shall befollowed while doing the termination.

A 100/80mm dia medium class GI pipe rising up to 2100mm (min.) above the ground level shall be fixed for H.V. cable for mechanical protection.

Air Break Switch: Air break switches shall be of triple pole 200 A manually gang operated suitable for mounting on a two pole structure. The air break switches shall be vertical tilting type. The switch shall be capable of operating through a system of levers and rod made from 25mm class 'B' G.I. pipe with handle and locking arrangement for operating of air break switches by a single person standing on ground. It shall be capable of being padlocked handle to open and close positions. Expansion type terminal connectors shall be provided at each end for connecting switch terminal to standard ASSR leads as required. Switch shall be provided with arcing horns of ample section and approved shape. All iron and steel parts shall be hot dip galvanized.

3.5 **DROP OUT FUSES:-** The unit shall be single pole outdoor type, adequately rated to provide full protection to the connected load. It shall be provided with suitable attachments to the insulators for holding in tension the fuse element which is carried between top and bottom contracts inside an insulated tube. The fuse shall be held in the latched position while the element is intact and shall open and shall switch down automatically after the blowing off the fuse due to the release of tension in the fuse element. Necessary operating rod of adequate length shall be

supplied having brass earthing chain with a crocodile clip rod which should provide adequate protection for safe operation at rated voltage. All hardware shall be hot dip galvnised.

3.6 **CONDUCTOR:-** These shall be aluminium conductor steel reinforced type confirming to IS 398-1961. The sizes of the conductors shall be as specified herein after. No joint permitted with the shackles or stain clamps. Binding of the conductors with insulator shall be with soft 12 SWG aluminium conductors.

3.7 **EARTH WIRE:-** A continuous G.I. earth wire of size not less than 8m SWG shall be run all along the distribution lines and service lines. It shall be securely fastened to the supports by means of cast iron reels or by suitable clamps. The earth wire shall be connected to the earth terminals provided on every 5th pole or as specified with same size of G.I. wire clamped on the pole.

3.8 **GUARD WIRE:-** Guard wire shall be provided for road crossing of the overhead lines and shall be bounded to earth wire and confirm to minimum clearances specified in I.E. rules. Cage guard shall be provided for vertical configuration distribution lines and cradle guard for horizontal configuration.

3.9 **LIGHTNING ARRESTORS:-** These shall conform to IS 3070-1966 (part II) or as applicable also conform to Rule 92 of I.E. rules. Horn gap type lightning arrestor shall be used for L.T./M.V. lines and shall be employed with each phase at terminal and other places mounted on poles or cross arms or as directed. Thyrite type surge diverter lightning arrestor shall be used for 11 KV rating lines and shall be installed one unit per phase at the terminations, transformer stations etc.

The lightning arrestors shall be connected ahead of fuses if any provided, also an independent earth electrode shall be provided for lightning arrestor.

3.10 **STAY/STRUT:-**

(i) **STAY:-** A stay set shall consist of stay rod, anchor plate, bow tightner or turn buckle, thimbles, stay wire and strain insulator. The stay rod shall be with stay grip in case turn buckle is used instead of bow tightner. The entire stay assembly shall be galvanized. The stay wire shall be made of 7/2. 15 mm dia G.I. as specified in the contract conforming to IS 2141 – 1968 grade 2. The anchor plate shall be of MS galvanized and not less than 30 cm x 30 cm x 6.4 mm thick and the size of stay rod shall be not less than 1.80 m (6ft) long and 19mm dia. Stay set shall be provided at angle or terminal poles and the stay rod with anchor plate shall be embedded in 1:2:4 concrete not less than .28 cubic meter in volume.

(ii) **STRUT:-** A strut shall generally consist of a pole of the same section which it supports or slightly lighter as specified in the contract.

3.11 **INSULATOR:-** The porcelain insulator shall conform to IS 1445-1966 suitable for overhead power lines below 1000 volts and IS 731-1971 for overhead power lines with a nominal voltage greater than 1000 volts. This shall be vitreous throughout and non-absorbant. The exposed surface shall be glazed. Insulator shall have adequate mechanical strength, high degree of resistance of electrical puncture and resistance to climatic and atmpospheric attack.

The shackle insulator shall be 90 mm dia x 75 mm high as per item of work.

The size of pin insulator shall be 65mm dia x 100 mm high. The pin insulator shall be suitable for 12mm cordeau thread and shall be complete with G.I. pin, buts and washers.

Boxes of all the accessories shall be looped with double earthing by means of 25mm x 5mm copper strips.

Zinc plated bolts and nuts shall be used for fixing the horizontal members with main vertical members with the help of suitable clamps.

An anti climbing wire fencing around the vertical members up to a suitable height shall be provided to prevent climbing by unauthorized persons.

Red Enameled H.V. danger notice plates shall be fixed on the structure as per local requirements.

The entire D.P. structure shall be painted with one coat of primer and two coats of Silver/Aluminium paint of approved quality.

3.11.1 **Testing and Commissioning:**

Commissioning checks and tests shall include all wiring checks and checking up of connections. Primary/Secondary injection tests for the relay adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following:

a) Operation checks and lubrication of all moving parts.
b) Interlock function checks.
c) Continuity checks of wiring, fuses etc. as required.
d) Insulation test: When measured with 500 V meggar the insulation resistance shall not be less than 100 mega ohms.
e) Trip test and protection gear test.
f) Any other tests as may be required by the License/Inspector shall be conducted
g) Any other test required by the Consignee/inspecting authority.

4.0 **11KV OIL FILLED DISTRIBUTION TRANSFORMER :-**

(OUTDOOR TYPE WITH OFF LOAD TAP CHANGER) :-

4.1 **General :-**

The transformer shall be double wound core type, oil naturally cooled suitable for Outdoor installation. The transformer shall be designed and manufactured as per IS 2026-1977 with upto date amendments and Transformer shall be selected, Installed & Maintained as per IS Code of Practice IS 10028 (Part I) - 1985 with upto date amendments and having no load voltage ratio as 11000/433V. Rating of Transformer shall be as per BOQ item.

4.2 **SPECIFICATION :-**

a) **Standard :-**

Unless otherwise stated below, transformer & transformer oil, shall conform to IS 2026 & 335 respectively.

b) **Climatic Conditions Affecting Operations :-**

Minimum Temperature - 5 degree C.

Maximum Temperature + 50 degree C.

c) **System of Supply :-**

11kv 3 phase, 50 Hz system.

d) **No Load Ratio :-**

11000/433 volts.

e) **KVA Rating :-**

Transformer shall be suitable for continuous rating as stated in BOQ and on drawings.

f) **Type :-**

Outdoor

g) **Winding :-**

The transformer shall be copper wound.

h) **Core :-**

The magnetic core shall be made up of cold rolled grain oriented low loss steel stampings.

i) **Cooling :-**

Natural oil cooling by means of pressed/round tubes around transformer tank (ONAN).

j) **Frequency :-**

50Hz plus minus 3%

k) **Rated Voltage :-**

Transformer shall operate at its rated KVA at any voltage plus minus 10% of rated voltage of that particular tap.

l) **Vector Group** :-

Corresponding to the vector symbols Dyn-11.

m) **Connections** :-

H.V. side of transformer shall be provided with air filled cable box suitable for minimum 3 core 95Sq.mm XLPE cable. Indoor heat shrinkable termination kit shall be used for termination of HV Cable. MV side of transformer shall be suitable for L.T. Cable connection arrangement.

n) **Tapping** :-

OFF load tap changing arrangement on 11kv side. The range for circuit taps which shall be provided on HV side shall be plus 5% to minus 5% in steps of 2.5 %.

o) **Temperature Rise** :-

The transformer shall conform to the requirements of temperature rise specified in IS 2026 (Part II) 1977. Continuously rated for full load, temperature rise not to exceed 50 degree C by thermometer in oil (55 degree C by resistance).

p) **Insulation Levels** :-

The insulation level shall be in accordance with IS : 2026 (Part III) 1977.

q) **Terminal Markings, Tappings & Connections** :-

The terminal marking, tapping & connections shall be in accordance with IS 2026 (Part IV) 1977.

r) **Requirement with regards to ability to withstand short circuit** :-

As per IS : 2026 (Part I) 1977.

s) **Impedance Voltage** :-

As per table 3 of IS : 2026 (Part I) 1977.

t) **Tap changing switch** :-

An externally hand operated off load tap changing switch with handle and a position indicating plate & locking device.

u) **Parallel Operation** :-

Transformer shall be suitable for parallel operation with similar unit of same rating.

4.3 **FITTINGS** :-

The followings accessories and fittings shall be provided with the transformer.

(i). **Lifting Lugs** :- The arrangement of lifting the active part of the transformer along with the cover of the tank by means of lifting lugs without disturbing the connections. Also complete transformer lifting lugs shall be provided.

(ii). **Rollers** :- The transformer to be provided with 4 Nos. rollers fitted on cross channels to facilitate the movement of transformer.

(iii). **Oil Conservator** :-The transformer to be provided with a conservator with welded end plates. It is to be bolted to the cover and can be dismounted for purposes of transport. It

has to be provided with oil level gauge with marking for minimum level and an oil filling hole with a cap which can be used for filtering of oil. For draining purposes a plug is to be provided. A connection pipe between the conservator and main tank is to be provided, which projects inside the conservator.

(iv). **Air Release Valve** :- An Air release valve shall be provided on top of the tank cover to facilitate the release of the entrapped air while filling of oil.

(v). **Breather** :-The transformer shall be provided with an indicating dehydrating silica gel breather of sufficient capacity.

(vi). **Drain Valve With Plug** :- The transformer to be provided with drain valve with plug at the bottom of the tank.

(vii). **Diagram And Rating Plate** :- One diagram and rating plate indicating the details of transformer connection, diagram vector group, tap changing diagram etc.

(viii). **Filter Valve** :- Filter valve on the top of the tank.

(ix). **Transformer Oil** :- Transformer should be supplied with first filling of oil

(x). **Earthing** :-Two separate earthing terminals are to be provided at the sides of the tank on both sides for earthing.

(xi). Any other accessories & fitting if mentioned in IS Code.

Instrumentation Manual :-

The successful bidder shall submit three copies of manual of complete instructions for the installations, operation, maintenance and repair, circuit diagrams, foundation and trenching details shall be provided with the transformer.

4.5 **Shop Drawings** :-

Manufacturer/ Contractor shall prepare and furnish shop drawings for the approval by the IRWO/ Consultant/ Engineer-in-Charge before commencing fabrication/manufacture of the equipment. Shop drawings shall be based on requirement laid down in the specification. The manufacture of equipment shall commence only after the shop drawings have been approved in writing by the IRWO/ Consultant/ Engineer-in-Charge. Transformer shall be manufactured as per approved specification of Local Supply Authority.

4.6 **Installations** :-

(i). The transformer shall be installed as per installation manual of the transformer supplier and conforming to Indian Standard IS 10028 (Part-II) 1981 with upto date amendments.

(ii). The transformer is to be erected on suitable cement concrete foundation / flooring. The transformer supplied shall be lifted by all lifting lugs for the purpose of avoiding imbalance in transit.

(iii). The transformer wheels shall be locked by suitable locking arrangement to avoid accidental movement of the transformer.

(iv). The transformer cable end boxes shall be of indoor type transformer and shall be sealed to prevent absorption of moisture.

(v). Dehydration at all the stages upto the handing over to the Owner shall be done by the contractor free of cost.

(vi). The transformer neutral earthing and body earthing shall be done as shown on the drawing and shall conform to Indian Standard IS: 3043-1987.

(vii). Two earths shall be provided for body earthing and two earths for neutral earthing. Copper shall be used for neutral earthing.

4.7 **Factory Tests** :-

The transformer shall be subjected to test as laid down in IS 2026 (Part-I) 1977 at the factory/manufacturing unit prior to dispatch of the transformer to the site. All original type test & routine test certificates shall be furnished.

4.8 **Test at Site** :-

Prior to commissioning of the transformer the following tests shall be performed.

(i). Insulation resistance of the winding between phases and earth of H.V. and M.V. Side.

(ii). Winding resistance of all the winding on all tap positions shall be taken.

(iii). Di-electric strength of transformer oil shall be checked in accordance with IS 335-1963.Incase the test is not satisfactory, the oil shall be filtered till proper dielectric strength of oil is obtained. A certificate for the same shall be given to Owner.

Contractor / Manufacturer shall give sufficient advance information about the test schedule to enable the Owner to appoint his representative. Tests shall be witnessed by IRWO before dispatch from factory. Instructions for dispatch shall be issued by IRWO after which transformer shall be brought to site.

5.0 MAIN L.T. PANEL :-

5.1 GENERAL :-

Main L.T. Panel shall be indoor type, metal clad, floor mounted, free standing, totally enclosed, extensible type, air insulated, cubicle type for use on 415 Volts, 3 phase, 50 cycles system with a fault level withstand of 25 KA RMS symmetrical or as specified in BOQ. Main L.T. Panel shall be provided with buscoupler switching & interlocking of incomer & buscoupler breakers of Main L.T. Panel.

5.2 STANDARDS :-

5.2.1 The equipment shall be designed to conform to the following latest requirements of IS Standards.

i. IS : 8623- Factory Built Assemblies of switchgear and controlgear.

ii. IS : 4237- General requirements for switchgear and controlgear for voltages not exceeding 1000 volts.

iii. IS : 2147- Degree of protection provided by enclosures for low voltage switchgear and controlgear.

iv. IS : 375- Marking and arrangement of busbars.

5.2.2 Individual equipment housed in the Main L.T. Panels shall conform to the following IS Specification.

i.	Moulded Case Circuit Breaker	-	IS: 13947 (Part-II) & IEC 947 (2).
ii.	Fuse switch and switch fuse units	-	IS: 13947 (Part-3) & IEC 947 (3).
iii.	HRC fuse links	-	IS: 13703
iv.	Current Transformers	-	IS: 2705
v.	Voltage Transformers	-	IS: 3156
vi.	Indicating Instruments	-	IS: 1248
vii.	Integrating Instruments	-	IS: 722
viii.	Control Switches & Push Buttons	-	IS: 6875
ix.	Auxiliary Contactors	-	IS: 13947 (Part-4/Sec.-I) & IEC 947 (4/1)
x.	Relays	-	IS: 3231

5.3 CONSTRUCTION :-

Main L.T. Panels shall be:-

i. Of metal enclosed, indoor, floor mounted, free standing construction, compartmentalized extensible type.

ii. Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.

iii. Provide dust and damp protection, the degree of protection being not less than IP 54 to IS : 2147.

iv. Be readily extensible on both sides by the addition of vertical sections after removal of the end covers.

Main L.T. Panel shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of :

i. A front-framed structure of rolled/folded sheet steel channel section, of minimum 2mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, fuse switch units, and main horizontal busbars, vertical risers and other front mounted accessories.

   The structure shall be mounted on a rigid base frame of 100 x 50 x 5mm thick M.S. Channel or as specified in the drawings. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

ii. A rear cable chamber housing the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

iii. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

iv. Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

v. All doors shall be lockable mounted lock.

vi. Gland plate shall be 3mm thick.

The height of the panels should not be more than 2200 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 1000mm. Operating handle not higher than 1800mm and not lower than 300mm.

Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 2mm thickness. All sheet panels shall be smoothly finished, levelled and free from flaws. The corners should be rounded.

The apparatus and circuits in the power control centres shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

Apparatus forming part of the Main L.T. Panel shall have the following minimum clearances.

i.	Between phases	-	50mm
ii.	Between phases and neutral	-	50mm
iii.	Between phases and earth	-	50mm
iv.	Between neutral and earth	-	50mm

When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions.

Creepage distances shall comply to those specified in relevant standards.

All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.

Functional units such as circuit breakers and fuse switches shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear. Panel shall be suitable for termination of busduct for incoming breakers.

Metallic perforated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorised access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections. GI earth strip of size 40mm x 5mm should run throughout the length of the LT Panel and brought out at the ends for connections.

5.4 **METAL TREATMENT & FINISH** :-

All steel work used in the construction of the L.T. cubicle panels should have undergone a rigorous metal treatment process as follows:-

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii. A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.

v. Drying with compressed air in a dust free atmosphere.

vi. Powder Coating paint of colour approved by IRWO/ Engineer-in-charge.

5.5 **BUSBARS** :-

The busbars shall be air insulated and made of high conductivity, high strength aluminium alloy complying with the requirement of grade E-9IE of IS-5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 25KA RMS symmetrical for one second and a peak short circuit

withstand capacity of 52.5KA. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and creepage distances shall be provided on the busbar system to minimize possibilities of fault.

The Main L.T. Panel shall be designed that the cables are not directly terminated on the terminals of breaker/switch fuse/fuse switch etc. but on cable termination links. Capacity of aluminium busbars shall be considered as 1.0 Amp/sq.mm of cross section area of the busbar and also conforming to table VI of CPWD specification of Internal Electrical Works (Part-I). The main busbars shall have continuous current rating throughout the length of L.T. Panel. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity upto 200Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consist of main horizontal busbar and auxiliary vertical busbars run in busbar alley/chamber on either side in which the circuit could be arranged/connected with front access.

Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves.

5.6 AIR CIRCUIT BREAKER :-

5.6.1. General :-

Air circuit breakers shall be incorporated in the panels wherever specified. ACB shall conform to BS: 3659 or IS: 13947 in all respects. ACBS shall be suitable for operation on 415 volts, 3 phase, 50 Hz, AC supply. All air circuit breakers using in the panel will be mounted in separate cubicles and will be of the same make to maintain the uniformity.

5.6.2. Type and construction :-

Air circuit breakers shall be of enclosed pattern, dead front air break type with trip free operating mechanism. Air Circuit breakers shall be of with draw out /Fixed type as specified in the BOQ and will be mounted on a rigid steel frame moving on horizontal balls. The ACBs shall be strong and robust in construction with suitable arrangement for anchoring when in fully engaged or fully drawn out positions. There shall be no dependence upon the panel board frame for any critical alignment. The withdrawal arrangement shall be such as to allow smooth and easy movement.

All the current carrying parts of the circuit breakers shall be silver plated. Suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring loaded design. The sequence of operation of the contacts shall be such that arcing contacts make before and break after the main contacts. Arcing contacts shall be provided with efficient arc chutes on each pole. The contact tips and arc chutes shall be suitable for ready replacement. Self aligning isolating contacts with automatic shutters to screen the live parts shall be provided. The design of the breaker shall be such that all the components are easily accessible for inspection, maintenance and replacement.

5.6.3 Operating Mechanism

Air circuit breaker shall be provided with a quick-make, trip free operating mechanism. The operating mechanism shall be strain-free spring operated. The system will have horizontal, self aligning, isolating pairs of moving and stationary power and control contracts. The unit will have three horizontal positions corresponding to:

i) Plugged in Position

Here both the power and control contacts are in made position and the breakers gets mechanically locked in this position. The breaker can go in ON position only after being locked in this position.

ii) Test Position

Here the power contacts get isolated where as the control contacts can be kept in made status. The breakers can be mechanically locked in this position and made ON and off for testing purposes.

iii) With drawn Position

In this position the power and control connections are in isolated status and the moving portion of the breaker can be dismantled from the panel.

An isolating shutter or set of shutters are to be provided for the automatic coverage of live power and control fixed isolating contacts in the withdrawn position.

iv) Maintenance position

Circuit breaker completely withdrawn out of cubicle for carrying out maintenance.

The breaker will have quick making trip free closing mechanism. The operation of the mechanism will be independent of the speed of the closing lever or the duration of the closing signal.

The breaker will have following indications distinctly notable from outside: -

- Mechanical indicator for spring fully charged.
- Mechanical indicator for spring discharged.
- Electrical indication of breaker ON status. (Protective release)
- Electrical indication of breaker OFF status. (Protective release)
- Electrical indication of trip circuit healthy.

All breakers will have switching ON and OFF time of less than 4 cycles and will have the following interlocks for the safe operation of the equipment.

Breakers to ON only when mechanically locked many of the three horizontal isolation position.

When the breaker is in plugged in position it will ON only with the front door closed.

Rating

The rating of the circuit breaker shall be as per the drawings and schedule of quantities. The rated/breaking capacity of the breakers shall be 35 MVA/50 KA or as specified at 415 volts. The rated making capacity shall be as per relevant standard.

Accessories

Circuit breakers shall be provided with the following Accessories.

i) Overload/Short Circuit and earth fault relays micro processor based with LED Display.
ii) Alarm switches (if specifically asked for)
ii) Auxiliary switches
iii) Circuit breaker position indicators ON/OFF/TEST/ISOLATED.
Testing

Testing of each circuit breaker shall be carried out at the works as per IS: 13947 and the original test certified shall be furnished in triplicate. The tests shall incorporated atleast the following:

i) Impulse withstand test

ii) Power frequency withstand test

iii) Short circuit test

iv) Temperature-rise test under rated conditions.

v) Also to supply CPRRI test Certificate.

5.7 MOULDED CASE CIRCUIT BREAKERS :

5.7.1 GENERAL :-

Moulded Case Circuit Breakers shall be incorporated in Main LT Panel, MDB / SDB & Meter Boards wherever specified. MCCB's shall conform to IS 13947-2 and/or IEC 947-2 in all respects. MCCB's shall be suitable either for single phase AC 230 volts or three phase 415 volts. MCCB shall be with thermo magnetic or static release type. All MCCB of 250Amp and above rating shall have microprocessor released for O/L, S/C & E/F protection.

5.7.2 FRAME SIZES :-

The MCCB's shall have the following frame sizes subject to meeting the fault level specified elsewhere.

i)	Up to 100A rating	.....	100Amp frame.
ii)	Above 100A to 250A	.....	250Amp frame.
iii)	Above 250A to 400A	.....	400Amp frame
iv)	Above 400A to 630A	.....	630Amp frame.

5.7.3 CONSTRUCTIONS :-

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be of rotary type quick make/quick break, trip-free type. The operating handle for simultaneous operation and tripping of all the three phases.

Suitable fire extinguishing device shall be provided for each contact. Tripping unit shall be of thermomagnetic or static type provided in each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. MCCB shall be line load reversible type. MCCB's shall be site adjustable thermal release (80% to 100%) of rated current. Device shall have IDMT characteristics for sustained overload and short circuits. MCCB shall be current limiting type MCCB shall be provided with rotary handle.

Contacts trips shall be made of suitable arc resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

5.7.4 RUPTURING CAPACITY :-

The Moulded Case Circuit Breaker shall have a service breaking capacity (Ics) of not less than 25KA RMS at 415 volts for Main L.T. Panels or as specified in BOQ.

5.7.5 TESTING :-

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished.

5.8 MEASURING INSTRUMENTS, METERING & PROTECTION :-

5.8.1 GENERAL :-

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.0 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 instruments 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.

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.

5.8.2 AMMETERS :-

Ammeters shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

5.8.3 VOLTMETERS :-

Voltmeter shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The voltmeter shall be provided with protection fuse of suitable capacity.

5.8.4 CURRENT TRANSFORMERS :-

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) 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 secondary current shall be 5A unless otherwise specified. The 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.

5.9 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 lamps 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.

5.10 CABLE TERMINATIONS :-

Cable entries and terminals shall be provided in the Main L.T. Panel to suit the number; type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

5.11 **LABELS :-**

Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of L.T. Panels.

5.12 **TEST AT MANUFACTURES WORK :-**

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates produced to the IRWO.

5.12.1 **TESTING AND COMMISSIONING :-**

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/ setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

i. Operation checks and lubrication of all moving parts.

ii. Interlocking function check.

iii. **Insulation test:** When measured with 500V meggar, the insulation resistance shall not be less than 100 mega ohms.

iv. Trip tests & protection gear test.

5.13 All Energy meters are to be suitable for remote monitoring through separate network of communications cables. Panels internal wiring is part of supply.

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6.0 CAPACITOR BANK & PANEL :-

6.1 GENERAL :-

This specification covers requirements of Medium Voltage Capacitors and Control Panel to be used for power factor improvement of the electrical system and shall be a part of Main L.T. Panels. Automatic Power Factor Correction Panel shall function to improve power factor of the system in which it is connected. It shall improve power factor upto 0.99 from initial power factor of 0.70. Capacitor Panel shall have 10-15% of capacitor bank directly connected to ensure power factor remains within prescribed limit during low load demand period and / or night period.

6.2 CODES AND STANDARDS :-

The design, manufacture and performance of power capacitors and accessories shall comply with all currently applicable statutes, regulations and safety codes for power installation as prescribed in relevant IS codes and to requirement of Local Electricity Supply Authority to which the equipment shall be installed.

Unless otherwise specified the capacitor and control panel shall conform to following.

a.	IS : 2834	-	Shunt capacitors for power systems.
b.	IS : 2147	-	Degree of protection provided by enclosures for low voltage switchgear and controlgear.
c.	IS : 4237	-	General requirements for switchgear and controlgear for voltages not exceeding 1000V.
d.	IS : 8623	-	Specification for factory built assemblies of switchgear and controlgear (Upto 1000 volts).
e.	IS : 2208	-	HRC cartridge fuse links upto 650 volts.
f.	IS : 4064	-	Specification for Fuse Switch & Switch Fuse switchgear and controlgear.
g.	IS : 2959	-	AC contactors for voltage not exceeding 1000 volts.

6.3 CONSTRUCTIONAL FEATURE :-

a) Capacitor bank shall be suitable for operation on 415 volts 3 phase, 4 wire, 50c/s, solidly earthed AC supply system. The capacitor shall be connected to the 415 V Switchgear bus and shall be manually as well as automatically switched in and out in steps so as to correct the power factor to be required value depending on the actual KVAR requirement of bus.

b) The capacitor bank shall be complete with the required capacitor units with the supporting post insulators, sheet steel cubicles, busbars, connecting strips, foundation channels, fuses, corrosion proof rating plate etc. Capacitor shall be MPP type. Reactor shall be provided to counter for presence of harmonics in the system.

c) Each basic unit is to be built up with a number of elements. These elements should be wounded with high grade metallised poly propylene film. These metallised film capacitors should be self healing, having very low loss factor. Capacitor element to be completely sealed with epoxy resins

to provide maximum humidity protection and highest insulation. The capacitor elements are to be given adequate outside insulation and should be put in all welded surface treated MS containers. These capacitors shall be impregnated with special grade of capacitor oil under high vacuum. The metal case shall be equipped with porcelain bushings to permit connection between power lines and active capacitors.

Externally each capacitor unit shall have two separate earthing points, name plate conforming to the requirements of IS-2834 (amended upto date), discharge resistances etc.

d) The capacitor bank may comprise suitable number of single phase self cooled hermetically sealed units in series parallel combination to achieve required KVAR rating. However, failure of one unit shall not create over voltage on other units connected in parallel to avoid failure of parallel units.

e) Each capacitor unit/bank shall be provided with directly connected continuously rated, low loss discharge device built into the unit to reduce the residual voltage to a safe value within the specified time as recommended in the relevant standard after the capacitor has been disconnected from the supply.

f) All capacitor shall be suitably protected against over current by means of suitable over current protection (other than fuses) which is adjusted to interrupt the circuit when the current exceeds the safe permissible limit. Capacitor units shall also be protected against the internal faults and the effected units/banks shall be automatically and immediately isolated in the event of such fault.

g) Each capacitor unit shall continuously operate at the following overload conditions separately.

   i. Over voltage upto 10% of the rated RMS voltage.

   ii. Over current upto 15% of the rated current.

   iii. Maximum reactive output upto 30% over the rated reactive output.

h) Each capacitor unit shall be individually protected by HRC fuses with visual indication for operation.

6.4 **CAPACITOR CONTROL PANEL :-**

a) The control panel shall be indoor, cubicle type, floor mounted, dust and vermin proof conforming to degree of protection IP-54 excepting the enclosure enclosing capacitor bank which shall be of protection class IP-41.

b) Cubicle shall comprise rigid structural frame enclosed by 2mm thick cold rolled sheet steel, doors and covers shall also be from 2.0mm thick cold rolled sheet steel. Structural framework with foundation bolts etc. shall be provided at the bottom to mount control panel directly on concrete/floor/steel channel base.

c) All doors, removable covers shall be gasketed all around preferably with neoprene gaskets.

d) The capacitors control panel shall, in general, comprise of the following and shall be housed in well ventilated panels. Capacitors and their control elements may be installed in different compartments of the same panel to minimize space requirement.

   i. Microprocessor based power factor correction relay.

   ii. Time delay and No-volt relays.

   iii. Protection fuses.

iv. Capacitor duty contactors for individual capacitor bank.

v. Change over switch for either automatic operation or manual operation with Push button control.

vi. Visual indications for capacitor IN-OUT.

e) Switches shall be triple pole, air break AC-23 duty. The switch shall have a quick make, quick break mechanism operated by a suitable external handle complete with position indicator.

f) The Compartment door shall be interlocked mechanically with the switch so that the door cannot be opened unless the switch is in OFF position. Means shall be provided to releasing this interlock at any time.

g) Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the listed short circuit current. Fuses shall be complete with fuse base and fitting of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.

h) The Contactors shall be three pole, air break type designed for capacitor duty with non bouncing silver/silver alloy contacts. Each Contactor shall be provided with 2 NC & 2 NO auxiliary lamps contacts rated at 10 Amp. Indicating lamps shall be LED type. Lamp and lens shall be replaceable from front.

i) The main buses and connection shall be of high conductivity aluminium/aluminium alloy, sized for specified current ratings shall be limited to 105 degree centigrade and 100 degree centigrade for silver plated copper joints and aluminium joints respectively.

j) For all bus connections adequate contact pressure shall be ensured by means of two bolt connection with plain and spring washers and locknuts.

k) Busbars and connections shall be fully insulated for working voltage with adequate phase/ground clearance. Insulating colour coded PVC sleeves for busbars and shrouds for joints shall be provided. Shrouds for busbar and for joints shall be provided. Shrouds for busbar joints and tapping points shall be of two part epoxy resin cast/fibre glass moulded. Minimum clearance of 32mm is required between phases and 26mm between phase and earth irrespective of sleeve/shrouds provided for busbar. Insulating shrouds shall be of moulded type.

i. Bus supports shall be non-hygroscopic type epoxy SMC with high creepage surface.

l) All buses and connections shall be supported and braced to withstand the stresses due to maximum short-circuit current and also to take care of any thermal expansion.

m) Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from the front to panel assembly.

n) The horizontal busbar chamber shall be separate and totally enclosed.

o) Gland shall be minimum 3mm thick.

p) Screws of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entry of insects.

q) All internal wiring inside the cubicle shall be carried out with 650 V grade, PVC insulated copper wires duly ferruled at either end. The power wiring above 100A shall be carried out with PVC insulated aluminium links.

r) Separate labels shall be provided for relay, instruments, switch, indicating lamp etc. Approval for the type of label shall be taken from the Engineer-in-charge.

s) Metal treatment, finish and painting shall be done as per the specification Para Ref. 3.4 of this tender.

t) Automatic control relay with necessary taps shall be provided.

6.5 **TESTS** :-

(a) Routine tests shall be carried out on assembled capacitors and control panel as per relevant Indian Standards.

(b) Type tests reports for similar capacitor units shall be submitted.

(c) Three (3) copies of type test and routine test certificates shall be submitted for Engineer-in-Charge approval before despatch of capacitor and control panel.

6.6 **INSPECTION** :-

(a) Visual inspection including witnessing routine tests shall be carried out by Engineer-in-Charge or his authorised representative.

(b) Contractor shall notify Engineer-in-Charge or his authorised representatives in writing atleast fifteen (15) days prior to Contractor's scheduled inspection test.

6.7 **DRAWINGS AND INSTRUCTIONS MANUALS** :-

(A). Contractor shall submit four copies of the following certified drawings after award of contract.

a. General arrangement of capacitor bank and control panel indicating main dimensions, type of mounting, locations of various devices etc. as foundation details.

b. Schematic diagram for automatic sequential switching with terminals and ferrules numbers.

c. Wiring diagram of control panel indicating terminal blocks and various apparatus.

d. Final list of components of control panel.

(B). Contractor shall submit four (4) copies of installation and maintenance manual.

(C). One prints of each drawing shall be returned to Contractor after making all necessary corrections, changes and required specification. Contractor shall incorporate these and send within fifteen days five (5) prints of these each drawing shall be marked certified for record and use.

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7.0 DISTRIBUTION & OUTDOOR LIGHTING FEEDER PILLARS :-

7.1 Outdoor type Distribution & Outdoor Lighting Feeder Pillars shall be suitable for 3 phase, 50Hz. 415 volts, A.C. system and shall generally conform to IS 5039. Rating and size of Feeder pillar shall be as detailed in drawings and in BOQ.

The Distribution & Outdoor Lighting Feeder Pillars shall be fabricated out of heavy gauge 2.00 mm thick MS sheet steel with suitable stiffeners. Distribution & Outdoor Lighting Feeder Pillars shall be constructed with slanting roof top / over hang for protection against rain & weather and adequately ventilated by providing louvers with wire mesh from inside. The Distribution & Outdoor Lighting Feeder Pillars shall be provided with degree of protection IP 54 as per IS : 2147.

Distribution & Outdoor Lighting Feeder Pillars shall be double door construction with M.S. hinges and handle for opening the door. Each door shall open to minimum 135 degrees. Locking on both the doors with two keys for each lock shall be provided with each Distribution & Outdoor Lighting Feeder Pillars. The Distribution & Outdoor Lighting Feeder Pillars shall be dust, vermin proof and weatherproof type.

Neoprene gaskets shall be provided for the doors. The enclosure shall be provided with ventilated louver cover with wiremesh, lifting hooks, supporting legs and double earth terminal with double washer.

The metallic parts of the enclosure shall be subjected to seven-tank process to include cleaning, derusting, rinsing, phosphatising etc. and epoxy painted.

Distribution & Outdoor Lighting Feeder Pillars shall be provided with suitable size of aluminium alloy busbars as detailed in BOQ. GI earth strip of size 32 mm x 5mm should run throughout the length of the feeder pillars and bought out at the ends for connections.

Moulded case circuit breaker shall be provided for incoming and MCB shall be provided for outgoing feeders & conforming to IS 8828-1978. Gland plate shall be 3mm thick with suitable number of flanged type brass cable glands of required sizes shall be provided. Provision shall be suitable for lighting the interior when the doors are open. Danger notice board shall be provided on front door of the Distribution & Outdoor Lighting Feeder Pillars.

Distribution & Outdoor Lighting Feeder Pillars shall fully comply with CPWD General Specification for Electrical works (Part-II External-1994). Erection or installation shall also be carried out as specified in CPWD Specification 1994.

7.1.1 INSTALLATION :-

Distribution & Outdoor Lighting Feeder Pillars shall be erected/installed on brick masonary foundation 600mm above surrounding ground level. All civil work like excavation PCC base concrete, brick masonary work, plastering, refilling, painting of brick masonary pedestal/foundation of feeder pillar including providing PVC sleeves in foundation for cable entry shall deemed to be included in quoted rates of Distribution & Outdoor Lighting Feeder Pillars.

MINIATURE CIRCUIT BREAKER :-

The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.

The MCB's shall have a rupturing capacity of 10 KA. Curve.

The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection.

Type test certificates from independent authorities shall be furnished.

7.3 CABLE TERMINATIONS :-

Cable termination compartment and arrangement for power cables shall be suitable for stranded aluminium conductors, armoured, PVC insulated and sheathed. 1100 V grade cables. The temperature rise over ambient of 50 degree C. at bus bars / terminals for external cable connections shall be limited to 20 degree C. For power wiring colour-coded wires shall be preferred.

All necessary cable terminating accessories such as Gland plates, supporting clamps and brackets, power cable lugs, hardware etc. shall be provided by the contractor.

The gland plates shall be removable type and shall cover the entire cable alley. Contractor shall ensure that sufficient space is provided for all cable glands. Gland plates for power cables only shall be factory drilled according to the cable gland sizes and number. For all single core cables, gland plates shall be of non-magnetic material.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

7.4 TEST AT MANUFACTURES WORK :-

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates produced to the IRWO.

7.5 TESTING AND COMMISSIONING :-

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/ setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

a) Operation checks and lubrication of all moving parts.

b) Interlocking function check.

c) **Insulation test:** When measured with 500V meggar, the insulation resistance shall not be less than 100 mega ohms.

d) Trip tests & protection gear test.

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8.0 CABLES (H.T. & L.T. CABLES) :-

8.1 H.T. CABLES :-

8.1.1 CONSTRUCTION :-

All H.T. Cables shall be of 11 KV grade XLPE insulated & PVC sheathed flat steel wires (strips) armoured electrical purity aluminium conductor cables shall be manufactured & tested in accordance with IS : 7098 (Part II) 1985. H.T. Cable shall be earthed type. The conductor shall be made electrical purity aluminium wires and shall be of stranded construction and shall comply to IS 8130. High quality XLPE unfilled insulating compound shall be used for insulation. Insulation shall be carried out by extrusion process and shall be chemically cross-linked in continuous vulcanisation process. Core screen shall consist of a layer of extruded semi-conducting compound. Additional insulation shield shall be provided with semi conducting and metallic tape shield over the extruded insulation shield. Inner and outer shielding with insulation shall have perfect bonding. Cores shall be stranded together with suitable non-hygroscopic fillers in the interstices and provided with common covering of plastic tape wrapping. Armouring shall be applied over the inner sheath and shall comprise of flat steel wires (strips). Outer sheath shall be of tough, heat resistance PVC compound as per IS: 5831 and shall be extruded over the armouring. Cables shall be tested for type tested & routine tested in accordance with IS: 7098 (Part II).

8.1.2 TERMINATION JOINTS :-

Terminal joints shall be carried out inside the cable end boxes fixed on the equipment. Cables shall be pencilled with layers of HT tapes wrapped over the conductor and the insulations then the entire joint shall be wrapped in layers of HT Tapes upto the terminals, butted and lugged. Lugs shall be fitted by the means of bolts and nuts with the terminal studs. On the glands, armour of the cable shall be fixed by means of clamps, which shall be grounded. Heat shrink cable termination kit shall be used for terminations.

8.1.3 INSTALLATION OF CABLES :-

Cables in the HT Rooms of the Sub-Station shall be laid in trenches. All cables shall be bent in radius not less than 15 times the diameter of cables or as prescribed by the manufacturer whichever is higher. Cable laying shall be carried out as per CPWD specifications.

8.2 L.T. CABLES :-

8.2.1 GENERAL :-

L.T. Cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

8.2.2 MATERIALS :-

L.T. Cables shall be XLPE insulated and PVC sheathed aluminium conductor armoured cables conforming to IS: 7098 (Part I)-1988. Cables shall be of 1100 volt and with ISI certification mark. Conductor of power cables shall be made of electrical purity aluminium conforming to IS 8130-1984. All cables shall be multi stranded , PVC insulated & PVC sheathed type (armoured or Unarmoured) of copper or aluminium conductor conforming to IS :1554 (Part –I)

8.2.3 INSTALLATION OF CABLES :-

Cables shall be laid directly in ground, pipes, masonary 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 as per CPWD specifications.

8.2.4 INSPECTION :-

All cables shall be inspected at manufacturer's works by IRWO'S ENGINEER-IN-INCHARGE. Cables shall be dispatched to site after issue of dispatch instructions by the inspecting agency. Any material found damaged during transit/ laying shall be rejected.

8.2.5 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 utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

8.2.6 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 metres. Cables shall be laid at depth of 0.75 metres below ground level. A cushion of sand total of 250mm 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 preserve. 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 metre long loop shall be provided at both end 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.

8.2.7 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.

8.2.8 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 surface, road ways, sidewalks, kerb walls or the works cut by excavation to their original condition to the satisfaction of the Engineer-in -Charge.

8.2.9 LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/CEILING :-

Cable shall be laid on perforated M.S. Cable tray. 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 at every meter length. Care shall be taken to avoid crossing of cable.

8.2.10 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.

8.2.11 CABLE MARKER

Metallic cable marker consisting of MS angle 25mm x 5mm thick with 125mm dia MS plate at top with inscription of cable marking duly grouted in ground with cement foundation.

8.2.12 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.

a. Before laying.

b. After laying.

c. After jointing.

On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

a. Insulation Resistance Test (Sectional and overall).

b. Continuity Resistance Test.

c. 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 tests.

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9.0 **POLES :-**

9.1 **M.S STEEL TUBULER POLE (SWAGED POLE) :-**

Steel Tubular M. S. Pole (Swaged Pole) shall be supplied as per BOQ item. One sixth of the length of the pole plus about 15 cm from base shall be coated with bitumen both internally & externally. Pole shall be provided with 300 x 300 x 6 mm M.S. base plate .

The poles shall be installed to a depth of about one sixth of length in cement concrete foundation 1:3:6 (1 cement: 3 coarse sand : 6 graded stone aggregate of 20mm nominal size). With not less than 20cm thick layer of cement concrete up to at least 15cm above ground level. Pole shall be painted with zinc chromate. Pole shall be with in-built loop-in Box.

9.2 **CABLE LOOP-IN BOX :-**

The cable loop-in boxes shall be mild steel of atleast 16 SWG thickness with hinged lockable lid and shall be complete with MCB, clamps and provision for termination of brass compression gland of suitable size cable as per specification & BOQ. Cable loop-in box shall be given a coat of zinc chromate primer before erection at site. Cable loop-in boxes shall be of weather gasket to make it water tight.

After erection the cable loop-in boxes shall be painted with two coats of paint of approved shade. Cable loop-in box shall face away from the road. Cost of clamp for fixing of cable loop-in box shall deemed to be included in cost of cable loop in box.

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10.0 **GI WIRE 6 SWG & GI WIRE 8 SWG**

This specification covers manufacture, testing and supply of hot dip galvanized MS solid wire of sizes 6 SWG (5 MM) & 8 SWG (4 MM) diameters.

10.1 **APPLICABLE STANDARDS :-**

10.1.1 **ZINC :-**

Zinc shall conform to grade Zen 98 specified in IS 209 & IS: 4826-1979 with upto date amendments.

10.1.2 **ZINC COATING :-**

Zinc coating shall be in accordance with IS: 4826-1979 for heavily coated hard quality.

10.1.3 **GALVANISING :-**

Galvanizing shall be as per IS:2629-1966, IS 4826-1979 with up to date amendments

10.1.4 **UNIFORMITY OF ZINC COATING :-**

Uniformity of zinc coating shall be as per IS:2633-1972 with up to date amendments

10.1.5 **TENSILE PROPERTIES :-**

The tensile strength of the wire after galvanizing shall be between 55-95 Kg/sq.mm ensuring MS wire mechanical properties as per IS-28:1972 8.1 to 8.3.

10.1.6 **FREEDOM FROM DEFECTS :-**

As per IS: 2629-1966 & 4826-1979 & with up to date amendments be ensured

10.2 **MATERIAL :-**

The mild steel wire shall have chemical composition maximum sulphur- 0.055%, phosphorous - 0.055%, Carbon 0.25%.

10.3 **TESTS :-**

During the process of manufacturer/fabrication and all tests for chemical, mechanical, galvanizing as per IS-280-1979, IS1521-1972, IS-1755-1961, IS:6745-1972 & 4826-1979 shall be carried out. The certificate towards, chemical composition shall be submitted for each lot offered for inspection.

The following tests shall be conducted in presence of the representative of the purchaser:

a) Visual physical inspection and measurement of specified dimension Coating test as per IS:1755-1961, IS 2629-1966, IS:2633-1972, IS:4826- 1969

b) Adhesion test as per IS:1755-1961,IS:2629-1966,IS:2633-1972,IS:4826- 1969,&IS:6745-1972

c) Tensile strength and breaking load and elongation determined as per

d) IS:1521-1972 with up to date amendments

10.4 **PACKING & MARKING :-**

Packing shall be as per IS:280-1979 and each coil shall be between 50-100 kg .marking shall be as per IS:280-1972

11.0 EARTHING

11.1 GENERAL

Earthing of Substation equipment shall be carried out in conformity with IS 3043-1987, Indian Electricity Rules and CPWD specification.

11.2 EARTHING OF NON CURRENT CARRYING METAL PARTS OF SUBSTATION EQUIPMENT (BODY EARTHING).

Body earthing of Substation equipment like Transformer, H.T. Panel & DG Set shall be done separately in the Substation Building. Whereas body earthing of Main L.T. Panels, Capacitor Panels etc. shall be independently earthed. Earthing electrode shall be 600 x 600 x 6mm thick G.I plate.

11.3 NEUTRAL EARTHING OF EQUIPMENT

Neutral terminals of Transformers shall be earthed independantly. Each neutral terminal shall be earthed with two independent earth electrodes. Earth electrode shall be 600 x 600 x 3mm thick copper plate. Earthing conductor shall be 25 x 5mm copper. upto to 500 kva and 32x5 mm upto 1000 kva Earthing conductor in ground shall be in G.I. pipe whereas inside building shall be on SMC insulator on surface.

11.4 EARTHING CONDUCTOR FOR SUB-STATION EQUIPMENT

Earthing conductor shall be G.I. Earthing conductor from earth electrode to earth bar shall be G.I. Strip. G.I. Strip laid in ground shall be protected with G.I. pipe whereas inside the building shall be on SMC insulator on surface.

11.5 EARTHING CONDUCTOR FOR INTERNAL ELECTRICAL WORKS

Earth continuity conductor from distribution board onward upto outlet point shall be of insulated copper conductor while earth continuity conductor from Sub Distribution Board to final distribution board (lighting & power) shall be of Insulated copper wire. For 3 phase distribution boards / outlets shall have 2 earth continuity conductors while single phase distribution boards outlets shall have one earth continuity conductor.

11.6 PLATE EARTH ELECTRODE

Earthing shall be provided with copper/G.I plate electrode of following.

i. Copper Plate Electrode. : 600mm x 600mm x 3mm thick

ii. G.I plate Electrode : 600mm x 600mm x 6mm thick

The electrode shall be buried in ground with its faces vertical and not less than 3.5metres below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode.

A funnel with mesh shall be provided on the top of this pipe for watering the earth electrode. Earth electrode the watering funnel attachment shall be housed in masonary enclosure of not less than 300 x 300 x 300mm deep. A precast RCC frame with cover shall be provided at top of chamber. Earth electrode may not effect the column footing or foundation of the building. In such cases electrode may be further away from the building.

11.7 **PIPE EARTH ELECTRODE** :-

GI pipe shall be of medium class 40mm dia and 4.5 metre in length. Galvanizing of the pipe shall conform to relevant Indian Standards. GI pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2 metre of length from bottom. The electrode shall be buried in the ground vertical with its top not less than 20cm below ground level as per detail enclosed. Earth electrode shall not be situated less than 2 metres from the building. The location of the earth electrode will be such that the soil has reasonable chance of remaining moist as far as possible. Masonry chamber of size 300 x 300 x 300mm shall be provided with water funnel arrangement, Heavy duty RCC frame and cover.

11.8 **ARTIFICAL TREATMENT OF SOIL** :-

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride, calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

11.9 **RESISTANCE TO EARTH** :-

The resistance of earthing system shall not exceed 1 ohm.

SECTION-2

TECHNICAL SPECICATIONS FOR DG SETS

NOTE : TECHNICAL SPECIFICATIONS AS DETAILED BELOW ARE GENERAL IN NATURE AND WILL BE APPLICABLE WHERE EVER REQUIRED BASED ON SCOPE OF WORK, BOQ AND DRAWINGS.

The Electrical Installation shall be carried out in accordance with Indian Standard Code of Practice for External Electrification Works. It shall also be in conformity with regulations and requirements of the Local Electricity Supply Authority.

i) CONTRACTOR'S DRAWINGS :-

- **Manufacturers' Drawings:** - The CONTRACTOR shall provide manufacturer's drawings, where applicable, or when requested by the IRWO / ENGINEER-IN-CHARGE. The manufacturer's drawings shall clearly, show all dimensions, details, specifications connections/ joints etc.

- **Approval of Drawings :-**

  All drawings prepared by the CONTRACTOR shall be submitted at the appropriate time to the ENGINEER-IN-CHARGE /IRWO by the CONTRACTOR .IRWO shall check and approve these drawings in a reasonable time and issue them to the CONTRACTOR as "Approved for Construction". Such approval shall however not relieve the CONTRACTOR of responsibility for any discrepancies, errors or omissions in their submittals.

The works shall be carried out in accordance with the Electrical Drawings to be issued by IRWO / ENGINEER-IN-CHARGE as "Approved FOR CONSTRUCTION".

ii) BAR CHART FOR EXECUTION OF WORK :-

The Contractor shall submit within one week of the acceptance of the tender, a BAR Chart to ENGINEER-IN-CHARGE, which shall indicate the planning for the execution of the entire work under the contract within the stipulated time given for completion. This shall be scrutinized by the ENGINEER-IN-CHARGE. The mutually agreed BAR CHART shall be binding on the Contractor for progress of the work & for completion by the due date.

The Contractor shall during the entire tenure of site work, provide accurate monthly reviews of BAR-CHART showing work targets & completed works for discussions with the IRWO.

Contractor's shall maintain a register of daily deployment of Electrician, Skilled/Unskilled Labour etc. on various activities and get it signed from Engineer-In-Charge on daily basis and shall produce before the IRWO as and when asked for.

iii) As Built Drawings and Maintenance Instruction Manuals:-

- The CONTRACTOR shall provide to the ENGINEER-IN-CHARGE / IRWO prior to the time of completion of the works as Built Drawings and Maintenance Instruction Manuals for all the equipments within the

scope of work. On completion of any relevant works the CONTRACTOR shall prepare two sets of "As Built" drawings of such works for their approval by Engineer-In-Charge. These drawings shall be a complete record of the works showing the positions and dimensions of all elements executed within the CONTRACTOR's scope of work.

- ☐ After approval by the ENGINEER-IN-CHARGE the CONTRACTOR shall forward to the IRWO four copies of the approved "AS BUILT DRAWINGS" & Working and Maintenance Instructions Manuals and four prints and one reproducible copy of each drawing. Drawings files on compact disc (CD) shall also be forward.

iv) QUALITY OF MATERIALS & GENERAL STANDARDS OF WORK :-

The CONTRACTOR under this contract commits himself to use first class materials and assumes full responsibility for the quality of all materials incorporated or brought for incorporation in the work. The work shall be executed in accordance with the best Engineering practice and as per directions of ENGINEER-IN-CHARGE.

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1. ENGINE

Compression, ignition, totally enclosed, 4 stroke cycle, cold battery starting, Turbo charger water cooled, radiator, 1500 RPM in accordance to BS 694-1958/IS: 10002-1981 complete with accessories. The engine should be continuous duty and confirming to BS 5514.

1.1 Manufacturer shall ensure that the sound level of DG Set do not exceed as per CPCB guideline of 75 db (A) at manufacturing stage.

1.2 The D.G. set shall be complete with acoustic canopy to reduce the noise standard level to confirm to environmental protection rules 1986 and in the ambit of notification no. G.S.R. 371E of ministry of environment & Forests G.O.I., New Delhi for stationary diesel generating sets.

The panel shall be punch press/hydraulic press brake manufactured body, constructed from rolled section, rigid in form and aesthetic in look. The weather proof enclosure shall be corrosion resistant and shall be made of cold rolled steel surface treated, phosphated and finally powder coated for a long lasting finish (in 7 tank process).

The D.G. set shall be suitable for operation in residential area, which demands low sound level while operating at full load.

The provision of canopy shall not reduce the efficiency of the DG set and keep the operating temperature with in the permissible limits specified by the manufacturer.

1.3 The manufacturer/supplier should offer a standard acoustic enclosure of 25 dB (A) insertion loss and also a suitable exhaust muffler with insertion loss of 25 dB (A).

MICRO PROCESSOR BASED (A & B)

A. Instrumentation on Engine.

a) Speedometer with time totalizer
b) Lub. Oil pressure gauge
c) Cooling water temperature gauge
d) Battery charger

B. Alarm/Trip (Audio and Visual) And Protection

Engine Over speed
High cooling water temperature, Engine over heating.
Low Lub. Oil pressure

Make of Engine	As per approved List
Rating	Suitable BHP for continuously delivering required KVA at 0.8 p.f
Model	To be mentioned by supplier
Cooling	Radiator Cooled
Aspitation	Turbo charged
No. of Strokes	4
No.of Cylinders	as per requirement

2. ALTERNATOR

Screen protected, drip proof, 3 phase 415 Volts, 4 wire, 50 Hz 0.8 p.f., 1500 RPM, Brushless alternator, continuous rating as per relevant Indian Standards. IS 4722/ B S 2613 & will be suitable for operation in tropical conditions. Alternator shall be with automatic voltage regulator at 415 Volt plus/minus 1%

Exciter

Self excited, self regulated, providing alternator output regulation at +/- 1% from no load to full load.

3. GENERATOR CONTROL PANEL

Floor mounting type totally enclosed 14 SWG, sheet metal cubical type switch board for the alternator incorporating all the instruments, protective devices, alarms as required Sub assemblies shall be fully drawn out type for easy maintenance.

4. AUTOMATIC MAINS CHANGEOVER PANEL (AMF) -

The AMF panel shall be floor mounted totally enclosed steel sheet cubical type suitable for the generator AMF panel shall automatically transfer the load from mains to emergency supply if the main supply fails or low voltage persists of more than 5 seconds. It shall also revert from emergency power to mains SEB supply when the mains voltage persists for more than 2 minutes. To achieve this microprocessor based MCCBs ..... Amps 4P, 50/36 KA,(as per BOQ) with O/L, S/C, E/F with 320 A 4 Pole AC-3 contactor with ..... Amps bus bar and main contactors as per drawings, Annunciation window, Aux-relays control contactors, MCB's & 24V Battery Charger as per LOGIC specified in the drawing. AMF panel shall be provided with Auto/ Manual mode with such delay features that transfer of load takes place on to the 2nd DG Set when the generator output of the Ist D G Set reaches 80% at its rated voltage and frequency. AMF panel shall be provided with Electronic multi function meter to display V, A, F, P.F., KW of **HPL/** L&T/ SECURA make. LED indicating lamps shall be provided to indicate the source of supply either from mains or the generator Suitable provision shall be made for cable termination as required on the mains supply side.

The following are the automatic operation and to be incorporated in the AMF panel.

a) The generator power and mains power at AMF panel are to be electrically interlocked through a Micro Processor based changeover used for main power supply to emergency load

b) Generator shall start automatically and be on line with in 10-40 seconds when the selector switch is in automatic position

AMF panel starts the diesel generator set automatically upon sensing unhealthy mains supply on the incomer to the AMF panel persistently for a period, which may be adjustable and variable from 10 to 100 seconds, when the generator has built up its normal voltage and frequency change over may take place The emergency on mains supply may be defined as follow :

1. Failure of 1, 2 or 3 phase
2. Under voltage condition (10% below normal voltage of 415 Volts A.C.)
3. Over voltage condition (10% above normal voltage of 415 volts A C .)

c) Faulty generator supply would be disconnected from load automatically. 2nd D.G Set coupled with L.T. bus will be operational as soon as the load on the Ist D.G. Set exceeds 80 %.

d) AMF panel shall transfer the load to mains supply after 0-2 minutes on resumption of stabilized healthy mains supply.

e) The diesel generator set stops after a time for engine cooling (60-600 seconds) and is ready for automatic start when required.

f) If the AMF panel trips because of a fault in load circuit, the diesel generator should not start automatically.

g) In the case of any engine fault, the emergency breaker of the AMF panel with trip, engine will stop and respective fault light will indicate on the panel. The engine can be restarted only after rectifying the engine fault after restoring the fault relay.

h) When the selector switch is in manual position, the operator shall have complete control of the system except that no safety or protective services and/or interlocks are to be by-passed

i) Transferring the selector switch (automatic/manual or vice versa) position should not cause any change in the operation condition of the system.

j) All the desired change over & load management operation shall be regulated through PLC.

k) Battery Charger rated at 40 amps at boost position complete with transformer, full wave rectifier and all other accessories.

A. Instrumentation

a. Battery Charging Volt meter & Ammeter for trickle & boost charging
b 1 set of phase indicator lamp,
c Hooter (Electronic)

B. Protection

a. Automatic voltage regulation at 415 volts plus or minus 1%
b. Under voltage relay.
c. Engine over speed of by original manufacturer.

C. Visual & Audio

a. One each for operation of protection circuit.
b High temperature, low lub oil pressure, over speed, low level of diesel in tank.

D. Indication

a. Set Running
b. Set fails to start.
c. Load on set/on mains supply.
d. Engine low lub Oil pressure
e. 2 nos. of spare annunciation windows.

E. **Out going Power Supply**

MCCB 4P, 400/320/250/125 AMP for 200 KVA DG sets & 400/250/125 Amp for 125 KVA DG sets of 50 KA/ 36 KA as per BOQ to the detailed specification of the work.

Contactors 400A/320A/250 A AC-3A category as per BOQ

5. **OTHER ANCILLARY EQUIPMENT :-**

Fuel Tank:
The engine shall be provided with daily service fuel tank sufficent for 24 hours consumption mounted near the D.G set in addition to a Standard Tank mounted on the base frame.

Silencer
Exhaust Silencer shall be residential type to reduce the noise level.

Cooling
The engine shall be water cooled with adequate capacity radiator with fan shall be provided.

6. **FUSES :-**

All the control components and sub circuits should be protected with low voltage HRC fuses wherever used shall be in accordance with **IS 13703** (part **1&2) 1993.** If contractor is used for Power isolation it must be backed up with fuses of adequate capacity.

7. **INDICATING INSTRUMENTS AND LAMPS :-**

All the indicating instruments mounted on the panel shall be of flush mounted and non-draw-out type. All the indicating lamps shall be clustered LEDs type and backed up the protective fuses on toggle switches.

8. **EARTHING :-**

All the non-current carrying parts of the panel shall be connected with the framework of the panel. Provision shall be made for connection of Main earth on both the sides of the panel. All Panels may be provided with double earth.

9. **LABELS :-**

Engraved PVC labels shall be provided on all circuit elements. Circuit diagram showing the arrangements shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet

10. **BUS BAR CONNECTION :-**

The bus bar and its connections shall be of copper of rectangular cross sections suitable for full load current for phase and neutral and shall be extensible on either side. Complete length of bus bars shall have the same sections for the rated current. The bus bars and interconnection shall be insulated with insulation tapes and colour coded. The bus bars shall be supported on unbreakable non hygroscopic insulated supports at regular intervals to withstand the forces arising from short

circuit in the system. All bus bars shall be provided in a separate chamber and properly ventilated. All bus bars connection shall be done by drilling holes in the bus bars. Extra cross section of bus bars shall be provided to compensate holes in the bus bars.

11. TECHNICAL DATA REQUIRED :-

i) Foundation details

ii) Physical dimensions and service clearances.

iii) Complete technical literature

iv) Fuel oil specifications and oil consumption per hour at full load.

v) Lubricating oil specification and oil consumption

12. SPECIFICATION OF MATERIALS :-

i) Exhaust Silencer Piping:

The exhaust silencer piping system shall be of heavy duty MS pipes conforming to class C. Suitable length of flexible piping shall be provided for connecting the exhaust piping to the engine as per the recommendations of the manufacturer. M S screwed flanges and bends shall be used as per site requirements.

Exhaust pipe shall be logged with rock wool insulation and 26 SWG aluminum cladding

ii) Water Piping and oil piping

Water piping shall be of C class G.I pipe. Oil piping shall be of G.I. or braided flexible type pipe only of appropriate size.

iii) Wiring

a) All the wiring outside the panel shall be drawn into 16 gauge M S conduits.
b) Minimum size of wires outside the panel shall be 2.5 sq.mm copper conductor
c) Minimum size of control cables inside the panel shall be 2.5 sq.mm conductor.
d) All the wires and cable shall be suitable for 650/1100 volts

13. EARTHING :-

a) General :-

All the non-current carrying metal parts of electrical installation shall be earthed properly. All metal conduits, cable sheaths, switchgear on all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Generator neutral shall be earthed separately. All eathing shall be in conformity with the relevant provision of rules 33 and 61 of the Indian Electricity Rules 1956 and Indian Standard Specifications I.S. 3043:1966.

b) **Earthing Stations**

Plate electrode earthing:

Earthing electrode shall consist of G.I. plate not less than 600mm x 600mm x 6mm thick for body/equipment earthing and 600mm x 600mm x 6mm thick copper plate of neutral earthing.

Plate electrode shall be buried as far as practicable below permanent moisture level but in any case top edge not less than 3 meters below ground level. Wherever possible, earth electrodes shall be located as near the water tap, water drain or a down take pipe. As far as possible Earth electrode shall not be installed in proximity to a metal fence. It shall be kept clear of the building foundation and in no case shall be nearer than 2 meters from outer face of the wall.

The earth plate shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. A 20 mm G.I. pipe shall run from the top edge of the plate to the ground level. The top of the pipe shall be provided with a funnel and a mesh for watering the earth through the pipe. The funnel over the G.I. pipe shall be housed in a masonry chamber, approximately 300mm x 300mm x 300mm deep. The masonry chamber shall be provided with heavy duty RCC cover resting over a C.I. frame embedded in masonry.

c) **Earth Connections**

All metal clad switches carrying medium voltage shall be connected with earth by two separate and distinct connections Earthing conductor inside the building wherever exposed shall be properly protected from mechanical injury by running the same in G 1 pipe of adequate size. Earthing conductor outside the building shall be laid 600 mm below the finished ground level.

The over lapping in G l/copper strips at joints shall be minimum 6 mm, the joints shall be riveted with copper rivets and brazed in approved manner. Lugs/ of adequate capacity and size shall be used for all termination of conductor wires above 6 sq.mm size. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances.

The contractor shall give notice well in advance to ENGINEER-IN-CHARGE before commencement of any site testing. All materials like consumable stores, fuel oil grease, lubricating oil etc required for the trials shall be arranged by the contractor. Load for testing shall be arranged by the Contractor.

a) The minimum size of wires outside the panel shall be 2.5 sq.mm copper conductor
b) The minimum size of control cables inside the panel shall be 2.5 sq.mm conductor.
c) All the wires and cable suitable for 650/1100 volts

14. <u>TRIALS</u> :-

a) **Preliminary Trials**

After completion of erection of generating sets and before carrying out main trials preliminary trials, shall be conducted in the presence of the ENGINEER-IN-CHARGE. Such trials shall include the checking and adjustments of all instruments relays, time interlocks and meters. Insulation resistance of stator, rotor and exciter windings and the air gap between stator, rotor 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 shall be tested for its satisfactory working.

b) **Main Trials**

The main trials shall include over 6 hours continuous run at full load including 1 hour run at 110% load. The load available with IRWO shall be made available and balance external load shall be arranged by the contractor for trial.

c) AMF panel and engine control 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 15% shall be allowed on the fuel oil consumption to cover possible errors of measurement/tests providing the satisfactory measurement. Tests providing the satisfactory performance of all safety and operating controls shall be carried out. Govern or trials shall be carried out as laid down in BS:639. Alternator insulation resistance and commutation check shall be as per BS:2613. Starting time of sets shall be tested at least five times with sufficient time internal to allow for cold start. On completion of tests, inspection doors shall be removed and running gears inspected and alignment has to be checked. Any further reasonable trial as suggested by the owner 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 ENGINEERIN-CHARGE. The successful bidder has to submit a list of recommended spares to owner for purchasing the same. A set of tools and tackles has to be supplied along with each set. List of recommended spares shall be indicated to owner.

15. **DAY SERVICE TANK :-**

Day service tank shall be of 2mm thick MS sheet fuel oil storage tank Calibrated Day Service for each DG Set of capacity sufficient for 24 hrs. Consumption capacity on full load for each set with all accessories such as oil level indicator, inlet pipe connection, outlet pipe connection to collect spilt oil, air vent pipe, manhole with cover low level float valve arrangements and interconnections between tanks and panel. The tank shall be provided with suitable, calibration scale.

16. **FOUNDATION :-**

Foundation shall be cast 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 details foundation drawings with 7 days of award of work. The foundation shall be constructed by the owner.

17. **FUEL OIL TRANSFER PUMP :-**

Separate hand driven semi-rotary type oil transfer pump shall be provided The pump should be suitable for transfer of fuel oil from barrel to day service tank.

18. One standard set of tools recommended by manufacturer for day to day maintenance shall be supplied free of cost by the contractor

19. 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 sprays with high corrosion treatment of two coats of synthetic enamel paint of approved colour. All piping shall be colour coded.

20. 12 VOLTS DC BATTERIES MAINTENANCE FREE TYPE :-

2 nos. Maintenance free batteries of 12 volts 180AH shall be provided.

21. BATTERY CHARGING EQUIPMENT :-

Battery charging equipment should be incorporated in the AMF panel and shall comprise of:

a) A.C. and D C "ON" and "OFF" switches with HRC fuses.
b) Indicating lamps for indicating mains "ON" and battery charging.
c) Ballast to give charging.
d) Single phase double wound (copper conductor) impregnated natural air cooled mains transformer for rectifier stock.
e) Rotary switch to give step control.
f) Single phase full wave bridge connected silicon rectifier stack.
g) Moving coil ammeter to indicate charging current.
h) Moving coil voltmeter with a selector switches to measure the battery/charger voltage.
i) Silicon blocking diodes connected to a suitable tap to maintain continuity of D.C. supply.
j) A.C. and D C . contactors of suitable rating as required.

All the components for battery shall be adequately rated and housed in a well-ventilated sheet steel cubicle with input terminals Proper cable glands shall be provided for incoming and outgoing cables.

22. FIRE FIGHTING EQUIPMENT

Fire buckets and fire extinguisher shall be provided in the diesel generating station as required by local government rules and regulations. A set of 5 fire buckets of 16 litres capacity duly filled with sand shall be provided. Foam type fire extinguishers 9 litres capacity 2 Nos. shall be provided in the diesel generating station. These extinguishers and fire buckets shall be kept in such locations, it will be easily accessible when required. Fire buckets shall be hung on angle iron stand. The fire extinguishers shall be fixed on the walls as directed by the ENGINEER-IN-CHARGE.

23. SHOCK TREATMENT CHART :-

Shock treatment chart explaining the method of shock treatment in English, Hindi and local language shall be provided duly framed in the diesel generating station **along with first aid box.**

24. WIRING :

Providing conduits and drawing wires from the following:

a) Control wiring between diesel generating set and the automatic changeover switch.
b) All wiring associated with the fuel oil transfer pump and including level controllers and circulating water pumps.
c) All wiring associated with D.C supply.
d) All earthing conductors associated with this installation.

All wiring and cables shall be PVC insulated copper conductor wires and cables suitable for 650/1100 Volts minimum size of wires for control wiring shall be 2.5 sq.mm and minimum size of wire for pumps shall be 4 sq.mm.

Statutory Inspections /Certificates

It will be the responsibility of the contractor to obtain clearance from electrical inspector to Govt of the state/Regulatory body as per Statuary requirement. The contractor shall obtain anti-pollution certificate from the Civil Authority if required. The inspection fee shall be reimbursed by the Purchaser. Otherwise manufactures pollution under control certificate as per stationary obligation shall be obtained by the contractor

Note :- The SLD enclosed with this tender is for guidance only. The contractor will prepare the SLD as per site conditions to achieve the change over Logics and obtain approval of IRWO

Technical Data Sheet

Sheet no. 1

Data Sheet for Diesel Engine of D.G.Set

S.No.	Short Description	Quoted Data
1	Continuous duty rating of the Diesel Engine in BHP/KVA/KW	
2	Make of Engine	
3	No. of Cylinders	
4	Engine Type Number	
5	Engine RPM	
6	Aspiration	
7	Cooling	
8	Type of Starting	
9	Type of Fuel Used	
10	Specific Fuel Consumption (Guaranteed)	
11	Lub Oil Consumption (in grams per hour)	
12	Output set site conditions after erection at site	

Technical Data Sheet

Sheet No.3

Data Sheet for Generator/ Alternator for D.G Set

S.NO.	SHORT DESCRIPTION	QUOTED DATA
1	Continuous rated output of the generator	
2	Continuous current rating	
3	Sites KW after duration	
4	Generated voltage	
5	Generated frequency	
6	Number of phases	
7	Standard	
8	Class of Insulation for alternator	
9	AC Power Factor	
10	Rated Speed(RPM)	
11	Make of alternator	
12	Model No.	
13	Efficiency : -	
a)	At Full Load	
b)	At half Load	
c)	At quarter Load	
14	Type of Excitation	

Technical Data Sheet

Sheet No. 5

Electrical Control Panel D.G.Sets

S.NO.	SHORT DESCRIPTION	SPECIFIED DATA	Quoted Data
1	Type of panel	Cubical free floor mounting	
2	Type of protection	IP-54 Protection	
3	Short Circuit ratings	31 MVA	
4	Sheets steel gauge	14 Guage MS	
5	Type of Category	Heavy Duty	
6	System of Voltage	415 VAC	
7	Phase	3 Phase and neutral 4 wire	
8	Features	Specially compartmentalized hinged front & back doors	
9	Bus Bars	Copper bars 4 Nos phase and neutral shall be of same size	
10	Standards	As per technical specification	
11	Paintings	As per Specifications	
12	Instrumentation & relays	As per Specifications	
13	Any other items (to be mentioned bidders)		

Sheet No. 6

Data Sheet for Battery Charging unit with Battery

S.NO.	SHORT DESCRIPTION	SPECIFIED DATA	QUOTED DATA
1	Input fuses	HRC Type as per ratings/ MCB DIN type	
2	Pilot lamps	Clustered LED Lamps	
3	Regulator for trickle Charger	1 No.	
4	Control Transformer	1 No.	
5	Bridge rectifier unit	1 No.	
6	Rectifier protection set	1 No.	
7	Ammeter	1 No.	
8	Voltmeter	1 No.	
9	Fuses for outgoing	1 set as per specification HRC for D.C. ratings	
10	Continuous operational O.P. Voltage	24 Volts D.C.	
11	Type of battery	Lead acid stationary maintenance free	
12	Ampere Hour	180 AH	
13	Any other item(to be specified by bidder)		

PREAMBLES TO SCHEDULE OF QUANTITIES

2. The rate for supply and erection of diesel Generator generally include.

   a. Fixing the generator on floor with Dunlop pad.

   b. Aligning engine and alternators and grouting.

   c. First filling of lube oil and replacing the oil after totals.

   d. Necessary Diesel Oil for trials.

3. The rates for panels and boards shall include:
   a. Supporting rigid framework.

   b. 2mm thick M.S. sheet housing

   c. Grouting to the foundation and effecting proper earth connections.

4. The cable rates shall include:

   a. Providing proper M.S. supports to cable at one meter intervals and grouting the clamp to ceiling or walls etc.

   b. Providing sealing compound, thimbles at joints and terminations as called for.

   c. Providing sleeves wherever the cables pass through wall.

5. The rates for earthing shall include:

   a. All fixing accessories shall as brass saddles, brass screws, cadmium coated nuts and bolts etc.

   b. Jointing by tinning riveting and soldering.

   c. Use of copper and effecting proper and adequate connections.

Painting of all metal work including Diesel Engine, Generator, Supports, Panel etc. as per specification

SECTION -3

TECHNICAL SPECIFICATIONS FOR 11KV/433V PACKAGE SUBSTATIONS

NOTE : TECHNICAL SPECIFICATIONS AS DETAILED BELOW ARE GENERAL IN NATURE AND WILL BE APPLICABLE WHERE EVER REQUIRED BASED ON SCOPE OF WORK, BOQ AND DRAWINGS.

The Electrical Installation shall be carried out in accordance with Indian Standard Code of Practice for External Electrification Works. It shall also be in conformity with regulations and requirements of the Local Electricity Supply Authority.

i) CONTRACTOR'S DRAWINGS :-

- **Manufacturers' Drawings:** - The CONTRACTOR shall provide manufacturer's drawings, where applicable, or when requested by the IRWO / ENGINEER -IN-CHARGE. The manufacturer's drawings shall clearly, show all dimensions, details, specifications connections/ joints etc.

- **Approval of Drawings :-**

  All drawings prepared by the CONTRACTOR shall be submitted at the appropriate time to the ENGINEER-IN-CHARGE /IRWO by the CONTRACTOR .IRWO shall check and approve these drawings in a reasonable time and issue them to the CONTRACTOR as "Approved for Construction". Such approval shall however not relieve the CONTRACTOR of responsibility for any discrepancies, errors or omissions in their submittals.

The works shall be carried out in accordance with the Electrical Drawings to be issued by IRWO / ENGINEER-IN-CHARGE as "Approved FOR CONSTRUCTION".

ii) **BAR CHART FOR EXECUTION OF WORK :-**

The Contractor shall submit within one week of the acceptance of the tender, a BAR Chart to ENGINEER-IN-CHARGE, which shall indicate the planning for the execution of the entire work under the contract within the stipulated time given for completion. This shall be scrutinized by the ENGINEER-IN-CHARGE. The mutually agreed BAR CHART shall be binding on the Contractor for progress of the work & for completion by the due date.

The Contractor shall during the entire tenure of site work, provide accurate monthly reviews of BAR-CHART showing work targets & completed works for discussions with the IRWO.

Contractor's shall maintain a register of daily deployment of Electrician, Skilled/Unskilled Labour etc. on various activities and get it signed from Engineer-In-Charge on daily basis and shall produce before the IRWO as and when asked for.

iii) **As Built Drawings and Maintenance Instruction Manuals :-**

- The CONTRACTOR shall provide to the ENGINEER -IN-CHARGE / IRWO prior to the time of completion of the works as Built Drawings and Maintenance Instruction Manuals for all the equipments within the

scope of work. On completion of any relevant works the CONTRACTOR shall prepare two sets of "As Built" drawings of such works for their approval by Engineer -In-Charge. These drawings shall be a complete reco rd of the works showing the positions and dimensions of all elements executed within the CONTRACTOR's scope of work.

After approval by the ENGINEER-IN-CHARGE the CONTRACTOR shall forward to the IRWO four copies of the approved "AS BUILT DRAWINGS" & Working and Maintenance Instructions Manuals and four prints and one reproducible copy of each drawing. Drawings files on compact disc (CD) shall also be forward.

iv) QUALITY OF MATERIALS & GENERAL STANDARDS OF WORK :-

The CONTRACTOR under this contract commits himself to use first class materials and assumes full responsibility for the quality of all materials incorporated or brought for incorporation in the work. The work shall be executed in accordance with the best Engineering practice and as per directions of ENGINEER -IN-CHARGE.

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1.0 CODE & STANDARDS FOR PACKAGE TYPE SUBSTATION :-

1.1.1 All equipment and material shall be designed manufactured and tested in accordance with the latest applicable Indian Standard / IEC standard.

1.1.2 The electrical installation shall meet the requirement of Indian Electricity Rules as amended upto date relevant IS code of practice and Indian electricity act.

11.3 The Package type Substation offered shall in general comply with the latest issues including amendments of the following standards but not restricted to it.

Title	Indian Standards
High Voltage Low Voltage Pre-Fabricated Substation	IEC:62271 -202
11 kV Switchgear cubicles	IS:13118, IS:3427, IEC: 60694, IEC: 60298
Code of practice for selection, installation and maintenance of Switchgear	IS:10118
Ring main unit 11KV Grade	IS:9920, IEC: 60265
Distribution Transformer	IS: 2026
Colour for ready mix paints	IS:5
Enamel synthetic, exterior a) Undercoating, b) finishing	IS:2932
L.T. Fuseboard Panel	IS:5039
Indian Electricity Rules	1956 & latest update
Indian Electricity Act	2003

1.2 DESIGN CRITERIA :-

1.2.1 Package Substation consisting of **11KV SF6 insulated Non-Ext compact switchgear with VCB + Transformer + L.T. Switchgear** with all connection accessories, fitting & auxiliary equipment in an Enclosure to supply Low-voltage energy from high-voltage system as detailed in this specification. The complete unit shall be installed on a substation plinth (base) as **Outdoor Substatio n.** 11KV VCB controls incoming -outgoing feeder cables of the 11KV distribution system. The Vacuum Circuit Breaker shall be used to control and isolate the 11kV/433V Distribution transformer. The transformer L.T. side shall be connected to L.T. switchgear. T he connection cables to consumer shall be taken out from the L.T. switchgear. Capacitor Panel shall be installed in the package type Substation.

1.2.2 The prefabricated package type substation shall be designed for a) Compactness, b) fast installation, c) maintenance free operation, d) safety for worker/operator & public.

1.2.3 The Switchgear and component thereof shall be capable of withstanding the mechanical and thermal stresses of short circuit listed in ratings and requirements clause without any damage or deterioration of the materials.

1.2.4 For continuous operation at specified ratings temperature rise of the various switchgear components shall be limited to permissible values stipulated in the relevant standard and / or this specification.

1.2.5 **Service Conditions:**

1.2.5.1 The equipment offered shall be suitable for continuous satisfactory operation in tropical area of Installation.

Enclosure: The Enclosure, High Voltage switchgear -control gear, Low Voltage switchgear - control gear & Transformer of the package type substation shall be designed to be used under **normal outdoor service condition** as mentioned. The enclosure should take minimum space for the installation including the space required for approaching various doors & equipment . The enclosure construction shall be such that it fully protects ingress of rain water & rusting .For this purpose , construction without welded joint is preferred.

1.3 SPECIFIC REQUIREMENT

The main components of a prefabricated package type substation are Transf ormer, High - voltage switchgear -control gear, Low -voltage switchgear -control gear, corresponding interconnections (cable, flexible, busbars) & auxiliary equipment. The components shall be enclosed, by either common enclosure or by an assembly of enclosure. All the components shall comply with their relevant IS/IEC standards.

1.3.1 **Ratings:**

Description	**Unit**	**Value**
Rated Voltage / Operating Voltage	kV rms	11
Rated frequency & Number of phases	Hz & nos.	50 & 3
Rated maximum power of substation	Kva	200 KVA to 1000 as per requirement
Rated Ingress protection class of Enclosure	IP:	IP:54 for LT & HT switchgear compartment & IP:23 for Transformer compartment
HV Insulation Level		
Rated withstand voltage at power frequency of 50 Hz	kV rms	28

Rated Impulse withstand Voltage	kV peak	75
HV Network & Busbar		
Rated current	Amp	630A
Rated short time withstand current	kA rms/ 3sec	20
Making capacity for switch -disconnector & earthing switches	kA peak	52kA
Breaking capacity of Isolators (rated full load)	A	630A
LV Network		As per the BOQ

1.3.2 **Outdoor enclosure**:

1.3.2.1 The enclosure shall be made of Galvanised Sheet Steel or as per manufacturer's standards tropicalised to Indian weather conditions.

1.3.2.2 The metal base shall ensure rigidity for easy transport & installation.

1.3.2.3 The structure of the substation shall be capable of supporting the gross weight of all the equipment & the roof of the substation compartment shall be designed to support adequate loads.

1.3.2.4 The protection degree of the Enclosure shall be **IP: 54** for Proper / adequate ventilation aperture shall be provided for natural ventilation by way of Louvers etc.

1.3.2.5 The doors shall be provided with proper interlocking arrangement for safety of operator.

1.3.2.6 The H.V. & L.V. outgoing of the transformer are to be connected to Breaker of HT Panel Board & incomer of the L.V.

1.3.3 **Internal Fault** : Failure within the package type substation due either to a defect, an exceptional service condition or mal-operation may initiate an internal arc. Such an event may lead to the risk of injury, if persons are present. It is desirable that the highest practicable degree of protection to persons shall be provided.

1.3.4 **Covers & Doors** : Covers & doors are part of the enclosure. When they are closed, they shall provide the degree of protection (IP 54) specified for the enclosure. Ventilation openings shall be so arranged or shielded that same degree of protection as specified for enclosure is obtained. All covers, doors or roofs hall be provided with locking facility or it shall not be possible to open or remove them before doors used for normal operation have been opened. The doors shall open outward at an angle of at least 90° & be equipped with a device able to maintain them in an open position.

1.3.5 **Earthing** : All metallic components shall be earthed to a common earthing point. It shall be terminated by an adequate terminal intended for connection to the earth system of the installation, by way of flexible jumpers/strips & Lug arrangement. The continuity of the earth

system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry. The components to be connected to the earth system shall include :

a) The enclosure of Package type / prefabricated substation,

b) The enclosure of High voltage switchgear & control gear from the terminal provided for the purpose,

c) The metal screen & the high voltage cable earth conductor,

d) The transformer tank or metal frame of transformer,

e) The frame &/or enclosure of low voltage switchgear.

3.6 Package type substation enclosure has internal lighting activated by associated switch for HV, Transformer & LV compartments separately.

3.7 **Labels** : Labels for warning, manufacturer's operating instructions etc. & those according to local standards & regulations shall be durable & clearly legible.

3.8 **Cleaning & Painting** :

a) The paints shall be carefully selected to withstand tropical heat rain. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

b) Special care shall be taken by the manufacturer to ensure against rusting of nuts, bolts and fittings during operation. All bushings and current carrying parts shall be cleaned properly a fter final painting.

c) The Fabrication process shall ensure that there are no sharp edges on GI sheet used.

1.3.9 **11KV SF -6 insulated VCB Panel Board** : The requirement of 11KV HT Panel is as under.

1.3.9.1 SF6 insulated VCB Breakers complete with operat ing mechanism suitable for load breaking fault making with cable box accessible from the front.

The above breakers, Busbars should be mounted inside a robotically welded sealed for life, stainless steel tank of 3mm thick sheet metal. The tank should be filled with SF6 gas at adequate pressure. The degree of protection for gas tank should be IP67.

1.3.9.2 The VCB is required to control 11 kV/433 volts distribution Transformer of rating 500 KVA / 200 KVA and relay settings shall be selected accordingly.

1.3.9.3 **General Finish** : Totally enclosed, metal clad, vermin and dust proof suitable for tropical climate use as detailed in the specification.

1.3.9.4 **Breaking & Making Capacity** : Breaker shall be capable of having ru pturing capacity of minimum 20 KA (35 0 MVA) symmetrical at 11000 volts three phase.

1.3.9.5 **Busbar**: Switchgear shall be complete with all connection, bus -bars etc. Copper bus bars continuous rating shall be 800 Amps. The bus bars should be fully encapsulated by SF6 gas inside the steel tank.

1.3.10 **Switchgear**:

1.3.10.1 The VCB pressure vessel shall be sealed for life, the enclosure shall meet the "sealed pressure system" criteria in accordance with IEC: 62271-200/100 (a system for which no handling of gas is required throughout service life of approximate 20 years.) There shall be no requirement to 'top up' the SF6 gas. In addition, manufacturer shall confirm that maximum leakage rate is lower than 0.1% per year. It shall provide full insulation, making the switchgear insensitive to the environment. Thus assembled, the active parts of the switchgear unit shall be maintenance free.

1.3.10.2 The switchgear & switchboard shall be designed so that the position of different devices is visible to the operator on the front of the switchboard & operation is visible as well. The switchboard shall be designed so as to prevent access to all live parts during operation without the use of tools.

1.3.10.3 11 KV VCB Panel Board should be tested for internal arc fault test.

1.3.11 VCB:

1.3.11.1 The Unit shall consist 630A Tee-off spring assisted, three pole VCB circuit breaker, with integral fault making/ dead breaking earth switch. The function shall be naturally interlocked to prevent the main & earth switch from being switched 'ON' at the same time & the CB not allowed to trip in 'Earth On' position. The selection of the main/earth switch lever on the panel, which is allowed to move only if the main or earth switches in the off position. The lever shall be able to pad locked in either the main or earth position.

1.3.11.2 The manual operation of the circuit breaker shall not have an effect of the trip spring. This should only be discharged under a fault (electrical) trip condition; the following manual reset operation should recharge the trip spring & reset the CB mechanism in 'main off' position.

1.3.11.3 Protection :

Protection Relays: The CB shall be fitted with microprocessor based self powered relay inside the front cover to avoid any tampering.

1.3.12 Cable Box:

1.3.12.1 Every VCB shall be provided with suitable and identical cable boxes for connecting 3 core, 11kV cable from vertically below. The cable boxes shall be so located at convenient height to facilitate easy cable jointing work. The height available for cable termination should be minimum 500mm The Cable termination shall be done by Heat shrinkable Termination method so adequate clearances shall be maintained between phases for Termination. Access to all the cables should be possible form the front of HT Panel Board.

1.3.12.2 **Locking Arrangement**: Suitable padlocking arrangements shall be provided as stated below.

a) CB manual operating handle in the "OFF" position.

b) Each feeder Panel operating handles in 'Closed' 'Open" or 'Earth' position.

c) Each VCB operating handle in 'Closed', 'Open', or 'Earth' position.

1.3.13 **Ratings** :

1.3.6.1	Switchgear Data	
a)	Type	VCB in SF -6 Tank
b)	Number of phases	3
c)	Voltage	11000V
d)	Rated Frequency	50 Hz
e)	Rated Current	630 Amp (Breaker)
f)	Short Circuit rating	
	i) Breaking	Minimum 20 KA (350 MVA) at 11 KV
	ii) Short time withstand for 3 Sec.	Minimum 20 KA
	iii) Rated S/c making	52 kA peak for Breaker
g)	Short duration power freq.	28 kV
h)	Insulation Level	75 KV peak
i)	System earthing	Solidly earthed at substation

1.3.14 **Tests For 11 KV HT Panel Board** : Each type of 11kV Switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards i.e. IS:9920, IS:3427, IS:13118, IEC:265, IEC:298 and during manufacturing and on completion

1.3.15 **Routine Tests :** The routine test shall be made on each complete prefabricated substation. The shall include but not necessarily limited to the following:

a) Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme and proper functioning of the equipment.

b) All wiring and current carrying part shall be given appropriate High Voltage test.

Routine shall be performed in presence of IRWO's representatives.

1.3.16 Distribution Transformer (Oil Filled Transformer)

1.3.16.1 **Requirement : 11000/433 Volt Oil immersed, 200 KVA to 1000 KVA as per requirement** ONAN cooled suitable for installation at outdoor in Enclosure for ground mounting. The transformer should be hermitically sealed & should be with corrugated wall design

1.3.16.2 **Voltage Ratio :** No load voltage 11000/433 volts within tolerance as stipulated in IS:2026.

1.3.16.3 **Rating:** The transformer shall have a continuous rating as specified at any of the specified tapping position and with the maximum temperature rise specified.

1.3.16.4 **Temperature Rise :** The maximum temperature rise at the specified maximum continuous output shall not exceed 40°C by thermometer in the hottest portion of the oil or 50° C measured by resistance of winding above ambient temperature, not exceeding 40°C daily average or 50°C maximum.

1.3.16.5 **Type of Load :** The transformer shall be suitable for carrying load within temperature rise indicated in the Indian Standard specification IS: 6600 'Guide for load ing of oil immersed Transformer'.

1.3.16.6 **Overloads:** The transformers shall be suitable for carrying overload within temperature rise indicated in IS: 6600 'Guide for Loading of oil immersed Transformer'.

1.3.16.7 **Connections:** H.V. Delta and L.V Star connected with neutral brought out on the secondary side for connection to earth; Vector group DYn11 of IS:2026.

3.3.16.8 **Tapping :**

a) Each transformer shall be provided with **Rotary type tap switch** so as to provided for a voltage adjustment on H.V. from +7.5% to –7.5% of rated voltage of 11000 volts in 6 equal steps (7 position) to obtain rated voltage of 433 volts on LV side. The tapping shall be provided for following voltage ratios at no load.

b) Each transformer shall be provided with adjustable **tapping Links** such as to provided for a voltage adjustment on H.V. from + 7.5% to –7.5% of rated voltage of 11000 volts in 6 equal steps (7 position) to obtain rated voltage of 433 volts on LV side. The tapping shall be suitable to change on H.V. side by links provided for this purpose.

1.3.16.9 **Cleaning & Painting :**

a) All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents, as required to produce a smooth surface free of scales, grease and rust.

b) The internal surfaces in contact with insulating oil shall be painted with heat resistant insulation paint which shall not react & be soluble in the insulating liquid used.

c) The external Surfaces, after cleaning, shall be given two coats of high quality epoxy based rust resisting primer as per IS:2074 followed by filler coats.

d) The transformer shall be furnished with coats of weather resisting battleship gray epoxy based enamel paint as per IS:2932 specially recommended for transformer use.

e) The paints shall be carefully selected to withstand tropical heat rain, effect of proximity to the sea etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

f) Special care shall be taken by the manufacturer to ensure against rusting of nuts, bolts and fittings during operation. All bushings and current carrying parts shall be cleaned properly after final painting.

1.3.16.10 Both H.V. and L.V. bushings shall have creepage corresponding to very heavily polluted atmosphere.

1.3.16.11 **Oil:** New transformer oil used shall be according to IS:335.

1.3.16.12 **Phase Marking & Danger Plate** : Phase markings in fluorescent paint on small non-corrodible metallic tags shall be permanently fixed for H.V. and L.V sides. Phase markings tags shall be proper ly fixed with proper alignment. Danger plates shall be provided on the H.V & LV sides, mentioning the Corresponding Voltages.

1.3.16.13 **Core** : The core shall be constructed from high grade, cold rolled, non -ageing, low loss, high permeability, grain orien ted, cold -rolled grain oriented silicon steel laminations. The transformer shall be so designed as to have minimum humming noise. The percentage harmonic potentials with the maximum flux density under any conditions shall be such that capacitors connecte d in the system shall not be overloaded.

1.3.16.14 The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer. The core and coil assembly shall be capable of withstanding without injury, the thermal and mechanical effects of short circuit at the terminals of any winding as per IS:2026.

1.3.16.15 **Impedance Volts** : The Percentage impedance value at 75 Deg. C at any tap shall be 5% subject to tolerance as specified in IS:2026.

1.3.16.16 **Regulation:** The regulation at 75°C at full load at unity and 0.8 power factor subject to the usual tolerance as per IS:2026 shall be specified in the bid.

1.3.16.17 **Power Freq. High Voltage & Insulation Level (Impulse voltage)** : The distribution transfo rmer shall be designed so that they are capable of withstanding high voltage & impulse voltages as per IS:2026 and as given below:

a) Impulse Voltage for 11kV winding: 75 kV (1.2/50 Microsecond wave shape).

b) High Voltage : 28kV rms.

1.3.16.18 **RATINGS (Summary) :**

S. No.	Application	200 KVA to 1000 KVA as per requirement, Corrugated Tank
(i)	Service	Outdoor in an Enclosure, Distribution Transformer
(ii)	Type	Oil immersed corrugated tank
(iii)	Cooling system	ONAN

S. No.	Application	200 KVA to 1000 KVA as per requirement, Corrugated Tank
(iv)	No. of Phases	3
(v)	No. of winding per phase	2
(vi)	Rated output (MVA) With ANAN cooling	200 KVA to 1000 KVA as per requirement
(vii)	Rated voltage in KV (Line to Line)	HV-11 kV LV-0.433 kV
(viii)	Rated frequency	50 Hz
(ix)	Temperature rise above 40°C	
a)	In winding by resistance	50°C or above
b)	In Oil by thermometer	40°C or above
(x)	Insulation level	
a)	H.V. Power Freq. KV rms	28 kV
b)	H.V. (kVpeak) Impulse	75 kV
c)	L.V. (kV)	-
(xi)	Vector Group	Dyn11
(xii)	Parallel operation	Yes
(xiii)	Type of taps provided	Off Load full capacity
a)	Taps provided on	H.V. winding
b)	Range of taps	+7.5% to -7.5% in steps of 2.5%
		(6 steps, 7 position)
c)	Method of Tap Change control	Rotary Switch
d)	Manual load	Yes 'Off Circuit'
(xiv)	Percentage impedance at 75 Deg. C	5% with tolerance
(xv)	System earthing	

S. No.	Application	200 KVA to 1000 KVA as per requirement, Corrugated Tank
a)	H.V.	Solidly earthed
b)	L.V.	Solidly earthed
(xvi)	Terminal arrangement	
a)	H.V.	From H.V. Bushing on Top.
b)	L.V.	From L.V. Bushing on Top.
c)	L.V. Neutral	From L.V. Neutral Bushing on Top.
(xvii)	Transformer -bushing voltage class	
a)	H.V. (kV)	12 kV class
b)	L.V. (kV)	1.1kV class
(xviii)	System fault level	
a)	H.V. side	350 MVA (11 kV)
b)	L.V. side	-
(xix)	Short circuit withstand capability duration	3 sec.
(xx)	L.T. side C.T. ratings	
a)	C. T. Ratio	800/5 Amps & 400/5 Amps
b)	Class of Accuracy	1
c)	Burden	15 VA
d)	Type	ring type

1.3.16.19 Fittings & Accessories For Corrugated Tank Transformer :

The following accessories conforming to IS:3639 shall be provided for 11kV / 0.433kV, distribution transformer.

a) Two earthing terminals with copper lugs. The lugs shall be provided in such a way that they shall not obstruct the movements of rollers. The earthing continuity for all the connected equipments shall be properly done.

b) Two lifting lugs for complete transformer as well as enclosure.

c) Off circuit tapping switch shall be rotary type, 3 pole gang operated, top mounting draw out type only. Tap switch shall be suitable for rated current considering 20% overloading &

operating voltage. Switch shall be provided with externally operating hand wheel handle with indicator and locking device, with direction changing facility and locking arrangement.

d) **Rating plate and diagram plate** of durable non -corroding metal giving information as required under IS:2026. Rating plate shall also include Transformer **Actual %Z, No -Load Loss & Full -Load Loss at 75°C**. The name plate marking shall be done with fluorescent colour. Each equipment shall carry individual name-plate with proper instructions & affixed with screws.

1.3.17 **LT Switchgear :**

1.3.17.1 System:-

a) **Declared voltage** :– 3 Phase, 433V (±6%) 50 Hz,

b) **Neutral** :– Solidly earthed at substation.

1.3.17.2 General finish:- Tropical, totally enclosed, metal -clad, weather -proof, vermin and dust proof.

1.3.17.3 Enclosure:- Type of enclosure shall be able to provide the degree of protection IP:54 .

1.3.17.4 **Circuit Ways :**

As per the requirement given in the specifications / schedule of quantities .

1.3.17.5 **Construction :**

a) The terminals shall be of sufficient mechanical strength and shall provide adequate electrical contact for the appropriate size of cable used. They shall be capable of receiving appropriate size of Aluminum conductors. They shall be provided with stainless steel nut bolts, plane washers and spring washers for cable connection.

b) The enclosure shall be of sheet steel of 2mm CRC sheet steel, dust vermin proof, duly powder coated and wired as per standard engineering practi ce and CPRI tested.

c) No contact pressure shall be transmitted through insulating material & the gripping of the conductor shall take place between metal faces.

1.3.18 **Earthing :**

1.3.18.1 Earthing arrangement shall be provided for earthing each cable, PVC cable gland, neutral busbar, chassis and frame work of the cubicle with separate earthing terminals at two ends. The main earthing terminals shall be suitably marked .The earthing terminals shall be of adequate size, protected against corrosion, and readily accessible. These shall be identified by means of sign marked in a legible manner on or adjacent to terminals.

13.18.2 Neutral bus bar strip shall be connected to Earthing terminal with help of copper strip of suitable capacity & nut -bolt arrangement. Neutral busbar strip should be brought outside the enclosure duly clamped for further connection.

1.3.19 **Accessories:** The following accessories shall be supplied duly mounted..

One LED lamp (with necessary fuse) to illuminate the fuse board internally.

1.3.20 **LT Switchgear**

Specification/Selection of Air Circuit Breaker and Moulded Case Circuit Breakers:-

1) Upto 160A MCCBs shall be used of 25kA Short Ckt. Current and should be microprocessor release

2) From 200A -400A MCCBs shall be used of 35kA short Ckt. Current and should be microprocessor release.

3) From 500A-630A MCCBs shall be used of 50kA short ckt. Current and should be microprocessor based.

Rating of MCCB	Electrical Endurance	Mechanical Endurance
Upto 160 A	7000 Opns	25000 Opn s
Above 160 A	4000 Opns	15000 Opns

Frame Size

The MCCB shall have the following Frame Size:

a)	Upto 160 A. Rating	160 A Frame
b)	From 160 A. to 250 A.	250 A Frame
d)	From 250 A. to 400 A.	400 A Frame
e)	From 400 A. to 630 A.	630 A Frame

For thermal magnetic protection the O/L adjustment should be 75% -100% and for microprocessor -based release the adjustment should be 40% - 100% and S/c for 2 to 12 times.

4) From 800A onwards ACBs shall be used of 50kA(Icu=Ics) with Thermal Magnetic (TM) based overload ,short circuit and earth fault protection.

Rating of ACB	Electrical Endurance	Mechanical Endurance
Upto 1600 A	10000 Opns	20000Opns
2000-4000A	5000 Opns	15000 Opns

The air circuit -breakers (ACB's) used in low -voltage in stallations shall be designed, built and tested in compliance with the standards of the IEC 947-2 & EN 60947,

- The ACB's shall have a rated operating voltage of up to 690 V (50/60Hz)
- The rated insulation voltage shall be equal to or greater than 1000 V.
- The rated impulse withstand voltage shall be equal to 12 kV; the device can be used for every installation category in this way, in compliance with the international standards CEI IEC 664-1

Setting range of protection release

a) Overload protection shall have adjustable setting from 40% to 100% of the ACBs rated.

b) Current in steps of 10% and adjustable time setting from 3-18m sec.

c) Short circuit protection shall have adjustable current setting from 100% to 1000% of

d) the overload setting and adju stable time delay setting for fault discrimination from 50 - 500 m sec.

e) E/F protection if specified will have adjustable current setting from 40% to 100% of ACB rated current and adjustable time setting from 100-800m sec. It shall be possible to charge th e release setting on load.

f) There should not be any defeat facility of overload protection.

1.3.21 **TYPE/ROUTINE TEST ON PACKAGE TYPE SUBSTATION :-**

1.3.21.1 **TYPE TESTS FOR THE PACKAGE TYPE SUBSTATI ON :-**

The offered package type substation should be fully type tested as per the IEC-1330

1.3.21.2 **Routine Tests** : The routine tests shall be made on each complete prefabricated substation.

a) Voltage tests on auxiliary circuit.

b) Functional test.

c) Verification of complete wiring.

1.3.21.3 **Test Witness** : Routine test shall be performed in presence of IRWO 's representative.

1.3.21.4 **Test Certificates :**

1.3.21.4.1 Test report for the test mentioned under Type tests clause shall be submitted.

1.3.21.4.2 Certified reports of all the tests carried out at the works sha ll be furnished in three (3) copies for approval of the IRWO .

1.3.21.5 **Warrenty :**

Material and equipment shall be guaranteed for period of 24 months from date of supply or 18 month from date of commissioning.

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2.0 **CAPACITOR BANK & PANEL (Optional) :**

GENERAL :-

This specification covers requirements of Medium Voltage Capacitors and Control Panel to be used for power factor improvement of the electrical system and shall be a part of L.T. Panels. Automatic Power Factor Correction Panel shall function to improve power factor of the system in which it is connected. It shall improve power factor upto 0.99 from initial power factor of 0.70. Capacitor Panel shall have 10-15% of capacitor bank directly connected to ensure power factor remains wi thin prescribed limit during low load demand period and / or night period.

2.2 **CODES AND STANDARDS :-**

The design, manufacture and performance of power capacitors and accessories shall comply with all currently applicable statutes, regulations and safety codes for power installation as prescribed in relevant IS codes and to requirement of Local Electricity Supply Authority to which the equipment shall be installed.

Unless otherwise specified the capacitor and control panel shall conform to following.

a.	IS : 2834	-	Shunt capacitors for power systems.
b.	IS : 2147	-	Degree of protection provided by enclosures for low voltage switchgear and controlgear.
c.	IS : 4237	-	General requirements for switchgear and controlgear for voltages not ex ceeding 1000V.
d.	IS : 8623	-	Specification for factory built assemblies of switchgear and controlgear (Upto 1000 volts).
e.	IS : 2208	-	HRC cartridge fuse links upto 650 volts.
f.	IS : 4064	-	Specification for Fuse Switch & Switch Fuse switchgear and controlgear.
g.	IS : 2959	-	AC contactors for voltage not exceeding 1000 volts.

2.3 **CONSTRUCTIONAL FEATURE :-**

a) Capacitor bank shall be suitable for operation on 415 volts 3 phase, 4 wire, 50c/s, solidly earthed AC supply system. The capacitor shall be connected to the 415 V Switchgear bus and shall be manually as well as automatically switched in and out in steps so as to correct the power factor to be required value depending on the actual KVAR requirement of bus.

b) The capacitor bank shall be complete with the required capacitor units with the supporting post insulators, sheet steel cubicles, busbars, connecting strips, foundation channels, fuses, corrosion proof rating plate etc. Capacitor shall be MPP type. Reactor shall be provided to counter for presence of harmonics in the system.

c) Each basic unit is to be built up with a number of elements. These elements should be wounded with high grade metallised poly propylene film. These metallised film capacitors should be self

healing, having very low loss factor. Capacitor element to be completely sealed with epoxy resins to provide maximum humidity protection and highest insulation. The capacitor elements are to be given adequate outside insulation and should be put in all welded surface treated MS containers. These capacitors shall be impregnated with special grade of capacitor oil under high vacuum . The metal case shall be equipped with porcelain bushings to permit connection between power lines and active capacito rs.

i. Externally each capacitor unit shall have two separate earthing points, name plate conforming to the requirements of IS-2834 (amended upto date), discharge resistances etc.

d) The capacitor bank may comprise suitable number of single phase self cooled her metically sealed units in series parallel combination to achieve required KVAR rating. However, failure of one unit shall not create over voltage on other units connected in parallel to avoid failure of parallel units.

e) Each capacitor unit/bank shall be pr ovided with directly connected continuously rated, low loss discharge device built into the unit to reduce the residual voltage to a safe value within the specified time as recommended in the relevant standard after the capacitor has been disconnected from the supply.

f) All capacitor shall be suitably protected against over current by means of suitable over current protection (other than fuses) which is adjusted to interrupt the circuit when the current exceeds the safe permissible limit. Capacitor units shal l also be protected against the internal faults and the effected units/banks shall be automatically and immediately isolated in the event of such fault.

g) Each capacitor unit shall continuously operate at the following overload conditions separately.

i. Over vo ltage upto 10% of the rated RMS voltage.

ii. Over current upto 15% of the rated current.

iii. Maximum reactive output upto 30% over the rated reactive output.

h) Each capacitor unit shall be individually protected by HRC fuses with visual indication for operation.

2.4 **CAPACITOR CONTROL PANEL :-**

a) The control panel shall be indoor, cubicle type, floor mounted, dust and vermin proof conforming to degree of protection IP-54 excepting the enclosure enclosing capacitor bank which shall be of protection class IP -41.

b) Cubicle shall comprise rigid structural frame enclosed by 2mm thick cold rolled sheet steel, doors and covers shall also be from 2.0mm thick cold rolled sheet steel. Structural framework with foundation bolts etc. shall be provided at the bottom to mount control panel directly on concrete/floor/steel channel base.

c) All doors, removable covers shall be gasketed all around preferably with neoprene gaskets.

d) The capacitors control panel shall, in general, comprise of the following and shall be housed in well ventilated pane ls. Capacitors and their control elements may be installed in different compartments of the same panel to minimize space requirement.

i. Microprocessor based power factor correction relay.

ii. Time delay and No -volt relays.

iii. Protection fuses.

iv. Capacitor duty contactors for individual capacitor bank.

v. Change over switch for either automatic operation or manual operation with Push button control.

vi. Visual indications for capacitor IN-OUT.

e) Switches shall be triple pole, air break AC-23 duty. The switch shall have a quick make, quick break mechanism operated by a suitable external handle complete with position indicator.

f) The Compartment door shall be interlocked mechanically with the switch so that the door cannot be opened unless the switch is in OFF position. Means shall be provided to releasing this interlock at any time.

g) Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the listed short circuit current. Fuses shall be complete with fuse base and fitting of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.

h) The Contactors shall be three pole, air break type designed for capacitor duty with non bouncing silver/silver alloy contacts. Each Contactor shall be provided with 2 NC & 2 NO auxiliary lamps contacts rated at 10 Amp. Indicating lamps shall be LED type . Lamp and lens shall be replaceable from front.

i) The main buses and connection shall be of high conductivity aluminium/aluminium alloy, sized for spec ified current ratings shall be limited to 105 degree centigrade and 100 degree centigrade for silver plated copper joints and aluminium joints respectively.

j) For all bus connections adequate contact pressure shall be ensured by means of two bolt connection with plain and spring washers and locknuts.

k) Busbars and connections shall be fully insulated for working voltage with adequate phase/ground clearance. Insulating colour coded PVC sleeves for busbars and shrouds for joints shall be provided. Shrouds for bus bar and for joints shall be provided. Shrouds for busbar joints and tapping points shall be of two part epoxy resin cast/fibre glass moulded. Minimum clearance of 32mm is required between phases and 26mm between phase and earth irrespective of sleeve/shrou ds provided for busbar. Insulating shrouds shall be of moulded type.

i. Bus supports shall be non-hygroscopic type epoxy SMC with high creepage surface .

l) All buses and connections shall be supported and braced to withstand the stresses due to maximum short -circuit current and also to take care of any thermal expansion.

m) Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from the front to panel assem bly.

n) The horizontal busbar chamber shall be separate and totally enclosed.

o) Gland shall be minimum 3mm thick.

p) Screws of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entry of insects.

q) All internal wiring inside the cubicle shall be carried out with 650 V grade, PVC insulated copper wires duly ferruled at either end. The power wiring above 100A shall be carried out with PVC insulated aluminium links.

r) Separate labels shall be provided for relay, instruments, switch, indicating lamp etc. Approval for the type of label shall be taken from the Engineer-in-charge.

s) Metal treatment, finish and painting shall be done as per the specification Para Ref. 3.4 of this tender.

t) Automatic control relay with necessary taps shall be provided.

2.5 **TESTS :-**

(a) Routine tests shall be carried out on assembled capacitors and control panel as per relevant Indian Standards.

(b) Type tests reports for similar capacitor units shall be submitted.

(c) Three (3) copies of type test and routine test certificates shall be submitted for Engineer -in-Charge approval before despatch of capacitor and control panel.

2.6 **INSPECTION :-**

(a) Visual inspection including witnessing routine tests shall be carried out by Engineer-in-Charge or his authorised re presentative.

(b) Contractor shall notify Engineer-in-Charge or his authorised representatives in writing atleast fifteen (15) days prior to Contractor's scheduled inspection test.

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SECTION -4

TECHNICAL SPECIFICATIONS FOR LIFTS/ELEVATORS

NOTE : TECHNICAL SPECIFICATIONS AS DETAILED BELOW ARE GENERAL IN NATURE AND WILL BE APPLICABLE WHERE EVER REQUIRED BASED ON SCOPE OF WORK, BOQ AND DRAWINGS.

1.0 SCOPE :- This section deals with technical requirement of lift installation, its components, safety devices various type of controls and methods of operation. The broad technical details will be as per Annexure 'A'.

2.0 **Drive Machinery:-**

2.1 **Electric supply** :-Three phase, 50 c/s, 415 V electric supply shall be made available. The entire lift equipment should be suitable for operation at +10% to -15% of the rated supply voltage.

2.2 **Geared Machine** :- The lift machine shall be of worm gear reduction type with motor, brake, worm gearing and driving sheave and suitable for type of control specified.

2.3 **Sheaves:-** Sheaves and pulleys shall be of hard alloy, cast iron, SG iron or steel and free from cracks, sand holes and others defects. They shall have machined rope grooves. The traction sheave shall be grooved to produce proper traction and shall be of sufficient dimension to provide for war in the groove. The deflector sheave shall be grooved so as to provide a smooth bed for the rope. The deflector or secondary sheave assemblies where used shall be mounted in proper alignment with the traction sheave. Such deflector sheaves shall have grooves larger than rope diameter as specified in clause 8 of IS 14665 (Part-4Sec.3):2000. The size of all the sheaves shall be in accordance with clause 8.4 of IS 14665 (Part-4-Sec. 3):2000. Wherever necessary suitable protective guards may be provided.

2.4 **Shaft Keys:-** Shafts which supports sheaves, gears, coupling and other members which transmit torque shall be provided with tight fittings keys of sufficient strength and quality.

2.5 **Brake :-** The lift drive machinery shall be provided with an electro-magnetic brake or motor operated brake normally applied by means of springs in compression when the operating device is in off position. The brake shall be suitably curved over the brake drum or brake disc and provided with fire proof friction lining. The operation of brake shall be smooth, gradual and with minimum noise. The brake shall be designed to be of sufficient size and strength to stop and hold the car at rest with rated load. The brake should be capable of operation automatically by the various safety devices current failure and by the normal stopping of the car. The brake shall be released electrically. It shall also be possible to release the brake manually, such releases requiring the permanent application of manual forces so as to move the lift car in short stops. For this purpose suitable brake release equipment wherever necessary shall be supplied with each lift installation and the same shall be kept in safe custody to prevent misuse.

2.5.1 **Bearings:-** Bearings shall be either of the anti-friction metal sleeve type with oil reservoirs, self, lubrication, oil gauges, capped filler openings and drains of the ball roller or sintered type subject to oil flood lubrication or grease lubrication.Grease lubricated bearings shall have grease gun connections and drain plugs. The bearings and lubricant reservoirs shall be dust tight and shall incorporate effective seals to prevent leakage. The outer end of the bearings shall be closed with a removable oil tight plate. Thrust bearings shall be of the ball or roller type and shall have two sets of balls or rollers arranged to minimize backlash for efficient working.

3.0 **Type of controls:-**

3.1 **Variable Voltage Variable Frequency:-** The elevator shall be provided with VVVF Control.

.0 **Installation aspects:-**

.1 **Installation in Machine Room** :- Lift machine room to accommodate the drive machinery, controller etc. shall be located on top of the lift shaft. The layout of equipment there should be such as to allow free movement of maintenance personnel inside.

4.1.1 **Ventilation of Machine Room** :- Machine room to be provided with mechanical ventilation to avoid over heating of the electrical equipments and to ensure proper operation of the controller by means of suitable nos. of exhaust fans (to be provided by IRWO)

4.1.2 **Vibration, Isolation** :- Vibration and isolation arrangement shall be provided to prevent transmission of vibration of the building and structure.

.2 **General Illumination of Lift well:-** Suitable light points shall be provided in the lift well by the IRWO.

.0 **Guide rails:-** Guide rails shall be in accordance with clause 3 of IS 14665 (Part 4-Sec.2) 2000. Only machined guide rails shall be permitted for cars for passengers and hospital lifts. Formed sheet metal rails shall be used up to speeds of 1.75 mps for counter weight applications. The guide rails shall be continuous throughout the entire travel and shall withstand without any deformation the action of safety gear with a fully loaded car.Generally the guide rails shall be supported by brackets secured to the hoist way frame at each floor. The rails shall be securely fastened to the brackets or other supports by approved heavy rail clamps. All necessary guide rails packing or additional supports shall be provided to prevent guide rail deflection and stresses exceeding to prescribed limits. The stresses on the guide rail due to the horizontal forces imposed on it during loading, unloading and running calculated without impact, shall not exceed 1100 kg/sq. cm based upon the class of loading and the deflection shall not exceed 5mm. The guide rail brackets, their fastenings and supports shall be capable of resisting the horizontal forces mentioned above, with the total deflection at the point of support not in excess of 3mm.Guide rails shall extend from pit floor to the underside of concrete slabs or grafing at top of the lift well. They shall be erected in plumb and parallel with a maximum deviation of 3mm. All shimming required shall be of metal securely held in place. Jointing plates shall be so located as not to interfere with supporting clamps and brackets. The bolts shall be used with spring lock washers. The guide rail anchorage at pit floor must be made without puncturing the water proofing. The expansion joints in the guide rails shall be so designed as to avoid jerks in the lift car. Machined guide rails shall have finished surfaces which shall be coated with corrosion preventive compound which shall be maintain till the commissioning of the installation. Before the car is placed in operation, the preventive coating shall be removed and the guide rails thoroughly cleaned and smoothened.

6.0 **Lift Car :-**

6.1 **Car Frame :-** The car frame shall be in accordance with Clause-4 of IS 14665 (Part 4-Sec.3) : 2001 made of sheet steel of rigid construction to withstand without permanent deformation the operation of safety gear. The car shall be so mounted on the frame that vibration and noise transmitted to the passengers inside is minimized.

6.2 **Car platform :-** The car platform shall be of framed construction and designed on the basis of rated load evenly distributed. The dimensions shall conform to IS:14665 (part 1) 2000 unless otherwise specified. The flooring shall be smooth and of anti-skid surface. The flooring shall be strong enough to take the rated load without any deformation or damage.

6.2.1 A load plate along with overload alarm, giving the rated load and permissible maximum number of passengers should be fitted in each lift car in a conspicuous position.

6.3 **Car Body** :- The car shall be enclosed on all sides by a metallic enclosure. The enclosure including the door shall withstand without deformation of thrust of 35kg applied normally at any point and as per IS 14665 (part 4/Sec.3)-2001. Ventilation openings shall be as per IS 14665 (Part 4/Sec.3)-2001.

6.3.1 Stretcher guards/trolley guards made of PVC housed in a stainless steel beading shall be fitted at suitable level(s) to rear and side panels for bed lifts.

6.3.2 Lift car door shall have a fire resistance rating of one hour.

6.3.3 Grounding switch at ground floor level, shall be provided on all the lifts to enable the fire service to ground the lifts.

6.4 **Car roof** :- The roof of the car shall be solid type capable of supporting a weight of at least 140kg and as per IS 14665 (Part-4 – Sec.3): 2001.

6.5 **Car Thresholds**:- Car entrance shall be provided with metal thresholds having a grooved surface. Thresholds for lifts having horizontally sliding car doors or gates shall have machined or extruded guide grooves.

6.6 **Toe Guard Aprons** :- The toe guard apron of gauge not less than 1.6mm sheet steel may be provided extending at least 15mm beyond entrance jambs at each side. The guards shall have a straight vertical face extending below the level of the finished car floor and not less than the depth of the leveling zone plus 7.5mm. The bottom of guard shall extend 700mm for lifts up to speed of 1.5mps and 1000mm for lifts above speed of 1.5mps below vertical face and beveled at 15 degree angle from the vertical. It shall be seamed to car platform construction and be reinforced and braced.

6.7 **Clearance** :- The clearance between the top of the car and the soffit of the lift shaft roof, bottom of the car and the pit floor, the buffers etc. and the clearance between the car and the lift well, between the car and the landing sill, between two lift cars in the same shaft etc. shall be provided as per IS 14665 (Part 1,2 &4) and relevant lift rules mentioned in Appendix-I)

6.8 **Car Apron, Landing Thresholds and Sills** :- An apron shall be fitted to the platform such that no dangerous gap exist at any time when the landing door is opening. Thresholds and sill plates shall be provided at the landings also. The distance between landing sill and the sill on car platform shall not be more than 30mm.

Provision of telephone with minimum two connections – one at the operator's room and other at guard room and the emergency signal with re-chargeable batteries as source of supply shall be made in the lift cars.

The device used for emergency signals should incorporate a feature that gives immediate feedback to the car passengers that the device has worked properly and the signal has been passed on to the intended agency. This shall be achieved by pressing of button from control room which shall give audio signal to the passengers in the car.

6.9 **Emergency Power Supply for lift car** : - This shall include suitable secondary battery with trickle/ boost charge arrangement and invertors power pack with necessary contractors for supplying the lift fixtures in the lift car. The same battery shall also feed the alarm bell and communication equipment.

6.10 **Lift Car Interior Finish** :- The side, rear and fascia panel shall be of scratch resistant stainless steel sheet. The False ceiling in the lift car shall be crafted from mild steel powder coated to suitable colour with LED lamps and fan diffuser (s) in different colour.

6.11 **Operating Panel Inside the car** :- The car operating panel shall be of metal, flush mounted and duly finished to match the car interior décor and shall contain all the devices as may be specified depending upon the type of operation required. In addition separate illuminated panel for indicating the floor and

direction may be provided on the top or the door way. All switches shall be fade proof and the devices shall be of suitable quality. Each device and its operating position shall be legible fade proof and marked. The Call buttons inside & outside the Lift Car should be Braiile type to suite the blind persons.

6.12 **Car and landing entrances:** - The car and landing doors shall be of flush type sheet steel in Plain finish only for power operation. The flush type further be centre opening. Power operated car and landing doors shall be so designed as not to injure any person during their closure by means of provision of a safety pressure switch which shall cause the doors to reopen on the slightest pressure. In case of power operated doors, it shall be possible on power failure, to open them from the car side. All the openings for passenger lifts shall be 2000mm clear in height. The door opening and closing shall be accomplished smoothly and quickly without undue noise, vibration and shock and their movements shall be cushioned and checked at both limits.

6.13 Car Doors :-

The car doors shall be hung from the top M.S fabricated track and means shall be provided to prevent the door from jumping off the track. The doors shall be provided with two point suspension sheave type hangers suitable for the type of door operation specified. The hangers shall be securely fastened on bearings mounted on a malleable iron or steel bracket. Arrangements shall be provided for vertical and latest adjustment of car doors. The sheaves shall move on a M.S fabricated track so shaped as to permit free movement of sheaves with regard to vertical adjustment of sheave bracket or housing.The car door shall be centre opening horizontal sliding stainless steel in plain finish for office whereas telescopic horizontal sliding stainless steel for hospital lift.

A potential cause of accidents could be the attempts made to open the landing door lock of lower floor in case the car stops away from floor level due to power failure. Since the car door can be opened in case of power failure so as to improve the ventilation and avoid claustrophobic situations etc. as outlined in IS 14665(Part 2/Sec.1): 2000 Para 10.9.1, there is a tendency among trapped passengers to make attempts to open any accessible landing door which can be opened by a electromechanical latch in the landing doors as the lock is accessible through open car doors. This attempts in panic may result in accidental fall into the lift pit. In order to ensure that the trapped passenger do not attempt opening the landing door, the electromechanical latch should be so designed that it is inaccessible or invisible to the passengers in the car.

In order to avoid accidental closure of doors while boarding or alighting the car, a tamper proof infrared curtain covering almost the entire height of the door should be provided in the lift doors.

6.14 **Provisions as per Barrier Free requirements:-**

Hand rails not less than 900 mm long at 900 mm above floor level shall be fixed on all the three sides of the Car.

The time of an automatically closing door should be minimum 5 seconds and the closing speed should not exceed 0.25M/Sec.

The interior of the car shall be provided with a device that audibly indicate the floor the car has reached and indicate that the door of the cage for entrance/exit is either open or closed.

7.0 **Landing doors** :- Each landing door shall be complete with locks, headers, sills, frames, rims, hanger supports with cover plates, fascia plates etc. The finished work shall be strong, rigid and neat in appearance. Plain surfaces shall be smooth and free from warp or buckle. Mounded surfaces shall be clean out, straight and true. Fastenings shall be concealed from the face side of the material. Steel Sills shall be provided with a suitable nosing of approximately 25mm depth on the shaft side.

For the purpose of identification, the lift number should be displayed outside the landing door & inside the car. This numbering may be used as reference for the purpose of routine/preventive maintenance, reporting of any incidents etc.

A Self laminating display board indicating that " CAUTION : Do not use lift in case of FIRE" should be provided above each lift.

8.0 These instructions on Do's and Don'ts should be displayed at a conspicuous location with large and understandable script and should be written in Hindi, English and regional language (where official regional language is notified). These instructions shall be framed in suitable stainless steel frame.

9.0 **Leveling :-**

All lift (s) shall be incorporated with suitable floor leveling devices. In case of lifts with automatic power operated doors and with A.C VVVF controller a separate level device for automatic leveling with leveling accuracy of +/- 5mm shall be incorporated.

10.0 **Counter Weight :-** The counter weight for lift cares shall be in accordance with clause 6 of IS 14665 (Part 4-Sec-3): 2001 and shall be designed to balance the weight of empty lift car plus approximately 50 per cent of the rated load. It shall consist of cast sections firmly secured in relative movement by at least two numbers steel tie rods having lock nuts/split pins at each end and passing through each section and Housed in a rigid steel frame work. Cracked and broken sub weights shall not be accepted.

10.1 **Counter Weight Guards :-** Guards of wire metal/mesh shall be provided in the lift pit to a suitable height above the pit floor to eliminate the possibility of injuries to the maintenance personnel.

10.2 **Guide shoes :-** Two numbers of guide shoes at the top and two numbers at the bottom shall be provided on the lift car and counter-weight.

10.3 **Type of shoes :-**

For passenger lifts and bed-cum-passenger liftsa) For speed up to 1.5mps sliding guide shoes shall be used. Sliding guide shoes for car shall be always flexible and for counterweight solid guide shoes can be used up to 1.0 mps.b) For speeds more than 1.5mps roller guide shoes shall be used for car and counter weight.

10.4 **Flexible type/solid sliding guide shoes:-** The car shall be provided with solid or spring loaded swiveling guide shoes with renewable liners, where the lift car speeds are up to and including 1 MPS. The cars with speeds beyond 1 MPS shall be provided with spring loaded guide shoes with renewable liners or the guide shoes shall be of roller type.

10.5 **Roller type guide shoes :-** Each roller type shoe shall be of an approved type consisting of rollers assembled on a substantial metal base and mounted as to provide continuous contract of all rollers with the corresponding guide rail surfaces under all conditions of load and operation. The rollers shall run on the three finished guide rail surfaces and shall operate quietly.

10.6 **Mounting of guide shoes :-** Guide shoes shall be provided with adjustable mountings & shall be rigidly secured in accurate alignment at the top and bottom on each side of the car sling and counter weight frame construction, when oil buffers attached to the bottom of counter weight are used, additional guide shoe shall be provided on each side of the buffer frame. The design of guide shoes and car safety device shall be coordinated so as to ensure the provision and installation of equipment with clearance specified in clause 6.7 of this Chapter.

11.0 **Lift Ropes – IS 14665 (part 4/Sec 8)-2001 :-** Round strand steel wires ropes made from steel wire ropes having a tensile strength not less than 12.5 tonnes / cm2 and of good flexibility shall be used for lift. Lubrications between the strands shall be achieved by providing impregnated hemp core. The lift

ropes shall conform to IS 14665-(Part-4-Sec.-8):2001 and the following factor of safety shall be adhered to. The minimum diameter of rope for cars and counter weight of passenger and goods lift shall be 8mm.

Rope speed of passenger & goods lifts (m/s)	Factor of safeties.
0.5 or less	8
Exceeding 0.5 to 1.0	8.6
Exceeding 1.0 to 2.0	10
Exceeding 2.0 to 3.5	11
Exceeding 3.5	12

11.1 **FIND Rope Fastenings :-** The ends of lift ropes shall be properly secured to the car and counter weight hitch plates as the case may be with adjustable rope shackles having individual tapers babbit sockets, or any other suitable arrangement. Each lift rope shackle shall be fitted with a suitable shackle spring, seat washer, shackle nut and lock and shackle nut split pin.

11.2 **Guards for lift ropes :-** Where lift ropes run round a sheave or sheaves on the car and/or counterweight of geared/gearless machine suitable guards shall be provided to prevent injury to maintenance personnel.

11.3 **Number & size of ropes :-** The contractor must indicate the number and size of lift ropes and governor ropes proposed to be used, their origin, type, ultimate strength and factor of safety. The contractor should furnish certificate of ropes from the rope manufacturers issued by competent authority.

12.0 **Safety Equipments :-** Every lift installation shall necessarily be provided with the following safety features:

12.1 The safety gear shall be provided in accordance with IS 14665 (Part-4-Sec.4):2001 each type of car safety shall be actuated by a speed governor.

12.2 **Governor :-** The car safety shall be operated by speed governor located overhead and driven by governor rope suitably connected to the car and mounted on its own pulleys. The rope shall be maintained in tension by means of weighted or spring loaded tension sheaves located in the pit. Governor shall be provided for lifts with a travel of more than 5.5 meters. The governor rope shall be not less than 6mm in dia and shall be made of steel or phosphor bronze. These shall be in accordance with IS 14665 (part4/sec-4):2001. Governor for car safety gears shall be adjusted to actuate the safety gear at the following speeds:-a) For rated speeds up to 1 m/s maximum governor tripping speed shall be either 140 per cent of rated speed or 0.88 m/s, whichever is higher. For rated speed above 1 m/s maximum governor tripping speed shall be 115 per cent of the rated speed plus 0.25 m/s.Minimum governor tripping speed shall be 115 per cent of the rated speed.

12.2.1 The governor shall be of "V" groove wheel design and only wheel is stopped to actuate the car safety upon a pre-determined over speed downward without damaging the rope.

12.3 The governor, rope and sheave shall be so located so as to minimize danger of accidental injury to the equipment.

12.3.1 The governor sheave and tension sheave shall be according to clause 2.4 and the sheave bearing shall be according to clause 2.7 of this Chapter.

12.3.2 The requirements for field tests on car safety and governor and for drop tests to sliding type car safeties shall be as specified in the specifications for testing of lift installation.

12.4 **Terminal limit switches :-**

12.4.1 **Terminal switches :-** These shall stop the car automatically at terminal floors within the top and bottom permissible over travel. They shall act independently of the operating devices, the ultimate limits switches and the buffers. They shall be in accordance with clause 8 of IS: 14665 (part 3-Sec.1) :2000.

12.4.2 Terminal stopping devices located in shaft or in the car and operated by cams shall be fitted with rollers having a rubber or other approved composition to provide silent operation when actuated by the cam. When the lift car cross head is 60cm from the nearest obstruction above it, no projection on the car shall strike any part of the overhead structure.

12.4.3 Lift with speeds over 1.25 meters/second shall not have the normal terminal stopping device located on the car or on the guide rails or in the machine room.

12.5 **Ultimate Terminal Switches** :-These shall be provided in accordance with the statutory requirements and standing practices. When provided these shall arrange to stop the car automatically within top and bottom clearances independently of the normal terminal switches but with the buffers operative. These shall be in accordance with clause 8 of IS: 14665 (part 3/Sec 1)-2000.

12.6 **Buffers –(IS14665 (Part 4/Sec 1)-2001)** :- Buffers shall be spring/oil type of speeds up to 1.5 mps and only oil type for speeds higher than 1.5mps.Buffer shall be suitable for installation in the space available. Buffer anchorage at pit floors shall be installed avoiding puncturing of water proofing.Oil buffers of the car and counter weight shall be of the spring return type or of gravity type.The partial compression of spring return oil buffer when the car is in level with terminal landing will not be acceptable.All buffers shall be tested at manufacturer's works and a copy of the test report shall be submitted.When the lift car rests on fully compressed buffers there shall be at least 60cms clearance between the lowest point in its car frame and any obstruction in the pit exclusive of buffers and their supports. Similarly when the lift car crosses head is 60 cm from the nearest obstruction above it, no projection on the car shall strike any part of the overhead structure.The contractor must indicate the name of buffer manufacturers, buffer stroke and certified maximum loads.

12.7 **Door Locks :-** Electro-mechanical door lock shall be provided for all the landing doors and they shall be such that the doors cannot open unless the car is at rest at the particular landing. It shall not be possible to move the car unless all the landing doors and the car door are closed and locked. All the locks and contacts shall conform to IS: 14665 (Part 1/Sec.6)-2001 shall be positive and pass the prescribed endurance and reliability test from a recognized testing laboratory. They shall be so located as to be inaccessible to un-authorised personnel. The electromechanical latch should be so designed that it is inaccessible or invisible to the passengers in the car.

12.8 **Other safeties** :- Besides these safety devices mentioned above, motor operated electro-mechanical brake (Clause 1.6) counter-weight guards (Clause 8.1) alarm bell, emergency door lock release operating key and associated safety and other safety requirements shall also be included.

13.0 **Lift operations :-**

13.1 **Automatic cum-attendant operation :-**

13.1.1 Single Automatic Push Button with/without attendant - The operating devices for this operation shall incorporate in the car control panel, car buttons corresponding to the various landings served and single landing button at each landing, all electrically connected to controller governing floor selection, direction of travel, acceleration, retardation etc.This system shall be so arranged that when the car is not in use, on pressing a landing call button the car shall start automatically provided all the doors are closed. During the movement of the car and also when car stops at floor landing, other landing call buttons are in-operative for a predetermined time. The pressing of a car button shall automatically start the car and send it to the desired landing. In all the cases, the starting of the car is contingent on the

establishment of landing door and car inter-lock circuits. To indicate the availability, or "in use" light shall be placed in the landing call button panel. When light shall be OFF the passenger shall be able to call the car. In case of power operated doors, the landing and car doors shall be arranged to open automatically when the car is parked at landing after all the calls are served and the lift is parked at any landing. The doors can remain open or alternatively if desired, the car shall be arranged to close after a pre-determined time unless closing is prevented or interpreted by the car doors re-opening device or the door open button.The lift shall be suitable for dual operation with or without attendant by the provision of key operated transfer switch indicating 'attendant' and automatic position. During 'attendant' operation the landing call shall be disconnected from the control system and shall be connected to an annunciate in the lift car.

3.1.2 **Simplex Selective – Collective operation with/without attendant** :- Automatic operation by means of one button in the car for each landing level served and by up-and-down buttons at the landings, wherein all stops registered by the momentary actuation of the car made as defined under non-selective Automatic Operation but where in the stops registered by the momentary actuation of the landing buttons are made in the order in which the landings are reached in each direction of travel (irrespective of the sequence in which the buttons have been actuated). With this type of operation, all 'up' landing calls are answered when the car is traveling in the up direction and all 'down' landing calls are answered when the car is traveling in the down direction, except in the case of the uppermost or lowermost calls which are answered as soon as they are reached in-respective of the direction of travel of the car. A by-pass button (non-stop button) shall also be provided inside the car to enable the attendant to by-pass any landing if the car is full or if otherwise so required.

14.0 **Controlling Equipment** :- The movement of the car shall be electrically controlled by means of a controller located at the top landing.

14.1 **Control circuits**The control circuit shall be designed to the type of lift specified for safety operation. It shall not be possible to start the car unless all the car and landing doors are fully closed and landing doors locked. The circuit shall have an independent fuse protection for fault and over loads and be arranged so that earth fault or an open circuit shall not create unsafe condition. The circuit shall be so arranged that for the stoppage of the car at specified landing or for actuation of a contactor by emergency switches or operation of safety gears the system shall not depend upon the completion or maintenance of an electrical circuit to cut off power supply and apply the brakes. This requirement is not applicable to dynamic braking and speed control devices.

14.2 **Terminal Boards** :- All wiring for external control circuits shall be brought to a terminal board with means of identification of each wire. Metallic/plastic identification tags shall invariably be provided. All connections of wires to terminal boards shall be adequately clamped or screwed.

14.3 **Auxiliary Switches** :-

14.3.1 **Emergency stop switches** :- On top of the lift car an emergency stop switch shall be provided for use by maintenance personnel. Stop switch shall be provided in the machine room. Operation of these switches/buttons shall cancel all the registered calls and landing calls for that particular lift.

14.3.2 **Maintenance switch on top of the car**:- For purpose of inspection and maintenance, maintenance switch shall be provided on top of the car. The control circuitry shall be so arranged that in the event of the operation of this switch:a. The car speed shall be less than the rated speed not exceeding 0.85 meters/sec.b. The car movement shall be possible only on the application of the continuous pressure on a button. It shall be so mounted to prevent any inadvertent operation.

14.3.3 **Fireman Switch:-** Fireman switch with glass to break for access shall be provided at ground or main floor for all the lifts. The operation of this switch shall isolate/or cancel all calls to all the lifts and the lifts will stop at the next nearest landing if traveling upward. The door will not open at this landing and

the lifts will start traveling to ground floor. If these were already traveling down, they will go straight to ground floor direct without stopping en route.

14.3.4 **Inspection facility** :- An inspector's change over switch and set of test buttons shall be provided in the controller. Operation of the Inspector's change over switch shall make both the car and landing buttons inoperative and permit the lift to be worked in either direction from machine room for test purposes by pressing corresponding test buttons in the controller. It shall not however interfere with the emergency stop switches inside the car or on the top of the car.

14.3.5 **Safety Line indicators** :- Visual tell tale lights may be provided to monitor the conditions of faults in the safety line of the lift for easier fault finding. These indicators will remain lit when safety circuits are normal.One indicator shall be provided for each safety on the controller. If any indicators fail to light up as the lift proceeds in its sequence of operation, there shall be visual indication of the safety line open circuit and also its location for easier fault finding.

14.4 **Control wiring :-**

14.4.1 **Wiring in machine room** :- Power wiring between the controller and main board controller to various landing shall be done in heavy gauge conduit or metal duct and shall conform to I.E Rules 1956 and CPWD. Specifications for electrical works. Following general principles shall be followed in wiring:**(a)**

i. Control cables carrying DC and power cable carrying AC shall not be run in the same conduit or metal duct and they shall be laid as per I.E rules.

ii. Metal duct with removable inspection cover shall be preferred.

iii. In case of control cables also the harness shall be separate as far as feasible for separate functions and laid separately in suitably dimensioned metal duct or in a separate conduit such as the signaling, locking, lamp indication and safeties. Control cables for different voltages in the lift installation works should be laid as per IE Rules.

(b)

At least 5 per cent with a minimum of 5 unconnected spare wires shall be available out of all the lines to be provided in the wiring harness from the midway junction box to the machine room.

(C)

There shall be a master isolating switch Fuse associated with the controller heavy duty load break, quick make quick break type TP&N preferably interlocked with controller cabinet door. Isolator handle shall have provision for external locking in off position.All relays shall be suitable for lift services and shall incorporate adequate control wipe for reliable operation. Relays shall operate satisfactorily between 80 per cent to 110 per cent of their voltage. Main motor contactors shall be suitable for A.C duty. Tenderer shall be required to furnish full details of make, type applicable standard, voltage and current rating, duty class, type and routine tests done etc., on contactors and relays. Copies of type test certificates and other test certificates shall also be furnished by the successful tenderer.All cables shall be with copper conductors and flame retardant or PVC insulated of appropriate size. The cables feeding motor and in heavy current flow paths shall be so selected that the size matches the protecting fuses and will not result in more than 2 per cent voltage drop from the main board to the terminals of motor. Control cables shall not be less than 0.5sq.mm or equivalent if stranded; where installation of heavy gauge conduits present difficulties, short lengths of flexible conduits will be permitted but effective electrical continuity and earth bonding shall be ensured. Ferrules shall be slipped at the ends of all cables as per standard control wiring practice. All terminal blocks shall be suitably marked.

14.4.2 **Trailing Cables:-** A single trailing cable for lighting control and signal circuit is permitted, if all the conductors of this trailing cable are insulated for maximum voltage running through any one conductor of this cable. The lengths of the cables shall be adequate to prevent any strain due to movement of the

car. All cables shall be properly tagged by metallic/plastic tags for identification.Trailing cables shall run a junction box on the top of the car to a junction box located in the shaft near midpoint of travel and from these junction boxes conductors shall be run to the various locations.Trailing cables exceeding 30 meters in length shall run so that the strain on individual cable conductors will be reduced to a minimum and the cables are free from contact with the car counterweight, shaft walls or other equipment.Trailing cables exceeding 30 meter in length shall have steel supporting fillers and shall be suspended directly by them without rubbing over other supports.Cables less than 30 meters in length shall have no- metallic fillers and shall be suspended by looping cables around supports of porcelain spools type or equivalent.5 per cent of the total capacity subject to a minimum of 5 wires shall be available unutilized in the trailing cable every where suitably distributed between various functions.

14.3 **Earthing :-** Metal frames and all metal work of the lift controller frame etc. shall be earthed with double earth leads taken to the earth bar. Looping shall be permitted if such routing is feasible. All other individual metallic frame work of components etc. shall be loop earthed. (Earth stations to be provided by the deptt.)

15 **Miscellaneous :-** Principle of segregation function wise shall be accepted as far as possible in the general arrangement of components. All terminal blocks shall be of 650 V grade.

16 **Controller casing :-** The controller unit comprising of the main circuit breaker adjustable overload and phase reversal and phase failure protection all the circuit elements transformer, rectifier for D.C control supply, inverter power pack, terminal blocks etc. shall be enclosed in an insect proof, sheet steel floor or wall mounted cabinet with hinged doors at front or at both sides of the controller casing. Sheet steel used for controller cabinet shall not be less than 18 gage and shall be properly braced where necessary. Suitable gland plate shall be provided for cable entry. The battery for the charger unit shall be suitably placed in the machine room. All sheet steel work shall be painted with two coats of synthetic enamel paint of suitable shade both inside and outside over two coats of zinc primer.

15.0 **Lift Rope Compensation :-** The lift rope compensation for lift travel shall be provided for lift travels beyond 40m in all case.

16.0 **Automatic Rescue Devices (ARD) :-** Provision of the automatic Rescue Devices (ARD) meant for the purpose of bringing the lift car to the nearest landing doors. The ARD shall have the following specifications:

16.1 ARD should move the elevator to the nearest landing in case of power failure during normal operation of elevator.

16.2 ARD should monitor the normal power supply in the main controller and shall activate rescue operation within 10 seconds of normal power supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor the elevator will detect the stop. After the elevator has stopped, it automatically opens the doors and parks with door open. After the operation is completed by the ARD the elevator is automatically switched over to normal operation as soon as normal power supply resumes.

16.3 In case the normal supply resumes during ARD in operation the elevator will continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal power supply resumes when the elevator is at the landing, it will automatically be switched to normal power operation.

16.4 All the lift safeties shall remain active during the ARD mode of operation.

16.5 The battery capacity should be adequate so as to operate the ARD at least seven times a day provided the duration between usages is at least 30 minute. These SMF batteries should be placed in a separate enclosure. Batteries should be of Exide

TECHNICAL DETAILS OF LIFTS

The broad technical details for all types of lifts will be as per IS / NBC
(All dimensions in mm):-

Parameters	13 Passengers	8 Passengers	6 Passengers
Lift Well size	2500x1900	1900x1900	1900x1700
Car size(inside)	2000x1100	1300x1100	1100x1000
Clear opening	800(wide)x2000(high)	800(wide)x2000(high)	700(wide)x2000(high)
Pit Depth	1600	1600	1500

Common for all the above lifts.

Type of lift	Passenger Elevator
Type of Control Drive	A.C. Variable Voltage Variable Frequency (V3F)
Location of Machine room	Geared machine to be placed directly above Hoist way
Power supply	415 volts 3 phase 50 Hertz alternating current
Auxiliary	Single Phase 230 volts 50 cycles alternating current
Car Enclosures	Constructed in scratch resistance stainless steel Panels
Flooring	Granite Flooring
Ceiling	Constructed in scratch resistance stainless steel
Electric light	LED lights in car
Car Fan	Cross Flow Fan of make Khaitan/Usha/Crompton/ Havells
No. of car entrance	One Front Located
Car Entrance & Hoist way entrance.	Centre opening power operated doors in scratch resistance stainless steel Panels with emergency key opening at all landings
Door operation	Automatic & Multi Rays Electronic door detector system
Indicators car/landing	Digital floor position and travel direction indicator in the car and at all landings & car operation panel with luminous floor button in the car

Type of Operation	Simplex Full Collective with / without attendant
Leveling Accuracy	+ /- 5mmProtected by two speed sliding stainless steel doors in hairline finish.
Landing Doors	--Scratch less Finish in stainless steel finish-
	—Rechargeable Battery operated emergency light-
Other Feature	—Rechargeable Battery operated emergency alarm-
	—Hand free intercom system in car, security guard room / gate (Wiring cable for security guard room / Gate shall be laid by IRWO.).**The intercom system in security guard room / gate shall be PBX type i.e a common telephone exchange for all the lifts in the complex..-**
	—Steel items such as Machine Beams, door frames sill angles, fascia plates-
	—System capable to withstanding ÷ 10% to-15% variation in supply voltage fluctuations-
	—Car platform constructed out of cold rolled grain oriented formed sheets of steel-
	—Fire man drive at ground floor & Fireman Switch-
	—Infra red curtain-
	—Automatic rescue device to work in controller and power failure-
	—Voice announcing system-
	—Key operated emergency stop switch in series with the normal switch-
	—Over load warning device.-

Note:. The tenderer shall visit the site and take the actual dimensions of the lifts well and lift head room of machine room and dimensions of central openings.

SECTION-5

TECHNICAL SPECIFICATION FOR INTERNAL ELECTRIFICATION WORKS

NOTE : TECHNICAL SPECIFICATIONS AS DETAILED BELOW ARE GENERAL IN NATURE AND WILL BE APPLICABLE WHERE EVER REQUIRED BASED ON SCOPE OF WORK, BOQ AND DRAWINGS.

1.0 General Outline :-

The electrical installation works 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 requirement of the Local Electricity supply authority and fire insurance regulation. Electrical work in general shall be carried out as per following CPWD specifications with up to date amendment.

1.1 General Specification for Electrical Works :-

(Part I – Internal)-1994

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

1.2 Internal Wire & Conducting system :-

These specifications shall be read in conjunction with the attached drawings and B.O.Q wherever there is contradiction the superior specification shall prevail.

1.3. Scope of Work :-

The entire work of internal electrification including the electrification work up to unit distribution board with in the D.U and further Sub- Mains from unit DB to Meter Board at each floor including the supply and installation of cubical type Meter Boards, Distribution Boards, MCB, ELC B for each DU.

Further the work of installation of Lightning Arrestor with aviation light for building protection along with down comers and earth pits as required, for multistoried builsings.

The entire works shall be carried out as per description & specification given below.

However the general character and the intended scope of Electrical works to be carried out under this contract is illustrated in the drawings and describe here in The contractor shall carry out and complete the work under this contract and all other work assigned therein, every respect in conformity with the requirements of the notified in Indian Electricity Rules as amended till date, the relevant regulation of Electric Supply Authority concerned I.S-732-1989 Indian standard code of practice for electrical wiring installation and upon the directions and approval of IRWO. Wherever the specifications are not given herein and required the higher standard of materials and workmanship, otherwise these specifications shall take precedence over the above.

The work shall also include all incident jobs connected with Electrical installations, such as cutting, drilling the holes, chasing through walls and floor etc. and making good the surface as original condition. Cable passing through walls, floors, and roofs shall be laid in pipes and not grouted directly by masonry. In general the work, to be performed under this portion shall include internal electrification of dwelling units, complete in all respect and shall cover the following:

a) Wiring for light points, fan points and power points, including supply and fixing of conduits of required size, G.I boxes, switches, sockets, fan regulators and allied accessories if any required to complete the job, Prior to laying of the conduits, the contractor shall carefully examine the drawings and satisfy him regarding the No. and size of conduits, size and location of switch boxes and other relevant details.

Any changes if required due to site condition and suggested by the contractor shall be got approved from the IRWO, before actual work is commenced, this shall be incorporated in the as built drawing to be prepared by the contractor after completion.

b) The entire work of internal electrification for Community Hall, Gym, Stilt Floor, and Common Areas such as Lift Lobby, Corridors, Mumty Room, and Lift Machine Room etc. shall also be considered as part of this contract.

c) Distribution Board shall be installed in the Electrical Room at stilt floor level (for multistoried buildings)

d) Building protection against lightning shall be provided by installing Conventional type Lightening Arrestor with aviation light along with all required earth strips up to earth pits including making of earth pits. The same shall be part of the contract.

e) Providing Earth Pits for Meter Boards, and Panels of all blocks shall be part of this contract.

f) Providing 2 x 2.5 mm^2 of copper conductor in separate conduit for power back up for each DU from meter box to sub distribution board.

g) Providing 1 x 2.5 mm^2 of copper conductor cable is separate conduit from main distribution Board upto nearest balcony and terminated in 5 A switch socket (for Inverter Supply).

Note: The list of electrical points for each category of units with quantities is attached hereinafter for reference.

1.4 :- Standards:-

The following latest standards and rules shall be applicable:

IS: 732: Code of practice for electrical wiring installation (System voltage not exceeding 1100 V).

IS: 1646: Code of practice for fire safely of building (General) Electrical installation.

IS: 9537: PVC Conduits for Electrical installation.

IS: 2667: Fittings for rigid steel conduits for electrical wiring.

IS: 3480: Flexible steel conduits for electrical wiring.

IS: 3837: Accessories for rigid steel conduits for electrical wiring.

IS: 694: PVC insulated cables up to and including 1100 V.

IS: 1293: Plugs and sockets outlets of rated voltage up to and including 250 V.

IS: 8130: Conduits for insulated electric cable and flexible cord.

IS: 3854: Switches for domestic and similar purposes.

IS: 3419: Fittings for rigid non metallic conduits.

IS: 4648: Guide for electrical layout in residential building.

IS: 4649: Adopters for flexible steel conduits.

IS: 14772: Boxes for enclosures of Electrical accessories.

IS: 4615: Switch socket outlets. (Non – interlocking type)

IS: 8884: Code of practice for installation of Electric bells and call system.

IS: 2551: Electric Danger notice plates.

IS: 3646: Code of practice for interior illumination.

IS: 371: Ceiling Roses

IS: 302: General and safely requirement for household and similar electrical appliances.

IS: 3043: Code of practice for ear thing.

IS: 5216: Guide for safety procedures and practices in electrical work.

2.0 Conduiting and Wiring System:-

2.1. Conduiting System:-

Separate conduit for Electrical, T.V. and Telephone system shall be laid. Further in no case the Electrical wiring of light circuit and power circuit shall be laid in same conduit. Separate individual conduit for each light and power circuit should be laid form D.B. to switch board in case of light circuit and first point in case of power circuit. Each run of conduit for circuit or point wiring should not have more than 2 Nos. of Quarter (90 degree bends). Maximum permissible nos. of wires that may be drawn in to PVC conduits:-

Size of wire	Size of PVC conduit (Dia in mm)			
Nominal cross sectional area (in sq.mm)	19/20	25	32	40
	Nos. of maximum wires			
1.0 sq.mm	7	13	18	20
1.5 sq.mm	5	10	14	16
2.5 sq.mm	5	8	12	14
4.0 sq.mm	3	6	10	12
6.0 sq.mm	-	4	8	10
10 sq.mm			6	8

2.3 Counduits (Specifications) :-

The conduits shall be delivered at site in original bundles and bear the stamp of the manufacturers. No FRLS conduits less than 20/25 mm dia. shall be used for electrical works. Flexible conduits shall be provided where ever directed.

ISI mark Medium Duty P.V.C Conduits, Bends, Sockets etc, shall be used in cast slabs floors stair case and for electrical, T.V., telephone sub mains etc, Medium class P.V.C Conduits, bends, sockets etc may be used in walls.

Separate conduits shall be laid for light points, power points, sub mains, telephone & T.V. system. At no case light and power circuit will be laid in same conduit.

Only horizontal and vertical run of conduits shall be permissible in the wall. However if the site condition call for a deviation, the same shall be got approved form the Engineer – in – charge.

Junction boxes of adequate size shall be provided with modular covers with brass machine screws wherever required. Rubber blank closures shall be used to plug in extra holes in junction boxes, outlets as required. Proper care should be taken while taking out drops from cast slabs so that the outlets are conveniently connected to the conduits. Wherever horizontal beams are expected to be crossed, proper sleeves should be left for crossing the beams at the time of casting chiseling at later date.

If the chase is made in an already finished surface, the contractor shall fill the chases and finish it to match the existing finish. Contractor shall not cut any reinforcement to fix conduits, and when the conduit is to be embedded in concrete member, it shall be adequately tied with the reinforcement to prevent displacement during casting. Loose conduit shall be provided at all points where conduit crosses any expansion joint in the building.

The end of all conduits shall be thoroughly cleaned and made free form grease, oil or paint before making the joints. The continuity of conduit system shall be properly maintained by using adhesive bonding at bends, sleeves sockets etc. The specification of conduits for Telephone and T.V. system shall be the same as the conduit for electrical work the minimum size shall be 25 mm. A Separate conduit of 25 mm dia shall be laid for power back up wiring form Meter Board to distribution Board for each dwelling Unit. Also a separate conduit of size 25 sq.mm shall be laid from the distribution board to the nearest balcony for providing wiring for inverter.

NOTE:-

The colour for electrical conduits shall be off white/cream whereas the colour for T.V. and Telephone system shall be grey. These colours shall be followed for sleeves, bends, and sockets also. This colour code is proposed for clear identification of conduits for electrical and other system.

The bends, sleeves, socket etc, shall be heavy duty/class. As far as possible the conduiting should be planned/laid in such a way that minimum tee joint, junction boxes, bends etc, are used. However each run of conduit for circuit or point wiring should not have more than 2 Nos. of quarter (90 degree) bends.

Medium class ISI mark M.S conduits of size 20/25 mm dia. bends, sockets etc. shall be used for conduiting at surface in lifts well for lighting & power. Pipe shall be jointed with the threaded socket. The pipe shall have minimum four threads for jointing with sockets, junction boxes etc.

2.4 Points & Circuit Wiring :-

2.4.1 All the equipment, fitting and accessories, materials selected for the wiring installation, shall confirm to the relevant Indian Standards wherever these exist. These will be of makes as specified in the tender.

2.4.2 Looping back system of wiring shall be adopted.

2.4.3 A light circuit will not have more than 10 points of lights, fans and 6 amps socket outlets or a load of 800 watts, whichever is less. Power circuit will not have more than one outlet per circuit. Circuit wiring will form part of point wiring and no extra payment on this account will be entertained. Each circuit shall have independent Neutral and earth wire. Black colour shall be used for neutral and green for earth conductor; red, yellow and blue shall be used for three phases. In each DU/other areas, light points shall be on one phase and power points on other two phases. Rotation of phases shall be done in other DU's/ other areas.

2.4.4 All the wiring shall be recessed conduit with PVC insulated unsheathed, multistrand, copper conductor wires of sizes 1.5 sq.mm for light points/circuit and 4 sq. mm for power points/circuits.

2.4.5. Only ISI marked PVC conduits (Medium), with suitable accessories shall be used Minimum size of conduits used shall not be less than 20 mm dia.

2.4.6 Separate conduits shall be laid for the wiring of lighting/ fan points including circuits, power points including circuits, sub mains, telephone and TV systems.

2.4.7 Junction boxes in the conduit run on walls/ceiling wherever required shall be provided with Hylum sheet covers of not less than 3 mm thick. Also rubber closers shall be used to plug in extra holes of junction box outlets as required.

2.4.8. Each light or power circuit will have not less than 2.5 sq mm or 4 sq mm insulated earthing copper conductor respectively for independent earth continuity wire. Location of the light and power points shall be as per the details in drawings and as approved by the engineer. The specified minimum size of PVC insulated stranded copper conductor wire for electrical system shall be as follows:

S. No.	Description	Wire size (Phase, Neutral)	Wire size (Earth)
1	Light Point	1.5 sq mm	1.5 sq mm
2	Light circuit	2.5 sq mm	2.5 sq mm
3	First General power point 16 / 20 A	4.0 sq mm	4.0 sq mm
4	Second (Looped) Power points 10 / 16 A	2.5 sq mm	2.5 sq mm

2.4.9 Height of the switch boxes shall be as per the details in approved drawings.

2.4.10 Electrical Installation & Testing: Each light point shall comprise of providing and fixing recessed conduit including accessories. PVC insulated 1.5 sq mm copper conductor wire, light point outlet box, 6 amp SP modular switch in 2 mm GI box with modular cover plate of approved shade, etc, as required and complete with circuit wiring including continuous copper earth wire. Light point in staircase, where specified shall be one way or two way type, each controlled by two nos. or two ways modular switches. Wiring test report shall be arranged by the Contractor.

2.4.11 Each 5 pin 6 amp socket outlet points shall comprise providing and fixing of recessed conduit and accessories, 1.5 sq mm copper conductor PVC insulated cable, 6 amps 5 pin socket outlet and 6 Amp SP modular switch in 2 mm GI box modular cover plate of approved shade and earthing the earth pin of socket outlet with 1.5 sq mm insulated single stand earthing copper conductor for ear thing etc. complete as required.

2.4.12 Each ceiling fan/exhaust fan point shall comprise of providing and fixing recessed conduit including accessories, PVC insulate 1.5 sq mm copper conductor cables 1.5 sq mm insulated earthing copper conductor for earth the fan regulator, 6 Amp SP modular switch in 2 mm thick GI box with modular cover plate of approved shade, 150 mm Hexagonal 2 mm thick GI box ,for fan clamp with 12 mm dia. 450 mm long MS rod, bent downwards at ends etc. complete. Circular 3 mm laminated sheet cover shall be provided for fan box.

2.4.13 a. 1.5 sq mm insulated single strand earth wire of copper conductor shall

be run for all lights and fan points wiring as continuous earth wire.

b. All metallic fixtures to be earthed.

2.4.14 Each 6 pin 16 Amp socket outlet point shall comprise of providing and fixing recessed conduit including accessories, 4 sq mm PVC insulated copper conductor wires, 16 Amp 6 pin socket outlet, 16 Amp SP modular switch in 2 mm thick GI box modular cover plate of approved shade and including earthing of the earth pin of socket with 4.0 sq mm insulated single strand earthing copper conductor for earthing complete as required.

2.4.15 Each call bell point shall comprise of providing and fixing recessed conduit including accessories, PVC insulated copper conductor cable, outlet junction box, 6 Amp SP modular bell push in 2 mm thick GI box with modular cover plate of approved shade etc. complete as required.

2.4.15 Sub main and main wiring comprising PVC insulated stranded, copper conductor cables of required size (based on load of individual flat) in recessed conduit shall be provided. The size of the PVC conduit shall be as per relevant IS codes, amended up to date.

2.4.16 PVC/ Porcelain connections shall be installed at wiring terminal for fitting /fans etc.

2.4.17 Earthing electrode/Plate earthing confirming or IS 3043 shall be provided.

2.4.18 Sub – main for DG supply from each D.U.,DB to Meter Board shall be 2 Nos. of 2.5 sq.mm PVC insulated, stranded, copper conductor wires laid in separate PVC conduit.

2.4.19 1x2.5 mm2 PVC insulated standard copper conductor for Sub main from inverter supply from main distributor board in each DU up to nearest balcony laminated in 5A switch socket (Light CKT).

3.0 **Distribution Boards:**

3.1 **General:-**

The MCB distribution boards shall be suitable for operation on 230/415 vollts,3 phase, 4 wire , 50 Hz A.C supply system or 230 volt, 1 phase,2 wires, 50 Hz A.C. supply system.

The distribution boards shall be factory made; metal clad 2 mm (14/16 SWG) CRCA sheet, double door with the inner door fixed with screws, having cutouts for ELC'B', MCBs, Isolator etc. The outer door shall be hinged mounted (removable) and the MCB knobs shall not be visible from outside. The doors shall be powder coated whereas the body of D.B. shall be stove enamel painted of approved shade. The DB shall be dust, vermin proof to a protection level of IP54. The DBs shall have RYB indicators. Per phase isolation wherever demanded in BOQ shall be provided in the D.B.. Separate loose wire box shall be provided over each D.B. Sufficient space shall be maintained within the D.B. to accommodate spare wires, which shall be properly strapped and dressed. Proper numbering on all circuit shall be done and the corresponding number ferrules shall be inserted in the wiring. MCBs shall be ISI marked as per approved list and of at least 10 KA rupturing capacity. The MCB shall be connected on the phase or live wire of each circuit. The housing of the MCB shall be heat resistant and having high impact strength. Schematic circuit diagram of D.B. duly covered by plastic laminated shall be pasted on the inner side of outdoor. **Contractor shall submit sample D.B. of each category to the Electrical in charge IRWO complete with all wiring and connections, fittings etc. for approval prior to actual supply of material.**

3.2 Installation:-

3.2.1 The DB's shall be assembled and aligned together and be installed at site as per installation Manual/ instruction of the DB manufacturer.

3.2.2 The installation shall confirm to relevant Indian Standard specification and requirement of local site conditions.

3.2.3 The DB shall be installed in surface / concealed manner at the location as shown in the respective drawings.

3.2.4 All minor electrical and mechanical work required to be attended to on the DB shall be completed in an approved manner after installation but before energizing the D.B.'s

3.3 Test:-

Prior to commissioning of the D.B.'s following tests shall be carried out for each flat as laid down in IS 732.

3.3.1 Mechanical endurance test shall be carried out by closing of all the MCB's switches etc.

3.3.2 Insulation resistance test shall be carried out between phases and between phases to earth bus, keeping the isolating switch in open position. Similar test shall be carried out keeping the isolating switch in closed position.

3.3.3 Polarity of Switches.

3.3.4 Earth continuity.

3.3.5 Earth resistance.

3.3.6 Testing, installation material and inter incidental necessary to conduct the tests shall be provided by the Contractor at his own cost. All the above tests shall be carried out preferably in presence of Engineer/or his authorised representative and tests record in test sheet.

3.3.7 All the interlocks, controls and tripping mechanisms of the switch gears shall be tested for their proper functioning.

4. Telephone Wiring System

4.1 Conduiting :-

All concealed/ surface installation including the conduit run above the false ceiling space shall be heavy gauge black enameled MS/ PVC conduit. The specification for materials &installation shall be same as described in electrical section. All relevant clauses are applicable for telephone system as well. The conduit for telephone system shall be installed minimum 1 feet away from the power conduit. Care shall be taken so that no telephone is run in parallel to Electrical conduit in close proximity. Wherever telephone conduits cross power conduits, they shall be at right angle to each other. All telephone conduits shall be earthed .The size of conduit shall depend upon no. of wires to drawn. However minimum size of Conduit shall be 25 mm.

4.2 Boxes & Telephone Outlets:-

All concealed boxes shall be of suitable for modular type socket as described in the electrical wiring section & shall match with electrical wiring accessories. The boxes/main junction box small be suitable for wall mounting having opening for cable/conduit entry. All PVC cable shall enter the telephone junction box from the bottom through brass cable glands and enough cable length shall be available for termination. Each PVC cable saving the telephone socket shall be marked for identification. Junction boxes shall be fully enclosed, kept tight with lockable hinged doors. Boxes shall be zinc anodized type & same make as of socket/outlets. Prior to the system installation the contractor shall consult telephone department for their requirements and notify the Construction manager/Consultants on the same. All equipments like tag blocks, wires shall be of approved makes.

4.3 Each telephone points shall comprise of 25 mm dia PVC conduit Pipe (with fish wire) recessed inside wall /as required at site including providing & fixing of jack Mini telephone socket outlets in 16 SWG GI box with modular cover plate of approved shade, complete as required.

4.4 TV Antenna point comprises 25 mm dia. PVC conduit Pipe (with fish wire 0 recessed inside wall /as required at site including supply & fixing of suitable socket outlet in GI box with modular cover plate of approved shade and suitable socket outlet for aerial wires.

5 Meter Boards:-

The meter board shall be cubical type made out of CRCA sheet not less than 16 gauge. It will have the following compartments the meter board shall be as per requirement of respective State Electricity Board.

5.1 Bus bar chamber with Copper / Aluminum bus cars of adequate ratings, suitable for 415 volts, 3 phases, 50 cycles AC supply.

5.2 Independent lockable compartment with hinged door hylam sheet 12 mm thick, for each flat for housing KWH meter. For facilitating meter reading cover will be equipped with standard size window covered with 2 mm transparent plastic sheet. Each meter cubical shall be number painted for identification of flat number. One inch pad lock shall be provided for all the metering cubicles, Bus-bar and main switch chambers .The pad locks shall be of approved make. Neutral link and Kit-Kat fuses outgoing TPN MCB shall be separately housed and shall have lockable cover. Suitable cable ally be provided for sub mains shall be housed in a separate lockable sealable chamber mounted by the side of metering panel.

5.3 MCB shall be housed in separate chamber other than metering cubical.

5.4 All inter connected wiring of not less than 10 sq. mm PVC insulated stranded copper conductor cable shall be provided between bus bar chamber to meter chambers and to MCB chambers.

5.5 Earthing connection at two points as required.

5.6 The meter board shall be dust and vermin proof free standing/wall mounted type. The design of the meter board will be as per requirements of State Electricity Board. PVC gasket shall be provided under the covers.

5.7 Cable galleries shall be provided in the metering panel for easy run/termination of wiring.

5.8 The meter board shall be painted with powder coating process of approved shade and manufacture.

5.9 Meter board drawing shall be got approved form State Electricity board/Company by the contractor. Two earting strips of suitable sign shall be providedfornthe main earthing arrangement. Earthing bus shall be provided for wiring continuous earth conductor on the Pkt. Single storey independent fall shall be provided with MS CRCA should fabricated steel box as per requirement of power supply authorities duly approved by this.

5.10 fabrication, erection, testing and commissioning of cubical type. totally enclosed dust and vermin proof (ingress Proction IP-42) floor/wall mounted switch board to fouse switch gear and energy meters for flats power supply with hinged . Lockable doors fabricated from minimum 2 mm thick CRCA sheet with all accesible Live Part shrouded and aluminium Bus Bars insulated will heat shrinkable sleeves, including inter connection to eacth etc. completed as required.

6:- PROTECTION OF BUILDING AGAINST LIGHTNING & EARTHING SYSTEM :-

6.1- Introduction :-

Protection of building against lightning shall generally be done in accordance with I.S 2309-1989. A brief of the same is given below for guidance. Protection of special structures like trees. Live stock in fields, structures supporting overhead lines, structures with highly combustible roof etc. shall is strictly done in accordance with I.S. 2309-1989.

6.2- Principle of Protection :-

The Principle for protection of building against lightning is to provide a conducting path between earth and the atmosphere above building through which lightning discharge may enter the earth without causing damage to the building. If adequately earthed metal parts of proper properties are provided and spread properly on and around the building to avoid damage.

The required conditions of protection are generally met by placing all the air terminals whether the form of vertical finials or horizontal conductors, on the upper most part of the building or its projections with lightning conductors connecting the air terminals with each other.

6.3- Zone of Protection :-

The zone of protection of lightning conductor denotes the space within which a lightning conductor provides protection against a direct lightning stroke by diverting the stroke to itself.

For a single vertical conductor, the zone is described as a cone with its apex at the highest point of the conductor and with an angle, called as protective angle, between the side of the cone and the conductor. In general, for the purpose of providing an acceptable degree of protection the protective angle of any single component part of an air termination network, namely, either one vertical or one horizontal conductor is considered to be 45° between two or more vertical conductors of equal height spaced at a distance not exceeding twice their height, the equivalent protective angle within the space bounded by the air terminations may be taken as 60° degree to the vertical, while the protective angle away from conductors is still taken as 45° to the vertical.

6.4- Materials and Dimensions :-

6.4.1-The materials of lightning conductor, down conductors, earth terminations etc. of the protective system shall be reliable resistant to corrosion or be adequately protected against corrosion. The materials recommended are (a) copper: solid or flat copper strip of 98 % conductivity conforming to relevant I.S. specification shall be used. (b) Copper clad steel: Copper clad with proper covering permanently and effectively welded to the steel core shall be used. The proportion of copper and steel shall be such that the conductance of the material is not less than 30 % of conductance of the solid copper of the same total cross – sectional area. (c) Galvanised Steel: Steel thoroughly protected against corrosion by a zinc coating shall be used. (d) Aluminum: Aluminum 99 % pure and with sufficient strength and protected.

6.4.2-Aluminium should not be used underground or in direct contact with walls.

6.4.3-All air Terminations shall be G.I and all down conductors shall be of G.I. or aluminum except where the atmospheric conditions necessitate the use of copper or copper clad steel for air terminations and down conductors.

6.4.4-The recommended shape and minimum sizes of conductors for use above and below ground in Table I and Table II respectively.

6.5 Design Considerations :-

When designing and installing lightning conductors, the following items should be taken into consideration:

6.5.1-The entire lightning protective system should be mechanically strong to withstand the mechanical forces produced in case of a lightning stroke.

6.5.2-The lightning protective system should be so installed that it does not spoil the architectural or aesthetic beauty of the building.

6.5.3- For the purpose of lightning protection, the vertical and horizontal conductors are considered equivalent and the use of pointed air terminations or vertical finials is, therefore , not regarded as essential. An air termination may consist of a vertical conductor, a single horizontal conductor or a system of horizontal and vertical conductors for the protection of bigger buildings.

6.5.4- A vertical air termination where provided need not have more than one point and shall protect at least 30 cm. Above the project ,salient point or network on which it is fixed.

6.5.5- Horizontal air terminations should be so interconnected that no part of the roof is more than 9 M away from the nearest horizontal termination along the outer perimeter of the roof is used. For a roof of larger area, a network of parallel horizontal conductors shall be installed.

6.5.6-Horizontal air terminations should be coursed along contours such as ridges, parapets and edges of flat and where necessary over flat surfaces in such a way as to join each air terminations to the rest and should themselves form a closed network.

6.5.7-All metallic finials, chimneys, ducts, vent pipes, railing, gutters, metallic flag stuff etc. on or above the main surface of the roof of the structure shall be bonded to, and form part of, the air termination network. If portions of structure very considerably in height, any necessary air termination or air termination network of the lower portion should in addition to their own conductors, be bonded to the down conductors of taller portions.

6.5.8-All air terminators shall be effectively secured against overturning either by attachment to the object to be protected or by means of substantial braces and fixing which shall be permanently and rigidly attached to the building. The method and nature of the fixings should be simple, solid and permanent, due attention being given to climatic conditions and possible corrosion.

6.6- **Down Conductors :-**

6.6.1-The number and spacing of down conductors shall largely depend upon the size and shape of the building and upon aesthetic considerations, the minimum of down conductors may, however, to decide on the following considerations:

a) A structure having a base area not exceeding 10 sq. m may have one down conductor only, if the height of the air termination providers sufficient protection. However, it is advisable to have at least two down conductors except for every small building.

b) For structures having base area exceeding 10 sq. m the number of down conductors required should be worked out as follows:

(i) One for first 100 sq. m plus one more for every additional 300 sq. m or part there of or

(ii) One for every 30 m of perimeter. The smaller of the two shall apply.

6.6.2-Down conductors should be distributed round the outside walls of the structure. They shall preferably to be rum along the corners and other projections, due consideration being given to the location of air terminations and earth terminations. Lift shaft shall not be used for fixing down conductors.

6.6.3- Metal pipes leading rainwater from the roof to the ground may be connected to the down conductors but cannot replace them. Such connections shall have disconnecting joints.

6.6.4-In deciding on the routing of the down conductor, its accessibility for inspection, testing and maintenance should be taken into consideration.

6.7- **Joints and Bonds :-**

The lightning protective system shall have as few joints in it as possible. Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective. In the down conductor below ground level there shall be no joints. The joints may be clamped, screwed, bolted, riveted, braced or welded. The bonding of the external metal forming part of a structure or drain water pipe shall have cross sectional area not less than that employed for the main conductors. Gas pipe, however in no case shall be bonded to the earth termination system.

6.8 **Fasteners:-**

Conductors shall be securely attached to the building or other object to be protected by fasteners which shall be substantial in construction, not subject to breakage and shall be of galvanized steel or other suitable materials with suitable precaution to avoid corrosion. The lightning conductor shall be secured are not more than 1.20 m apart for horizontal shall be secured at not more than 1.20 m apart for horizontal run 1.0 m for vertical run.

6.9 Earth Terminations:-

Each down conductors shall have an independent earth termination. The interconnection of all the earth termination shall be preferable. It should be capable of isolation for testing purpose by 'testing joints'.

6.10 Earth Electrode:-

Earth electrode shall be constructed and installed in accordance with the clauses under chapter 6 "Earthing" of Section 1 in "General specifications for electrical works (part -1 Internal)-1972 "(Latest amendment).

6.11-The whole of the lightning protective system should have a combined resistance to earth not exceeding 10 ohms before any bonding has been affected to metal in or on a structure 0 to surface below ground.

TABLE – I

Shapes and Minimum sizes of Conductors for use above Ground

S. No.	MATERIAL & SHAPE	MINIMUM SIZE
1	Round copper wire or copper clad steel wire	6 mm diameter
2	Stranded copper wire diameter)	50 sq. mm or (7/3.0 mm
3	Copper strip	20 mm x 3 mm
4	Round galvanized iron strip	4 mm diameter
5	Galvanised iron strip	20 mm x 3 mm
6	Round aluminum wire	4 mm diameter
7	Aluminum strip	25 mm x 3 mm

TABLE-II

Shapes and Minimum sizes of Conductors for use below Ground.

S. No.	MATERIAL & SHAPE	MINIMUM SIZE
1	Round copper wire or copper clad steel wire	4 mm diameter
2	Copper strip	32 mm x 6 mm
3	Galvanized iron Strip	10 mm x 6 mm
4	Galvanized iron strip	32 mm x 6 mm

7 Earthing :-

All the non current carrying parts of electrical installation shall be earthed as per IS: 3043. All equipment, metal conduits, rising mains, cable metal armor, switch gear distribution boards, meter and all other metal parts shall be connected to earth electrodes. Earthing shall be in conformity with the provision of rules 32, 61, 62, IER 1956. For neutral Grading copper conductor and for body ear thing Galvanized iron shall be used.

8 Cable Trays

Fabricating and installing of perforated M.S cable trays including horizontal and vertical bend reducers, tees, cross members and other accessories as required and suspended/hinged on walls/ceiling with M.S suspenders/ fasteners and including paintings with powder coating as required for carrying of sub mains from meter board to shaft.

9 Completion Drawing

The contractor shall submit one complete set of originals and further two copies of all layout drawings to IRWO on completion the works. These drawing must contain the following information.

Location of D.B.s, switch boards light point's power points etc.
Complete schematic diagrams layout of the entire installation etc;
Layout of conduiting of Electrical, T.V and telephone system.
The changes/deviation during execution viz. a viz. execution drawing if any.

10 Inspections

10.1 The contractor shall be responsible for obtaining the NOC from Electrical Safety Inspector / State Electricity Board of the state. All statutory fee paid for the inspection of the installation shall be reimbursed by IRWO.

11 The internal wiring shall be done by "A" class Electrical Contractor to be approved by IRWO.

12 General Guidelines, Regulation and Standards:-

The installation shall strictly comply with the following standard (latest/ amended).
Indian Electricity Act/ Indian Electricity Rules. (latest/ amended).
Code of practice for electrical wiring installation (I.S.Codes).
CPWD specifications for internal works. (latest/ amended).
Wherever specification given here in call for a higher standard of material/ workmanship these shall take precedence over above.

General guidelines showing quantity of points for different categories of Dwelling Units (changes as per site requirements can be made)

Dscription	Type IV	Type III	Type II	Community Centre
Light Point	33	26	16	Electrical points as per
Two Way Light Point	5	4	3	approved layout drawing
Ceiling Fan	8	8	6	
Exhaust Fan	5	4	3	
6 Amp. Plug Point	14	12	9	
Switch Board with (6 Amp.) Plug Point	14	2	7	
16 Amp. Plug Point	9	9	6	
16 Amp 2nd Power Point	5	4	3	
Inverter Point	1	1	1	
Telephone Point	5	4	3	
Television {Point	5	4	3	
A.C. Point	5	4	3	
Chandeliar Point	1	1	1	

INDIAN RAILWAY WELFARE ORGANISATION

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