HSCC (INDIA) LIMITED

(A Subsidiary of NBCC (India) Limited)
(A GOVERNMENT OF INDIA ENTERPRISE)
E-6A, Sector-01, Noida-201301

Dated: 06/02/2019

AMENDMENT No. – I

Project Name: Tender for "Construction of ADVANCED NEUROSCIENCES CENTRE and their Maintenance during Defect Liability Period at PGIMER, Chandigarh on Comprehensive Design, Engineering, Procurement and Construction (EPC) basis".

Tender No. : HSCC/PGIMER/ANSC/CHANDIGARH/2019 dated: 31.01.2019.

This has reference to the subject work, Revised Technical Specifications of Electrical works are hereby uploaded under the head of tender notification.

Bidders are requested to follow the revised technical specifications of electrical works only, which shall be treated as a part of the contract to be uploaded along with tender/bid.

All others terms and conditions of tender shall remain same.

Prospective bidders are advised to regularly scan through HSCC e-tender portal http://www.tenderwizard.com/HSCC and http://www.hsccltd.co.in as corrigendum/amendments etc., if any, will be notified on this portal only and separate advertisement will not be made for this.

(- Sd -)
DGM (Civil)

REVISED TECHNICAL SPECIFICATIONS
OF ELECTRICAL WORK

GENERAL SCOPE OF WORK

The scope of work shall cover internal and external electrical works for **CONSTRUCTION OF ADVANCE NEUROSCIENCE CENTER AT PGIMER CHANDIGARH.** The scope of work covers electrical equipments as per BOQ. Also, supply, installation, testing and commissioning of electrical works of the project including the following main items/systems:

i. H.T. Sub-station including VCB panel, Transformers, bus ducts, HT cables etc
ii. Main LT , Capacitor panels (APFC),AHF Panel, Rising mains, MV Panels
iii. DG sets including AMF panels / Synchronizing panel etc.
iv. Rising mains, MV Panels.
v. MCB Distribution Boards.
vi. UPS
vii. Internal electrification through concealed MS conduit and provide light points, fan points, socket outlets etc. including supplying, installation, testing and commissioning of light fixtures, fans etc.
viii. Conduiting and wiring for telephone points including Main Telephone Distribution Boards (Tag Blocks), telephone outlets etc. complete with telephone cabling from tag blocks to telephone & telephone instruments etc.
ix. Addressable Fire Detection & Alarm System consisting of Main Fire Control & Indicator Panel, Smoke & Heat Detectors, Manual Call Points Hooter etc. including conduiting/wiring & cabling complete.
x. Conduiting and wiring for cable TV.
xi. Conduiting for computer networking.
xii. Public Address System
xiii. CCTV.
xiv. Nurse Call System.
xv. Lifts,
xvi. LT Cabling.
xvii. Earthling, safety equipments and misc items required for electrical installation complete in all respect.
xviii. Lightning protection system consisting of lightning arrestor, finial, horizontal and vertical strips, test joints, earth electrodes etc.
xix. Audio Visual System.
xx. Integrated Building Management System.
xxi. Parking Management System
xxii. Light Control .
xxiii. Access Control
xxiv. Solar PV cell
xxv. External Electrification
xxvi. Any other items/ works required for the completion of electrical work.
xxvii. Enhancement/Sanctioning Electrical Load from State Electricity Board.
xxviii. Submission of GA drawings of electrical equipments and getting approvals from Client/HSCC/Owner before manufacturing/fabrication.

xxix. Obtaining approvals from Chief Electrical Inspectors, Local Electricity Supply Authority, Telecom Department, and any other statutory authorities for the complete scope.

xxx. Contractor shall submit equipment drawing from manufacturer along with the layout etc. and working drawings for approval from HSCC Electrical Engineer before manufacture / commencement of work at site.

xxxi. Contractor has to submit the working drawing of internal & external electrification based on our tender drawings for the approval of HSCC Electrical Engineer before commencement of work.

xxxii. Contractor has to take the approval of DB schedule/drawing of each DB from HSCC.

xxxiii. If, details of any electrical item/ system are left out, then kindly refer the CPWD specifications & approval from Engineer.

xxxiv. If any item describe in DBR or specifications are favoring particular make the equivalent model of approved make in the list of approved makes can be accepted.

2.0 REGULATIONS AND STANDARDS

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

a)	CPWD General specifications for electrical works	Part-I (Internal)- 2013
b)	CPWD General specifications for electrical works	Part-II (External)-1995
c)	CPWD General specifications for electrical works	Part-III (Lifts & Escalators)-2003
d)	CPWD General specifications for electrical works	Part-IV (Substation)-2007
e)	CPWD General specifications for electrical works	Part VII (DG Sets) 2006
f)	CPWD Specification/norms for measurement	Latest revision
g)	Guide for marking of insulated conductors	IS 5578
h)	Guide for uniform system of marking and identification of conductor and apparatus terminals.	IS 11353
i)	Low voltage switchgear and control gear assemblies	S 8623 Part-1 to 3
j)	Specification for low voltage switchgear and control gear	IS 13947
k)	Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000V AC and 1200 V DC	IS 2675
l)	Code of practice for selection, Installation and maintenance of switchgear and control gear.	ISI 10118 Part – 1 - 4
m)	Low-voltage fuses for voltages not exceeding 1000V AC or 1500V DC	ISI13703 Part-1&2
n)	XLPE PVC insulated electric cables	IS 7098
o)	PVC insulated cables for working voltages upto and including 1100V.	IS 694

p)	Conduit for electrical installations	IS 9537
q)	Accessories for rigid steel conduits for electrical wiring	IS 3837
r)	Boxes for the enclosure of electrical accessories	IS 14772
s)	General and safety requirements for luminaries	IS 1913
t)	Code of practice for earthing	IS 3043
u)	Electrical accessories – circuit breakers for over current protection for household and similar installations.	IS 8828
v)	Low voltage switchgear and control gear	IS 13947 part 1 – 5
w)	Residual current operated circuit beakers	IS 12640
x)	Current Transformers	IS 2705
y)	Voltage Transformers	IS 3156
z)	Direct acting indicating analogue electrical measuring instruments and their accessories	IS 1248 part – 1 to 9
A1)	Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages upto and including 1000V ac and 1200V DC.	IS 13947 & IS 1336
B1)	ONAN Transformer	IS 1180
C1)	Energy Conservation Building code	(Latest)

In case of contradiction in specification the priority of the documents shall be as follows:

CPWD/ IS specification, BOQ, drawings, Technical specifications

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H.T. PANEL

1.0 11KV VACUUM CIRCUIT BREAKER PANEL BOARD

1.1 GENERAL:

Vacuum Circuit Breaker shall be incorporated in H.T. Panel wherever specified. VCB's shall conform to 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. Vacuum Bottle of VCB should be of same make as of VCB. Life of CB shall confine to M2E2. Panel shall be internal Arc tested as per IEC/ IS Standards.

1.1.2 TYPE AND CONSTRUCTION:

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

a. Circuit Breaker Compartment
b. Busbar Compartment
c. CT and Cable Compartment

1.2.1 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 provided panel on the front.

1.2.2. 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 aluminum oxide. The contacts shall be of chromium copper and butt shaped.

1.2.3 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 draw out carriage shall have two positions for the circuit breaker viz isolated/test & service position. Bus bars 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.

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

1.2.5 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 recognized phosphate process and shall then be given power coating (Electrostatic) paint of manufacturer's standard shade.

1.2.6 The switchgear constructions shall be such that breaker operation and internal explosions do not endanger the operating personnel, 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, bus bar 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 at least 2.0mm thickness. It shall have a rigid, smooth, leveled, flawless finish.

1.2.7 Voltage transformer of burden not less than 100VA and of proper ratio as specified shall be provided. the accuracy class for the VT shall be 0.5 as per is 3156 part 1 to III for incomer and class I for outgoing panels. The PT shall be of cast epoxy resin construction. It shall be fixed/withdraw able type. HRC fuses circuit Breaker shall be provided on both HV and LV side. Adequate space at the rear of the panel shall be provided for the termination of power & control cables. The panel shall be provided with suitable terminating arrangement for the termination of cables .Burden of PT should match with the requirement of client.

1.2.8 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.

1.2.9 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 draw out carriage. It shall, however, be possible to open the shutters of busbars side and cable side individually.

1.2.10 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 1.5 sq. mm; 1.1kV grade stranded copper PVC insulated cable. All control fuses shall be HRC link type.

1.2.11 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 1.5kV for one minute.

1.2.12 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 color 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.

1.3 BUSBAR AND REGULATORS

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

1.3.2 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.

1.3.3 Busbar insulators shall be of track-resistance, high strength, and 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.

1.3.4 EARTHING AND PROTECTIVE EARTHING

Copper earthing bus shall be provided. It shall be bolted/ welded to the framework of each panel. The earth bus shall have sufficient cross time fault currents to earth without exceeding the allowable temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting. 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. Earthing rod consisting of 16 Sq.mm. stranded/flexible copper cable 15 Mtr. long and connectors shall be supplied. Cost of this earthing rod is deemed to be included in the cost of VCB Panel.

1.3.5 METERING AND PROTECTION

The VCB Panel Board shall be provided with epoxy resin current transformers for metering and protection. The protection CT's shall be of accuracy class 5P 10 of 2705- part –III- 1992. The metering CTs shall confirm to the metering ratio and accuracy class 0.5 of is 2705-1992 for the incomer and class I for the outgoing panels. Ammeter and voltmeter to be installed on panel shall be digital type. Voltmeter transformer of burden not less than 100VA shall be 0.5 as per IS 3156 part -1 to part III for incomer and class I for outgoing panels. The PT shall be fixed /withdraw able type. HRC fuses/ MCB shall be provided on both HV and LV side. All meters shall be 96mm squire pattern, flush mounting type necessary selector switches. Necessary lamps of low voltage type with built in resistors shall be provided (maximum wattage 2.5watt. Burden of CT should match with the requirement of the client. Fault Level of CT should be equal to fault of HT Circuit Breaker for 1sec.

1.3.6 OPERATING MECHANISM

1.3.6.1 Vacuum Circuit Breaker shall be equipped with motorized 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.

1.3.6.2 Interlocking and Safety Arrangement

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

i. The draw out 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 draw out carriage mechanism.

1.3.7 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 500MVA (26.3 KA RMS) at 11 kV. The rated making capacity shall be as per the relevant standards.

1.3.8 ACCESSORIES:

1.3.8.1 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

1.3.9 ADDITIONAL ACCESSORIES

1.3.9.1 The loose items to be supplied with the 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 & Circuit Earthing Trolley.

1.3.10 Mounting

1.3.10.1 Vacuum Circuit Breakers shall be mounted as per manufacturer's standard practice.

1.3.3.11 Auxiliary Supply

a. The tripping shall be at 24 Volt D.C. through a power pack unit or Battery Charger or as given in BOQ.

b. Space heater indication & other auxiliary supply requirement shall be at 230 V AC. Necessary termination arrangements complete with isolating switch, control fuse & link shall be provided at one place in the panel for receiving the purchaser's cable.

1.3.12 TESTS

1.3.12.1 Factory Tests

The circuit breakers panel shall be subjected to routine tests at manufacturer's 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 along with the offer.

a. Temperature rise test.
b. Impulse & power frequency voltage test
c. Short time current test on circuit breaker.

1.3.13 Site Test

1.3.13.1 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. Cleanliness of insulators and general Cleanliness of panel to remove traces of dust, water etc.

1.3.13.2 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.

1.4 HT CABLES

1.4.1 Construction

H.T cables shall be of 11kV grade XLPE earthed insulated & PVC sheathed flat steel wires (strips) armored electrical purity aluminum conductor cables shall be manufactured & tested in accordance with IS Specification.

1.4.2 TERMINATION JOINTS

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

1.4.3 INSTALLATION OF CABLES

Cable laying shall be carried out as per CPWD specifications.

1.4.4 CABLE TRAY

Cable tray is manufactured at Indian Standard Specification. laying is done as per IS & CPWD specification.

1.4.5 EARTHING

Earthing specified in BOQ is done as per IS & CPWD specification.

2.0 11 KV TRANSFORMERS

GENERAL

The transformer shall be double wound core type with low loss, non ageing, high permeability, Prime Grade, CRGO with M4 grade or better , perfectly insulated and clamped to minimized noise and vibrations.

- Major civil work such as foundations, trenches, etc will be paid as per civil works.
- Minor civil work like cutting and making good all damages caused during installation and restoring the same to their original finish will be inclusive in the price.

2.01 (OLTC TYPE)

Transformer shall be outdoor duty type. The transformer shall be fabricated as per IS 1180 specification amended up to date and having voltage ratio as 11kV/0.433kV. **The Transformer loss will be as per 1180 Amended up to Date.**

SPECIFICATION

STANDARD-:

Unless otherwise stated below, transformer & transformer oil shall conform to IS 1180 & 335 respectively.

SYSTEM OF SUPPLY:- KV 3 phase, 50 Hz system

NO LOAD RATIO:- 11000/433 volts

KVA RATING:- Transformer shall be suitable for continuous rating as stated in BOQ.

TYPE:- Out door

WINDING:- The transformer shall be copper wound.

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

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

FREQUENCY:- 50Hz plus minus 3%

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

VECTOR GROUP:- Corresponding to the vector symbol Dyn-11

CONNECTIONS

H.V side of transformer shall be provided with suitable size cable box for 3 core XLPE cable. Indoor heat shrinkable termination kit shall be used for termination of HV Cable.MV side of transformer shall be suitable for bus duct connection arrangement.

TAPPING

ON load tap changing arrangement on 11kv side. The range for circuit taps, which shall be provided on H.V. side, shall be plus 5% & minus 15% in steps of 1.25%

TEMPERATURE RISE

The transformer shall conform to the requirements of temperature rise specified in IS: 1180.Continuously rated for full load, temp. rise not to exceed 50 degree C by thermometer in oil (55degree C by resistance)

INSULATION LEVELS

The insulation levels shall be in accordance with IS 2076 (Part III) 1977 .

TERMINAL MARKINGS, TAPPING & CONNECTIONS

The terminal marking, tapings 7 connections shall be in accordance with IS 2026(Part1V) 1977.

REQUIREMENTS WITH REGARDS TO ABILITY TO WITHSTAND SHORT CIRCUIT.

As per IS 2026 (part I) 1977

IMPEDANCE VOLTAG

As per table 3 of IS 1180

ON LOAD TAP CHANGING SWITCH

On load tap changer with RTCC panel and AVR

PARALLEL OPERATION

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

GENERAL REQUIREMENTS OF TRANSFORMERS

Transformer shall be suitable for operating at rated capacity continuously at any of the taps under ambient conditions and with the voltage and frequency variations indicated without exceeding permissible temperature rise and without any detrimental effect to any part.

Transformer shall be designed to be loaded as per IS:6600.

On Load tap changer shall be provided in the transformer with RTCC panel. The range of OLTC will be -15% to +5% in the steps of 1.25% as per BOQ.

All windings shall have uniform insulation resistance to earth.

Disconnecting chamber shall be air filled. Suitable cable end box shall be provided for termination of cables. Gland plate for single core cables shall be non-magnetic.

Transformer shall be able to withstand electrodynamic and thermal stresses due to terminal short circuit of the secondary, assuming the primary side is being fed from an infinite bus. All leads and windings in cores shall be properly supported. Short circuits withstand and duration shall be 2 secs. As per IS: 1180.

Short circuit test results for similar transformers shall be furnished.

There shall be a marshalling box for gathering all alarm signals. All alarm shall be wired up to terminal strip provided in marshalling box. 20% spare terminals shall be provided. Armoured cable of 2.5 sqmm cu shall be provided along with suitable size glands for terminating these contacts in marshalling box.

Guides shall be provided to facilitate tanking and untanking of the core with the coil assembly. The details of anchoring of core and coils assembly of tank shall be furnished.

Radiators shall be provided on the tank to facilitate cooling. These shall be detachable type and shall be provided with isolating valves at ends, drain plugs and air release plug. Radiators of 1.2 mm thickness seamless steel tubing or pressed sheet steel.

Means for lifting and jacking of transformer shall be provided.

Class-A insulating material specified in IS:1271 shall be used. Paper insulation shall be new and free from punctures. Wood insulation, wherever used, shall be well seasoned and treated.

The mineral oil shall comply with IS: 335. 10% extra oil in seal tins/ drums shall be supplied.

All valves shall be of globe type. Valve body of carbon steel and trim of 135 cr. Steel.

Oil temp. Indicator for measuring top oil temp. Shall comprise 150mm dial type thermometer pocket and capillary tube jacketed with PVC sleeve. Thermo-meter shall have 2 sets of contacts, one for alarm and the other for trip, and set points can be set by hand. Contacts shall be wired up to marshalling box.

Buchholz relay shall be provided as per IS: 3637. It shall be double float type with two sets of contacts for alarm and trip with facility for testing by injection of air by hand pump and with cock for draining and venting of air. Relay shall be provided with shut off valves on conservator side as well as on tank side.

Alarm and trip contacts shall be suitable for 1A 230 AC.

A marshalling box shall be provided to accommodate all auxiliary devices except those which are to be located directly on transformer. It shall be of dust, weather and vermin proof type of sheet steel 2mm thick and shall have sufficient apace for ease of cabling. 20%extra terminals shall be provided.

All steel surfaces exposed shall be treated with suitable anti –trust, anti –corrosive paints

Bushing insulator shall be rated for max. System voltage and shall be as per IS. Bushing shall be enclosed in terminal box and shall be detachable from outside the tank. Separate neutral bushing shall be provided for earthing the neutral. When LT cable box is provided, a neutral bushing shall be brought out for solid earthing.

Transformers shall have same percentage impedance & other characteristics with foundation plan parallel operation as per IS: 10028

FITTINGS

The following 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 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 provide. A connection pipe between the conservator and 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 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. DIAGRM WITH RATING PLATE: One diagram and rating plate indicating the details of transformer connection diagram vector group tap changing diagram etc.
viii. THERMOMETER: Dial type thermometer (150mm dia) with maximum set pointer 75 degree C electrical contacts for electrical contacts for electrical alarm at high temp.
ix. EXPLOSION VENT: Explosion vent or pressure relief device shall be provided of sufficient size of rapid release of any pressure that may be generated within the tank and which might result in damage in the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank.
x. FILTER VALVE: Filter valve on the top of the tank.
xi. BUCHOLTZ: Oil actuated relay equipment shall confirm to IS 3637-1966(amended up to date) and shall be double float type having contacts which close following oil surge or under incipient fault condition. Bucholtz relay shall have contacts for alarm / trip.
xii. WINDING TEMPERATURE INDICATOR :

xiii. Winding temperature indicator with electrical contact for alarm/ trip
xiv. OIL TEMPERATURE INDICETOR: Oil temp. Indicator with alarm & trip contacts.
xv. MARSHALLING BOX: the transformer shall be provided with suitable size marshalling box to terminate the control cables of thermometer and bucholtz relay.
xvi. CONTROL CABLING: all control cables required from Marshalling box to H.T panel board for Trip/alarm of winding temp. Indicator, oil temp indicator, Buckholz relay etc. shall be provided and deemed to be included in the rate of transformer equipments.
xvii. TRANSFORMER OIL: First filling of oil.
xviii. EARTHING: Two separate earthing terminals are to be provided at the sides of the tank on both the sides for earthing.
xix. ON LOAD TAP CHANGER; High speed resister type OLTC shall be provided along with RTCC and AVR.

SOAK PIT

Soak pit for oil filled transformer shall be made are per IS 10028 (Part II) 1981 with up to dated amendments. Sump shall be formed in the transformer room and shall be connected to soak pit outside the transformer room with a pipe. All the civil works required for the soak pit shall be done by the contractor and the cost shall deemed to be included in quoted rates of the transformer item.

INSTRUMENTATION MANUAL

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

SHOP DRAWINGS

The selected supplier shall prepare and furnish shop drawings for the approval by the consultant/client before commencing fabrications/ manufacture of the equipment. Shop drawing shall be based on the requirement laid down in the specifications. The manufacture of the equipment shall be commencing only after the shop drawings have been approved in writing by the consultant. Transformer shall be manufactured conforming to specification of Local supply authority.

INSPECTION

i) The transformer shall be inspected on arrival as per the inspection manual of the supplier
ii) Shall be examined of any sign of damage and special attention shall be given to the following parts.

Oil tank and cooling tubes
Bushes crakes or broken
Oil sight glass

INSTALLATION

i) The transformer shall be installed as per transformer manual of the transformer supplier and conforming to Indian standards.

ii) The transformer is to be erected on suitable size M.S channels embedded in the cement concrete flooring including providing & fixing the channel. 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 sealed to prevent absorption of moisture.
v) The transformer natural earthing and body earthing shall confirm to Indian Standard.

FACTORY TEST

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

TESTING 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) The supplier gives sufficient advance information about the test schedule to enable the owner to appoint his representative.

HIGH SPEED RESISTOR ON LOAD TAP CHANGER

GENERAL

High speed resistor on load tap changer shall be provided with the transformer wherever specified. The high speed resistor OLTC shall be for rated voltage up to 11KV rating current of 100 Amp, 3phase, 17step conforming to Indian standard with AVR & RTCC panel.

TYPE AND CONSTRUCTION

OLTC shall be a compact unit for use with three phase distribution transformer. It shall be completely self contained and designed to bolt directly to a part flange on the transformer.

The assembly comprise of
1. Tank
2. Selector Switch
3. Driving Mechanism
4. Barrier Board
5. Local control Gear
6. Control cable Terminations
7. AVR & RTCC panel

TANK

The complete tap changer shall be housed in a single tank of welded sheet steel construction. The tank shall be divided into two separate compartments to house the selector switch, driving mechanism and Local control gear. Access to the compartments shall be made easy by means of

removable covers and a weather proof door. Anti- condensation heater shall be provided in the compartment which houses driving mechanism and control gear.

OPERATION MECHANISM

An impulse is received either from a remote control panel or from a local manual operation switch, which energies the appropriate raise/lower contactor to initiate a tap changer in the required direction. The contactor when energized seals itself via its own contact and the driving motor commences to run. At a predetermined point a directional sequence switch closes, taking over the handling duties of the contactor whose original hold circuit shall be isolated. At the completion of the tap changer the directional sequence switch opens and de- energizes the driving motor. The arrangement ensures that a short period initiating pulse shall be accepted by the control gear.

CONTROL CABLE TERMINATION

A detachable undrilled gland plate and the terminal station for all the external connections shall be provided in the driving mechanism compartment of the tap changer.

AUTOMATIC VOLTAGE REGULATOR

Solid state automatic voltage regulator shall be provided for the regulation of the secondary voltage of the power transformer with on load tap changer (OLTC). The band width control shall allows the dead band to be set in the terms of upper (LOWER VOLTS) and lower (RAISE VOLTS) voltage limit around a particular nominal value with a specified sensivity. AVR shall be provided with time delay control to allow the regulator to respond only to voltage fluctuations lasting for period greater than a selected time delay. Where the voltage correction requires more than one tap change, the time delay shall be reinitiated before further tap changes. Regulations shall reset automatically after voltage correction. Solid state lamps (LED) shall be provided to indicate voltage outside the preset limit & control relay operation.

RTCC PANEL

RTCC panel shall be provided to operate OLTC from control room located in substation. RTCC shall be provided with main switch, a sequence selector switch. RTCC shall be provided with lower push button & raise push button, tap change in progress & complete. A.C supply ON/OFF lamp indicator & AVR relay operated operation indication. Cubical panel shall be totally enclose, floor mounting and fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness. All the sheet steel work forming the exterior of RTCC panel shall be smoothly finished and all steel work used in construction of RTCC panel shall undergone a regrious metal treatment process consisting of effective cleaning by hot alkaline degreasing solution followed by the cold water rinsing, pickling in dilute sulphuric acid to remove scales and rust formation, a recognized phosphating process , passivating in deoxidize to retain & augment the effects of phosphating, drying with compressed air and dust free atmosphere, primer coating with two coats of highly corrosion resistant primer applied under strictly controlled conditions and finished coat of stoving

3.00 CAPACITOR PANEL

3.01 SCOPE

Supply, installation, testing and commissioning of medium voltage capacitors and Automatic Power Factor Correction Panel (APFC) for improvement in power factor of electrical system. It will be connected to main LT panel. It shall improve power factor up to 0.98 legging from initial power factor. Capacitor panel shall be provided with day/ night mode selector switch and double ratio C.Ts, for day/ night mode. Day/ night mode shall be selected based on estimated day / night load requirement. The panel shall include all the specified capacitor banks, switchgears, controller, filter reactors, control gears, busbars, meters, earthing, interconnections etc

3.02 RATING

Capacitor units as specified in the BOQ shall be used to form a bank of capacitors.

3.03 ENCLOSURE

The panel shall be indoor, floor mounted and free standing type with IP-42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure and shall be finished with powder coating in the approved colour shade. Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided. The front portion shall house the switchgear and the rear portion shall house capacitors and series reactors (14%). The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

3.04 APFC Relay

Microprocessor based APFC relay, (intelligent VAR controller) of suitable steps as mentioned in the BOQ, shall sense the PF in the system and automatically switch ON/OFF the capacitor unit or bank to achieve the preset target PF. The controller shall have digital settings of parameters like PF, switching time delay, step limit etc, indication of PF, preset parameter, minimum threshold setting of 1% of CT current.

3.05 CAPACITORS

The capacitor shall generally confirm to IS: 13585:1994 and IEC 60931:2002
General specification: three phase, delta connected, 50 Hz.

i. Voltage: Must be designed to with stand system over voltage, increased voltage due to series reactor and harmonics. It should be rated for 525V for 14% detuned reactor. The KVAR of Capacitor banks should be increased proportionately for combination of Capacitor + reactor.

ii. Capacitor type: The capacitor unit shall be Heavy Duty MPP resin filled, copper wound type. The dielectric should be made of polypropylene. Capacitor Impregnation shall be Oil Type. Capacitor should be fitted with safety device for each capacitor units. The capacitor should be low loss type (total losses should not exceed 0.45 W/ KVAR).

iii. Temperature category: -25 degree C to 70 degree C.

iv. Over voltage +10% (12h in 24 hours), +15%(30 minutes in 24 hours), +20% (5 minutes) and 30% for I minute as per clause 6.1 of IEC 60931

v. Over current: 2.5x In

vi. Peak inrush current withstand: 400 x In

vii. Capacitor shall be provided with permanently connected discharge resistors so that residual voltage of capacitors is reduced to 50 volts or less within one minute after the capacitors are disconnected from the source of supply.

viii. Each capacitor bank shall be provided with a terminal chamber and cable glands suitable for AYFY cable as specified.

ix. Separate earthing terminal shall be provided for earth connection of each bank.

De-tuned Filter

- Detuned filter reactor shall be used along with power capacitors to mitigate harmonics, improve power factor and to avoid electrical resonance in LV electrical networks.
- The low voltage filter Copper reactor shall be series type having a three phase, iron core construction suitable for indoor use. The reactor shall be air cooled and the layout shall be in accordance with IEC 60076.
- The permitted tolerance of inductance shall be + 3% of rated inductance value.
- The limit of linearity of inductance of the filter reactor shall be as follows $1.8*I_n$ with $L=0.95*L_N$.
- The reactor shall be fitted with a temperature sensitive micro-switch in the centre coil (normally open) for connection to trip circuits in case of high operating temperatures.

3.06 SWITCHGEAR & PROTECTION:

Incomer switchgear will be as specified in BOQ. Suitable rated Power Contactors or Special Capacitor duty contactor for each step shall be used and must be capable of capacitor switching duty. Busbars shall be suitably colour coded and must be mounted on appropriate insulator supports.
Power cable used shall have superior mechanical, electrical and thermal properties. Internal wiring between main bus bars, contactor, capacitor etc shall be made with 1100 volt grade PVC insulated FRLS copper conductor of appropriate size by using suitable copper crimping terminal ends etc suitable bus links for input supply cable termination shall be provided.
Control circuit shall be duly protected by using suitable rating MCB. An emergency stop push button shall be provided to trip thru entire system (22.5 mm dia, mushroom type, press to stop and turn to reset). 440 Volt caution board shall be provided on the panel.

3.07 TESTS AT AMNUFACTURER'S WORKS:

All routine and type tests as per IS:2834 relevant to capacitor bank s as amended upto date shall be carried out at manufacturer's works and test certificates to be submitted to HSCC.

3.08 TESTS AT SITE:

Insulation resistance with 500 V DC Megger shall be carried out and test results should be recorded.
Residual voltage shall be measured after switching of the capacitors and the same shall not be more than 50 volts after one minute. Each discharge resister shall be tested for its working.
Drawings and Instruction manual:

3.09 INSTALLATION:

Capacitor bank shall be installed at least 30 CM away from the walls on suitable frame work of welded construction. The earth terminals provided on the body of capacitor bank shall be bonded to main capacitor panel earth bus with 2 nos 8 SWG copper or 6 SWG GI earth wire.
Contractor shall submit four copies of the following certified drawings:

i. General arrangement of capacitor bank and control panel indicating main dimensions, type of mounting, location of various devices etc., including foundation details.
ii. Schematic diagram for automatic sequential switching with terminals and ferrules numbers.
iii. Wiring diagram of control panel indicating terminal blocks and various apparatus.
iv. Final list of components of control panel.

Contractor shall also submit four sets of installation and maintenance manual.

3.1 Active Harmonic Filter

1. General

1. DESCRIPTION

Design, manufacture, testing & supply of 3-phs/4-wire, 440 V, 300 A(Multiple of 60A module i.e 60X5), IP20, active harmonic filter. AHF shall implement the following.

1. Eliminate the harmonics up to the 50^{th} order.
2. Offer dynamic var compensation.
3. Balance the load actively to all phase.
4. Should have 3 level topology
5. Should have integrated overload, overvoltage &under voltage protection etc.
6. Ensure low losses.

2. Detail Description.

1.1 AHF shall have capability to eliminate harmonic from 2nd up to 50^{th} order with facility to
Select any individual harmonic up to 50^{th} order. It should also provide flicker compensation for pure sine wave & rate of harmonic reduction should be equal to or greater than 97%

1.2 AHF shall provide reactive power compensation for both leading & lagging Current

1.3 AHF should have provision to balance the load in all phases & unloaded the neutral wire.

1.4 AHF Shall have 3 level topology (12 IGBTs) to ensure low losses & higher quality voltage output (ripple should be very low).

1.5 AHF should have following inbuilt safety features.

a) Overload protection
b) Internal short-circuit protection
c) Overheating protection
d) Overvoltage &under voltage protection
e) Inverter bridge protection
f) Grid Resonance protection
g) Fan fault protection

1.6 AHF shall have low losses (less than or equal to 25 watt/Amp for typical signature spectrum)

1.7 Reaction time shall be less than or equal to 5o microsecond.

1.8 Steady state response time shall be less than or equal to 5 millisecond

1.9 Switching frequency shall not be less than 20 Khz

4.0 Main LT, MV & FLOOR PANELS

4.1 GENERAL

Main/Sub Distribution Panels 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.

4.2 CONSTRUCTION

Main/Sub Panels shall be:

i. Of metal enclosed, indoor, floor mounted, free standing construction (unless otherwise specified) 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.

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

v. All panels shall be front access type.

Main/Sub Panels 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 the following:

i. A front-framed structure of rolled/folded sheet steel channel section, of minimum 2 mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, moulded case circuit breaker, main horizontal busbars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2 mm thickness and 100 mm height. 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 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.

The height of the panels should not be more than 2400 mm for MV Panels. Operating handle of breaker in top most compartments shall not be higher than 1800 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 350mm.

Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 1.6 mm thickness. All sheet panels shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the power control centers (panels) 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/Sub Panels shall have the following minimum clearances.

i.	Between phases	- 32 mm
ii.	Between phases and neutral	- 26 mm
iii.	Between phases and earth	- 26 mm
iv.	Between neutral and earth	- 26 mm

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 with 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 moulded case circuit breakers 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 bus duct for incoming breakers.

Metallic/insulated 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 unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

4.3 METAL TREATMENT & FINISH

All steel work used in the construction of the Main/Sub 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. Panel shall be powder coated with epoxy based powder paint after the above process so as to render the material suitable for corrosive environment.

vii. Paint shade shall be Pebble (light) grey, shade no RAL 7032 unless otherwise specified.

4.4 BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminum alloy complying with the requirement 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. 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/Sub Panels shall be designed that the cables are not directly terminated on the terminals of breaker etc. but on cable termination links. Capacity of aluminum busbars shall be considered as 0.8 Amp per sqmm. of cross sectional area of the busbar. The main busbars shall have continuous current rating throughout the length of Panels. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity up to 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 auxillary 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.

4.5 SWITCHGEARS

Refer subhead 4.00 – LT switchgears

4.6 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Main/Sub Distribution Panels 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. A cable chamber 150 mm. high shall be provided at the bottom through out the length and depth of the MDB/SDB. 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.

4.7 LABELS

Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of Main/Sub Distribution and all Panels.

4.8 TEST AT MANUFACTURES WORK

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates submitted.

4.9 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: As per CPWD Specifications.

d) Trip tests & protection gear test.

5.0 L.T. SWITCHGEARS

5.1 AIR CIRCUIT BREAKERS

5.1.1 GENERAL

Air circuit breakers shall be incorporated in Main Distribution Panels wherever specified. ACBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. ACBs shall be suitable for operation on 415 volts, 3 phase, 50Hz, AC supply. Electrical/ Mechanical endurance of the ACB shall be as per IS/ IEC 60497.

5.1.2 TYPE AND CONSTRUCTION

Air Circuit Breakers shall be of enclosed pattern, dead front type with 'trip free' operating mechanism. It shall have microprocessor based electronic release. Air Circuit Breakers shall be EDO type (Electrically drawout type unless otherwise specified) with horizontal drawout carriage. The ACBs shall be strong and robust in construction with suitable arrangements for anchoring when in fully engaged or fully drawn-out positions. The carriage or cradle on which the breakers are mounted shall be robust design made of fabricated steel, supported on rollers. Cradle shall also comprise of main and secondary separable contacts and all draw out mechanism in a completely fig welded assembly. There shall be no dependence upon the switchboard 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 and these shall be such suitable for being lifted out for inspection of main as well as arcing contacts. The contact tips and arc chutes shall be suitable for ready replacement. Self aligning isolating contacts shall be provided. The design of the breaker shall be such that all the components are easily accessible to inspection, maintenance and replacement. Interphase barriers shall be provided to prevent flashover between phases.

5.1.3 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 operating handle shall be in front of the panel type. The design shall be such that the circuit breaker compartment door need not be opened while moving the breaker from completely connected, through test, into the disconnected position. Electrical operated breakers shall have a motor wound spring charged closing mechanism. Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring. The operating mechanism shall be such that the breaker is at all times free to open immediately and the trip coil is energised. Mechanical operation indicator shall be provided to show open and closed position of breaker. Electrically operated breakers shall be additionally provided with mechanical indication to show charged and discharged condition of charging spring. 24 volt DC supply through battery backup for closing and opening for tripping circuit.

Means shall be provided for slow closing and opening of the breaker for maintenance purposes and for manual charging and closing of electrically operating breakers during emergencies.

5.1.4 INTERLOCKING AND SAFETY ARRANGEMENT

Air Circuit Breakers shall be provided the following safety and interlocking arrangements:

i. It shall not be possible for breaker to be withdrawn when in "ON" position.

ii. It shall not be possible for the breaker to be switched on until it is either in fully inserted position or for testing purposes it is in fully isolated position.

iii. The breaker shall be capable of being racked into 'testing', 'isolated' and ‘maintenance’ positions and kept locked in any of these positions.

iv. A safety catch to ensure that the movement of the breaker, as it is withdrawn is checked before it is completely out of the cubicle.

v. The operating mechanism shall provide for racking the breaker into connected, test and disconnected positions without operating compartment door. When cubicle door shall be open position, the breaker can be pulled out to a fourth position, maintenance, where free access shall be possible to all parts of the breaker.

5.1.5 RATING

The rating of the circuit breaker shall be as per the drawings and schedule of quantities. Rated service breaking capacity (Ics) of the breakers shall be 50kA unless otherwise specified at 415 volts. The rated making capacity shall be as per the relevant standard.

5.1.6 ACCESSORIES

The breaker shall be equipped with electronic microprocessor based release to provide over current & earth fault protection. The breaker shall be fitted with following accessories for control, signal and interlocking.

i. Auxillary contacts 6 NO + 6 NC, of rating 16Amp at 415 volts 50Hz.

ii. Shunt release for tripping the breaker remotely and shall be suitable for 240 volt/415 volt 50Hz with range of operation from 10% to 130% of rated voltage.

iii. Micro switches shall be mounted on the cradle of draw out breaker to indicate the position of the breaker on the cradle.

a. Kit for test/isolated indication.
b. Kit for service position indication.
c. Kit for shutter assembly.

iv. Accessories for following interlocking schemes shall be provided.

a. Accessory kit for locking the breaker in isolated position. This kit is useful for interlocking scheme as well as keeping personnel and equipment safe.

b. Door interlock kit: Panel or cubicle door cannot be opened with the ACB in Test or Service position.

c. Lockable trip push button.

5.1.7 MOUNTING

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

5.1.8 TESTING

Testing of each circuit breaker shall be carried out at the works as per IS 2516 and the original test certificate shall be furnished in triplicate. The tests shall incorporate at least the following.

i. Impulse withstand test.

ii. Power frequency withstand test.

iii. Short circuit test.

iv. Temperature - rise test under rated conditions.

5.2 MOULDED CASE CIRCUIT BREAKERS.

GENERAL

Moulded Case Circuit Breaker shall be incorporated in the Main/Sub Distribution Boards wherever specified. MCCBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. MCCBs shall be suitable for three phase 415 volts. MCCBs shall have microprocessor based over current and short circuit releases with adjustable current setting or Thermal Magnetic with variable current setting as per BOQ.

5.2.1 Technical Specifications

MCCB should be suitable for 100% isolation.

Electrical/ Mechanical endurance shall be as per IS/ IEC 60497.

Fault identification of O/L, S/C, E/F shall be indicated on panel door.

The MCCB should be current limiting type with trip time of less than 10 milli sec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ.

MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2 /IEC 60947-2 and should have test certificates for breaking capacities from independent test authorities CPRI / ERDA

MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses.

The breaking capacity of MCCB shall be minimum 35KA / 50 KA or as specified in BOQ. The rated service breaking capacity should be equal to rated ultimate breaking capacities (Ics=Icu).

All MCCBs upto 200A ratings should be provided with Thermal Magnetic type release with adjustable Overload and fixed short circuit protections or specified as BOQ. MCCBs of ratings 250A & above shall be provided with Microprocessor based having inbuilt adjustable protections against Over Load (L), Short Circuit (S) and Ground Faults (G)] with time delay or specified as BOQ.

All MCCBs should be provided with the Rotary Operating Mechanism. The ROM should be with door interlock (with defeat feature) & padlock facility

MCCB should have Spreader links & Phase barriers as standard feature. Superior quality of engineering grade plastics confirming to glow wire Tests as Per IEC 60695-2-1 should be used for insulation purpose.

The handle position shall give positive indication of ‘ON’, ‘OFF’ or ‘Tripped’ thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts.

5.2.2 FRAME SIZES

The MCCBs shall have the following frame sizes subject to meeting the fault level or as per manufacturer’s standard practice.

a.	Upto 100A rating	.....	100A frame.
b.	Above 100A upto 200A	.....	200A frame.
c.	Above 200A up to 250A	.....	250A frame.
d.	Above 250A up to 400A	.....	400A frame.
e.	Above 400A up to 630Aq	.....	630A frame.
f.	Above 630A to 800A	.....	800A frame.

5.2.3 CONSTRUCTIONS

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable "ON", "OFF" "and" "tripped" indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCBS shall be provided with rotary handle.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermal magnetic or static release type provided in each pole & connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.

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

5.2.4 BREAKING CAPACITY

Unless otherwise specified, rated service breaking capacity of the Moulded Case Circuit Breakers shall be minimum 35kA.

5.2.5 TESTING

a. Original test certificate of the MCCB as per Indian Standards (IS) 315-C-8370 shall be furnished.

b. Pre-commissioning tests on the Main Distribution/Sub Distribution Board incorporating the MCCB shall be done as per standard.

5.3 SWITCH DISCONNECTOR FUSE UNITS

The Switch Disconnector Fuse Units shall be double break type suitable for load break duty (AC 23) quick make and break action. Hinged doors shall be duly interlocked with operating mechanism so as to prevent opening of the door when the switch is in 'ON' position and also prevent closing of the switch when the door is not properly secured. All contacts incoming and outgoing terminals of switch shall be adequately sized to receive proper size of cables. High rupturing capacity (HRC) fuse links shall be provided with switch fuse units and shall be in accordance with IS 13703-1&2-1993 and having rupturing capacity of not less than 31 MVA at 415 volts. HRC fuse links shall be provided with visible indicators to so that they have operated. The switch disconnector fuse units shall be manufactured in accordance with IS 13947-3-1993.

FUSE

Fuse shall be of the high rupturing capacity (HRC) fuses links and shall be in accordance with IS 13703-1&2-1993 and having rupturing capacity of not less than 31 MVA at 415 volts. The backup fuse rating for each motor/equipment shall be chosen as the fuse does not operate on starting of motors/equipments.

5.4 MEASURING INSTRUMENTS, METERING & PROTECTION

5.4.1 GENERAL

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

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

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

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

5.4.2 DIGITAL AMMETERS

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

5.4.3 DIGITAL VOLTMETERS

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

5.4.4 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 acceptable minimum class of various applications shall be as given below:

Measuring : Class 0.5 to 1

Protection : Class 5P10.

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

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

All Current Transformer shall be Cast resin type.

5.5 MISCELLANEOUS

Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamp covers, bulbs & lenses shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

6.0 DIESEL GENERATOR SETS

6.1 INTENT OF SPECIFICATION

6.1.1 This specification covers the Supply, Installation Testing Commissioning of Diesel **Gen-Sets with Acoustic Enclosure,** complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under.

6.2 SCOPE OF WORK:

6.2.1 Scope of Supply & Services:

General Scope of work shall include, supply, erection, testing and commissioning of the following:

a) Diesel engine complete with all accessories, an Alternator directly coupled to the engine through flexible/rigid coupling complete with all accessories for starting, regulation and control, including base frame etc. interconnecting piping and accessories, power and control cable glands and lugs.

b) Diesel Local/Remote control panel including cables between bidders local equipment and special cables if any.

c) Equipment necessary for engine cooling system, radiators, pumps, valves, inter connecting pipes etc.

d) Equipment necessary for fuel storing and distribution, day oil tank (990 Lt.), pipings, pumps, valves, level indicators etc.

e) Flexible connections and residential type silencer of exhaust system, including thermal lagging.

f) Batteries with iron battery stand and battery charging equipment, including their connections as necessary along with tools & accessories for battery maintenance.

g) Anti Vibration Mountings etc.

h) Preparing all related shop drawings for approval from client/consultant and statutory bodies.

i) Obtaining approval of the installation of Diesel Generators by the Electrical Inspectorate and Pollution Control bodies and any other statutory bodies.

j) Minor civil works like chasing, grouting etc. for execution of jobs.

k) Carrying out performance and guarantee test at site available load but not more than the capacity of D.G. Set.

l) Acoustic enclosure as per CPCB norms and type approved.

m) All control Cabling between alternator & Panel will be in the scope of work and will be inclusive in the price.

n) Major civil work such as foundations, trenches, etc will be paid as per civil works.

o) Minor civil work like cutting and making good all damages caused during installation and restoring the same to their original finish will be inclusive in the price.

6.2.2 Specific Exclusions:

Following items of works are excluded from the scope of works under this specification:

a) All civil works relating to DG foundation etc.

b) All cables between contractors and owners equipment other than special cables external to the equipment.

6.3.2 The installation work shall conform to Indian Electricity act and Indian Electricity Rules as amended up to the date of installation.

The fuel oil installation shall meet all statutory requirements of Govt. of India as amended up to the date of installation. Any approval required from statutory authorities shall be obtained by the Contractor. Nothing in this specification shall be construed to relieve the contractor of these responsibilities.

6.3.3 Equipment conforming to any other National/International Standard which ensures equal or better quality may be accepted. In such case the bidder shall furnish copies of the standards in English along with his bid and shall clearly bring out the salient features of comparison with corresponding listed standards.

6.3.4 The equipment furnished under this specification has to operate in a tropical climate and shall be given tropical and fungicidal treatment as per relevant specification

6.3.5 Period of Operation/Duty Cycle:

The sets are intended to supply power only during an emergency for essential services and may be idle for long periods except for periodic routine tests once in a week. When there is a total failure of main power supply, the sets shall be required to operate continuously at full load for a period which at times may exceed even 24 hours.

The set shall be capable of running at full load for not less than 300 hrs continuously or as per manufactures recommendations. The change period both for the lube oil, lube oil filters shall be minimum 300 Hours of operations or as per manufactures recommendations.

The time to Top overhaul, major overhaul & maintenance schedules shall be specified by the bidders.

6.04 CODES & STANDARDS

The design, construction, manufacture, inspection, testing and performance shall comply with all the currently applicable statutes, safety codes, relevant Bureau of Indian Standard (BIS), British Standards (BS), International Electro Technical Commission (IEC) publication, NEMA & VDE standards amended upto date.

Some of the applicable standards are listed below :

BS– 5514/ISO 3046/DIN 6271	Reciprocating internal combustion engines
BS – 4613	Electrical performance of rotating electrical machine
BS – 4999/5000	Applicable parts of BS 4999/5000
IEC–34–1/IS–4722/VDE 0530	Specification for rotating electrical machines.
IS – 4889	Method of determination of efficiency of rotating electrical machinery.
IS – 6491	Degrees of protection provided by enclosures for rotating electrical machinery.
IS – 4729	Measurement and evaluation of vibration of rotating electrical machines.
AIEE – 606	Recommended specification for speed governing (1959) of internal combustion engine generator units.
IS – 2705	Current transformers.
IS – 1248	Electrical indicating instruments.
IEEE – 115	Test procedure for synchronous machine.
CPWD Norms CPCB NORMS	CPCB -2 (Latest)

CPWD General Specification for electrical Part VII DG set 2013

6.4 ENGINE:

6.4.1 Type:

The diesel engine shall be of stationary type four stroke/two stroke with vertical in line or (V) type cylinder arrangement, Turbo-charged, cooled with radiators.

6.4.2 Rating:

a) Prime power BHP rating of the engine shall be such that the DG set deliver the specified net electrical output while supplying power/driving all electrical and mechanical auxiliaries connected to alternator terminals and engine shaft at specified site conditions and ambient temperature of 50^{O}C. The bidder shall submit the deration calculations if the engine is not designed for 50deg C. ambient temperature.

b) It shall also be capable of satisfactorily driving the alternator at 10% over load at the rated speed for one hour in any period of 12 hours of continuous running.

The bidder shall have to furnish copy of deration chart from the original manual of the engine manufacturer and supporting calculations to arrive at diesel engine rating.

6.4.3 Speed and Vibration Levels:

a) Speed shall be 1500 revolutions per minute. Speed governor/over speed protection shall be provided.

   At due running conditions, speed shall be stabilized at plus or minus 2% nominal speed, regardless of load. At transient condition, engine speed shall vary not more than 10% plus or minus. Governor class shall be A1 (4% drop) for normal application unless otherwise specified.

b) The engine vibration level shall not exceed 100 microns.

6.4.4 Lubrications:

a) The engine shall have a closed cycle forced & splash lubricating system with positive oil pressure and a crank chamber for collection/storage of the lubricating oil during circulation.

b) A lubricating oil filter shall be provided for operation under normal conditions for a period of 300 hours without the necessity of its replacement or cleaning.

c) In case lubricating oil coolers are required it shall be supplied as an integral part of the Diesel Generator Set.

d) Necessary temperature and pressure gauges and other instruments shall be supplied and fitted on the lubrication system.

e) A lubricating oil level dipstick suitably graduated shall be provided and located in the accessible position.

6.4.5 Fuel System:

a) The engine shall be capable of running on all types of diesel fuel oil normally available in India.

b) The fuel consumption of the engine at full, three quarters and half of its rated power output shall be indicated by the Contractor in the bid.

c) A fuel service tank of 990 litres capacity with each D.G. Set shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. All pipe joints should be brazed/welded.

6.4.6 Air Intake System:

The diesel engine shall be provided with special dry type air filters having low resistance to air passage, high dust retaining efficiency and provision for easy cleaning. Filters shall be suitable for achieving satisfactory engine operation and ensuring the engine life under tropical humid conditions, with sulphur dioxide fumes, abrasive dust and coal particles of 5 to 100 microns present in the atmosphere. The minimum efficiency of filters shall be 90% down to 5 micron size.

6.4.7 Cooling:

The diesel engine should be water cooled with radiator heat exchanger system. The cooling system should include temperature gauge with high temp., alarm/trip corrosion resistor etc.

6.4.8 Engine Governor:

The governor shall be Electronic ISO-Chronous type to maintain zero speed rate or regulation and shall be Al type as per BS:5514 in order to take care of heavy motor starting. It shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However, a tripping shall be provided if speed exceeds maximum permissible limit. The governor shall be suitable for operation without external power supply.

6.4.9 Turbo Charger:

It shall be of a robust construction, suitable of being driven by engine exhaust having a common shaft for the turbine and blower. It shall draw air from filter of adequate capacity to suit the requirements of the engine.

6.4.10 Quietness of Operation:

a) The engine shall be designed to achieve maximum quietness of operation.

b) Efficient residential silencer shall be provided as per engine manufacturer's approved make only for the exhaust.

c) Noise level of the set shall not exceed 115-120dbA at one meter distance of the engine.

6.4.11 Engine Starting:

a) Engine starting shall be by electric starting motor complete with manual/automatic starting arrangement. The starter motor shall conform to IS:4722 and shall be of adequate power for its duty and be of inertia or pre-engaged type. The pinion shall positively disengage when the engine starts up or when the motor is de-energized. The engine cranking shall be only from the panel both for AMF & DG sets (Manual) and any engine starting devices etc. that are given as original fitment on the engine by engine manufacturers shall be either removed or padlocking arrangement given for this so that all normal start/stop operations could be done only from panel whether the set is AMF or manual.

   The engine wiring shall be appropriately modified, ferruled to totally match with schematic drawings of the panel.

b) Time for Run-up to Speed:
   From the initial operation of the starting device, the engine shall start, run up to normal speed and be capable of accepting 60% of full load within a maximum time of 20 seconds, and full load within a further 20 second.

6.4.12 Starter Battery:

a) The battery shall conform to the requirement of IS:1651. Starting battery each of 12 V, heavy duty high performance approved make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions. Type/voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The battery set shall be capable of performing at least (5) five normal starts without recharging.

b) The battery shall be provided with good quality teakwood stand painted with acid proof black paint with min 3mm thick rubber mat below the batter.

c) Batteries shall be of load container type only and not with PVC moulded sealed container so that each individual cells are available for individual monitoring during its life span. Each cell shall be provided with electrolyte filling cap with level floats for easy monitoring of electrolytic level.

d) The battery shall be provided with 2 Nos. cables, minimum 1.5m long heavy duty rubber/PVC insulated cabling with brazed tinned lug at one end and with brazed tinned brass terminal lug at battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.

e) The lugs shall be clearly stamped (+) or (-) and positive cable also red sleeved for easy identification.

f) The batteries Set shall be supplied fully filled and first charged ready to use.

6.4.13 Battery Charging System:

a) Float rate charging and quick rate charging system shall be provided at the generator panel with appropriate bridge charger system, LC network, rate selector switch and generously rated charging transformer and silicon one rectifier bridge, so that the cranking battery system can be kept fully charged at all times from E.B. supply network with quick charging rate limited to 0.8 times rated discharge current with provision in control transformer and Si rectifier present to enable boost charging the battery at 2 times rated discharge current in case of emergencies. To this and in the mode selector switch boost charge position shall be present which however shall be kept disconnected at mode selector switch normally.

b) DC ammeters to clearly indicate float charging current and quick/boost charging current shall be provided.

c) Dropper resistor network on the load side of battery charger system shall be provided so that higher charger voltages in quick or boost conditions does not get impressed on the I/L and Contactor coils, which voltage shall remain well within +10% of rated voltage.

d) Battery charging subsystem shall be designed for continuous operation at cubicle ambient of $50^{O}C$ corresponding to $45^{O}C$ ambient outside and should be designed to operate at 1.5 times rated maximum current corresponding to boost charge current which can reach in practice as high as 2.5 times or 3 times rated discharge current.

e) Any charger dynamo and dynamo charging current network present on the set shall be made in operative so that both for AMF and manual application the cranking battery system is kept charged from the charger at the panels at all times during or shut down periods of the set.

f) To the above and in case of manual DG sets, the input to charger subsystem viz., 240 V AC is foreseen to be provided from customer network from the portion that is normally supplied by manual DG Set during DG operation or being fed by E.B. System.

6.4.14 Engine Fitments:

The engine shall be provided with but not limited to following essential basic fitments:

Crank case breather	-	Dry type element.
Air Cleaner	-	Dry type mounted.
Corrosion resistor	-	to control acidity and impurities from coolant.
Lubricating Oil Cooler	-	
Filters	-	Lub oil & fuel oil, paper element type.
Coolant Pump	-	Gear Driven.
Fuel Pumps	-	Priming & Transfer
Governor	-	Electronic Class A1.
Turbo Charger	-	Exhaust gas driven in case of turbo charged engines.
Flywheel with flywheel housing	-	SAE Type
Vibration dampers	-	One Set
Exhaust/Intake manifolds	-	
Oil Sump (crank case) with dip stick		
Engine Supports		
Residential type silencer in exhaust system		
Electrical starter 12 V or 24 V		
Safety controls & instruments		

6.4.15 Engine Instrumentation:

The following instruments mounted on instrument panel shall be essentially present as minimum:

- Engine speed tachometer with service hour counter
- Lub oil pressure gauge
- Coolant water temperature gauge

The instrument panel shall be mounted on engine using rubber dampers for vibration isolation.

The gauges shall have clear red marking to identify the limiting dangerous levels, `Zone Markings' on the scale to indicate the normal healthy & abnormal operating zones for the parameters concerned.

The metering could be either normal electro-mechanical analogue type or electronic digital type, latter being preferred as manufacturers fitment only.

The engine control panel must be supplied by the engine manufacturer only.

6.5 ALTERNATOR:

6.5.1 The alternator shall have brushless type with rotating field and static excitation circuit controlled by field control unit suitably compounded for voltage and load current for a self excited self regulated system.

6.5.2 The alternator shall be in SP-DP enclosure, foot mounted with ball and roller bearings on end shields.

6.5.3 The alternator shall conform to IS:4722/BS:2613 and shall be suitable for tropical conditions.

6.5.4 The alternator shall comply with the following specifications:

Rating	-	As per BOQ. (Shall be capable of 10 % over loading at the rated speed for one hour of 12 hours continuous running).
Voltage	-	415 V
Speed	-	1500 RPM
Frequency	-	50 Hz.
P.F.	-	0.8 lag
Enclosure	-	IP:23
Insulation	-	H
Execution		-Self excited, self regulated with brushless system and static voltage control unit suitably compounded for voltage and current to maintain terminal voltage constant at ± 5% at all load for p.f. not less than 0.8. lag.
Terminal Box	-	As per BOQ.
Earthing Studs	-	2 Nos. in each DG

6.5.5 Neutral Point:

The winding of the alternator shall be star-connected.

6.5.6 Terminal Box and Connection:

The alternator output terminals shall be enclosed in a terminal box mounted in an accessible position on the alternator frame. As far as possible, connections between the exciter and alternator shall be contained within the machine frame and connections carrying A.C. and D.C. shall be segregated from each other. The terminal box shall be of sufficient size to conveniently terminate the size and number of the Owner's cables, which shall be intimated during detailed engineering. Suitable tinned copper pads shall be provided for power cable termination along with all necessary hardware and cable lugs. Glands and lugs shall be provided for control cables also. For single phase cables, gland plate shall be of non-magnetic material. Gland plate shall be removable type.

6.5.7 The generating set shall be so designed that it is capable of reaching its full voltage and frequency and shall be ready to take full load within 30 seconds of a remote starting impulse being received.

6.5.8 Acoustic Enclosure:

Thickness of Sheet

High Class sheet metal fabricated enclosure for reducing the noise level of DG Set and also acts as weather proof housing. Genset will be an integral part of acoustic enclosure and whole construction will be on multi-fold sheet channels and ISMC sections. Enclosure construction is fully bolted keeping in view the major service requirements all doors are provided with specially designed hinges and lockable handles, battery, fuel tank is housed inside the enclosure.

Acoustic Materials:

Rock wool in the form of slabs of 75 – 100 mm thickness and 48 KG/Metric cube density (Specification of Rock wool conforms to IS:8183).

Further to increase the life of Acoustic material resin coated fiber glass cloth is provided on exposed surface of Rock wool slabs and the panels are supported by perforated sheets.

Ventilation:

Acoustic enclosure is designed in such a way that there are no hot pockets around engine and it is provided with suitable designed engine radiator/or additional axial flow fan and does not allow the temperature to rise more than $7^{O}C$.

To achieve optimal output and minimum sound level from the DG Set, suitable openings with acoustic hoods are provide for increasing the inflow of air required for combustion and forced ventilation. Air intake system as per the recommendations and engine requirement are provided.

- Acoustic hoods with noise splitters provided to block and reduce the sound leakage.

- The sound control system designed to suppress the sound level to 75 db maximum at 1 meters distance in open environment.

Silencer:

Specially designed low noise silencer is provided. Silencer & engine exhaust outlet, connected with flexible SS below.

Vibration Isolation:

To avoid transfer of vibration from Genet to enclosure & surrounding specially designed vibration isolators are used.

COOLING TOWERS

Cooling Tower if required as per BOQ Shall be as per Standard manufacturers recommendations/ Practice . The cooling towers of adequade capacity to be installed at the terrace of the complex from where the common header of the cooling towers shall be brought down to the DG room in the basement. Soft water is required to be filled up in make up water tank for closed circuit cooling of engine.The contractor has to obtained the data from the Manufacturer for the requirement of the cooling tower capacity of the DG sets.

6.6 AMF PANEL:

6.6.1 General:

a) The control panel shall be sheet steel enclosed and shall be dust and vermin proof providing a degree of protection of IP-42. Sheet steel used shall be cold rolled and at least 2.0mm thick and properly braced and stiffened.

b) Control panel shall be provided with hidden hinged door(s) with pad locking arrangement and suitable brackets/channels shall be provided for floor mounting.

c) All doors, removable covers and plates shall be casketed all around with neoprene gaskets. All accessible live connections shall be shrouded and it shall be possible to change individual switches, fuses, MCCBS without danger of contact with live metal.

d) All live parts shall be provided with at least phase to phase and phase to earth clearances in air of 25mm and 20mm respectively.

e) Adequate interior cabling space and suitable removable cable gland plate shall be provided. Necessary number of cable glands shall be supplied and fitted on to this gland plate. Cable glands shall be screwed on type and made of brass.

f) Two number of earthling terminals shall be provided.

g) All sheet steel work shall be degreased, pickled, phosphate and then applied with two coats of zinc chromate primer and powder coat finishing both inside and outside of shade 631 (gray).

6.6.2 AMF Control of Diesel Generating Sets:

a) All DG Sets shall be controlled independently.

b) Diesel Generator shall be capable of being stopped manually from remote as well as local. However, interlock shall be provided in the DG local control panel to prevent shutting down operations as long as circuit breaker is closed.

c) Auto Operation:

When mains power is available, the healthiness of this power will be monitored through a mains voltage monitor. If voltages on the 3 phases are within limits, the monitor will send a closing signal to the mains breaker and mains power will be connected to the load.

If the voltage drops on any phase or on all phases, the monitor will sense this drop through a timer, and if this drop persists for more than a pre-adjusted period of time (say 1 to 20 seconds) a signal is sent to the engine starting circuit while at the same time opening the mains supply breaker and disconnecting load from mains as voltage is below acceptable limits.

The engine starting control monitor will send a signal to the D.C. battery supply for starting the engine through the starting solenoid. When the engine is healthy, it starts up in a few seconds and the generator develops voltage. The generator voltage monitor, monitors the voltage and when the voltage is developed, this give a signal to the generator breaker which

closes and connects the diesel generator to the load. Simultaneously, it sends a signal to de-energize the engine starting circuit and the starter motor is disengaged. The engine protection circuits for high water temperature and low lubricating oil pressure are also energized.

d) Resumption of Supply:

If voltage from mains is resumed, the main voltage monitor will sense this voltage for healthiness, i.e. for maintained correct voltage for a period of time (adjustable up to three minutes) and then send a signal to stop the engine and to change over the breakers from generator to mains and normal supply is resumed to the load. The solenoid operation and closing and tripping of breakers should be done through control voltage 24 V.D.C.

e) Failure to Start:

A three attempt starting facility using two impulse timers and a summation timer for engine shall be provided and if voltage fails to develop within 30 seconds from receiving the first start impulse, the set shall lockout automatically and a visual and audible alarm shall be given in the control panel. The remote panel shall receive "DG Trouble Alarm".

6.6.3 The control panel shall have the following provisions for the control of each DG Set:

1. MCCB's & ACB's as per BOQ.
2. Master engine control which for OFF/AUTO/MANUAL/TEST with a facility for starting and stopping of the set.
3. Voltmeter 144 Sqmm with selector switches for alternator/Mains/Phases complete with protection.
4. Local/Remote selector switch to facilitate remote starting/stopping of the DG Set.
5. Frequency meter 144 Sqmm reed type.
6. Current transformers required for metering.
7. Ammeter 144 Sqmm with C.T. & selector switch, KWH Meter, KW 144 Sqmm.
8. Mains Supply, voltage monitor.
9. Engine control monitor.
10. Alternator voltage monitor.
11. D.C. Control relays, timers.
12. Engine protection system for low oil lubricating pressure and high water temperature.
13. Window type annunciator with static relays, alarm/hooter and accept, test, rest push buttons for all functions.

14. Engine hours run counter.

15. Control fuses.

16. Lifting Hooks.

17. Gland Plates.

18. Power/Control Contactors.

19. Earthing Studs.

20. Antivibration pads.

21. IDMT relays [CDG – 31]

22. Under Voltage Relays

23. Over Voltage Relays

6.6.4 Indication/Annunciation:

Pilot indicating lamps/shall be provided for the following:

1. Charger - ON/OFF
2. Earth Fault
3. Set shutdown due to `Engine high water temp.'
4. Set shutdown due to `Low oil pressure'
5. Set shut down due to `Lock of fuel'
6. Over speed trip

Indicating lamp shall be of the panel mounting filament type with series resistors.

6.6.5 The DG Sets would normally be controlled from remote for which following provisions are being made on the remote control panel. The necessary control devices/contacts for these external connections shall be wired out to the DG control panel terminal blocks.

1. Starting and stopping of the DG Set
2. DG running indication
3. Watt hour meter, Wattmeter, Voltmeter, Ammeter and Frequency meter.

6.7 ENGINE SAFEGUARDS:

Safeguards shall be provided and arranged when necessary to stop the engine automatically by the following:

a) Energising a solenoid coupled to the stop lever on the fuel injection pump rack.
b) De-energising the "fuel on" solenoid

c) Energising the "fuel - cut off" solenoid.

The operation of the safeguard shall at the same time give individual warning of the failure by illuminating an appropriate local visual indicator and remote alarm at generator panel.

The contactors, relays and other devices necessary for signal and control, for above purposes shall be provided at Generator panel.

At the set at a easily accessible place an “EMERGENCY STOP” mushroom head stay put type P.B shall provided to stop the set in emergency mode.

The safe guard to “STOP THE SET” shall stop the set irrespective of mode selection of the set viz Auto, Manual or test for following cases, with simultaneous isolation of alternator ckt.

a) Emergency stop P.B’s operation
b) Over speed.
c) Low lube oil pressure.
d) Earth fault

6.8 SYNCHRONISING PANEL

6.8.1 The technical specification and details of the microprocessor based PLC controller for the DG set synchronizing and load sharing shall be as follows

6.8.2 The microprocessor based PLC panel shall be suitable for use with AVR and electronic speed governor to protect and monitor DG sets.

6.8.3 Double Frequency Meter and Double Voltmeter shall be provided in synchronizing panel.

6.8.4 Synchro check relay also shall be provided.

6.8.5 The PLC shall be provided with following features and audible alarm:

- Engine pre glow control
- Fuel solenoid control
- Engine starter control
- KVA controlled cool-down timer
- Speed monitoring
- Over speed protection
- Oil pressure monitoring, alarm and shutdown of the engine.
- Water temperature monitoring, alarm and shutdown of the engine
- Battery voltage monitoring
- Over speed monitoring and alarm.
- 3 attempt start failure alarm
- Under/Over Frequency
- Reserve Power (Inverse time delay)
- Loss of excitation
- Over current (inverse time delay)
- Loss of utility power detection
- Load surge
- Current unbalance
- Voltage unbalance
- Mains Protection (vector shift, df/dt ROCOl)
- True RMS power calculations accurate control
- Configurable loading/unloading ramp rates
- Isochronous load sharing of up to 4 units using percentage based load sharing
- Base load control for optimum fuel efficiency
- Import export control using a watt transducer
- Soft utility transfer function
- Digital signal processing to eliminate harmonic issues
- Adjustable phase window, Voltage and dwell time
- Safe dead bus closing logic internal to the control
- Synchronization across generator and mains breakers
- Multiple short re-closing with adjustable time delay
- Manual voltage and speed adjusts for manual synchronizing
- VAR sharing on isolated busses using percentage based reactive load sharing
- Power factor or VAR control when base loaded

- Externally adjustable VAR or PF set point levels.
- The DG set shall start and stop automatically based on plant bus demand.

A) The PLC system shall be provided with built in relays for protection of the following:
- Reverse Power
- Reverse KVAR
- Over current
- Under and over voltage
- Under and over frequency
- Synchronization check and earth fault relay.

B) The PLC system shall be suitable for load sharing by sensing active and reactive power.

The PLC system shall comprises of the following:

- Main processor unit
- Power module for power supply to the processor and the system
- Power monitor to monitor voltage, KVA, KVAR, KW, KWH, KVAH, KVARH.
- 16/32 channel Digital input module
- 16/32 channel Digital output module
- EEPROM for main processor unit
- Computer to PLC communication card with necessary cables.
- Window based operator interface Software Package
- Mounting chassis for the equipment

The microprocessor based main processor of the system shall be suitable for 128 digital I/P and 128 O/P and comprises of the following:

The main processor unit shall be suitable for operation on 24 Volts DC with integrated memory. The integrated Ram memory shall be 20 K Words for program, data and constants plus data memory and flash EP ROM of 16 K works for backup application program, communication card and real time clock.

4 Nos. discrete combination module (Input/output Module) shall be provided and the same shall be suitable for operation on 24 volts DC system. Combination module shall be with 16/32 inputs and 16/32 output channels as per the actual requirement.

- 1 No. 2 slot extension rack
- 1 No. Ram back up battery unit
- 8/4 Nos. digital input module
- 8/4 Nos. digital output module

The CPU display unit shall be suitable for 4 lines of 40 characters. The display shall be with back lit LCD. Clarity shall be not less than 5 x 7 pixels. The height of the characters shall be not less than 5 mm. The data entry shall be with the help of 24 function keys. In addition to this there shall be 10 service keys and 12 alphanumeric keys.

The system shall be provided with RS 232 communication port.

6.9 OPERATION AND COMMUNICATION

7.9.1 The PLC shall monitor the bus bar load continuously. In event of mains failure the PLC shall give signal to select and start the generator, which is closer to the load sensed during the last 60 seconds. In case the load at the time of main failure is more than the highest rating DG set, the PLC shall give command to start 2 Nos. DG sets to suit the load, synchronize the sets and give command to close the breaker on the main LV panel.

7.9.2 If load starts reducing the PLC shall give command to turn off the DG sets through cool down timer. On restoration of main power supply, the PLC shall check the voltage and frequency and if they are stabilized and with in the permissible tolerances, the PLC shall give command to shut down the DG sets through cool down timer.

7.9.3 The control and monitoring of the cooling tower and fan and feed pump shall be done through PLC control system. Necessary control wiring between cooling tower, pumps and PLC panel shall be carried out within the scope of work.

6.10 SYNCHRONIZING MODULE

6.10.1 The synchronizing module shall be a microprocessor based intelligent unit, which shall monitor the electrical parameters and shall able to communication with the PLC control unit in the process of synchronizing and load management. The system shall be suitable for dynamic synchronization. The synchronizing module shall be suitable for programming and set the preferred difference between DG set and bus bar.

6.10.2 The synchronization module shall monitor and fulfill the following conditions before the system synchronizes the DG set to mains.

6.10.3 Feed bank signal from the DG breaker on main LV panel that the breaker is in open condition.

- Bus bar voltage is present
- Generator voltage is present

6.10.4 The frequency regulator in the system shall start when the generator voltage and the bus bas voltage is over 50% of normal voltage. The voltage regulator in the system shall start when the frequency is within 90% of the normal system frequency.

The system shall close the breaker on the power panel with out carrying out synchronization when all the below mentioned conditions are fulfilled.

Feed back signal from the DG breaker on main LV panel that the breaker is in closed condition.

- Bus bar voltage is present
- Generator voltage is present

The synchronizing module shall transmit all monitored electrical parameters to the PLC unit and the PLC unit shall start controlling the synchronization of the DG sets and its load management. The data logging, monitoring and controlling shall be through a PC based SCADA station.

6.11 TESTS:

The alternator of each type and rating shall be type tested for the following tests as per IS:4722, IEEE 115 & BS:5000. Test certificates to be provided for routine and type tests from the manufacturers.

6.12 ERECTION, TESTING, COMMISSIONING AND PERFORMANCE & GUARAANTEE TESTS/PROCEDURE AT SITE:

The entire work of erection, testing and commissioning of equipment supplied under this package shall be carried out by contractor and performance and guarantee tests to be conducted at site are also included under the scope of this specification. For this purpose the contractor shall depute suitable qualified technical supervisor to site on advance intimation to the Owner along with all special testing equipment required for testing and performance and guarantee tests. The supervisor(s) shall be responsible for the installation, testing, commissioning checks and performance & guarantee tests mentioned in relevant clauses of this volume and the checks recommend by the contractor.

The contractor shall ensure that the equipment supplied by him is installed in a neat workman like manner such that they are leveled, properly aligned and well oriented. The tolerances shall be established in Contractors drawings and/or as stipulated by the Owner.

All special tools and tackles and spares required for erection, testing and commissioning of equipment shall be supplied by the contractor.

Erection, testing and commissioning manuals and procedures shall be supplied, prior to dispatch of the equipment.

The contractor shall ensure that the drawings, instruction and recommendations are correctly followed while handling, setting, testing and commissioning the equipment.

6.13 Commissioning Check Tests/Performance and Guarantee Test:

In addition to the checks and test recommended by the manufacturer, the contractor shall supervise the following acceptance tests to be carried out on each test at site.

i. Load Test:

The DG Set shall be given load test at site for a period of at least 6 hours depending upon the actual power factor of the load and set shall be subjected to the maximum achievable load without exceeding the engine or alternator capacity.

This full load test is to be followed immediately by a 10% overload run for one hour. The performance of the engine, alternator shall be satisfactory at the end of this overload run.

During the load test half hourly records of the following shall be taken:

a) Ambient temperature
b) Cooling water temp.
c) Lubricating oil pressure.
d) Speed
e) Voltage, wattage and current output.
f) Oil tank level

ii. Speed and Governing:

The speed of the engine shall be verified to ensure that it conforms to the requirement of BS:5514.

iii. Check of Fuel Consumption:

A check of the fuel consumption shall be made through out the test run of full load and overload.

iv. Noise Level:

The equivalent `A' weighted sound level measured at a distance of 1 meter horizontally from the base of any equipment furnished and installed under these specifications expressed in decibels to a reference of 0.0002 microbar, shall not exceed the limit given as per CPCB norms. 75 dbA average at 1 mtr. distance from acoustic enclosure.

7.00 BUS TRUNKING/ RISING MAINS

7.1 SCOPE

This section covers manufacture, supply, installation, resting and commissioning of sandwich insulated bus trunking, & rising mains, indoor/ outdoor type.

7.2 Supply voltage

415/ 440 Volt, 3 phase, 4 wire, 50 Hz AC supply.

7.3 Standards for compliance:

IS: 8623/ 1993 I & II and IEC 60439/ I & II.

7.4 Construction:

The enclosure will be made from 16 SWG GI/ CRCA sheet steel powder coated of approved shade. Bus bars would be of high conductivity aluminium in "Sandwich" construction and the conductors will be individually insulated with halogen free, fire retardant class–B or better insulation. No drilling of Bus bar is permitted. Length of the section will be limited to maximum three metre. Bus bar of one section will be connected to bus bar of adjacent section by uni-block joint system removable as separate sub-assembly, so that it can be inserted or removed without disturbing the adjacent sections.

7.4.1 Technical Parameters:

Bus trunking / Rising Main shall be designed to withstand short circuit current of 50 KA for one second.

Bus bar system should be designed for high temperatures withstand capability.

Insulation voltage 1.1 KV/1.0 KV or as per manufacturer Standard Practices

Bus trunking will be suitably chosen to give permissible voltage drop.

Plug in boxes

Plug in boxes will be of draw out type. Contacts will be of silver plated copper and spring loaded. Earth connection will be the first to make and last to break during insertion and with drawl. Plug in boxes will be made from 1.6 mm CRCA sheet steel powder coated. Inside the plug in Boxes MCCB with the fuses will be located as per requirements. The operating handle will be interlocked with plug in box cover so that MCCB can be operated only with the suitable cover in closed position. The plug in box will be interlocked with bus bar trunking so that it can not be inserted or removed with the plug in box lid open. MCCB will be of 4 pole type unless otherwise specified in BOQ. Short circuit breaking capacity of MCCB in PIB should be same as that of bus trunking i.e. 50 KA.

7.5 List of test to be carried out:

7.5.1 Routine tests:

i. Verification of insulation resistance.
ii. Inspection of assembly, interlocks, locks etc.
iii. Dielectric test.

Copies of the following certificate should be submitted:

i. Verification of temperature rise limits
ii. Verification of di-electric properties.
iii. Verification of short circuit strength.
iv. Verification of degree of protection.
v. Insulation resistance test with 500 volt megger. The insulation resistance shall be not less than 100 mega ohm.

8.0 INTERNAL ELECTRIFICATION OF BUILDING

8.1 SCOPE

As specified in subhead 1.00

8.2 GENERAL

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

- Specifications for Electrical Works Part-I (Internal) by CPWD – 2005 or latest revision
- Specifications for Electrical Works Part-II (External) by CPWD – 1994 or latest revision

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

8.3 DISTRIBUTION BOARDS.

As a general practice only MCB type double door DB shall be used or as specified in BOQ.

Distribution Board shall be standard type. Distribution boards shall contain miniature circuit breakers of rating specified in BOQ/DB Schedule.

Miniature circuit breakers shall be quick make and quick break type with trip free mechanism. MCB shall have thermal and magnetic short circuit protection. All miniature circuit breakers shall be of minimum 9 KA rated rupturing capacity unless otherwise specified.

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

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

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

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

Before procurement of Distribution Boards, MCB's, ELCB's (incomer and outgoings) etc., the contractor has to take approval of the DB Schedule/Drawings of each DB from the HSCC Electrical Engineer. The whole unit i.e. Distribution Board, MCB's, ELCB's etc. shall come from the manufactures premises/workshop. After inspection and clearance from the HSCC Electrical Engineer the same may be dispatched to site for installation. However if a single component (such as ELCB or MCB or DB) is required for any reason such as replacement, increase in no. of circuits in the DB, change in the load of existing circuit, change in the total load on a particular DB etc., the same may be ordered separately but after the approval of HSCC Electrical Engineer.

8.4 METALLIC CONDUIT WIRING SYSTEM.

8.4.1 TYPE AND SIZE OF CONDUIT.

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

8.4.2 CONDUIT JOINTS.

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

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

8.4.3 PROTECTION AGAINST CONDENSATION.

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

8.4.4 PROTECTION OF CONDUIT AGAINST RUST.

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

8.4.5 PAINTING OF CONDUIT AND ACCESSORIES.

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

8.4.6 RECESS CONDUIT.

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

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

8.4.7 METAL OUTLET BOXES & COVERS.

The switch box shall be made of modular metal boxes with suitable size modular cover plates. Modular metal box shall be made of mild steel on all sides except on the front.

The metal box (other than modular type) shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Metal boxes upto 20 x 30 cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20 x 30 cm size shall be of 16 SWG. The

metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm. All boxes shall be covered from top with Phenolic laminated sheet of approved shade. These shall be of 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and conform to grade P-I of IS: 2036-1994.

8.4.8 ERECTION AND EARTHING OF CONDUITS.

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

8.4.9 SWITCHES.

All 5 and 15 Amp switches shall be modular type of 240 volts A.C. grade. All switches shall be fixed on modular metal boxes. All 5 Amp socket shall be 3 pin type and 15 Amp socket shall be 5/6 pin type (unless otherwise specified) suitable for 15/5 Amp. All modular switches, sockets, telephone outlets, TV outlet etc. shall be in off white finish unless otherwise specified. The switches controlling the lights or fans shall be connected to the phase wire of the circuit. Switch boards shall be located at 1200 mm above finished floor level unless otherwise indicated on drawings or directed by Engineer-In-Charge.

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

8.4.10 COVER PLATE.

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

8.4.11 WALL SOCKET PLATE.

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

8.5 WIRING.

All PVC insulated copper conductor wires shall conform to relevant IS Codes. All wires/cables shall be stranded type irrespective of its size. Cable conductor size and material shall be specified in BOQ.

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

Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switchboards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red/yellow/blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour PVC insulated wire for RYB phase wire respectively and black colour PVC insulated wire for the neutral wires. Bare copper wire shall be used as earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing and jointing of copper conductor wires and cables shall be as per CPWD specifications.

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

Nominal Cross-Sectional area of conductor in Sq.mm.	25mm		32mm		38mm		51mm		64mm	
	S	B	S	B	S	B	S	B	S	B
1	4	5	6	7	8	9	10	11	12	13
1.5	10	8	18	12	-	-	-	-	-	-
2.5	8	6	12	10	-	-	-	-	-	-
4	6	5	10	8	-	-	-	-	-	-
6	5	4	8	7	-	-	-	-	-	-
10	4	3	6	5	8	6	-	-	-	-
16	2	2	3	3	6	5	10	7	12	8
25	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	4	3	5	4

NOTE :

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.

2. The columns headed `S' apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed `B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

3. Conduit sizes are the nominal external diameters.

8.5.1 JOINTS.

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

8.5.2 LOAD BALANCING

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

8.5.3 COLOUR CODE FOR CIRCUIT WIRING.

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

8.5.4 CLASSIFICATION OF POINTS.

8.5.4.1 General

Classification and measurement of Point wiring shall be as per CPWD specification for Electrical Works (Part-I-Internal) 1994.

8.5.4.2 Point Wiring (Modular)

Definition of point wiring

A point (other than socket outlet point) shall include all work necessary in complete wiring to the light points/fan/exhaust fan/call bell point from the controlling switch/MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit i.e. from first switch board (wiring from distribution board to first switch box is covered in the circuit wiring and is not in the scope of point wiring) to subsequent switch board(s) in the same distribution circuit. The point wiring includes all materials specified below including chasing the wall (in case of recessed wiring in wall), fixing the conduit and making the wall good as it originally was. It also includes supply, drawing, testing and commissioning of wires.

Scope of point wiring

Following shall be deemed to be included in point wiring.

(a) Supply & fixing conduit & conduit accessories for the same and wiring cables (including supplying and drawing wires) between the switch box and the point outlet. [See also (i) below]
(b) All fixing accessories such as clips, nails, screws, phil plug, rawl plug etc. as required.
(c) Modular Metal boxes for control switches, regulators, sockets etc. recessed or surface type, modular base plates and modular cover plates over the same.
(d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding modular metal boxes if any, provided the switchboards for loose wires/conduit terminations.

(e) In case of recessed wiring in wall the scope includes chasing of wall, fixing the conduit and making the wall good as it originally was.
(f) Control modular switch (5/6A) as specified.
(g) Ceiling rose or connector (in case of points for ceiling/exhaust fan point, prewired light fittings and call bells).
(h) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
(i) Interconnecting wiring between points on the same circuit, in the same switch box or from another. Interconnecting wiring from first switchboard to subsequent switch board(s).
(j) Protective (loop earthing) conductor (as specified in the BOQ) from one metallic switch box to another in the distribution circuits, and from switchboard to each point (light/fan/exhaust fan/call bell etc).
(k) Bushed conduit where wiring cables pass through wall etc.
(l) Ceiling rose (in the case of pendants except stiff pendants).
m) Lamp holder (in the case of goose neck type wall bracket, batten holder and fittings which are not pre-wired)..
n) Back Plate (in the case of stiff pendants).

Note :- In the case of call bell points the words "from the controlling switch or MCB" shall be read as "from the ceiling rose meant for connection to bell push".

Measurement of Point Wiring (other than socket outlet points)

i) There shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting,

ii) No separate measurement shall be made for interconnections between points in the same distribution circuit and for the circuit protective (loop earthing) conductors between metallic switch boxes.

8.5.5. Circuit and Submain Wiring

Circuit Wiring

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

Submain Wiring

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

Measurement of circuit wiring and submain wiring

(i) Circuit and submain wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit, exclusive of interconnections inside the switchboard etc. The increase on account of diversion or slackness shall not be included in the measurement.
(ii) The length of circuit wiring with two wires shall be measured from the distribution board to the first nearest switch box in the circuit irrespective of whether neutral conductor is taken to switch box or not.

(iii) When wires of different circuits are grouped in a single conduit, the same shall be measured on linear basis depending on the actual number and size of wires run.

(iv) When circuit wires and wires of point wiring are run in the same conduit, circuit wiring shall be measured on linear basis depending on the actual number and sizes of wires run in the existing conduit.

(v) Protective (loop earthing) conductors, which are run along the circuit wiring and submain wiring, shall be measured on linear basis and paid separately. This is not applicable if protective conductor is clubbed with the BOQ item of circuit and submain wiring.

8.5.6 Power Plug Wiring

5A Plug Wiring

Wiring for all 5 A Socket Outlets shall be done with 2X1.5 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, from the switchboard or 15A power point as the case may be.

Measurement of 5A point wiring shall be done on Linear basis from switchboard/15A power point to 5A point. Conduit of power SOCKET wiring can also be used for 5A socket outlet wiring, but both phase and neutral wires shall come directly from switchboard/power socketoutlet. Looping of neutral shall not be done.

15A Power Plug Wiring

Wiring for all 15 A Socket Outlets/Gyser point shall be done with 2X4 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, directly from the MCB-Distribution Board or from one power socket outlet to another in case of computer power points. Looping shall not be done in general 15A power points (other than computer power points).

Measurement of power socket outlet wiring shall be done on basis under following two subheads:

i) Directly from MCB-Distribution Board to the Socket Outlets
ii) From One power socket outlet/computer power point to another (looping)

Wiring for 20A Metal Clad Socket Outlets

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

No extra payment shall be made on account of minor changes in location of power points (15A or 20A or computer power points) due to change in the architectural layout or change due to any other reason. Height of the power socket outlets shall be 300mm from the finished floor level unless otherwise specified.

8.5.7 CONDUCTOR SIZE.

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

i. Light point. - 1.5Sq.mm

ii. Ceiling /Cabin/Exhaust Fan Point - 1.5Sq.mm

iii. Call Bell Point - 1.5Sq.mm

iv. Plug Point (5 A Outlet) - 1.5Sq.mm

v. Circuit Wiring - 2.5Sq.mm

vi. General Power Point - 4Sq.mm

vii 20A Industrial Socket Outlet – 6 Sqmm

viii Special Power Point – 6 Sqmm

ix A/C Box with 32A MCB- 6 Sqmm

8.5.8 LIGHTING FIXTURE AND FANS

8.5.8.1 GENERAL

a. Normally all light fixture will be LED type and shall be with driver etc, ready to use condition.

The Contractor shall supply and install lighting fixtures including but not limited to lamps, driver /ballasts, accessories fixing hardware necessary for installations, as shown on the Drawings, as required, and as herein specified.

b. All fixtures shall be delivered to the building complete with suspension accessories, canopies, hanging devices, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes, etc. all wired and assembled as indicated.

c. Full size shop detail drawings of special fixture or lighting equipment, where called for in the fixtures schedule, shall be submitted to the HSCC Electrical Engineer for approval.

d. Fixtures, housing, frame or canopy, shall provide a suitable cover for fixture outlet box or fixture opening.

e. Fixtures shall comply with all applicable requirements as herein outlined unless otherwise specified or shown on the Drawings.

f. Manufacturer's name and catalogue number of light fixtures, fans, switchgears etc. shall be strictly adhered.

g. Fixtures shall bear manufacturer's name and the factory inspection label.

h. Fixtures shall be completely wired and constructed to comply with the IEE wiring regulations requirements for lighting fixtures, unless otherwise specified.

i. Revamping the fixture shall be possible without having to remove the fixture from its place.

j. Lamps of the proper type, wattage and voltage rating shall be furnished and installed in each fixture.

8.5.9 INSTALLATION

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

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

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

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

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

8.5.10 LAMPS-GENERAL

LED will be used

Lamp shall be supplied and installed in all lighting fixtures listed in the BOQ.

Lamp shall be the part of Fitting no extra Payment will be made

Lamps used for temporary lighting service shall not be used in the final fixture units.

Lamps shall be of wattage and type as shown in the BOQ.

Lamps for permanent installation shall not be placed in the fixtures, until so directed by the Engineer In-charge.

8.5.11 FIXTURE SAMPLES

Detailed catalogue for all fixtures or if so required by the HSCC Electrical Engineer sample fixtures shall be submitted for prior approval of the HSCC Electrical Engineer before orders for the fixtures are placed.

8.5.12 TESTING

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

All non-operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer In-charge.

8.5.13 CEILING FANS

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

8.5.14 EXHAUST FANS

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

9.00 TELEPHONE SYSTEM

9.1 Telephone point wiring

(a) The point wiring shall be carried out with two pair telephone wire/cable, unarmoured, PVC insulated, 0.61 mm dia annealed tinned copper conductor (IS: 2532-1965)in suitable size conduit (one pair always remaining spare for one point)

Minimum Diameter of Conduit for Internal/External Telephone Wiring - 20mm.

If more than one telephone point has to be provided at one point, multicore, unarmoured telephone cable shall be used (pairs required are equal to 2 No.of points) in suitable size of conduit.

(b) The point shall commence from the main telephone tag box/sub tag box and would terminate at outlet box of point. Connection at both ends included in point wiring.

(c) Fixing of conduit, conduit accessories draw out boxes and outlet box etc. in concealed/surface conduit works as that of wiring for light fixtures shall be applicable for telephone wiring conduit system also.

(d) Joint in telephone wiring (between main tag box/sub tag box and outlet box of point) shall not be allowed and the contractor should bear the wastages of wire if resulted due to this special requirement of telephone system.

(e) External/Internal telephone and intercom wiring can be drawn in the same conduit, provided after drawing wires, 50% of conduit cross sectional area is free. However, independent PVC insulated telephone wire of suitable pairs shall be used for external, internal and intercom.

(f) To identify each pair of multipair telephone wire/cable, PVC indication numbers shall be put on both ends of pair just before termination.

10.02 Telephone Tag Boxes

These shall be of MS sheet 2 mm thick with connector suitable for telephone connection (as approved by ITI). It shall have hinged MS sheet cover.

9.2 EPABX SYSTEM

10.2.1.1Scope:

This specification covers the design, manufacture, testing and supply of digital Electronic Private Automatic Branch Exchange (EPABX), Telephone Sets, MDF, Back-up Power supply system, Voice Mail System etc.

10.2.1.2 Code and Standards:

The telephone system and the components shall conform to the latest edition of the "The International Telegraph and Telephone Consultative Committee (CCITT)" and other Indian and International standards as applicable.

9.2.1.3 Site Condition:

All the equipments shall be designed and tropicalised to withstand the site conditions as specified in the schedule of quantities.

9.2.1.4 Technical Requirements

Calling line identification display on all extension (external line as well as intercom)

In built SMDR (Minimum1500calls)

In built USB port for programming on system /CPU

Memory backup based on SD card with at least 5 years duration

At least 2 in built ports for external music source connectivity

Power voltage Ac 100v-240v

In built interface for connecting optional External battery bank-36v(12vx3)

AUTO ATTENDENT-04 CHANNEL

In skin, of same brand as EPABX. Expandable to 08/12 channels

UPS Suitable for above configuration or optional External Battery bank-36 v(12x3)

System should be-

100% non –blocking Digital Hybrid IP PBX employing PCM/TDM principles

Based on universal Slot Architecture

Capable of supporting connection of additional Digital phone from another digital phone without need for any other adaptor or hardware

Supporting optional CLI on analogue P&T line

Supporting optional multiple 4 channel DISA cards

Supporting ISDN BRI (4line & 8 line) and PLI

Supporting optional IP Gateway/ Extension card

Supporting optional CTI card

Supporting Floating extension

Supporting major networking protocols such as FXO, FXS , E &M (8 channel), E1 & QSIG (PRI/ BRI)

Supporting Background music on Key Telephone

Supporting Background music on Key Telephone

Supporting 3 to * party conference supporting unattended conference.

Supporting 32 party broadcast feature

Supporting internal and external paging interface with different paging groups

Supporting multiple call hop forwarding facility

Supporting off hook Call Announcement on high end Digital Key phone

Supporting the facility of DISA, DDSA, external call forwarding, Trunk –to –Trunk Transfer and walking class of service

Supporting voice calling on intercom

Supporting Boss Secretary function

Supporting direct connectivity or Digital extension port

Supporting CTI

Supporting call budget management

Supporting CLI based routing

Supporting Mobile Integration

Absent message capability in – built
Speed Dial- At least 1000 on system and 10 per extension

Should have extension personal Identification Number (PIN)/ password- up to 10 digits per extension

Should give call log of at least 10 outgoing numbers and 100 incoming numbers per key phone extensions

Having Message/ Ringer Lamp on Digital phone (dual colour) to indicate the following distinct status on High Mid Key phone:

i. Internal call

ii. External Call

iii. Message

10.2.1.5 Main Distribution Frame (MDF)

A Krone MDF mounted in sheet steel enclosure shall be supplied along with the exchange. I.P.M. shall be provided in the MDF for all junction lines and external one. All cables coming from field will be terminated on the MDF.

9.2.1.6 Operator's Console

The operator's console shall be digital, desk top type, compact in design and electronic based. Electronics switching shall be used to make various connections, cord connections shall not be accepted. The operator console should work on single pair. Status of all the analog extensions and digital extensions shall be indicated on LED display. Suitable Add on module shall be provided for this.

9.2.1.7 The console shall provide the following facilities:

i) Answering an incoming call
Operator can answer an incoming call, whether from an internal extension or from External Junction line.

ii) Call Waiting
An unattended call waiting for more than a predetermined time shall automatically go to standby operator.

iii) Setting up External calls
It shall be possible for an operator to set up external calls.

iv) Automatic Recall

Incoming calls will be automatically returned to the operator if the called extension does not answer within a predetermined time or called extension is busy.

10.0 ADDRESSABLE FIRE DETECTION AND ALARM SYSTEM

10.1 GENERAL

The Contractor shall supply and install the Addressable Fire Detection & Alarm System as per schedule of quantities are as herein specified. The system shall include Addressable Main Fire Alarm Control Panel, battery charger, batteries, addressable heat detectors, addressable smoke detectors, manual fire alarm station, fire alarm bells/hooters, response indicators, conduiting, wiring and all necessary accessories required to complete fire alarm system installation as per IS: 2189-1988. Equipment like control panel, smoke detector, heat detectors etc shall be UL approved or as specified in BOQ.

10.2 FEATURES

The system shall be general alarm electrically supervised type activation of manual fire alarm station or any of the automatic alarm initiating devices shall sound the general alarm bells on all floors and shall give indication on the control panel. The signal shall be continuous unit the station from which it is originated is restored to normal and a reset button on the control unit is operated.

The system shall be electrically supervised against open and ground on both the stations and signal device wiring. Open and ground in the system shall cause a trouble bell to ring at the fire alarm control panel and a trouble lamp to light. It shall be possible to silence the bell but the lamp shall remain lit until the fault is rectified. Incase of power failure the system shall automatically changeover to the battery standby.

10.3 CONDUITING & WIRING

Conduiting & Wiring for FDA system shall be carried out in M.S Conduit with copper conductor PVC insulated wires.

10.4 CONTROL PANEL

The fire control panel has to be addressable type.

The Main Fire Control Panel shall be constructed to sheet steel of red colour, and provided with windows for the alarm and trouble lights. All components shall be of the plug in type, for simple replacement and extension in the future. Control panel shall be wall mounting type conforming to IS 513-1986.

The number of loops is mentioned in B.O.Q. Each loop shall be able to support at least 128 any device addressable analog/digital (as the case may be) sensors and control module etc or as specified in BOQ. The control panel shall have alphanumeric display. The Main Fire control panel shall be provided with all necessary relays, resistors, fuses, transformers, rectifiers and all other components to assure full and proper functioning of the system. All relays shall conform to the relevant IS Standards. Control panel shall include power include power on lamps, system trouble lamps, audible trouble signal, trouble silence switch with ring back, alarm silence push button with repeat alarm capability, low battery indicator with reset, ground detection indicator,

alarm reset, milli ammeter, supervised alarm lamps, zone "Open" test pushbutton, zone alarm test push button, end of line resistors etc.

Each zone shall be equipped with an auxiliary contact for control of a remote annunciation.

Main control panel shall include a power supply model to provide a filtered and regulated source of power to provide additional power wherever supplementary power is required within the system. It shall include an output fuse, key reset switch, provision for automatic transfer to standby power upon primary power failure.

Main control panel shall in addition have audible signal and lamp to indicate as failure of the charge of battery.

Two stages general Alarm shall be provided in which a continuous evacuation alarm is immediately given in zone of fire and its adjoining zones. In other zone intermittent alarm signal shall be provided as per IS 2189-1988.

Repeater Panel shall be of same specification as main control panel and shall have fire/fault indication with audio device.

10.5 CHARGER AND BATTERY

Unit shall comprise a ventilated cabinet supplied complete with charger, meters, high rate charge switch and lock and key in a sheet metal enclosure.

10. 6 ELECTRONIC HOOTERS

Hooter shall be electronic solid-state speaker type having tone for fire, which shall be wailing. Hooter should be loop powered having an output of approximately 6 watt. The audible range shall be around 100m under normal condition. Cable for this in our system shall be 2 cores. The switching shall be provided on the control panel. The outer enclosure of the speaker shall be of MS sheet and shall be suitably oven baked and painted. The speaker shall be 4" heavy magnet type. All hooters shall be on one or more circuits.

10.7 MANUAL ALARM CALL POINT FOR SURROUNDINGS (ADDRESSABLE)

The manual call point shall be electrically compatible with the standard range of automatic detectors so that it can be connected directly into a supervised two-wire zone of the manufacturer's standard range of control units. The manual call point shall be of pleasant, streamlined and flat appearance permitting its use as flush and surface mounted unit. The manual call point shall consist of base plate, insert and cover. The push button shall have minimum one normally closed plus one normally open contacts. The push button shall not be shrouded and the same shall be projected out from the surface of the MS Box. The whole assembly of push button shall be enclosed in the 16 SWG MS Box except from the front side. The front side shall be sealed with breakable glass covering neoprene or equivalent gasket. The glass cover shall be fixed in such a way that the actuating push button is kept depressed (with NC contact open) so long as the glass cover is in contact. In case of fire, when the glass cover is broken to give the fire warning the push button shall be released due the spring action hence giving remote fire alarm through the NC contact. The breaking of the glass must release an alarm. All inscriptions,

texts and marks must be on the manual call point front plate, not on the glass, so that the glass can easily be replaced anywhere. The alarm contacts shall be of self-cleaning design to prevent failure after a prolonged period of inactivity in unclean environments.

It shall be possible to test the call point without destroying the seal or removing the cover. The manual call point shall be equipped with a self-holding device to maintain the alarm condition until reset by an authorized person. The complete unit and the push button shall be painted signal Red. The internal surface of the MS enclosure of the box shall painted white colour. The external painting shall be of synthetic enameled paint. Aluminium hammer shall be suspended on a hook fixed to the external MS enclosure by means of a non-corrodible easy breaking of the glass cover.

Manual alarm call point located on the outer walls of the building and/or exposed to weather conditions shall be weather proof type and satisfying the requirement of APB.

10.8 OPTICAL (PHOTOELECTRIC) TYPE SMOKE DETECTORS (ADDRESSABLE TYPE)

The optical type smoke detectors shall be based on light attenuation by smoke/ or light scattering by smoke particles. Smoke detectors shall have an inherently stable sensor with built-in automatic compensation for changes in ambient conditions. All electronic circuits must be solid-state devices and virtually hermetically sealed to prevent their operation from being impaired by dust, dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts or components subject to wear. The response sensitivity of each detector shall be factory set. A built-in barrier shall prevent entry of insects into the sensor. The detector shall be designed for fast and simple laboratory cleaning.

The detector shall be inserted into or removed from the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance. The manufacturer shall produce and provide test equipment allowing to test and exchange smoke detectors upto 7m (23ft) above floor level. The detector shall connect to the control unit via a fully supervised two-wire circuit.

The detector shall be capable of being remotely tested from control panel.

10.9 HEAT DETECTOR (ADDRESSABLE TYPE)

Heat detector shall be combined rate of rise and fixed temperature type. Heat detectors shall consist of two independent thermistors, designed to automatically compensate virtually hermetically sealed to prevent their operation from being impaired by dust, dirt of humidity. All circuitry must be protected against usual electrical transients and protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts or components subject to wear. It shall be possible to test the detector in the field. The response (activation) of a detector shall be clearly visible from the outside by a flashing light of sufficient brightness. The e detector shall be installed into the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance. The detector shall connect to the control unit via a fully supervised two-wire circuit.

The manufacturer shall produce land provide test equipment allowing to test and exchange rate-of rise/fixed temperature hear detectors up to 7m (23ft) above floor level.

10.10 PLUG-IN BASES

The smoke & heat detectors shall fit into a common type of standard base. Once a bases has been installed, it shall be possible to insert, remove and exchange different types of detectors by a simple push-twist movement. The standard base shall be equipped with crewels wiring terminals capable of securing wire sizes upto formation and weakening of contact pressure. The standard base shall be supplied with a sealing plate, preventing dirt, dust, condensation or water from the conduit reaching the wire terminals or the detector contact points. All standard bases shall be supplied with a removable dust cover to protect the contact area during installation and construction phase of the building. It must allow the check out and certification of the zone wiring before insertion of any detectors. The standard base shall feature a built-in mechanism, which allows mechanical locking of as installed detector head, thus preventing unauthorized removal or tempering while maintaining.

The detector contact points shall be designed to retain the detector safely and to ensure uninterrupted contact also when exposed to continuous severe vibration. All electronic components of base and modules must be solid state and virtually hermetically sealed to prevent their operation from being impaired by but, dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The standard base shall allow snap-on insertion of an (optional) electronic module, it shall be possible to turn a standard base part into an individually addressable detector base with its own unique identification address at the control unit. The standard base shall have a built in alarm indicator which is repeatable by connecting a simple 2 core wire to the base. No changes in the zone wiring shall e required to operate the additional alarm indicator. Removal and insertion of dust covers or detectors shall be feasible by a simple push twist movement, even if the locking device has been activates. Special base assemblies shall be available for use in air ducts and aspiration air-sampling system wherever required.

Contractor is required to submit samples and get approved from HSCC Electrical Engineer of all above mentioned items including Response Indicators, Hooters, manual call points.

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11.0 NURSE CALL SYSTEMS & AND COMMUNICATION SYSTEM

11.01 NURSE CALL SYSTEM

Nurse Call System shall be designed for patient in the Hospital to call for assistance in case of emergency and reduce the critical time for receiving medical attention by pressing a button which shall belocated on the bed side of the patient

General Information:

The complete system must satisfy the criteria of the standards UL/ VDE0834 part 1 and part 2 in full that apply for call systems and all other standards and regulations mentioned therein. **As proof of this, the issuing party must supply on request a valid certificate obtained from an independent and accredited testing centre**.

11.02 General System Characteristics

11.02.1 Applicable standards:

The system components, functional procedures and data relevant for ensuring the security of the entire system must all conform to the relevant applicable regulations and standards:

- VDE 0834 – Call systems in hospitals, care homes and similar establishments, valid from 1 April 2000
- DIN-VDE 0834 / Part 1 – Device specifications, installation and operation, valid from 1 April 2000
- DIN-VDE 0834 / Part 2 – Environmental conditions and electromagnetic compatibility, valid from 1 April 2000
- Provision of electricity in accordance with EN60950, EN61000-4-2 to -4-6 as well as EN61000-3-2 and EN55011 (Class B), Discharge current and isolation voltage in accordance with EN60601-1 (DIN750 part 1)
- UL approved

as well as all standards and regulations referred to in these standards.

11.02.2 System architecture

Superordinate and/or centralised controller devices are not permitted for safety reasons. In the event of a system component failing, all other system components and functions must remain available in their entirety.

The network must guarantee a data transfer rate of 100Mb/s to end devices when a conventional network topology is used. **Data packets must be prioritised to ensure the safe and rapid transfer of critical data e.g. call or alarm messages.**

11.02.3 Centralised configuration

In the event that system extensions or modifications are made, the entire system must not need to be reconfigured in full, and **software and firmware upgrades must be carried out in a centralised manner over the network.**

11.02.4 Remote Maintenance

It must also be possible to set up remote maintenance access from the system server, which allows the manufacturer to carry out various services in agreement with the system operator:

- Modification of configuration of individual system components;
- Modification of configuration of the entire system;
- Execution of software updates as far as the individual system devices;
- Downloading of various log files for evaluation in the event of a fault;
- Checking for system faults and failures within the system.

11.02.5 Automatic Software Upload

If, during system operation, it becomes necessary to replace a system module, then this must be automatically detected by the permanently connected system server. The relevant firmware, software and configuration data are then automatically sent to the module and saved there.

11.02.6 Autarchic Computer systems

All system devices must, as necessity dictates, be equipped with autarchically functioning computer systems and software for the entire scope of functions. All speech connections must also be established autarchically. The required storage media must use FlashProm technology, which allows a software upgrade to be made during operation.

11.02.7 Enhanced Device Intelligence

12.02.7.1 Communications and patient terminals should be equipped for receiving up to 32 audio streams (e.g. radio programmes or in-house programmes). Furthermore, every system switch should contain an interface to an external TV device, which can be assigned to a specific room via the configuration.

11.02.7.2 Faults or failures which may occur must be automatically recognised by this technological platform, and indicated and automatically forwarded.

11.02.8 Indicator Displays and Membrane Keypads

11.02.8.1 Communications terminals, staff terminals and ward terminals must be equipped with a graphic display for plain text indication of the call area (ward), call location and type of call. Plain texts and various indicating signals as operator hints should be used for optimizing the functional process.

11.02.8.2 All system devices must be fitted with membrane keypads for hygiene reasons or to permit simple cleaning. Patient terminals must be supplied in a splash resistant version.

11.02.9 Patient terminal plug connection

The plug and socket connections between the patient terminal and the accompanying connection sockets in the wall or in the media duct must be done in such a way, that the plug is automatically released regardless of which direction the cable is pulled in. Neither the plugs, nor the plug sockets nor any other components should sustain any form of damage in the process. The disconnection of the plug and socket connection must be automatically recognised by the system, and a relevant message to be sent.

11.02.10 Surfaces of plastic components and membrane keypads

The membrane keypads of the communications terminals and the patient terminals as well as the plastic case of the patient terminal must be fitted with anti-microbial surfaces. Antimicrobial surfaces reduce the risk of an outbreak of infections transmitted by contact with the surfaces of the unit. This preventive measure increased hygiene conditions and minimises the spread of infections.

11.02.11 Self-monitoring

Constant self-monitoring of all the components in the system as well as constant self-monitoring of all data and call circuitsensures that failures or faults are automatically detected. At the same time, fault indications are generated automatically and safety functions carried out.

11.03 Integration with Other Systems

There should be possibility to integrate nurse call system with other system like fire alarm, EPBAX, HIS etc.

11.04.0 Functional Requirements

The system to be deployed must be able to contain the following functions, which must be realised without used superordinated controllers.

11.04.1 The server connected to the nurse call network must automatically recognise the system components that are connected such as system switches, patient, and communications and ward terminals as well as all connected call and cancellation buttons

11.04.2 System devices must communicate with one another via the network and make the relevant functional decisions autarchically.

11.04.3 Light signals, call signs and intervals between signals etc. must conform to the currently applicable VDE standards. In the explanation of functions and system parts, the terms mentioned therein are to be observed.

11.04.4 Presence marking – Green Color

11.04.4.1Rooms where members of the nursing staff are present are to be indicated using light signals in the corridor and at the location of the query. The marking must be carried out by using presence keys on the communications terminal. These presences are to be indicated by the presence key pressed being permanently lit, in the accompanying room signal lights in the relevant colour on the corridor on the ward terminal and on the control panel.

11.04.4.2 By pressing the presence buttons, calls and reminders are also cancelled and emergency calls, doctor calls, calls forwarded and secondary queries initiated by the same process.

11.04.5 Call types and priorities:

All types of calls are ranked according to priority within the entire system. The ranking is based on the wishes of the customer, and it must be possible to change this order at any time using the system configuration.

11.05.0 Switches:

11.05.1 Management Server

For uploading the firmware and the system configuration, for operating interfaces to foreign systems, for logging of all system events and as a central location for system configuration and remote maintenance and is an interface to all other foreign systems.CPU: Intel Xeon Dual core 2.3 GHz
RAM: 4GB DDR2-800
1xSATA HDD 300 GB
2xPCI
2x1GB LAN
Supply voltage: 115/230 VAC
Operating system: Linux (SUSE Server 10.x)
Electrical safety conforming to EN 60950-1Software

11.05.2 Event Data Base Recording Software

Software pack installed on the system server for automatically logging all eventsin the entire communications system, such as, e.g., calls, presence markings,call acknowledgements, reminders.

11.05.2.1 Software for integration with IPBX system

This interface used Voice over IP technology in accordance with the standard H.323 or SIP and is used for telecommunications between the patient terminals and the public telephone network as well as to other in-house extensions.

11.05.3 Backbone Switch

This switch is used to connect the system server to the communications network, for connecting all the other servers and foreign systems to be connected to the network, which exchange data with the network via an IP interface. Furthermore, backbone switches are also to be used for bridging large distances between the individual servers, foreign systems and peripheral modules. General requirements for all the types should be as per manufacturer recommendation and it should be minimum Layer 3 Switch with DTP and VLAN trunking layer 2 protocol.

11.05.4 System Switch

The system switch forms a decentralised communications node for exchanging data between the connected system devices and the rest of the communications system, must be equipped for redundant operation, and is supplied with 24V DC by the ward power supply. It contains both a row of IP ports for connecting IP capable end devices, as well as a connection for another data bus for all other system modules. Furthermore, the system switch acts as the data and audio interface to a room TV device and is fitted in a shielded metal case for surface mounting in the distribution case or in a false ceiling.
This system switch may not contain any moving parts and must not contain a ventilator fan.
consisting of,

- Metal case
- RJ45 socket, IP Port galvanically isolated conforming to EN 60950 and VDE 0834, UL;
- RJ45 sockets, each for a IP system port for connecting all IP capablesystem modules;
- RJ45 socket, IP Port for connecting communications, staff and ward terminals as well as control panel PCs;or for redundant use as listed above;
- Control LEDs for indicating the current operating state
- RJ45 sockets for connection of the external data bus
- All IP system modules are supplied with power usingPower over LAN technology
- 2 screw-type terminals for connecting the 24V DC supply voltage;

11.06.0 Nurse Call Components:

11.06.1 Nurse Station Terminal:

For use as a communications and information centre within a ward and for use in the relevant staff area or Nurse Stations.
Range of functions:

- Minimum 6” touch screen large LC display with 2way speech facility, inbuilt speaker, microphone.
- Displays date and time
- Permanent indication of the quantity of calls,reminders and occurring faults, outstanding at the time
- Displays all presences that are marked, depending on staff category listed on a desk (in the corresponding colours in accordance with VDE 0834/ UL and witha unique symbol),

- Displays all calls with their relevant colours inaccordance with VDE 0834/ UL and clear symbols foreach type of call,
- all call indications are automatically shown inaccordance with the priorities for indication which are stored in the system, starting with the highest priority call:
- The following information must be able to be imparted in this case: the exact type of call with information about the bed number or WC call, doctor call etc. the exact call location with information about theindividual room name and the care group to which.
- It might have been assigned to, for calls across more than one ward the relevant ward name must also be indicated
- Emergency calls must always be shown flashing,
- Colour graphic LC display, fordisplaying all details describe
- integrated SIP VOIP telephone
- a smash-resistant glass panel placed in front of the display,
- Microphone and loudspeaker for hands-free speaking(incl. volume adjustment),

11.06.2 Connection module for Nurse Station Terminal& Patient Handset with Speech

For installation in a double switchbox or in a media duct, both for connecting for connecting nurse station terminals; consisting of:

- Mounting rail,
- Connection circuit board with an RJ45 socket for theuplink from the system switch,
- RJ45 socket marked in colour and with measuresto ensure that the patient terminal is correctly connected, including the mechanical parts required for the auto disconnect mechanism,
- RJ45 for connecting a laptop belonging to thepatient: The patient thereby has access to the WWWvia the system's Internet server.
- DIN socket for connecting a diagnosticdevice

Fastening frame made of plastic for attaching theconnection module without needing screws

11.06.3 Patient Handset with Speech

Patient Handset with speech for communications, consist of:

- Splash resistant case

– Call button with nurse symbol with integrated finderand reassurance light

– Loudspeaker, microphone, headphones socket,

- Integrated contact-free smart card reader,

- Mechanism for inserting a smart card,

- Controlling 2 independent lighting circuits,

- Plastic case and membrane keypad in anti-microbial material,

11.06.4 Patient Handset push button type: Without Speech

It should consist of a plastic case in antimicrobial finish

- Call button with nurse symbol with integrated finder and reassurance light on the top end of the unit,
- Membrane keypad in antimicrobial finish with integrated LEDS for operation, consisting of:
  - 1 call key with
  - 2 lighting keys
- 2.80 metre connection cable with **auto-disconnecting** RJ45 connector plug,

11.06.5 Connection module with Call / Cancel Buttons: Patient bed Head Unit for non-speech

For installation in a double switchbox or in a media duct for connecting a patient handset and a diagnostic device, can also act as a Room controller comprising of:

- Mounting rail
- controller circuit board with flash prom with
- RJ45 sockets connecting the data circuits
- RJ12 sockets for connecting the external buttons mentioned in 7.6
- RJ45 socket with measures to ensure that the Patient handset is correctly connected, including the mechanical parts required for the auto disconnect mechanism,
- DIN socket for connecting a diagnosticdevice with disconnection call. The connection moduleautomatically recognises the external device that is connected using this socket and automatically triggers the relevant call in the event of an alarm.
- 1 membrane keypad with:
  - 1 call button (red with nurse symbol) includinga finder/reassurance light,
  - 1 presence key (green) including a control LED,
- Fastening frame made of plastic for attaching thecontrol module without using screws

11.06.6 Pull Cord Button – For Bath area

For installation in a switchbox, consisting of, mounting rail with circuit board, on which there are the functional and monitoring electronic circuits with:

- integrated finder lights or reassurance light
- 1 presence key (green) including control LED,
- micro switch a 2 metre pull cord and aluminous grip with a nurse symbol printed on it,
- RJ12 socket for connecting the data circuits;
- With a plastic cover
- Including installation frame for screwlessattachment on an installation case.
- Pull cord characteristics:
  - Max. force at break: 120N (ca. 12 kg)
  - for hygiene reasons it must also be possible to change the pull cord very easily using a snap hook;

11.06.7 Connection interface to the external monitor via DVI/ HDMI port

This interface displays text messages of nurse call system on standard computer monitors/ LCD/ LED screen. The module shall provide 2 inputs DVI or HDMI to connect any 3rd party LCD/LED screen to display nurse call indication along with dedicated nurse station for easy viewing by nursing staff.

11.06.8 Light module

For optical indication of calls, presences and reminders in the relevant colours conforming to VDE0834 and suitable for fitting on to an installation case, consisting of:

- 5 light chambers with light reflectors for homogeneous illumination
- 1 light chamber fitted with 3 ultra-bright red LEDs,
- 1 light chamber fitted with 3 ultra-bright white LEDs,
- 1 light chamber fitted with 3 ultra-bright green LEDs,
- 1 light chamber fitted with 3 ultra-bright blue LEDs,
- 1 light chamber fitted with 3 ultra-bright yellow LEDs,
- Every light chamber conforms to the light strengthset out by VDE0834,
- the LED life expectancy is approximately100,000 operating hours,
- Opal-coloured, translucent lamp cap

Room terminal – For Single Bed Rooms

For installation in all important rooms in the ward in which the possibility to communicate is required or desired, with integrated functional components and operating membrane keypad with coloured fields, LC display and symbols;
consisting of:
Membrane keypad for operation, comprising of:

- Call button (red with nurse symbol) with integrated finder and reassurance light
- Doctor call button (blue with doctor call symbol) with integrated reassurance light,
- Presence button (green) with control LED,
- Presence button (blue for the doctor) with control LED,
- LC Display
- Room terminal shall display the nurse call from other rooms/ patients, in case nurse acknowledge the call from room terminal.

Doctor Call & Cancel Button with sounder - for Wards

It shall consist of:

- 1 doctor call button (Blue) with a finder light
- 1 cancel button
- Integrated piezo buzzer

12.0 LIFT INSTALLATION

12.1 The scope of work shall cover design, supply delivery, installation, testing and commissioning of passenger lifts/bed lifts. The scope of work shall also include the following item of civil works.

a) Necessary scaffolding temporary barricade in the hoistway required during the erection of the elevators.

b) Minor building work comprising of cutting holes and making good the car and counterweight rail brackets, hall buttons and indicators including laying of sills in position.

c) Steel items such as machine beams, bearing plates buffer support channels, sill angles and fascia plates etc.

d) Suitable trap doors with steel chequered plate covers.

e) Providing and install a suitable vertical iron ladder for access to the pit.

f) Any other item required for successful completion and commissioning of lifts. (including the hoisting beam in the machine room)

12.2 The work shall be done in accordance with regulations of any local code and following ISI codes which govern the requirements of installations.

IS: 1860-1980 code of practice for installation, operation and maintenance of Electric Passenger and Goods Lifts.

IS: 3534-1976 Outline dimensions of Electric Lifts.

IS: 4666-1980 Specifications for Electric passenger and Goods Elevators.

Indian Electricity Act 2003.

Indian Electricity Rules, 1956.

Delhi Lifts Rules, 1942.

NBC-Part-B – Building service section-2 Electrical allied installation.

NBC-2016 part-4 Fire & safety

12.3 SHOP DRAWINGS AND APPROVAL OF ELECTRICAL INSTALLATIONS :

The selected tenderer shall prepare a furnish shop drawings for approval by The Client, such shop drawings shall be based on the Architectural drawings and requirements laid down in specifications, local laws and regulations etc.

The detailed drawings shall be submitted within one month of placement of order. The successful tenderer shall obtain the approval of electrical Inspector and other local authorities as per

requirements before submitting the drawings to Client/ Engineer. The contractor shall not proceed with in installation work till the drawings are approved by the Engineer-in-Charge. Expenses incurred such as license fee etc. towards obtaining the approval of Electrical Inspector, local authority shall be reimbursed to the contractor as per actual on production of documentary proof.

Approval of contractor's drawings shall not absolve the contractor of any of his obligations to meet the requirements of specification under this contract

Five sets of completion drawings operation manual, maintenance manual, spare parts details shall be submitted to the Client/ Engineer after completion of work.

12.4 GUARANTEE

The tenderer shall guarantee the equipment against all defects of materials and workmanship for a period of one year from the date of commissioning of the equipment as certified by the owner. Any defects arising during the guarantee period shall be rectified and replaced by the tenderer, at his own expense, to the satisfaction of the owner.

12.5 PERMITS, INSPECTION & LICENSE FEE

The contractor shall arrange all necessary local, provincial or national government permit and shall make arrangements for inspection and tests required thereby. Expenses to be borne by purchaser.

12.6 MAINTENANCE

After the completion of the installation and handling over of each elevator by the elevator contractor, DLP for the equipment furnished shall be provided for a period of twelve (12) months. This service shall include regular examination of the installation by trained employees, and shall include all necessary adjustments, greasing oiling, cleaning supplies and genuine standard parts to keep the equipment in proper operation, except any parts made necessary by misuse, accident or neglect caused by other. Contractor shall provide 24 hours Emergency local call back service facility and shall furnish full details of such facilities available.

12.7 POWER SUPPLY

The apparatus shall be designed to operate on 415 + 10% - 20% Volts, 3 Phase, 4 wires, 50 Hz A.C. Supply for illumination signal equipment shall be 240 Volts single phase 50Hz A.C..

12.8 ELECTRICAL WIRING

The necessary A.C. supply of 3 Phase, 415 Volts 50 HZ shall be made available in the main control switch unit to be provided by the contractor in the machine room. All the electrical works beyond the main supply switch shall be carried out by the contractor i.e. supply and installations of panels for drive motors, switches and control complete with wiring as per system requirement and approval of the Engineer.

The wiring shall be carried out strictly in accordance with Indian Electricity Rules and Indian code of Practice for Electrical Wiring Installation IS-732-1963 System Voltage not exceeding 650 V). For works not covered under any of the above wiring rules, the 13th edition of Electrical

Engineers (Condense) shall apply. The cable and conduits to be used shall be of suitable size and grade conforming to relevant IS specification. Wiring for LT switchboard to the motor terminal shall be with heavy duty 1.1 KV grade PVC insulated PVC sheathed, FRLS aluminium cable. All the trailing cables used for control and safety device shall conform to IS: 4289-1967, Specifications for lifts cables. The trailing cable circuits for controls, safety devices, lighting and signaling shall be separate and distinct.

Power wiring between controller and main board to various landings shall be drawn in suitable size heavy gauge conduit stove enameled/painted conforming to I.S specifications.

The Voltage and frequency of the supply shall be subjected to variations permissible under Indian Electricity Acts and Rules.

12.9 PARTICULAR SPECIFICATIONS

12.9.1 TYPE : Bed Lifts/Passenger Lifts.

12.9.2 NO. OF ELEVATORS : As Per Bill of Quantities.

12.9.3 CAPACITY : As Per Bill of Quantities.

12.9.4 SPEED : As Per Bill of Quantities.

12.9.5 FLOORS SERVED/RISE : As Per Bill of Quantities.

12.9.6 STOP : As Per Bill of Quantities.

12.9.7 OPENINGS : (All Openings on same side).
As Per Bill of Quantities.

12.9.8 OPERATION : Duplex/Simplex Collective as per BOQ.

12.9.9 CAR FRAME:

The car frame, which supports the car platform and enclosures, shall be made of structural steel and equipped with suitable guides and a car safety device mounted underneath the car platform. The hoist ropes shall include adjustable self/ aligning hinges. The car shall be so mounted on the frame that vibration and noise transmitted to the passenger is minimized.

12.9.10 CAR SAFETY AND GOVERNER :

Suitable car safety to stop the car whenever excessive descending speed is attained shall be operated by a centrifugal speed governor connected to the governor through a continuous steel rope.

The governor shall be provided with self tensioning device to keep governor rope in proper tension even after rope stretch. Suitable means shall be supplied to cut off power from the motor and apply the brake on application of the safety.

12.9.11 COUNTER BALANCE :

A Suitable guided structural steel frame with appropriate filler weights of cast iron shall be furnished to promote smooth and economic operation.

12.9.12 TERMINAL AND FINAL LIMITS :

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landings within permissible over travel and final limit switches shall be provided to automatically cut off the power and apply the brake, should the car travel beyond the permissible over travel. They shall act independently of the operating devices and buffers.

12.9.13 TERMINAL BUFFERS :

Heavy duty spring buffers shall be installed as a means of stopping the car and counterweight at the extreme limits of travel. Buffers in the pit shall be mounted on steel channels which shall extend between both the car and counterweight rails. Clearance between pit floor and buffer striker will be as per BIS norms.

12.9.14 CONTROLLER :

A Controller shall be provided to control starting stopping and speed of the elevator motor and also be automatically able to apply the brake if any of the safety devices operate or if power fails from any cause. In case of power failure and again restore of power the lift shall land to next floor and shall not go to basement/lowest level. Suitable software/hardware or rescue device shall be provided.

12.9.15 REVERSE PHASE RELAY :

A reverse phase relay shall be provided on the controller which is designed to protect the lift equipment against phase reversal and phase failure.

12.9.16 GUIDES :

Machined steel tee guides shall be furnished for the car and counterweight. The guide rails should be of steel solid and shall have tongued and grooved joints. Sliding clips shall be used for fastening the guides to allow building settlement without distorting the guide rails. To keep down the noise level and to reduce wear and tear of the sections, only Nylon Ribs shall be used in the guide shoes, after smoothening of the rails. The flanges shall be machined for the fish plate mounting such that rail alignment at joints almost remain constant.

12.9.17 FOUNDATIONS :

The machine shall be placed directly above the hoistway upon the machine room slab provided by the Owner.

12.9.18 ROPES :

The elevator shall be provided with traction steel ropes. Steel wire rope having a tensile strength of not less that 12.5 Ton/cm2 of good flexibility shall be used for lift. The lift rope shall conform to IS: 14665 – (Part-4- Sec-8):2001.

12.9.19 MACHINE :

The Gearless machine shall be of the single wrap traction type and shall include a motor, electromechanical brake, steel worm, bronze gear, gear less or as per manufacture standard ,steel sheave shaft and Farrow-Molybdenum sheave all compactly mounted on a single base or bed plate. The worm shaft shall be provided with ball bearings to take the end trust and roller bearings shall be furnished for the sheave shaft to ensure alignment and ling bearing life. The driving sheave shall be grooves to ensure sufficient traction and minimize rope wear. Shall be provided for all bearings and the worm gear.

12.9.20 BRAKE :

The direct current brake shall be spring applied and electrically released and designed to provide smooth stop under variable loads. The brake should be capable of operation automatically by various safety devices, current failure, and by normal stopping of car. It should be possible to release the brake manually, such releases brake manually, such releases requiring the permanent application of manual force so as to move the lift car in short sties. For this purpose one set of brake release equipment shall be supplied.

12.9.21 MOTOR :

The motor shall be suited to the service proposed and arranged for adequate lubrication. The motor shall be class F insulation and one (1) hour rated squirrel cage induction type having high starting torque. It shall also be provided with Thermisters embedded in the stator windings for the highest degree of thermal motor protection.

12.9.22 CONTROL

The control shall be variable voltage variable frequency A.C. variable voltage, closed loop control system using solid state devices and electronic speed pattern generator to command the motor from a velocity transducer and load compensation circuits for a comfortable ride.

In Normal operation, the electromagnetic brake shall only be applied when the lift has come to a complete standstill. The brake shall only be meant for holding the lift in position at every landing, providing stopping without any jerking effect.

Each controller cabinet containing memory equipment shall be properly shielded from the pollution.

MICROPROCESSOR

The control shall employ a microprocessor working on a program such that precision leveling and highly efficient handling of passengers for least possible waiting and reduced travel time is ensured. The microprocessor system should be designed to accept programming with minimum downtime. It should be able to monitor the state of input calls (such as car calls from COP and hall calls from hall fixtures) and output commands such as starting, decelerating and stopping the elevator. It should be able to generate floor location data, thereby, providing a reference position to establish the safety zones for door opening and closing, and also to initiate leveling slowdown.

12.9.23 DUPLEX COLLECTIVE OPERATION

The operation shall be duplex collective with/without attendant for each elevator and shall consist of the following:-

IN THE CAR

There shall be furnished a flush type attractively finished stainless steel panel which contains a series of luminous buttons numbered to correspond to the landings served, an emergency stop switch and an emergency call button connected to a bell which serves as an emergency signal.

AT HOISTWAY LANDINGS

There shall be provided an UP luminous push button and a DOWN luminous push button at each intermediate landing and a single button at the terminal landings.

The car shall not start unless the door is in the closed position and all hoistway doors are closed in the locked position.

If the car is idle and one or more car or landing buttons above the landing at which the car is standing are pressed, the car shall start in the UP direction and proceed to the highest landing for which any button is pressed and stops at intermediate landing for which a car button or up landing button is pressed sufficiently in advance of the car's arrival at such landings to permit these stops to be made. After each stop, the car shall proceed in the UP direction until it reaches the highest landing for which a call is registered. The car shall not stop on the UP trip at any landing in response to a DOWN call.

Similarly, if the car is idle and one or more car or landing buttons below the landing at which the car is standing are pressed, the car shall start in the DOWN direction, proceed to the lowest landing for which any button is pressed and stop at each intermediate landing for which a car button is pressed.

When the car is idle and a button for a landing above the car and a landing below the car are pressed, the car shall start towards the landing corresponding to the button pressed first. The call registered for the landing in the opposite direction from the car shall be answered after the car has responded to the farthest call in the direction established by the button pressed first.

A time relay shall hold the car for an adjustable interval of few seconds at the landings at which stops are made to enable passengers to enter or leave the car.

OPERATION WITH AN ATTENDANT

The regular car operating panel shall include buttons, switches, etc. for the collective-automatic control and shall also include.

A two-position key-operated switch marked to indicate ATT (attendant operation)

A buzzer: UP and DOWN direction light jewels and A non-stop button.

A car operating panel shall also include an UP and DOWN button.

When the key-switch is in the position of WITH ATTENDANT, the direction light and buzzer shall become operative and the UP and DOWN direction button in the regular car operating panel shall be made effective for the attendant operation.

When an attendant operation, the car and hoistway doors shall open automatically at each stop but the closing of the doors shall be subject to the UP or DOWN direction buttons. As a visual signal to the attendant, the UP and DOWN direction jewel shall illuminate upon registration of either car or landing calls to indicate the direction of the travel of the car. The attendant shall operate the elevator normally in the direction indicated by the direction jewel but, if desired, opposite direction travel may be realized by pressure of a car button for a landing in that direction from the car.

The pressure of a direction button shall cause the doors to close and the car to start in the direction desired, provided a call is registered for that direction. If pressure of the direction button is released before the car starts, the doors will re-open and car shall not travel. It shall so arrange the pressure on direction button can be released, once the car has started.

Continuous pressure of the nonstop button shall cause the car to by-pass all landing calls and respond only to registered car calls.

12. 9.24 CAR ENCLOSURES :

The car enclosures shall be of sheet steel and shall be of an elegant design comprising of the following :

a) Suspended ceiling with light diffuser Perspex ceiling and LED light.

b) Concealed pressure fan with grille in suspended ceiling. The lift shall have sensor so that the fan is operation only when if there is at least one person inside the lift.

c) Ceiling steel painted white.

d) Complete stainless steel car enclosure in plain finish for passenger and Bed Lifts

a) PVC flooring (with 3mm thick tiles of approved shade) for Bed Lifts
b) Mirror on one face (front face when we enter the car)

12.9.25 CAR DOOR

The car entrance shall be provided with stainless steel sliding doors in plain finish giving a clear opening of 1200mm wide by 2000mm high for bed lift. The lift car door shall have a fire resistance rating of one hour.

12.9.26 HOISTWAY DOORS :

At each landing, a center/ telescopic opening , stainless steel sliding door in plain finish giving a clear opening as per CPWD general specifications for electrical works –Part-III – Lifts & Escalators, shall be provided.

12.9.27 SIGNAL AND OPERATIVE FIXTURES :

The following signal and operative fixtures shall be provided for each lift in stainless steel face plates except in fireman's switch which shall have a glass face plate.

a) CAR OPERATING PANEL

There shall be one (1) No. panel in car, with hinged stainless steel face plate and shall comprise illuminated floor buttons, door open and emergency stop controls emergency call buttons, door open and emergency stop controls emergency call button, two position key operated switch, a Buzzer, UP and DOWN direction light panels, a non stop button, and an integral interphone. The jewels and accentuator shall be of modular construction, face plate mounted, rewired using snap on lugs.

b) HALL BUTTONS AND HALL POSITION INDICATOR

There shall be provided combined signal fixture (one riser) of compact design and of attractive hairline stainless steel face plate at the elevator entrance on each floor which for terminal landings shall have a single luminous push button and for intermediate landings shall have an UP luminous push button and a DOWN luminous push button. The jewels shall be of modular construction mounted on a stainless steel face plate. Whenever a button is pressed, the jewel shall light up to indicate registration of the call and shall remain enlighted till the car arrives.

c) CAR POSITION INDICATOR IN CAR

This shall be of compact design and of attractive hairline finish stainless steel face plate with easy to read digital display of the floors, indicating through which floor the elevator is passing or on which floor the elevator is stopped. This shall also incorporate illuminated arrows showing the direction of travel.

d) BATTERY OPERATED ALARM BELL AND EMERGENCY LIGHT

A solid state siren type alarm unit operated by 2 Nos. 9 volt rechargeable Nickel Cadmium batteries shall be provided which shall give a waxing and waning siren when alarm bell in the car is pressed momentarily.

An emergency light unit using a 9 volt dry battery power pack and incandescent lamp with stainless steel face plate shall be provided inside the car which shall operate automatically in the case of power failure.

e) OVERLOAD WARNING

Overload warning radars with audio-visual indication (visual indication shall show OVERLOADED) with stainless steel face plate shall be installed in the elevator car, so that when there is overload in the car the sign shall light up a flash indicating OVERLOADED and a buzzer

shall operate during this period and the doors shall remain open unit the overload is removed. Over load capacity will be 10% over and above the specified load capacity.

f) FIREMAN'S SWITCH

A toggle switch covered by a glass cover shall be provided on the ground floor for each elevator which shall permit a fireman to call the elevator to the ground floor by canceling all car and landing calls. The elevator shall then stop at the ground floor with the door open to permit the fireman to have exclusive use of the elevator without any interference from the landing calls.

g) INTERPHONE

Interphone shall have one master unit in each machine room, one master unit on the ground floor for each 1 (outside hoistway) and one slave unit in each elevator car.

12.9.28 ELECTRIC DOOR OPERATOR FOR CAR DOOR AND HOISTWAY DOOR :

An electric door operator for opening and closing the car door shall b e provided. The opening of a car and hoistway doors shall be such that the doors shall start opening meant for so that by the time the elevator stops completely, the elevator and hoistway doors shall be fully open.

The equipment shall consist of a machine on the elevator car operating the car door when the car is stopping at a landing.

The car door and hoistway door shall be mechanically connected and shall move simultaneously in opening and closing.

The car and hoistway doors shall be power opened and closed and shall be checked in opening and closing with an oil cushioning mechanism built into the gear unit.

Each hoistway door shall be provided with an interlock which will prevent movement of the car away from the landing unit.

The doors are closed in the closed position as defined in the ISI codes.

An electric contact for the car door shall be provided which shall prevent car movement from the landing unless the door is in the closed position as defined in the ISI codes. The locking arrangement shall be so designed that the electrical circuit cannot be completed unless the doors are in the closed position and mechanical latching is effected.

Necessary switches shall be provided in the elevator machine room to control the operation of the doors.

The car and hoistway, doors shall open automatically as the car is stopping at a landing. The closing of the car and hoistway door must occur before the car can be started. Doors can be stopped and reversed during their closing motion.

12.9.29 DOOR HANGER AND TRACKS :

For the car and each landing door, sheave type two point suspension hangers complete with tracks shall be provided. Means shall be provided to prevent the door from jumping off the track and for vertical and literal adjustment of doors.

Sheaves and rollers shall be of steel and shall include shielded ball bearing to retain grease lubrication. Adjustable ball bearings rollers shall be provided to take the upward thrust of the doors. Tracks shall be of suitable steel section with smooth surface. The locking of the two leaf parting type doors should be positive.

12.9.30 SAFETY SHOE :

A safety shoe (one on each door panel) shall extent to the full height of and project beyond the front edge of the car door.

Should this shoe touch a person or an object while the car door is closing, the car and hoistway doors shall return to the open position. The doors shall remain open until the expiration of a pre-determined interval and then close automatically.

12.9.31 LANDING ENTRANCE MATERIAL'S :

These shall consist of headers, extruded aluminium sills and strut angles.

12.9.32 WIRING :

Complete wiring in the equipment.

12.9.33 AUTOMATIC RESCUE DEVICE :

Automatic Rescue Device to be provided for all the lifts with battery backup so that it can land to the nearest level in case of power failure. Automatic Rescue Device shall have suitable battery backup so that it can operate minimum seven times in a day provided the duration between usage is at least 30 minutes.

13.0 LT CABLES

13.1 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.

13.2 MATERIAL

The L.T. power cable shall be XLPE Cable PVC insulated PVC sheathed type aluminium conductor armoured cable and L.T. control cable shall be PVC insulated PVC sheathed type copper conductor unarmoured cable conforming to IS: 7098: 1988 (Part-I) with up to date amendments.

13.3 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 HSCC Electrical Engineer. Cable laying shall be carried out as per CPWD specifications.

13.4 INSPECTION

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

13.5 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.

13.6 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 metre. Cables shall be laid at depth of 0.75 metres below ground level for LT Cables and 1 metre below ground level for HT cable. 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 along side 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 preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 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.

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

PROTECTION OF CABLES

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

EXCAVATION & BACK FILL

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

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

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

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

CABLES ON HANGERS OR RACKS

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

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

CABLES TAGS

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

13.7 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.

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

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.

14.0 CABLE TRAY

14.1 Ladder Type Cable Tray

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

14.2 Perforated Type Cable Tray

The cable tray shall be fabricated out of slotted/perforated M.S. Sheet as channel section single or double bended. The channel section shall be supplied in convenient length and assembled at site to the desired lengths. These shall be galvanised or painted as specified. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members, with cross-bracings between them by 50mm x 5mm flats welded/bolted to the angles at 1 m spacing. 2mm thick MS perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

14.3 Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 1994.

14.4 The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.

14.5 The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II - 1994. The sizes shall be specified considering the same.

14.6 The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 800mm.

14.7 Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part II -1994). The radius of bend, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

14.8 The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25mm x 5mm flats at specified spacing as per CPWD General Specification of Electrical Work Part II -1994. Flat type suspenders may be used for channels upto 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the PMC/Consultant to take the weight of the cable tray with the cables.

14.9 The entire tray (except in the case of galvanised type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

14.10 The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.

14.11 The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross-joints, etc, and paid for accordingly.

15.0 EARTHING

15.1 GENERAL

All the non-current metal parts neutral of transformers & DG set etc of electrical installation shall be earthed properly. All metal conduits trunking, switchgear, distribution boards, switch boxes, outlet boxes, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to CPWD General Specifications for Earthing work shall conform to Internal) -1994 and IS 3043 amended up to Date.

15.2 EARTHING CONDUCTOR

Earth continuity conductor along with submain wiring from Main/Sub Distribution boards to various distribution boards shall be of copper. Earth continuity conductor from distribution board onward up to outlet point shall also be of bare copper. Earth continuity conductor connecting Main & Sub Distribution boards to earth electrode shall be with galvanised MS strip.

15.3 SIZING OF EARTHING CONDUCTOR

Single phase distribution board shall have one earth continuity conductor while three phase distribution board shall be provided with two earth continuity conductors. Earthing of main switch board and sub switch boards shall be earthed with two independent earth electrodes or as indicated elsewhere. Earth conductor laid in ground shall be protected for mechanical injury & corrosion by providing GI pipe.

15.4 **Earthing System – specification**

Earthing system should comply to the requirements specified below. Earthing system should offer a resistance less than 5 ohms throughout the year. In places where Soil resistivity is more, multiple earth electrodes are to be installed to get the required value. Length of the earthing rod also can be increased to achieve low and stable resistance value.

Solid rods are recommended as earth electrode than a pipe due to the fact that solid rods can be easily driven by hydraulic hammers. Deep driven rods provide more stable and less Earth Resistance. Doubling the length of the rod will reduce earth resistance up to 40 %, where as doubling the diameter will reduce the resistance by only 10 %, but may increase the cost by 4 times. Lower earth resistance can also be achieved by increasing the number of earth rods. E.g. 40 % reduction in earth resistance is possible if the rods are increased from 1 to 2. The minimum spacing between earth pits should be equal to the length of the rod. Increasing the spacing between earth pits also reduces the earth resistance significantly.

Need and importance of Earthing:

- Human and Personnel safety.
- Equipment protection.
- Provides low impedance path for fault currents.
- To ensure good quality power.
- Protection against lightning and transient currents, noise reductions, Limitation of EMI.

References:
IEC 60364: Low Voltage Electrical Installations-Part 5-54: Selection & Erection of Electrical equipment-Earthing arrangement & protective conductors.
IEC 62561: Lightning Protection system Components.
IEC 62305: Protection Against Lightning –Part 3: Protection of structures & life Hazards
UL 467: Grounding and Bonding Equipments
UL96: Lightning Protection System – Components
IS 2309: Code of practice for protection of buildings & allied structures from lightning
IS 3043: Code of practice for earthing.

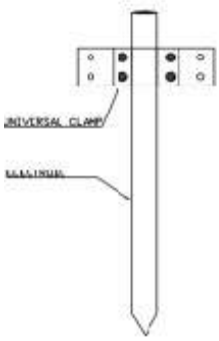
Components of earthing system:

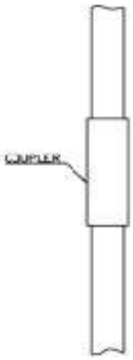
- Earth electrode
- Couplers and Connectors
- Inspection Chamber (Earth Pit)
- Earth enhancement material
- Connecting cable/tape/strip with accessories.

Earth Electrode:
Copper coated Solid steel Rods shall be made of high tensile low carbon steel rod, with molecular bonded with 99.9% electrolytic copper with minimum coating thickness of 250 microns. The minimum length of the earth rod shall be 3 meters which is either a single rod or smaller rods with couplers or similar arrangement. For dry areas, length of the rods can go up to 9 meters. The vendor should quote price of the rod in length of 3 meters. The rod as well as the couplers should satisfy the requirements as per the above-referred standards. For Lightning protection application rods should have a diameter of 14.2 mm or 17.2 mm. In order to carry fault current, earth rods used in Power networks should be of diameter 20 mm or 25 mm. In case of applications more than 3 meters, diameter of the rod should be 20 or 25 mm. These rods also should have facility to drive with an electric/hydraulic hammer.

Interconnecting Strips / Earthing Conductor: Copper coated steel strips / tapes should be used to interconnect different earthing rods as well as horizontal earthing (Ring earthing). These strips should have a coating thickness of minimum 70 microns and have minimum cross sectional area of 90 Sqmm. (Eg 30 X 3 strip)

Couplers / Connecting clamps:
Couplers for interconnecting rods should be made of Brass or any other copper alloy, which is resistant to corrosion. For rods with diameters larger than 20 mm self locking arrangements are preferable instead of couplers. Connectors for connecting Electrode with Earthing conductor/strip should be of Brass/copper alloy or copper coated steel. Fasteners should be made of Stainless steel. Size should be selected according to the electrode and earthing conductor dimensions. Different arrangements should be as per the below fig.





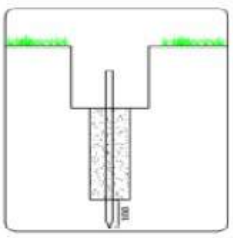
Inspection Chamber :
Should have an inner dimension of 250 mmX 250 mm X 250 mm made of FRP material. Flush Mounted, removable and lockable cover of the earth pit should be able to withstand 15KN. The area inside the inspection chamber should be such that, the UNIVERSAL CLAMP/EBB/Bus bar is not too deep inside the inspection chamber or projecting out of inspection chamber. The chamber should have facility for marking earth resistance and latest testing date by paint at the cover and previous recorded values inside the cover.

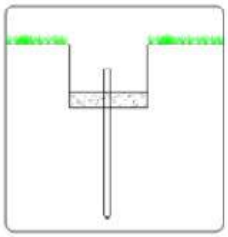
Earth Enhancement material:
This is a conductive compound producing low resistance of an earth termination system. Earth enhancing compound shall be so designed and constructed that in normal use their performance is reliable and without danger to persons and the surroundings. The material shall be chemically inert to sub soil and shall not pollute the environment. It shall provide a stable environment in terms of physical and chemical properties and exhibit low resistivity. It shall not be corrosive to the earth electrode itself. The material should have a resistivity less than 50 Ohm meter

Installation:
Normal soil in Marsh land: Electrodes can be hand driven or hammered into earth for the required length.

Semi Hard Soil: Electrodes can be hammered electrically or hydraulically for the required length.

Hard Soil: Bore a hole with a minimum diameter of 100 MM with at a depth of up to 3 meters. Place the electrode at the centre of the hole in such a way that bottom 100 mm of the electrode is in bond with the mother soil. For deep driven rods with depth more than 3 meters, remaining length of the rod should be driven into the mother soil. (ref fig)Fill the hole with earth enhancement compound.



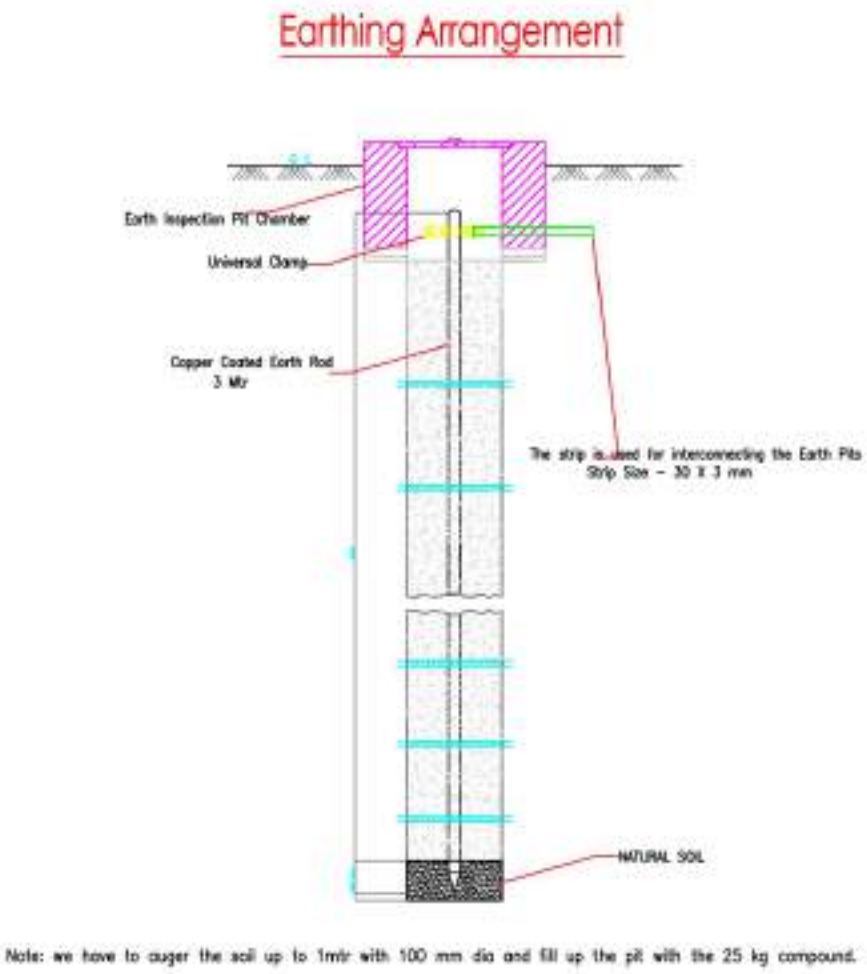


Inspection & maintenance:

Maintenance of the earthing system has to be done at least once in 6 months, preferably before the monsoon period and a record should be maintained to verify earthing system conductors and components, electrical continuity, earth resistance value, re-fastening of components viz-nuts, bolts etc.

Drawing:
Layout of the complete earthing system with dimensions shall be submitted.

Warranty: Earthing system should provide stable resistance for a period of 18 months after installation as well as for full season. During this period monthly readings are to be recorded by the end user.



16.0 SAFETY EQUIPMENTS

16.1 DANGER NOTICES

Danger notices shall be affixed permanently in a conspicuous position in Hindi or English and the local language of the district with sign of skull and bones at every overhead lines, transformer, electrical equipments motors, etc.

16.2 FIRST AID BOX

Standard first aid box with all standard contents shall be supplied.

16.3 FIRE BUCKETS

The fire bucket unit shall consist of our galvanised iron baskets, which shall be with round bottom, and of 13 liters capacity. They shall be filled with dry sand. Arrangement shall be made to hang them on GI pipe stand comprising of at least 2 vertical and one horizontal members of 50 mm GI pipe. The stands shall have hooks and locking chain arrangement. The buckets and stand shall be painted with epoxy red paint.

16.4 FIRE EXTINGUISHER

Foam type Fire extinguishers of 9 Kg. capacity and Dry Chemical type Fire Extinguishers of 10 Kg capacity shall be of approved make. It shall be filled with carbon tetrachloride. It shall have horns. Extinguishers shall be fixed on walls/columns with necessary clamps made out of 50 mm x 6mm MS flat and coated bolts and nuts grouted in wall/column.

16.5 RUBBER MAT

Corrugated rubber insulating matting shall be provided in front of all power & motor control centers, push button station and distribution board in the electrical rooms. The width of matting shall be one meter. It shall be as ISI mark.

16.6 INSTRUCTION CHART

Printed instruction chart both in English and Hindi and duly framed with front glass, prescribing treatment to be given to persons having Electric shock, shall be supplied.

17.0 UPS System

PART 1 - GENERAL

18.01 SUMMARY

A. This specification describes a three-phase continuous duty, on-line, double conversion, solid-state uninterruptible power system, hereafter referred to as the UPS. The UPS shall operate in conjunction with the existing building electrical system to provide power conditioning, back-up and distribution for critical electrical loads. The UPS system shall consist of, as required by the project, the UPS module, battery racks, static or maintenance bypass, and other features as described in this specification.

B. UPS level redundancy: All the UPS systems should operate in parallel redundant load sharing mode and all UPS systems should share the load equally. In case any UPS fails, the other UPS should take over 100% load instantaneously without break. Apart from above there are some UPS Units which are standalone units, all standalone UPS Should have static or maintenance bypass as inbuilt. Please refer BOQ for details on redundancy / standalone units.

17.02 UPS SYSTEM DESCRIPTION

A. The System Components: it shall be consist of the following main components:

1. Rectifier, Inverter, and Battery Charger.
2. Battery string(s) in Battery Racks.
3. Battery Breaker
4. Battery to Battery Interconnects / Battery to UPS Connections.

B. UPS: Each UPS shall operate as an on-line, fully automatic system in the following modes:

1. Normal: Utilizing commercial AC power, the critical load shall be continuously supplied by the Inverter. The Inverter shall power the load while regulating both voltage and frequency. The Rectifier shall derive power from the commercial AC source and shall supply DC power to the Inverter. Simultaneously, the Battery Charger shall charge the battery.
2. Battery: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.
3. Recharge: Upon restoration of the AC source, the Charger shall recharge the batteries and simultaneously the Rectifier shall provide power to the Inverter. This shall be an automatic function and shall cause no interruption to the critical load.
4. Bypass: If the UPS must be taken out of the Normal mode for overload, load fault, or internal failures, the static bypass switch shall automatically transfer the critical load to the commercial AC power. Return from Bypass mode to Normal

mode of operation shall be automatic. No-break transfer to and from Bypass mode shall be capable of being initiated manually from the front panel.

17.03 REFERENCES

A. UL 1778 (Underwriters Laboratories) – Standard for Uninterruptible Power Supply Equipment.
B. IEC 62040-1-1 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 1-1: General and safety requirements for UPS used in operator access areas.
C. IEC 62040-1-2 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 1-2: General and safety requirements for UPS used in restricted access locations.
D. IEC 62040-3 (International Electrotechnical Commission) – Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements.
E. NEMA PE-1 – (National Electrical Manufacturers Association) – Uninterruptible Power Systems standard.
F. IEEE 587 (ANSI C62.41) Category A& B (International Electrical and Electronics Engineers) – Recommended practices on surge voltages in low voltage power circuits.

18.04 SUBMITTALS

A. The UPS system shall be supplied with sufficient documentation, including the following manuals:

1. Installation and Operation Manual: One copy of the installation and operation manual shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians or representatives to install and operate the UPS equipment and accessories. The manual shall include the following major items:

a) UPS description

b) UPS site planning and unpacking

c) UPS installation

d) Optional accessory installation

e) UPS theory of operation

f) Operating procedures

g) System events

h) UPS maintenance

i) Performance and technical specifications

j) Wiring requirements and recommendations

k) Physical features and requirements

17.05 QUALIFICATIONS

A. The UPS manufacturer shall have ISO 9001 certification for engineering/R&D, manufacturing facilities and service organization.

B. The UPS manufacturer shall maintain a staffed 7x24x365 service availability for technical and emergency support.

C. Field Engineering Support: The UPS manufacturer shall directly employ a field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. Third-party maintenance will not be accepted.

D. Spare Parts Support: Parts supplies shall be located in the field to provide all emergency needs.

17.06 ENVIRONMENTAL REQUIREMENTS

A. The UPS shall withstand any combination of the following external environmental conditions without operational degradation.

1. Operating Temperature: 0 degrees C to + 40 degrees C without de-rating (excluding batteries).

2. Storage Temperature: - 25 degrees C to + 50 degrees C.

3. Relative Humidity (operating and storage): 95% maximum non-condensing.

4. Elevation: Operational: 1000 meters maximum without de-rating.

17.07 SAFETY

CE & IEC 62040-1

17.08 UPS STANDARD FEATURES

The UPS configuration shall consist of the following standard components and features:

A. Each UPS should consist of:

1. Rectifier/Charger: Each rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery. The rectifier/charger shall be a high-frequency PWM design, using Insulated Gate Bi-polar Transistors (IGBTs). The modular design of the UPS shall permit safe and fast removal and replacement of the rectifier/charger module. The rectifier/charger module shall also provide the following:

a) The rectifier shall be capable of drawing power from the utility with a power factor of 0.99 under nominal conditions.

b) The rectifier shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.

2. Inverter: Each inverter shall feature an IGBT pulse-width-modulation (PWM) design with high speed switching. The inverter shall also have the following features:

a) The inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.

b) The modular design of the UPS shall permit safe and fast removal and replacement of the inverter module.

c) The inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.

B. STATIC BYPASS: The bypass shall serve as an alternative source of power for the critical load when an abnormal condition prevents operation in normal mode. The bypass shall consist of a fully rated, continuous duty, naturally commutated static switch for high-speed transfers. The bypass shall feature the following transfer and operational characteristics.

1. Transfers to bypass shall be automatically initiated for the following conditions:
   a) Output overload period expired.
   b) Critical bus voltage out of limits.
   c) Internal over temperature period expired.
   d) Total battery discharge.
   e) UPS failure.
2. Uninterrupted automatic re-transfer shall take place whenever the inverter is capable of assuming the critical load.
3. Uninterrupted automatic re-transfers shall be inhibited for the following conditions:
   a) When transfer to bypass is activated manually or remotely.
   b) In the event of multiple transfers/re-transfer operations the control circuitry shall limit "cycling" to three (3) operations in any ten-minute period. The fourth transfer shall lock the critical load on the bypass source.
   c) UPS failure.
4. Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to bypass and from bypass shall be possible with the inverter logic. During manual transfers to bypass mode, the inverter must verify proper bypass operations before transferring the critical load to the bypass.
5. All transfers to bypass shall be inhibited for the following conditions:
   a) Bypass voltage out of limits (+/- 10% of nominal)
   b) Bypass frequency out of limits (+/- 3 Hz, adjustable, factory set)
   c) Bypass out of synchronization
   d) Bypass phase rotation / installation error
6. Static transfer time: No break, complete in less than 4ms.
7. The bypass shall be manually energized using the control panel

C. Monitoring and control components: The following components shall provide monitor and control capability:

1. Control panel with status indicators.
2. Alarm and metering display.

3. Building alarm monitoring.

4. Communication ports.

D. Battery management system: The UPS shall contain a battery management system which has the following features:

1. The battery management system shall provide battery time remaining while operating in normal mode and battery mode. Battery time available information shall be displayed real-time, even under changing load conditions. Upon commissioning, battery runtime information shall be available.

E. Wiring Terminals: The UPS module shall contain mechanical compression terminals for securing user wiring to the following locations:

1. Rectifier/charger input connections (3-wire plus ground)

2. Bypass input connections (3-wire plus ground for 3-wire plus ground output configuration (415Vac), or 4-wire plus ground for 4-wire plus ground output configuration)

3. DC link connections for battery cabinets (positive and negative).

4. AC output connections (3 or 4 wires plus ground).

17.09 UPS SYSTEM OPTIONS AND ACCESSORIES

The UPS system shall consist of the following options and accessories as required:

A. SNMP Network Adapter and UPS Power Monitoring Software (OPTIONAL): SNMP adapters shall provide a communications interface between the UPS module and SNMP-compatible network management systems. This capability shall allow the unit to be monitored remotely over an Ethernet network using a standard web browser.

B. MODBUS CARD – Required with each UPS.

C. Battery Rack: The battery rack shall house valve regulated, high-rate discharge, lead-acid batteries which provide energy to the support the critical load during a momentary loss of input power to the rectifier. The battery rack shall have the following features:

1. Power wiring internal to each battery cabinet shall be using Nyvin cables.

2. Each battery rack shall feature a DC rated circuit breaker (inbuilt or wall mount). The circuit breaker within the battery rack shall only provide protection to the battery string within that battery

3. Power and Control wiring between the battery rack and the UPS

4. BATTERY TYPE: 12V, VRLA SMF batteries

5. Battery Back-up: As per BOQ

17.10 UNINTERRUPTIBLE POWER SUPPLY RATINGS AND OPERATING CHARACTERISTICS

A Each UPS Continuous Ratings.

Please refer BOQ for ratings.

A. Rectifier/charger input:

1. Nominal three phase input voltage: 415 VAC:

   3-wire plus ground input

2. Operating input voltage range: + 10%, - 15% of average nominal input voltage without battery discharge.

3. For 50Hz systems, operating input frequency range shall be 45 to 55Hz.

4. Input power factor 0.99 lagging.

5. IGBT Based Technology

6. Normal input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode:

   a) Rectifier/charger input current limit shall be adjustable from 100 to 115% of full-load input current.

   b) Battery input current limit shall be adjustable from 10% to 15% of the UPS full load input current regardless of the actual load on the UPS.

7. On generator input current limit: The UPS shall have the following programmable input current limit settings while operating in normal mode on generator:

   a) Rectifier/charger input current limit shall be adjustable from 100% to 115% of full-load input current.

   b) Battery recharge input current limit shall be adjustable from 10% to 15% of the UPS full load input current regardless of the actual load on the UPS.

8. Input current total harmonic distortion (THD) shall be less than 5.0% @ 100% linear load condition.

9. Power walk-in: Ramp-up to full utility load adjustable from 3 seconds to 60 seconds.

10. Each UPS should be offered with Output Isolation Transformer, external to UPS. Isolation Transformer should be 1:1 Winding, H Insulation Class, Indoor Type, Air Cooled, Delta / Star Type.

B. Bypass input:

1. Synchronizing bypass voltage range shall be +/- 10% of average nominal input voltage.

2. Synchronizing bypass frequency range is centered on the nominal frequency.

3. Bypass and rectifier inputs can be supplied from out of phase sources if required.

4. Input surge withstand capability: The UPS shall be in compliance with IEEE 587 (ANSI C62.41), category A & B (6kV) **or better**

C. Rectifier/charger output:

1. Nominal DC voltage shall be as per vendor design.

2. Steady state voltage regulation shall be +/- 0.5%.

3. Voltage ripple shall be less that 0.5% (peak-to-peak).

4. Capacity: The rectifier/charger shall support a fully loaded inverter and recharge the battery to 90% of its full capacity within 10 times the discharge when input current limit is set at maximum.

5. Low line operation: The rectifier/charger shall be capable of sharing the DC load with the battery when the input voltage falls below the specified operation input voltage range, the on battery indicator shall enunciate operation in this mode.

6. DC sensing: Redundant DC voltage sensing methods shall be incorporated for providing battery over-voltage protection.

7. Battery charger characteristics: The UPS battery charging system shall have the following characteristics:

a) The charger shall be capable of being configured for several charge modes including:

(1) A charging mode that increases battery life by allowing the battery to rest, reducing positive plate corrosion

(2) A charging mode floating the battery at a set level, which can be adjusted via software, used for flooded cell applications

(a) Nominal Float Voltage: 2.25 V per cell.

(b) Equalizing Voltage: 2.38 V maximum per cell (adjustable).

(c) Automatic (time based) or manual (user initiated) equalization available

b) UPS will automatically adjust battery shutdown based upon loading and battery capacity.

(1) The UPS shall automatically adjust the final discharge voltage between 1.67 and 1.75 Volts per cell based on the existing load and the rate and length of discharge.

(2) The absolute minimum operational voltage is 1.67 V per cell (adjustable).

8. The UPS will automatically disconnect the battery system in case of full battery discharge followed by prolonged utility AC voltage failure. The time window before battery disconnection occurs shall be programmable for both time and voltage.

D. UPS output in normal mode

1. 415V, 3-phase, 3-wire or 4 wire plus ground. Output wiring configuration is based upon input wiring configuration for systems without internal transformers.
2. Steady-state voltage regulation (in inverter) shall be within +/- 1% average from nominal output voltage.
3. Transient voltage response shall be < +/- 5% from nominal voltage for 100% load step, full load re-transfers and full load drop on battery.
4. Transient voltage recovery shall be 25ms to within +/- 1% of steady state.
5. Linear load harmonic distortion capability: Output voltage THD of less than 3% for 100% linear load.
6. Non-linear load harmonic distortion capability: Output voltage THD of less than 5% for 100% non-linear load when tested using the non-linear load described in IEC 62040-3 connected line to neutral.
7. Manual output voltage adjustment shall be +/- 3% from nominal.
8. Line synchronization range shall be +/- 3Hz, adjustable to +/- 5Hz.
9. Frequency regulation shall be +/- 0.01Hz free running.
10. Frequency slew rate shall be 1 Hz/second maximum (adjustable).
11. Static transfer time: No break, completed in less than 4ms.
12. EMI Suppression: The UPS shall meet IEC 62040-2, EN50091 Class A restricted limits
13. Efficiency: The UPS efficiency in Online Mode should be

    >= 92% for UPS Rating <= 60 KVA

    >=94% for UPS Rating >60 KVA

17.11 MECHANICAL DESIGN

A. Ventilation: The UPS shall be designed for forced-air cooling. Air inlets shall be on the front of the unit. Air outlets shall be on the top / back as per OEM.

B. Cable entry: Standard cable entry for the UPS cabinet shall be through either the enclosure bottom or top. A dedicated wireway shall be provided within the UPS cabinet for routing user input and output wiring.

C. Front access: All serviceable subassemblies shall be modular and capable of being replaced from the front of the UPS (front access only required). Side or rear access for installation, service, repair or maintenance of the UPS system shall not be required.

17.12 CONTROLS AND INDICATORS

A. Microprocessor controlled circuitry: The UPS controls shall have the following design and operating characteristics:

1. Fully automatic operation of the UPS shall be provided through the use of microprocessor controlled Digital Signal Processing. DSP shall eliminate

variances from component tolerance or drift, and provide consistent operational responses.

2. All operating and protection parameters shall be firmware controlled, thus eliminating a need for manual adjustments. The logic shall include system test capability to facilitate maintenance and troubleshooting. Printed circuit board replacement shall be possible without requiring calibration.

3. Start-up and transfers shall be automatic functions.

B. Digital Front Panel Display: The LCD shall display UPS status, metering, battery status, alarm/event queue, active alarms and UPS configurations. The front panel display shall show a system mimic diagram with an outlined power path, current operating mode and event logs.

C. Control Panel Indicators: The UPS control panel shall provide the following monitoring functions with indicator LED's:

1. NORMAL: This shall indicate that the commercial AC utility or generator source is supplying power to the rectifier and the inverter is supporting the critical load. A text message shall indicate if the bypass line is not within tolerance.

2. BYPASS: This shall indicate that the UPS has transferred the load to the bypass circuit.

3. BATTERY: This shall indicate that the commercial AC utility or generator source has failed and the battery is supplying power to the inverter, which is supporting the load. A text message shall indicate if the battery charge is low or if the battery is installed but disconnected.

4. ALARM: This shall indicate that the UPS detects an alarm condition, outlined in detail in the operator's manual.

D. Control Panel Controls: The UPS control panel shall provide the following functions from front panel push buttons:

1. EVENTS: Displays the list of Active System Events and a historical log of system events. Historical logs shall include a detailed time stamped list.

2. METERS: Displays performance meters for the system or critical load. When selected, the front display shall show individual screens of input parameters, output parameters or bypass parameters including; voltage, current and frequency. In addition, the battery display shall show runtime remaining.

3. CONTROLS: Displays a System Controls screen. Allows selection of operating mode, normal, bypass, charger on/off and Power Module on/off.

4. SETUP: Allows display contrast, date and time information serial communication port configuration and display of firmware revision numbers.

5. RETURN: Confirms selection or returns to previous screen.

17.13 COMMUNICATIONS

A. MODBUS Card (Mandatory) is required with each UPS for integration with Building Management System

B. SNMP Card – (Optional) Should be available for monitoring UPS on LAN/WAN Network

17.14 UPS PROTECTION

A. Rectifier/Charger and Bypass protection shall be provided through fusing.

B. Battery protection shall be provided by molded-case circuit for an external battery bank.

C. Electronic current limiting circuitry and fuses in the Inverter circuit shall provide output protection.

D. To comply with agency safety requirements, the UPS shall not rely upon any disconnect devices outside of the UPS to isolate the battery rack from the UPS.

PART 3 - EXECUTION

18.15 INSTALLATION

A. Install in accordance with manufacturer's instructions.

17.15.01 COMMISSIONING

A. The following procedures and tests shall be performed by Field Service personnel during the UPS startup "as minimum activities"

1. Visual Inspection:
   a) Visually inspect all equipment for signs of damage or foreign materials.
   b) Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.
2. Mechanical Inspection:
   a) Check all the power connections for tightness.
   b) Check all the control wiring terminations and plugs for tightness or proper seating.
3. Electrical Pre-check:
   a) Check the DC bus for a possible short circuit.
   b) Check input and Bypass power for proper voltages and phase rotation.
   c) Check all lamp test functions.
4. Initial UPS Startup:
   a) Verify that all the alarms are in a "go" condition.

b) Energize the UPS module and verify the proper DC, walkup, and AC phase on.

c) Check the DC link holding voltage, AC output voltages, and output waveforms.

d) Check the final DC link voltage and Inverter AC output. Adjust if required.

e) Check for the proper synchronization.

f) Check for the voltage difference between the Inverter output and the Bypass source.

5. Operational Training: Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.

17.16 WARRANTY

All components of the UPS system shall be covered by a standard one-year warranty.

Manufacturer shall also include On-site user training, installation.

18. 00 ACCESS CONTROL SYSTEM

I. Software

1. System Overview

1.1. The Integrated Security Management System (ISMS) shall be a modular, networked access control system capable of handling large proprietary corporations with multiple remote sites, alarm monitoring, video imaging, badging, paging, guard tour. The system shall allow for easy expansion or modification of inputs, outputs, and remote control stations.

1.2. The system control at the central computer location shall be under a single software program control, shall provide full integration of all components, and shall be alterable at any time, depending upon the facility requirements. Reconfiguration shall be accomplished online through system programming, without hardware changes.

1.3. The software program shall be a true 32-bit, 3-tier client/server, ODBC compliant application based on Microsoft tools and standards. The software program shall operate in one of the following environments; Windows 2003 Server, Windows Vista Business, Windows XP Professional SP2, Windows 2000 Professional or Server using Service Pack 4.

1.4. The system shall support multiple communication servers on a LAN/WAN, to provide distributed networking capabilities, which significantly improve system performance.

1.5. The database architecture shall be MSDE 2000 as standard with the capability to utilize Microsoft SQL Server 2005; SQL Server 2005 Express Edition or SQL Server 2000.

1.6. The system shall have the capability to communicate with the control panels via LAN/WAN connections utilizing industry standard communication protocol.

1.7. The software program shall use Abstract Devices (ADV) for representing hardware devices in the system. The ADVs shall be used in Floor Plans to provide the user interface to control and monitor the system, and shall also be used in the Data Trees to organize, display, and control system information.

1.8. The system shall support both manual and automatic responses to alarms entering the system. Each alarm shall be capable of initiating a number of different actions, such as activation of remote devices, door control, and activation of WAV files.

1.9. The system shall provide both supervised and non-supervised alarm point monitoring. Upon recognition of an alarm, the system shall be capable of arming or disarming alarm points both manually and automatically, by time of day, and by day of week.

1.10. Access control functions shall include validation based on time of day, day of week, holiday scheduling, site code and card number verification, automatic or manual retrieval of cardholder photographs, and access validation based on positive verification of card, card and PIN, card or pin, pin only and Site Code only.

1.11. Alarm events with defined priorities shall be able to pop-up automatically in an Alarm event window for operator attention. The pop-up shall display the name of the event (reader, alarm point, cardholder or system alarm), time, date, site, account, if a card event the card number, type of event and cardholder name. An event counter shall also display the number of times the event was reported to the Alarm event monitor prior to Acknowledgement or Clearing the event. Event instructions shall be made available by double clicking on the event.

1.12. The Alarm event window shall allow the operator to initiate a physical response to the event as well as a written response. Responses shall include but not be limited to: acknowledge, clear, open a pre-programmed floor plan, energize, de-energize, pulse, time pulse, add comment, shunt or un-shunt.

1.13. Assigned passwords shall be possible to define the levels of system operation for each individual operator. System operation for individual operators shall include, but not be limited to, restricted time periods for login, available accounts and default language selection at login. Operator actions range from no view or control rights to basic monitoring including the ability to block the viewing of card and or personal identification numbers, to full control of the system including programming.

1.14. The system programming shall be user friendly, and capable of being accomplished by personnel with no prior computer experience. A quick start wizard shall allow the operator to easily program a system including basic time zones, access panels (IP connection, Modem Pools or direct connections to an RS-232 port), card activation to a general purpose access area and deactivation date. The software shall utilize drop boxes for all previously entered system-required data. The programming shall be MENU driven and include online “Help” or “Tutorial” information, as well as online data entry examples. The Help shall be available by using the F1 key. When using the F1 help access, the help menu will provide detailed information relative to the operation that the user is performing without the need to key in additional search parameters. An operation Tutorial shall also be provided with the access control software. The contents of the Tutorial shall include, but not be limited to: Floor plan setup and control, Visitor management integration, and Intrusion integration and operation.

1.15. After installation, the Customer shall be able to perform hardware configuration changes. These hardware configuration changes shall include, but not be limited to, door open time, door contact shunt time, point and reader names, when and where a cardholder is valid, and the ability to add or modify card databases as desired; For the intrusion system, any function that can be programmed from a physical keypad shall also be available from the system’s virtual keypad, without the services of the Contractor or Manufacturer.

1.16. Equipment repair shall be able to be accomplished on site, by module replacement, utilizing spare components.

Basic System Capabilities

The following functional capabilities are considered essential for the system described in this specification. The capabilities are to be considered standard, without the need for add-on software or hardware.

- General

i. All databases will have the ability to ADD, DELETE, REPORT, VIEW or EDIT information.
ii. Provide storage of all system transactions in a retrievable file.
iii. Log all events by time and date with reference to GMT.
iv. Provide capability to store all or selected system transactions to a disk file.
v. Provide ability for CUSTOMER to make system configuration changes such as, but not limited to door open time, door contact shunt time, point and reader names, when and where a cardholder is valid, and the ability to add or modify card databases at any time.
vi. Support "Global Anti-passback", allowing cardholder to enter/exit any card reader on the same RS485 drop line.
vii. Duress feature where when a PIN is used in conjunction with a card read, the number of digits are selected at the keypad where the PIN number is a value of one different from the normal PIN.
viii. Provide mode of system operation that stores system commands that were not accepted by the hardware.
ix. Provide mode of system operation that requires the operator to enter a response to an event when acknowledging it from the alarm view window.
x. Provide mode of system operation that allows acknowledged alarms to be automatically cleared.
xi. Provide mode of system operation where un-acknowledged events will cause the computer to continuously emit a pulsating beep until all un-acknowledged alarms are acknowledged. A momentary silence feature shall allow the beeping to cease for up to 60 seconds. The silence feature shall also provide a visual count down to when the beeping will begin again.
xii. Provide mode of system operation where when an acknowledged, but not cleared event will be reissued requiring acknowledgement when the event changes to an alarm or trouble state.
xiii. Provide mode of system operation that does not allow the operator to clear an alarm prior to it being restored to normal.
xiv. Provide ability for manual operator control of system output relays. The manual functions shall include the ability to energise, de-energise, return to time zone, or pulse the output relay. The pulse time shall be a programmable setting.
xv. Provide ability for manual operator control of system doors. The manual functions shall include the ability to Lock, Un-Lock, Shunt, Un-Shunt and Return to Time Zone.
xvi. Provide ability to automatically display stored "video image" of cardholder
xvii. The cardholder "video image" pop-up shall be activated based on a priority level set to the cardholder or reader. Information in the pop-up shall include, but not be limited to the cardholder's primary image a live video pop-up showing the person who initiated the pop-up, entrance name, time, date, cardholder name, and status. User shall be able to display up to 40 note fields. The size of the pop-up(s) shall be adjustable by the operator.
xviii. Support multiple card reader technology including Proximity, Wiegand effect, Biometrics, Magnetic stripe, Bar Code, Keypad, Card/keypad (PIN), High-speed long range Vehicle ID, Smart Card
xix. Provide a means for scheduled automatic backups of any or all database system files. A means to restore these files from a simple menu shall exist.
xx. Provide the ability to address up to 2 serial communication ports, where each port can be configured for either hardwired or dial-up. When configured for dial-up, any one port can support multiple dial-up locations.
xxi. Communication from the access control server to the remote control panels shall be selectable. Communication options shall be via RS-485 converter, dial-up, leased line from a defined communication port or by LAN/WAN using an IP address for direct connection to the remote RS-485 converter via network interface card. When using IP addressing it shall be un-acceptable

to use a communication port converter device on the communication server side of the transmission. A minimum of 64 such IP connections shall be allowed.

xxii. All commands and updates to the panels shall be verified and shall automatically retry if communications have failed.

xxiii. Provide the ability to select ACK/NAK communication feature by communications port for either dial-up or hardwire.

xxiv. Provide a system scheduler that shall automatically:

1. Call remote locations to retrieve history transactions and update panel information, including time and date.
2. Activate or deactivate cards locally or at remote dial-up sites.
3. Initiate a pre-programmed command event/action.
4. Synchronize system to controller time.

xxv. Provide the ability to initiate an alarm based on a transaction state. A transaction state shall be defined as but not limited to Normal, Alarm, Trouble, Ajar, Trace, Not Found, Anti-Passback Violation, PIN Violation, Time Zone Violation, Site Code Violation and System Alarms including Panel Com, Panel Power Failure, Modem Pool, Guard Tour, and Tamper.

xxvi. A host grant mode of operation shall exist that requires the host computer to grant accesses to "valid" cards. An alternate host grant mode shall allow the card access information to be downloaded along with unlocking the door for "valid" cards.

- Card Database

i. Provide a simple card and card holder database import utility. The utility shall be password protected and accessible only to administrators of the access control system. Information that can be imported shall include but not be limited to: First Name, Last Name, card number, activation date, de-activation date, status, up to 40 note fields and photo images. A simple CSV (comma separated value) file shall be used for the importing of data and image file names.

ii. Cardholder information shall include unique card number up to 15 digits and optional Personal Identification Number.

iii. Allow multiple cards per cardholder.

iv. Allow for up to 32 access levels to be assigned to a card, or a single "precision" access level. When using "precision" access levels it shall be possible to create a unique access level per card using an existing access level as a baseline template. This customized card access level shall have both beginning and ending dates.

v. Provide 40 user definable fields.

vi. Each card holder note filed shall allow the option to be entered as free form data or structured data. Structured data shall be by use of a template or drop list. The template and drop list shall be created by the operator. The capacity of the template shall allow for up to 65,000 characters.

vii. Provide special card options that include, but are not limited to:

1. Time zone reference, which defines valid time.
2. Visitor use, which provides a specified activation date and expiration date (spanning years).
3. Trigger control value, which can initiate a predefined procedure at the intelligent control independent from any control function from the system computer.

viii. Provide a card "Trace" function. The Trace function shall allow normal access control, but will provide a tracking alarm at the system monitor.

ix. Provide ability to store digital images and written signature of cardholder.

x. Provide the ability to prioritise specific card usage from 1 to 99 with separate priority options for Anti-passback, Trace, PIN Violation, Normal, Not Found, Expired, Host Grant, Site Code and Time Zone card activities or violations.
xi. Allow the user the ability to assign an operator message per card event state.
xii. Upon editing card information, the updated information shall be sent automatically to the appropriate access control panel, when hardwired, with no other user intervention. If the port is dial-up, the entry will be stored on disk and shall be updated when connection is made to the remote loop. If the scheduler is used, then card updates shall be sent based on scheduling.
xiii. In a traditional (Wiegand) 5-digit card database, the numbers 0 and 65,535 shall not be valid card numbers as some devices transmit these numbers on an improper read.
xiv. In a 15-digit card database, the number 0 shall not be a valid card number as some devices transmit this number on an improper read.
xv. A card shall have the ability to be allowed to access one or selected accounts up to all available accounts.

- Access Levels

i. It shall provide the ability to define specific times of access, specific readers for access, provide a template of a defined access level detail, where changes can be made to the template and saved as a new access level detail and provide an access control tree structure that allows groupings of entrances. User shall have the ability to group program all entrances on the branch or make specific changes to individual entrances.

- Alarm Monitoring – Alarms Only View

i. Report alarm point activity.
ii. Provide colour for each specific alarm point action of “Alarm”, “Normal” and “Trouble”, conditions.
iii. Provide the ability to access the default floor plan graphic for any active alarm point by a right click option, to acknowledge any alarm, card, or reader activity based on priority and to bypass alarms in the system
iv. Execute alarm notification in all modes of operation.
v. Provide display of system activity with the higher priorities displayed at the top of the list with identical points stacked with a frequency count of each point’s change of state.
vi. Provide ability for the operator to acknowledge and clear alarms from display. Prior to acknowledgment, the user shall be allowed to enter a response per alarm. The system shall offer a means to require acknowledgement of an alarm before it can be cleared.
vii. Provide a display of the most current transactions in real time.
viii. Provide the ability for dynamic alarm monitoring of alarm points in real time on the system computer’s video display terminal.
ix. Provide an alarm view filter that is structured as a tree allowing the operator to select individual devices or groups of devices to be viewed.
x. Provide a “Panel Not Responding” alarm if communication to a panel is lost.
xi. Provide real time printing of alarms as they occur by line printing with a dot matrix printer or provide printing of alarms, one page at a time, using typical Windows page printing.

- Alarm Monitoring/System Control – Tree View

i. Provide the ability for dynamic alarm monitoring of alarm points in real time on the system computer's video display terminal
ii. Provide colour and icon shapes for each specific alarm point action of "Alarm", "Normal" and "Trouble", and "Shunted".
iii. Access control panels in the alarm tree, like alarm points, shall also indicate if they are in the buffered mode of operation as well as any "system" related alarm such as "Tamper" or "Primary Power Loss" or Loss of communication.
iv. Devices connected to the communication server shall provide additional popup information as to the communication port or IP connection the device is programmed for.
v. Provide a means to launch a Virtual keypad from an intrusion panel partition to monitor the physical keypad remotely and to administer programming changes via the Virtual keypad.

- Operator Database

i. The software shall allow the assignment of operator levels to define the system components that each operator has access to view, operate, change or delete.
ii. The ability to view, edit or delete cardholder sensitive information such as note fields, card number and PIN shall be definable by field per operator.
iii. Define the accounts that the operator has access to.
iv. Provide the ability to log operator actions in the history files.
v. Provide default language to be used based on operator's login.
vi. Provide specified time periods that the operator can log in.

- Reports

i. Provide reporting capability for printing of selected system transactions from the disk files by specific time and date selection, range from time and date to time and date, or from start time to end time each day of the selected date range.
ii. Provide feature to generate a history report for an alarm point(s) state. An alarm point state shall be defined as Normal, Alarm, Trouble, or Ajar.
iii. Provide feature to generate a history report of system alarms. A system alarm state shall be defined by panel and include any of the following information: communication, ground fault, power, panel reset, low voltage, panel tamper, and loop communication.
iv. Provide feature to generate a history report for a card(s) state. A card state shall be defined as Normal, Trace, Not Found, Anti-Passback Violation, PIN Violation, Time Zone Violation, Site Code Violation, or Expired card. Additional search criteria shall include cardholders that meet up to at least 3-note field restriction and filter the report with defined reader location(s).
v. Provide feature to generate a history report for system operator(s) activities. The report shall include time, date, operator name the device associated with the action and the type of action performed by the operator. Activities shall include but not limited to: acknowledged and cleared transactions, door and relay control such as unlock, lock; door and input control such as shunt, unshunt; login, logout, panel initialisation, panel buffer and panel unbuffer.
vi. Provide complete database reporting of all data programmed into the system data files.
vii. Provide a means to define how long a card holder has been in a defined area. This report shall allow the time to be accumulated representing an attendance report. The definable filters shall include time/date range, reader(s) definition, card number, card holder and note field. The output of the report shall allow sort options to include First Name, Last Name, Event Time, and Card Number. The sorted data shall be selectable as Alpha or Numeric sorting and Ascending or Descending.

viii. Provide feature to generate a report based on the frequency of usage of a card. The report shall allow the operator to define a time/date period, a minimum and maximum usage limit, a means to define which reader or readers should be used to filter the report and the ability to further define the type of card to be reported on based on note field selections. This report shall also provide a disposition function. The cards meeting the filtering criteria shall be acted upon based on the disposition setting. Disposition settings shall include but not be limited to: Report only, De-activate the card or Re-assign to a specified an access level. This report shall be available in the event scheduler. When defining when to run the report an option to select the number of previous days to run the report against shall be provided. As an example a scheduled weekly report for the last 14 days could generate allowing for an overlap of time if desired.

ix. Provide a means to create report templates. Report templates shall include, but not be limited to, History and Card Holder information. The templates shall be able to be assigned to a scheduler to run automatically per the scheduler settings.

- Tracking/Muster Report

i. A tracking feature shall allow the system operator to identify an area and the person(s) in that area, which shall be defined by readers representing an IN or OUT read status.

ii. Defined areas shall provide an automatic update of how many cardholders are in the area.

iii. A view displaying all card holders in a defined tracking or muster area shall have the ability to be sorted in columns where by clicking on the column the data in the column shall be sorted. At a minimum, the columns can be sorted by: Card Number, Status, Card Holder, Reader, and Time/Date.

iv. A Muster area shall be defined by a reader(s) used to "muster" individuals in the event of an emergency.

v. Reports shall be generated for all muster or tracking areas in the system.

vi. Tracking areas shall include "nested" areas. Nesting allows for various reports from a large area to smaller areas within the large area.

vii. A Tracking and Muster area screen shall be continually updated with the most recent card activity, therefore minimizing the time required generating a report.

viii. A history-priming feature shall load history activities for the defined amount of hours when the software is started. This priming feature shall be implemented in the event that the system computer is offline when a muster call is initiated, thereby allowing the implementation of the tracking and muster features of the software. The history priming time shall be operator selectable in 1-hour increments up to 99 hours.

- Time Zones

i. Time zone definitions shall include Starting time, Ending time, Days of the week, and Holiday override.

ii. Minimum time zones that can be assigned to a panel shall be 63 and maximum unlimited.

iii. Holidays shall be definable in two different time zones allowing different time schedule to be programmed for each holiday type.

- Floor Plan Graphic

i. Provide the ability to import floor plan graphics stored in a WMF format and to associate all hardware devices (access, intrusion) to floor plan graphics allowing the user to control and monitor the system.

ii. Provide the ability to link floor plan graphics together in a hierarchy fashion and allow multiple floor plan views to be displayed simultaneously.

- Special System Functions

The manufacturer of the system shall provide in the system software the following unique applications as standard:

i. Guard Tour

- Guard Tour shall allow the operator to program a series of guard check points that must be activated to accomplish the task of a Guard Tour.
- The check point shall be either reader points or alarm contact points or a mixture.
- The Guard Tour can be timed sequential allowing travel time between points with +/- tolerance. This type of tour shall allow alarms to be generated for early, missed or late events.
- The Guard Tour can be un-sequenced with no time parameters.
- The Guard Tour shall be started by two methods, Manual or Scheduled by the access control system scheduler.

ii. ID Badging System/Video Image System

- Allow any card data fields to be assigned to a badge.
- Allow a stored cardholder image to be associated to any background. Each cardholder shall have any one of the background layouts associated to it.
- Provide the ability to create temporary or permanent badges.
- Badges shall be printed without the need to assign an access level or access control card number. Numbers and access levels may be assigned after the print process.
- Provide image export capability. Image shall be exported utilizing the cardholder's name as the file name in .jpg format.
- Provide unlimited custom badge layouts (only limited by the hard disk capacity).
- Provide 24-bit (16.7 Million) color palette for background design or foreground text and all fonts supported by Windows.
- Provide import capabilities of background information by video camera or via BMP, JPG, or TGA files.
- Provide for multiple bitmap images to be imported onto the badge layout.
- Provide video capture capability from a compatible TWAIN device, DirectX device or from a compatible video capture device, such as a high-resolution color camera.
- Provide ability for multiple card enrollment/badging stations on networked system.
- Provide signature capture or import capability for up to 99 signatures that can be previewed in the cardholders badge or printed on the cardholder's card.
- Provide the capability to have a front and back layout selected for a cardholder and the ability to print the card in one step (requires suitable printer) without the need to reinsert the card.
- Provide the capability to encode a magnetic stripe with information from any of the card data fields to include, but not be limited to: First Name, Last Name, Card Number, Activation date, Expiration Date or any data from the card holders note field.

iii. Networking

- Provide networking capabilities (LAN or WAN) as allowed by the computer's operating system license.
- The access control software shall support two networking methods. By default, Domain controlled networks shall be the standard configuration providing secure networking communications. The ability to work on less secure peer-to-peer (Workgroup) networks shall be allowed for lower security installations. The functionality shall be one or the other and not run in both modes at the same time.
- Provide the ability for a network system to support concurrent users up to the license limit, i.e., one station adding cards and making badges, another station monitoring alarms, yet another running data base report, another controlling door openings and alarm shunting, and so on.
- The workstation shall have the same UI (user interface) functionality as the Server, except the workstation shall not be able to perform database maintenance functions.

2. System Products

- Communication Ports And Loops

The computer shall have two serial communication ports. If additional ports are required, they shall be provided by installing additional compatible multi-port cards. Instead of communication ports a LAN/WAN solution is acceptable using standard 10/100/1000 Ethernet connections.
System communication ports shall be expandable up to a maximum of 255 ports.
Each communication port shall support one of the following configurations. Local direct connect loop or multiple remote loops via modem. A local RS485 multi-drop communication loop shall support up to eight intelligent controllers, 128 readers or 1024 output relays or monitor up to 1024 alarm points. Remote configuration shall be supported.

- Video Image/ID Badging System

The Video Image/ID Badging System shall include a personal computer running the badging software, camera, SVGA monitor, Video/Badge Printer, and Signature Capture Pad (optional).

- Front End Software Specifications

i. Databases: The software shall provide edit, add, delete, search, sort, and print options for records in selected databases.

ii. Printer Output: The software shall direct user-selected activity to the Windows supported printer.

iii. Monitor Display: The software shall display all system activity on a colour monitor in real time, except for remote locations configured as dial-up. The software shall allow a WAV file to be played upon all alarm conditions. The software shall provide an acknowledge function for all incoming alarm messages that are defined for alarm acknowledgment.

iv. Disk Storage: The software shall store user-selected activity on the hard disk. Report options shall recall selected history information from the hard disk. The user may request report information based on selected cardholders, specific areas and/or specific times. The software shall allow archiving by defined dates.

v. English Descriptions: The software shall support descriptive names for all database entries. The card database shall include name, number, PIN, access level, status, activation, and expiration date or limited usage and 40 user-defined fields.

- Front End Software Requirements

i. Password Protection: The software shall provide multi-level password protection, with user-defined operator name/password combinations. Name/password log-on shall restrict operators to selected areas of the program. The software shall allow the assignment of operator levels to define the system components that each operator has access to view, operate, change or delete.

ii. Action Messages: The software shall allow recall of user created text messages upon any condition.

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iii. Manual Panel Control: The software shall allow manual control of selected inputs, outputs and groups of outputs. Manual panel control shall include pulse, timed pulse, and energize/de-energize or return to time zone options for output points and shunt/unshunt or return to time zone options for input points. For entrances and readers manual control shall include but be limited to Lock, Un-Lock, Disable, Card only, Card-Pin only, Pin only, exit only and site code only. For partitions monitored by the intrusion panel the control shall include but not be limited to arm away, arm stay, disarm, refresh and provide a virtual keypad for the partition. For zones monitored by the intrusion panel the control shall include but not be limited to bypass, unbypass and refresh. Intrusion panel output control shall included activate, deactivate and refresh.

iv. Video Imaging/ID Badging:

a The Video Image/ID Badging software shall store cardholder images on hard disk. Stored images shall be displayed upon request.
b Custom card backgrounds shall be displayed upon request.

II. ACCESS CONTROL FIELD HARDWARE DEVICES

The security management system shall be equipped with access control field hardware required to receive alarms and administer all access granted/denied decisions. All field hardware shall meet FCC CE C-Tick requirements. The system shall include the 2-reader intelligent controller.

The IP-enabled controller is an advanced access control panel capable of providing solutions for medium to large applications. The controller provides power and flexibility with its 32-bit CPU architecture, TCP/IP protocol support, flash memory for firmware and large local card holder database.
The controller is designed to operate off-line, making access control decisions independently from a PC or other controlling device. It can also be connected to a host computer for system

configuration, alarm monitoring and direct control. Connectivity to the host computer is accomplished via TCP/IP network connection.
The board combines intelligent controller and reader interface into one complete unit. It connects for two readers via Wiegand controlling two doors. The controller can support up to 62 doors via RS485 multi-drop communication where 30 downstream controllers are connected to the gateway controller. This architecture can reduce the usage on LANs by using only one TCP/IP address to 62 doors. It accommodates a card database of 55,000 cards, and a transaction buffer of 45,000 transactions. It is designed with tile mounting configuration.

Specifications

Database:
• Cardholder capacity: 55,000
• Transaction storage: 45,000
• Flash programming for firmware revision updates
• Access level: 128
• Holidays: 255
• Time zone: 127
• Card reader formats: 128 Wiegand format support
• Credential facility codes: 8
• Dedicated tamper alarm
• Dedicated power fail alarm
• Real time clock:
- Geographic time zone support
- Leap year support
• Embedded web server to configure network attributes

Environment:
• Temperature: 0 to 50° C operational
-55 to 85° C storage
• Humidity: 0 to 85% RHNC

Communication:
• Ethernet port connected to TCP/IP network as master panel
• RS485 multi-drop connection for downstream panels

Onboard I/O:
• 2 Readers, expandable to 62 readers per gateway controller
• 8 Supervised inputs
• 4 Relay outputs

Operational Functionality:
• Operational modes:
- Card only
- Card and PIN
• Maximum site codes: 8 digit
• Anti-Passback support:
- Local
- Global

- Forgiveness
• Interlocks: 256

Approvals:
• CE/FCC/C-TICK

III. Proximity Card:
Access cards shall be used with access readers to gain entry to access controlled areas / zones(e.g.; doors, gates, etc.) and to hold information specific to the user.

- Provide (specify quantity) (badge protectors with clips or other accessories), of a type acceptable to the Architect.

IV. Biometric Finger Print Reader

Biometric Reader with Enrollment Kit & Enrollment Software (To be used for Entry purpose), Finger Print with Mifare , Support 2K fingerprint (Included application software support max. 4 readers),

V. Proximity Reader

Proximity Reader shall be compatible with all standard access control system.
Available with either wiegand or clock and data output.
Shall be Read HID card with formats up to 85 bits.
Read range 22 inches. Or depends on cards

Boom Barrier :-

Boom barrier Shall be High speed Hydraulic Type and having following specification:-

- Automatic Barrier for Beams up to 7 meter.
- Use Frequency 100%.
- Opening and closing time from 4 to 8 sec.
- Load bearing housing in steel protected by cataphoresis treatment and powder paint Ral 2004.
- Protection class- IP44.
- Electric Motor Power 220W.
- Thermal Protection at 120degree centigrade built into motor winding.
- Single phase motor with two rotation directions.
- Electric motor power supply 230Vac(+6%-10%), 50(60) Hz
- Die-Cast Distribution Flange.
- Adjustable Deceleration angle by cams.
- Automatically activated cooling Ventilation.
- Designed to accommodate Rectangular with skirt Beams.
- Built in electronic control Equipment.
- Motor rotation speed 1400-2800rpm.

19.00 BULDING AUTOMATION SYSTEM

1.0 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES:

1.1 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

BMS Building Management System
GUI Graphical User Interface
POT Portable Operator's Terminal
DDC Direct Digital Controls
LAN Local Area Network
PICS Product Interoperability Compliance Statement

1.2 ARCHITECTURE:

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet, and Modbus technology communication protocols in an interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-1995, BACnet TCP to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet at all levels.

C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. **Components or controllers requiring "polling" by a Master / Global / Host to pass data shall not be acceptable**.

D. Structured Query Language (SQL) or Java Database Connectivity (JDBC) or ORACLE compliant server database is required for all system database parameter storage. This data shall reside on a server for all database access. **Systems requiring proprietary database and user interface programs shall not be acceptable**.

E. Two (2) level hierarchical topology is required to assure fast system response times and to manage the flow and sharing of data. Systems Requiring Router, Gateways are not acceptable.

1.3 WEB BROWSER CLIENTS

The system shall be capable of supporting an unlimited number of users using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. **Systems requiring additional software (to enable a standard Web browser) to be resident on the DDC / client machine, or manufacture-specific browsers shall not be acceptable.** The Web browser software shall run on any operating system and system configuration that is supported by the Web browser.

The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

The Web browser client shall support at a minimum, the following functions:

User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

Graphical screens developed for the GUI shall be the same screens used for the Web browser client.

HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

Storage of the graphical screens (Static) shall be stored in DDC directly and should not depend on any other hardware.

The Web page shall get automatically refreshed without any user intervention.

Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

Modify common application objects, such as schedules, calendars, and set points in a graphical manner. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator and set holidays

View logs and charts

View and acknowledge alarms

The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to adjust their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

1.4 SYSTEM DESCRIPTION & INPUT OUTPUT SUMMARY

The proposed system shall be a Direct Distributed Digital Control (DDC) system. It shall be a PC based system and shall combine latest state of the art technology with simple operating techniques. The entire Monitoring of Building Management System (BMS) shall be comprise of a network of interoperable, stand-alone digital controllers communicating on an open protocol communication network to a host computer within the facility and communicating via the Internet to a host computer in a remote location. The BMS shall communicate to third party systems such as Chillers, VAVs, Energy meters, UPS, DG, Lifts, VFDs & HT/LT circuit breakers, access control systems, fire-life safety systems and other building management related devices with open, interoperable communication capabilities.

The BMS framework shall utilize built-in Internet connectivity to a broad range of distribution partners in the building automation, energy services, power/utility, and industrial sectors. The Framework shall bring together the ongoing computerization of control applications under single integrated system architecture.
The features shall be distributed both physically and functionally over the field controllers. Microprocessor based Direct Digital Distributed Controllers (DDC) shall interface with sensors, actuators and environmental control systems (i.e. HVAC units, chillers, pumps, fans, lighting etc.) and carry out followings functions:

a. Individual input/output point scanning, processing and control.
b. Centralize operation of the plant (remote control).
c. Static / Dynamic graphic details of plant and building.
d. Energy Management through optimization of all connected electrical and mechanical plants.
e. Alarm Detection and early recognition of faults.
f. Time, event and holiday scheduling as well as temporary scheduling.
g. Prevention of unauthorized or unwanted access.
h. Communication interface and control.
i. Suggestive preventive maintenance for all equipment as well as own error diagnosis.
j. Report generation.
k. Optimum support of personnel.
l. Data Visualization Tool

These Controllers shall be capable of functioning on a stand-alone mode i.e. in case of loss of communication with the central control station / Server, these shall function independently. DDC shall have microprocessors built-in as standard, which control the respective operation centers based on the required logic and also offer fast communication of data via the network communication system. The local access to these shall be either through an in-built display with keypad for each outstation or through a portable operator's terminal. The controllers shall be capable of executing advanced control algorithms like Optimum Start stop, PID control, auto PID tuning and schedule management. They shall also execute logic functions based on time and/or event. Totalization and averaging functions shall be an inherent feature of the controller.
Each stand-alone intelligent DDC Controller shall have a **single 32 bit processor**, on board Ethernet connectivity. These shall also control any other operations on the floor and shall be sized to suit the operation centres or system requirement. This shall help in reducing the site electrical installation.

The number of controllers for central plant room equipments shall be decided by the contractor. Overall, the system shall be provided with 15% spare capacity, with spare of at least 15% points on each controller.

There shall be one BMS control station located in Control Room. The Operator Station should use a simple Web Browser in conjunction with the BMS Server software. The Computer shall be sized to cover the graphic display memory, planning information, software & data storage requirement. The display shall be in the form of dynamic color graphics and text format with menu driven pop-up windows and help facility.

The following software packages shall be loaded into the system as minimum standard:-

a. Complete system operational software

b. Site specific data manipulation software

c. Graphics software

d. Alarm indication software

e. Internet Enabled Remote Monitoring Package.

DI=DIGITAL INPUT; AI=ANALOG INPUT; DO=DIGITAL OUTPUT; AO=ANALOG OUTPUT

2.0 CENTRAL STATIONS SOFTWARE AND HARDWARE

2.1 CENTRAL STATION SOFTWARE

A. A central server, located at Control Room, shall be provided. The server shall support all DDC's connected to the customer's network whether local or remote.
B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, PSTN or dial-up connection.
C. It shall be possible to provide access to all DDC & 3rd party integration units via a single connection to the server. In this configuration, each DDC can be accessed from the Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the Local Area network.
D. The server software shall provide the following functions, at a minimum:

- Complete control and monitoring of IBMS system from colour graphics pages on the machine, or from a remote web browser.
- Full client-server operation.
- SQL / JDBC / ORACLE Database.
- Comprehensive alarm handling with alarm retransmission and logging.
- Scheduled recording of logged data from DDC.
- Management of multiple controller occupation times.
- Multilevel security system.
- International language support
- Display of HTML pages from company Intranet, or Internet.
- Display of live, logged, or recorded data in multi-trace graphs.
- Simple engineering path using drag and drop operations.
- Self-learning of all local networks.
- Help file in PDF format for viewing or printing.
- Access to the configuration mode of devices.
- Display all devices on the system connected via LANs, internet works, autodialed links and Ethernet Network connections.
- Customised program creation environment.

The BMS software shall be simple, flexible and convenient to use such that an operator with minimal programming knowledge can use it to perform control / monitoring and to build programs for control applications, graphics to generate management information systems (MIS) reports. As well, on higher end it shall be possible to create customized programs to suite the site requirement by a software programmer. All necessary documents required to make customization possible should be available along with the software without any additional charge.

The operating system shall be the Microsoft Windows XP / Windows 7 / Windows 2008 Server / Enterprise /Professional 32 / 64 bit multitasking environment. The networking software shall use the TCP / IP LAN protocol. The system shall be capable of supporting up to 25 simultaneous operator workstation connections but however presently we need Five User Option.

2.2 Monitoring and control functions

Monitoring:

The system shall support data acquisition using periodic scanning, exception reporting or on operator request. The system shall support a range of scan intervals, ranging from less than 5 second up to several minutes as desired / required. The system shall allow certain selected points to be scanned more often / faster than other points.

The communication techniques shall be optimized to minimize network traffic while providing good system response and reliability. The system shall also provide utilities to compile aggregate statistics on communication link usage.

Control:

Control transactions issued by the operator shall be communicated to control devices using a write followed by read to ensure the integrity of the transaction. If the read following the write to the device indicates that the control action has failed, the operator shall be informed by means of a control failure alarm. The priority of the control failure alarm shall be configurable by the user

2.3 System Database

The system shall provide a real-time database incorporating data from analogue, logical or pulse inputs. The database shall be configurable by the end user without the need for any programming and shall be able to modify on-line without interrupting operation of the system. In addition to point based information, the database shall also provide historization capabilities for analogue, digital, pulse; event based information and calculated values. This information shall be accessible by all facilities of the system such as custom displays, reports, trends, user written application, etc.,

The real-time database shall use suitable data structures to collect and store the following categories of data, as minimum.

- Access points
- Analogue points
- Status points
- Accumulator points
- Historical data

- Event data

The facility shall also exist to accommodate user defined data structures.

Each of the point database structures shall be comprised as a composite point with a number of associated parameters that may be referenced relative to a single tag name. Specifically, each of these parameters shall be accessible by various sub-systems such as the graphical operator interface, report generation system and application program interface in a simple format without the need to know any internal storage mechanism.

The system shall maintain portions of the data base requiring frequent high-speed access as memory resident information and other less frequently accessed data as disk resident data.

Database backup shall be possible with the system on-line including backup of historical based data. The database backup shall be part of GUI software & shall be possible to configure automatic backup at regular interval without any user interference / attention. All other backup such as graphic pages / drawing etc can be windows based where simple copy & paste should be enough for taking backup other than database. Long term storage of this data shall be possible using the zip drive. The system shall have the provisions for importing this data at later date for analysis and long terms MIS reports.

Point data shall be stored in a composite point database structure that provides a wide range of configurable information including but not limited to:

- Point name and description
- Multiple locations for data storage and device scanning addresses.
- Scan period
- Multiple dead-band or hysteresis settings
- Monitoring and control access restriction information.
- Location of operator alarm handling instructions
- Location of ancillary information associated with the point.

2.4 Historical data storage

Collection of historical point data shall be configurable as part of the point definition. Once configured, this data shall be collected automatically. Historical data collection shall be provided for both snapshots and averages with intervals ranging from 5 seconds to several hours.

The system shall provide the necessary means to easily locate the particular value of interest for any of the historical points. The graphical operator interface, trend, report generation and application interfaces shall be able to access historical data.

2.5 Trending

The system shall provide flexible trending allowing real-time, historical or achieved data to be trended in a variety of formats. In addition, trend data types shall be able to combine to allow for comparisons between data e.g. current real-time data versus archived data. The system shall provide trending capability with following functions.

- Real time trending
- Historical trending
- Archived history trending
- Trend scrolling
- Trend zoom
- Export option / Copying of currently displayed trend data to the clipboard for pasting into spreadsheet or document.

The system shall allow the trending of a minimum of 5 points in a single trend display set. For each trend set display it shall be possible for operators to configure the number of historical samples and ranges displayed. Points configured in trend sets shall be changeable on-line.

Operators shall be able to zoom in on information displayed on trend sets for closer inspection by dragging out an area of interest with the mouse or other pointing devices. From such a selection, it shall be possible to copy the underlying data to the windows clipboard for subsequent pasting into spreadsheet application such as Microsoft excel

2.6 Alarm Management

The software shall include a well organized alarm management facility to enable the operator to react quickly and efficiently to alarm conditions. Apart from the specific points identified for alarm annunciation in the I/O points schedule, the alarm types supported shall included:

- Very high value alarm
- Very low value alarm
- Large deviation alarm
- Rate of change alarm
- Unreasonable value alarm
- Delay to avoid nuisance alarm / short time change in value

The system shall permit any of these alarm types to be applied to the analog and accumulated points.

- The software shall permit at least 90 levels of alarm priorities to be assigned to each alarm ranging from the lowest to the highest. These levels shall be easily distinguished by the manner in which they are presented such as the color of the alarm message, blinking of the alarm message, varying audible alarms, etc., All alarm shall be logged in the event / alarm file and / or on the alarm printer. On acknowledgement of an alarm, it shall be possible to automatically issue a reset command to the controller so as to attempt to reset the alarm point.

2.7 Reporting

The system shall support a flexible reporting package to allow easy generation of report data. The reports provided shall include pre-configured standard reports for common requirements such as alarm / event reports and custom report generation facilities that are configurable by the user.

The following pre-formatted reports shall be available on the system:

- Alarm / event report

- Operator trail report
- Point trail report
- Alarm duration report
- All point report
- Point attribute report
- Lockout summary
- Over-ride summary

Configuration of these reports shall only require entry of the schedule information, and other parameters such as point name or wildcard, filter information, time interval for search and destination printer to fully configure the report. No programming shall be required

The requirement of the above mentioned reports shall be as follows:

Alarm/Event Report

This report shall be summary of all events of a specified type for nominated points occurring in a time period. The time period may be specified as an absolute start and end date and time, or as a period to the current time.

Operator trail report

This report shall be a summary of all operator actions relating to a specific operator in a specified period.

Point trail report

This report shall be provided to produce a summary of all events of a specified type occurring in a period on nominated points.

Alarm duration report

This report shall be provided to calculate the total amount of time a nominated point or group of points has been in an alarm condition over a given time period.

All point report

A report shall be provided to produce a list of point information, including point name, description, point type, engineering units, and current values.

Point attributes report

A report shall be provided for summaries of the points selected as per the following criteria:

- Out of service
- Alarm suppressed
- Abnormal input levels
- In manual mode.

Over-ride summary

This report shall be used to provide the summary of all points / commands that have been over-ridden by the operator.

2.8 Time Schedules:

The system shall include the facility for time scheduling activities on both a periodic and one-off basis. All time schedules shall be configurable via the Operator workstation. Each time schedule entry shall consist of:

- Date
- Time
- Point name
- Point Parameter
- Target Value
- Type of scheduling

The available time schedule type shall include:

Daily – to be executed everyday

Workday – to be executed on the week days

Holidays – to be executed on holidays

Individual days – to be executed on a particular day

The system shall also have the provision for programming temporary schedules that over-ride the normal schedule.

2.9 Energy Monitoring & Analysis:

Energy Monitoring & Analysis should be integral part of GUI. It shall support minimum of 50 Energy points for analysis purpose. The software shall provide the following feature but are not limited to,

a) It shall be possible to generate & view detailed Daily, Weekly & monthly graphs of the energy meter / point identified.
b) It shall be possible to see and analyze the total energy usage in a building and also shall be possible to identify by which system is major user of the energy.
c) It shall be possible to compare the energy points week against week, day against day in a month, identify Maximum, Minimum & average daily values & Energy usage for different periods of time of the day.
d) It shall be possible to make cost and consumption analysis or CO2 reports on consumption.
e) Based on the energy consumed it shall be possible to rank the systems or building (in case of multi location buildings)
f) Software shall allow the user to compare the predicted / forecasted energy or based on historic performance with current performance.
g) It shall be possible to create energy signature with respect to ambient / outside temperature of the day

h) Software shall allow the user to identify the exceptions happened in the system due to which energy consumption was increased.
i) It shall be possible to compare the energy consumption after introducing a energy saving strategy for further fine tuning or to visualize the savings achieved.

2.10 Operator Interface:

The operator interface provided by the system shall through an intuitive graphical user interface and shall allow for efficient communication of operational data and abnormal conditions. It shall provide a consistent frame work for viewing of information. Critical areas (such as alarm icons) shall be visible all the times. A predefined area on the screen shall provide operator messaging, and this area shall also be visible at all times.

The operator interface shall be interactive and based on graphics and / or icons. Standard tool bar icons and drop-down menus shall be available on all standard and custom display to allow easy access to common functions.

The system shall provide an operator interface with the following minimum capabilities:

- Window re-size, zoom in, zoom out.
- Dedicated icons and pull down menus to perform the following:
- Associated display
- Alarm summary
- Alarm acknowledgement
- Previous display recall
- Graphic call-up
- Trend call-up
- Point detail
- Current security level
- Alarm annunciation
- Communication fail annunciation
- Operator message zone.

2.11 Area assignment / area profile

Each operator shall be assigned one or more specific areas / functions of the facility with the appropriate monitoring and control responsibility. An area shall be defined in this context as a logical entity comprising of a set of points in the system. This is turn may represent a physical space in the facility or a particular utility or a particular equipment.

The system shall provide the facility to create area profiles, which combine areas and time periods, and which can be assigned to operators with the same area access requirements. By using area profiles in this way, area access can be specified to apply during certain time periods, allowing different areas of access at different times of the day or week.

2.12 Command partitioning

It shall be possible to assign to each operator a set of allowed commands / operating for each assigned area. With this feature, it shall for example be possible to configure an operator to set a digital point to On, but to disallow the same operator from setting the same digital point to OFF.

2.13 Standard system displays

The following displays shall be included as part of the system:

- Alarm summary display
- Event summary display
- Point detail template displays
- Trend set template displays
- Communication status displays
- System status displays
- Operator scratch-pad display.

2.14 System Status Displays

These shall display the following information

- Points in alarm condition pending acknowledgement
- Points which remain in an alarm condition state but which have been acknowledged.
- Communication failure
- Printer Status
- Operator workstation status
- Controller status

2.15 Administrative Displays

The system shall provide the following full screen display

- Master system menu
- Report summary
- Alarm summary
- Event summary
- Display summary.
- Area assignment
- Holiday assignment
- History assignment
- Push-button assignment
- Operator definition
- Operator message board
- Events archive and retrieval
- Time period summary

2.16 Other requirements

It shall be possible to launch any windows based applications, such as Microsoft word or Microsoft excel, from within the operator interface.

2.17 Help Facility

Software shall be provided to facilitate programming and storage of the system operation manuals in the hard-disk. The operation manual shall be retrieved by On Line Help mode so as to enable the operator to self learn the system operation, command, or function as and when needed.

This `help' facility shall be made available to the operator by use of a dedicated key or a single key click on the mouse. A minimum help shall be available for every menu item and dialogue box.

The facility shall contain both text and graphics to provide information about the selected function directly.

The information provided shall be in simple clear language and shall be possible to search the help based on typical word included in the process.

When a point is overridden by operator command from an operator workstation or a local workstation, an alarm message shall be output to the appropriate alarm printer and to respective operator workstation. Alarm messages shall require operator acknowledgement.

When a point returns to normal, the event shall be recorded in control stations as 'Return to Normal'.

The Operator workstations shall be capable of displaying a list of all points in alarm for the building in a single summary. Systems which require the operator to make a separate summary for alarms shall not be acceptable. The software shall also provide details of particular alarm occurred on a point.

2.18 21 CFR Part 11

The computer system software and hardware should be 21 CFR part 11 compliant.

Therefore, vendor to carry out system qualifications accordingly

All instruments, software supplied shall be validated, tested and certified complying to 21 CFR Part – 11.
Contractor shall strictly follow the procedures as laid down in the necessary guidelines.

3.0 3rd Party System Integrator Units:

A. The 3rd party Integration unit shall provide the interface between Ethernet LAN and the 3rd party field control devices such as DDC or PLC or any other devices which need to be integrated. These shall also provide supervisory capability of functions over the devices connected to it. **The purpose of using these units should be limited to integrate devices only, not for any DDC interface with GUI, provided by others.**
B. The Unit must provide the following hardware features as a minimum:
   a. One no. on board RS-232 port
   b. One No. on Board RS-485 port
   c. Provision to include / add additional communication card
   d. Battery Backup
   e. Minimum RAM of 128 MB & Flash of 64MB

C. The Unit must communicate over TCP/IP with communication speed of 10/100MBPS.
D. The Integration unit shall have built in drivers for open protocol such as
    a. Bacnet over MSTP
    b. Bacnet over IP
    c. Modbus over MSTP
    d. Modbus over IP
    e. Lon FTT
    f. Lon IP
    g. Mbus over TCP
    h. Mbus Serial
    i. SNMP

    If the above drivers are add-on products, it shall be made available / considered while selecting the unit & the same to be confirmed in writing.

E. The Integration unit shall provide flexibility of adding communication ports (RS485) by adding communication cards, minimum one slot, when required rather than adding additional unit itself.
F. The Integration unit shall have inbuilt JAVA engine and it shall be possible to configure the IO, if required, of the 3rd party devices.
G. The Integration unit should be capable of handling multiple protocol simultaneously and should not be restricted to single protocol.
H. The Integration unit should have inbuilt memory for program storage.
I. The Integration unit should automatically backup its database for the user defined interval.
j. User authentication should be integral part of the unit.
K. All vendors are required to provide the documentation highlighting the capabilities mentioned above.
L. All units shall have LEDs for fault / status identification such as
    a. LAN active (one per port in case of multiport units)
    b. LED to display proper functionality / Status of the unit.
    c. LED to display healthiness of CPU of the unit.

4.0 DIRECT DIGITAL CONTROLLER

4.1 DIRECT DIGITAL CONTROLLER (DDC) HARDWARE REQUIREMENT :

1) DDC controllers shall be capable of fully "stand- alone" operation i.e. In the event of loss of communication with other DDC's or Control Station, they shall be able to function on their own.

2) The controllers shall consist of **single 32 bit microprocessors for reliable throughput**, with EEPROM based operating system on BACNET

3) The memory available to the controller board should serve as working space and there should not be any limitation of using particular function block other than the memory.

4) The controllers shall be UL listed and conforming to CE.

5) The controller shall have support programs built in RAM for minimum of 120 hours in the event of a power failure and it shall be possible to fit any battery thus expanding the time limit to 5 years. An alarm shall be generated on low battery voltage. The battery shall not be required to supply power to actuators, valves, dampers etc.

6) DDC shall have embedded **TCP/IP connectivity** so that it can be hooked into the Local Area Network (LAN) provided by the client / can be on dedicated network created by the vendor. Each DDC can be accessed from the **Graphical User Interface (GUI)** or from a standard Web browser (WBI) by connecting to the server.

7) Controller shall have capability to communicate with other controllers for any interlock or data sharing using peer to peer technology. The Controller which route the messages or data sharing through the system or any intermediate hard ware / controller shall not be acceptable.

   Vendor to demonstrate this capability during the commissioning time and the same shall be verified at the time of handing over.

8) Each controller shall have RS232 port built on to it so that any trouble shooting required at field level can be carried out without removing the controller from the network (LAN).

9) All controllers shall accept **230V, 50Hz** Uninterrupted power supply, provided by end user, directly so that the in between hardware such as transformers and SMPS are avoided.

10) Controller shall support DHCP addressing over Local Area Network (LAN) so that the static IP requirements are reduced however a single static IP shall be provided for system so that it can be hosted on to internet in consultation with end user / consultant.

11) All controllers shall have capability to provide 24V DC auxiliary power supply for the sensor which requires power, however the same shall not be required to high power consuming devices / equipments such as actuators, dampers etc.

Vendors to provide details on the same at the time of offer.

12) The Controllers shall have proportional control, Proportional + Integral (PI) Control, Proportional plus Integral plus Derivative (PID) Control, Two Position Control and Time Proportioning Control and algorithms etc, all in its memory and all available for use by the user, i.e. all the control modes shall be software selectable at any time and in any combination. The analog output of Proportional Control, PI Control, and PID Control shall continuously be updated and output by the program shall be provided. Between cycles the analog output shall retain its last value. Enhanced integral action in lieu of Derivative function shall not be acceptable.
Automatic loop tuning facility should be available to tune the loop at regular interval and adjust the gain or the integral / derivative time.

13) The controllers shall have a resident real time clock for providing time of day, day of week, date, month and year. These shall be capable of being synchronized with system / time master clocks in the network.

   Upon power restoration all clocks shall be automatically synchronized to the time master controller which will be set during the commissioning phase.

14) The microprocessor based DDC's shall be provided with power supply, A/D and D/A converters, memory and capacity to accommodate a maximum of 128 input/output (I/O) hardware points (with or without an expansion board).

15) If the controllers provided by the contractor have the configurable plug in function cards, then the following minimum specifications shall have to be met :

i) The cards shall provide for analog or digital, input or output, hardwired connections to the installed plant.

ii) The quantity and combination of these cards shall be determined by the requirements of the plant in that location with the concurrence of the Owner/ Consultant.

16) The DDC's shall have 15% spare capacity for each type of point (digital/analog input/output) to give flexibility for future expansion.

17) All DDC controllers shall have 10 / 12 bit A/D resolution and be capable of handling voltage, milli-ampere, resistance or open and closed contacts inputs in any mix, if required.

Analog inputs/outputs of the following minimum types shall be supported:

a. 4-20 mA.
b. 0-10 volts.
c. 2-10 volts.
d. Resistance Signals (either PTC or NTC such as PT 100, PT 1000, PT 3000, NTC20K)

Digital input/output types to be supported shall be, but not limited to the following:

i) Normally-open contacts.

ii) Normally-closed contacts.

iii) Pulse inputs

Modulating outputs shall be true proportional outputs and not floating control type.

18) It shall be possible to change the analog inputs to accept any of the above depending upon the site condition or system requirement using a jumper. **The DDC which is configured using software trigger / switch shall not be acceptable.**

19) Controller's packaging shall be such that, complete installation and check out of field wiring can be done prior to the installation of electronic boards.=

20) All board terminations shall be made via plug-in connectors to facilitate trouble-shooting, repair and replacement. Soldering of connections shall not be permitted.

21) Controllers shall preferably be equipped with diagnostic LED indicators with at least indication for Power up Test OK, Watch dog and Bus Error. All LED's shall be visible without opening the DDC cover.

22) It shall be possible for the controllers to accept regulated uninterrupted power supply to maintain full operation of the controller functions (control, logging, monitoring and communications) in the event of a localized mains failure.

23) Controllers requiring fan cooling are not acceptable.

24) There shall be the facility for accessing controller data information locally, via a portable plug-in color LCD display which will be common to all controllers and normally removed to prevent unauthorized tampering. In either case, access to the system thus provided shall be restricted by passwords in the same way as at the main operator terminal.

25) In case the Portable operator Terminals (POT) are required to programmed the controllers, sockets shall be provided for same. Attachment of POT shall not interrupt or disable normal panel operation or bus connection in any way.

26) The controllers shall be housed in vandal proof boxes to protect them from tampering by any unauthorized personnel. All DDC controllers used in plant room spaces and external application shall be housed IP66/IP54 rating enclosures.

27) It shall be possible to add new controllers to the system without taking any part of the system off-line.

28) All DDC should have XML web service option which can be enabled in later stage for any higher interface with IT infrastructure or any other service.

29) Individual DDC should be BTL (Bacnet Testing Lab) tested.

4.2 DIRECT DIGITAL CONTROLLERS CAPABILITIES :

1) The Controllers shall have a self analysis feature and shall transmit any malfunction messages to the Control Station. For any failed chip the diagnostic tests, printout shall include identification of each and every chip on the board with the chip number/location and whether the chip "Passed" or "Failed" the diagnostic test. This is a desired requirement as it would facilitate trouble-shooting and ensure the shortest possible down time of any failed controller. Controllers without such safety feature shall be provided with custom software diagnostic resident in the EEPROM. The tenderer shall confirm in writing that all controllers are provided with this diagnostic requirement.

2) Operating system (O.S.) software for controllers shall be EPROM resident.

Controllers shall have resident in its memory and available to the programs, a relevant library of algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences.

3) In the event of failure of communication between the controllers and/or Control Station terminal, alarms, reports and logs shall be stored at the controllers and transmitted to the terminal on restoration of communication.

4) In the event of memory loss of a Controller or the expiration of back-up power, on start-up of the unit the necessary data-base shall be downloaded manually so that the logic built are verified by the user. However, controllers requiring a manual intervention for the re-boot of software are not desired.

5) Where information is required to be transmitted between controllers for the sharing of data such as outside air temperature, it shall be possible for global points to be allocated such that information may be transmitted either on change of incremental value or at specific time intervals.

6) Controllers must be able to perform the following energy management functions as a minimum,

a. Time & Event programs
b. Holiday Scheduling
c. Maximum and Distributed power demand
d. Optimum start and stop program
e. Night purge
f. Load reset
g. Zero energy band
h. Duty cycle
i. Enthalpy analysis and control
j. Run Time Totalization
k. Sequencing and Optimization
l. Exception scheduling

- Detailed description of software features and operating sequence of all available energy management software shall be submitted with the tender for evaluation by the consultant.
-

7) The DDC Controllers shall have Adaptive Control capability whereby the control software measures response time and adjusts control parameters accordingly to provide optimum control. The software shall allow self-tuning of the variable control loops (all or any of P, P+I, P+I+D) of the AHU's and chiller system so as to provide the most efficient and optimized controls at different load conditions. The energy management programs shall update their parameters based on past experience & current operating conditions.

8) Alarm Lockout shall be provided to prevent nuisance alarms. On the initial start up of air handler and other mechanical equipment a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating an alarm comparison logic. Tenderers shall indicate their proposed system alarm handling capability & features.

9) Run time shall be accumulated based on the status of a digital input point. It shall be possible to total either ON time or OFF time. Run time counts shall be resident in non-volatile memory.

10) It shall be possible to accommodate Holiday and other planned exceptions to the normal time programs. Exception schedules shall be operator programmable up to one year in advance.

11) All DDC shall have trend / log storing capacity in built into it. It shall be possible to have stored the data for at least 40 days @ 1 hour sampling time for all the points of the DDC (used or unused).

12) Minimum communication should be 10MBPS for each of the controller.

13) DDC should be forward compatible type so that any expansion or upgrade of the system required in the future is easily taken care off without scrapping / removing / disturbing the existing working system.

14) DDC Should allow user to include graphics, if required, however it shall be of static in nature.

15) All DDC Should be capable of sending email to specific user in the event of alarm, identified by end user / consultants.

5.0 PORTABLE OPERATORS TERMINAL (POT)

1) POT shall be provided to allow operator readout of system variables, override control and adjustment of control parameters. The POT shall be portable and plug directly into individual controllers for power and data.

2) The minimum functionality of POT shall include :

- Set points to a fixed value or state.
- Display diagnostic results.
- Display sequentially all point summary and sequentially alarm summary.
- Display/change digital point state, analog point value.
- Display/change time and date.
- Display/change analog limits.
- Display/change time schedule.
- Display/change run time counts and run time limits.
- Display/change time and/or event initiation.
- Display/change programmable offset values.
- Access DDC initialization routines and diagnostics.
- Enable/disable points, initiators and programs.
- Display/change minimum ON/OFF and maximum OFF times.

3) The POT shall be complete with command keys, data entry keys, cursor control keys **or** liquid crystal display (LCD). Access shall be via self prompting menu selection with arrow key control of next menu/previous menu and step forward/backward within a given menu.

4) Connection of a POT to a controller shall not interrupt or interfere with normal network operation in any way, prevent alarms from being transmitted, or interfere with Control Station commands and system modifications.

5) Connection of POT at any controller shall provide display access to all controllers on that bus. In case the controller has a fixed LCD display and entry keyboard, then the display access shall be available on each screen.

6) It should be possible to override the commands given through POT by the Operator Control Station.

7) POT shall have touch screen color display and it shall possible to hook this to Local area Network so that the entire system data can be visualized.

8) POT shall have self learning capability so that it can recognize the DDCs on the network and update all points without any manual programming.

6.0 DATA COMMUNICATION

The communication between controllers shall be via a dedicated or customer provided Ethernet communication network as per standards. Controller's microprocessor failures shall not cause loss of communication of the remainder of any network. All networks shall support global application programs, without the presence of a host PC.

Each controller shall have equal rights for data transfer. There shall be no separate device designated as the communication's master. Those systems using dependent controllers shall be pointed out by the contractor and a dual Hot redundant transmission media with automatic switching and reporting in the event of line faults will have to be provided.

The communication network shall be such that:

1) Every DDC must be capable of communicating with all DDC's on its own.

2) Network connected devices shall be capable of sending message after successive retries shall constitute a communication or device failure.

3) Each controller is to be provided with a communication watchdog to assure that the failure is reported to central station.

4) Error recovery and communication initialization routines are to be resident in each network connected device.

5) The communication protocol shall incorporate CRC (Cyclic Redundancy Check) to detect transmission errors.

Single or multiple standalone controller failures shall not cause loss of communication between active DDCs connected on the communication network. Full communication shall be sustained as long as there are at least two operational stand alone control panels active on the communication network.

All the System Integration Units shall be linked together on a Local Area Network.

The communication network shall include provision for automatically reconfiguring itself to allow all operational equipment to perform as efficiently as possible in the event of single or multiple failures.

The BAS supplier shall be required to provide details of standards to which their system conforms.

7.0 FIELD DEVICES

7.1 ELECTRIC AND ELECTRONIC CONTROLS RELATED EQUIPMENT

General Requirements

All controls shall be capable of operating in ambient conditions varying between 0-55 deg. C and 90% R.H. non-condensing.

All Control devices shall have a 20 mm conduit knockout. Alternatively, they shall be supplied with adaptors for 20 mm conduit.

Ancillary Items
When items of equipment are installed in the situations listed below, the BAS contractor shall include the following ancillary items:

(i) Weather Protection

All devices required to be weatherproofed are detailed in the Schedule of Quantities. IP ratings for the equipment are mentioned in the respective section.

(ii) Pipework Immersion

Corrosion resisting pockets of a length suitable for the complete active length of the device, screwed ½" (13 mm) or ¾" (20 mm) NPT suitable for the temperature, pressure and medium.

(iii) Duct Mounting (Metal or Builders Work)

Mounting flanges, clamping bushes, couplings, locknuts, gaskets, brackets, sealing glands and any special fittings necessitated by the device.

7.2 TEMPERATURE SENSOR

Temperature sensors for space, pipes and ducts, shall be of the Resistance Temperature detector (RTD) type or thermistor. These shall be two wire type and shall conform to the following specifications :

1) Immersion sensors shall be high accuracy type with a high resistance versus temperature change. The accuracy shall be at least ± 1.33 deg C.

2) Immersion sensors shall be provided with separate Brass thermo well. These shall be manufactured from bar stock with hydrostatic pressure rating of at least 10 kgf/cm^2.

3) The connection to the pipe shall be screwed type. An aluminum sleeve shall be provided to ensure proper heat transfer from the well to the sensor. Terminations to be provided on the head. Flying leads shall not be acceptable.

4) The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections.

5) Duct temperature sensors shall be with rigid stem and of averaging type. These shall be suitable for duct installation.

6) Outdoor air temperature sensor shall be provided with a sun shield.

7) The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

The temperature sensors may be of any of the following types :

1) PT 100, PT 1000, PT 3000
2) Thermistor

7.3 HUMIDITY SENSOR

Space and duct humidity sensors shall be of capacitance type with an effective sensing range of 10% to 90% RH. Accuracy shall be + 3% or better. Duct mounted humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with a housing. The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections. The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

7.4 FLOW METER

Water flow meters shall be either Electro magnetic or ultra sonic type. For electromagnetic flow meter, teflon lining with 316 SS electrodes must be provided. The housing shall have IP 55 protection. Vendors shall have to get their design/ selection approved by the Consultant, prior to the supply.

The exact ranges to be set shall be determined by the contractor at the time of commissioning. It should be possible to 'zero' the flow meter without any external instruments, with the overall accuracy of at least ± 1% full scale.

7.5 PRESSURE TRANSMITTER FOR WATER

Pressure transmitters shall be piezo-electric type or diaphragm type. (Bourdon Tube type shall not be acceptable). Output shall be 4-20mA or 0-10V DC and the range as specified in the data sheet depending on the line pressure. Power supply shall be either 24 V AC, 24 V DC or 230 V AC. Connection shall be as per manufacturer's standards. The pressure detector shall be capable of withstanding a hydraulic test pressure of twice the working pressure. The set point shall fall within 40%-70% of the sensing range and detector shall have sensitivity such that change of 1.5% from the stabilized condition shall cause modulation of the corrective element. The sensor must be pressure compensated for a medium temperature of -10 ^{o} C to 60^{o} C with ambient ranging between 0 ^{o} C to 55 ^{o} C.

7.6 DIFFERENTIAL PRESSURE SWITCH FOR PIPE WORK

These shall be used to measure pressure differential across suction and discharge of pumps. The range shall be as specified in the data sheet. Switch shall be ON with increase in differential. Housing for these shall be weather proof with IP 55 protection. The pressure switch shall be capable of withstanding a hydraulic test pressure of 1.5 times the working pressure. The set point shall fall in 40-70% of the scale range and shall have differentials adjustable over 10%-30% of the scale range. The switches shall be provided with site adjustable scale and with 1 NO/NC contacts.

7.7 DIFFERENTIAL PRESSURE SWITCH FOR AIR SYSTEMS

These shall be diaphragm operated. Switches shall be supplied with air connections permitting their use as static or differential pressure switches.

The switch shall be of differential pressure type complete with connecting tube and metal bends for connections to the duct. The housing shall be IP 54 rated. The pressure switches shall be available in minimum of 3 ranges suitable for applications like Air flow proving, dirty filter, etc. The set point shall be concealed type. The contact shall be SPDT type with 230 VAC, 1A rating.

The switch shall be supplied suitable for wall mounting on ducts. It should be mounted in such a way that the condensation flow out of the sensing tips. Proper adaptor shall be provided for the cables.

The set point shall fall within 40%-70% of the scale range and l has differentials adjustable over 10%-30% of the scale range.The switches shall be provided with site adjustable scale and with 1 NO/NC contacts.

7.8 AIR FLOW SWITCHES

Air flow switches shall be selected for the correct air velocity, duct size and mounting attitude. If any special atmospheric conditions are detailed in the Schedule of Quantity the parts of the switches shall be suitably coated or made to withstand such conditions. These shall be suitable for mounting in any plane. Output shall be 1 NO/NC potential free. Site adjustable scale shall also be provided.

7.9 AIR PRESSURE SENSOR

The pressure sensor shall be differential type. The construction shall be spring loaded diaphragm type. The movement of the membrane in relation to the pressure should be converted by an inductive electromagnet coupling which would give an output suitable for the controller. The pressure sensor shall be in a housing having IP 54 ratings in accordance with IEC 529. Suitable mounting arrangement shall be available on the sensor. The sensor shall come complete with the PVC tubes & probes.

7.10 WATER FLOW SWITCH

These shall be paddle type and suitable for the type of liquid flowing in the line. Output shall be 1NO/1NC potential free.

7.11 **CO SENSOR**

CO Sensor shall be integrated Surface mounted type on the field. These shall work on 24V AC/DC supply with the output being standard type i.e. 4-20 mA / 0- 10 Volts etc. Response time of the detector shall be <10 minutes

7.12 AIR VELOCITY SENSOR

Air Velocity Sensor shall be integrated Surface / Duct mounted type on the field. These shall work on 24V AC/DC supply with +/- 10% variation the output being standard type i.e. 4-20 mA / 0- 10 Volts etc with an accuracy of +/- 3%. It shall be possible to select the different ranges by changing the jumpers on the sensor. At least 3 selection ranges on the sensors are required.

7.13 CO2 SENSOR – Space Type

CO2 Sensor shall be wall / Surface mounted type on the field. These shall work on 24V AC/DC supply with the output being standard type i.e. 4-20 mA / 0- 10 Volts etc. The sensing range required shall be 0-2000 PPM with good resolution.
The preferred type of sensing element / method is NDIR type with accuracy of +/-30PPM or +/-5% of measured value. Warm up time of sensor shall be <2 minutes & response time is better than 150 seconds. Sensor shall be suitable to fix & operate at 1500 to 1750mm above the finished floor level.

7.14 LEVEL SWITCH

The level switches shall have to meet the following requirement:

Type	:	Float Type/Capacitance type/Conductivity type
Mounting	:	To suit application.
Connection	:	Flanged ANSI 150 lbs RF Carbon steel
Float material	:	316 SS
Stem Material	:	316 SS
Output	:	1 NO, 1 NC potential free
Switch Enclosure	:	IP 55

8.0 ENCLOSURES FOR CONTROLLERS AND ELECTRICAL PANELS

All the controllers shall be housed in Lockable Vandal proof boxes which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust and vermin proof and suitable for tropical climatic conditions.

The panel shall be metal enclosed 18 SWG CRCA sheet steel cubicle with gaskets between all adjacent units and beneath all covers to render the joints dust proof. All doors and covers shall be hinged and latched and shall be folded and braced as necessary to provide a rigid support. Joints of any kind in sheet metal shall be seam welded with welding slag grounded off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and secured with the frame and holes in the panels correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided

with nuts. Self threading screws shall not be used in the construction of control panels. Knockout holes of approved size and number shall be provided in the panels in conformity with the location of incoming and outgoing conduits/cables. Lamps shall be provided to support the weight of the cables. The dimension of the boxes shall depend on the requirement with the colour decided in consultation with the Architect/Consultant.

Note: All panel enclosures used in plant room spaces and external to building shall be suitable for outdoor application (IP 54 protection).

9.0 CONDUITS AND WIRING

Prior to laying and fixing of conduits, the contractor shall carefully examine the drawings indicating the layout, satisfy himself about the sufficiency of number and sizes of conduits, sizes and location of conduits and other relevant details. Any discrepancy found in the drawings shall be brought to the notice of Architect/Engineers any modifications suggested by the Contractor shall be got approved by the Architect /Engineers before the actual laying of conduits is commenced.

9.1 **CONDUITS/TRUNKER**

Conduits and accessories shall conform to relevant BS Standards. PVC conduits of required dia shall be used as called for in the schedule of quantities. Joints between conduits and accessories shall be securely made, with help of adhesive.

The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

9.2 **CONNECTIONS**

All jointing methods shall be subject to the approval of the Architect/Engineer. Separate conduits shall run for all power wiring.

The threads and sockets shall be free from grease and oil. Connections between conduit and controller metal boxes shall be by means of brass hexagon smooth bore bush, fixed inside the box and connected through a coupler to the conduit. The joints in conduits shall be smooth to avoid damage to insulation of conductors while pulling them through the conduits.

9.3 **BENDS IN CONDUIT**

Where necessary, bends or diversions may be achieved by means of bends and/or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with a finished wall surface. No bends shall have radius less than 2-1/2 times the outside diameter of the conduit.

9.4 **FIXING CONDUITS**

The conduits, junction boxes, outlet boxes and controller boxes once installed in position, shall have their outlets properly plugged or covered so that water, mortar, insects or any other foreign matter does not enter into the conduit system. Surface conduits shall be fixed by means of spacer bar saddles at intervals not more than 500 mm.

The saddles shall be 2 mm x 19 mm galvanized steel flat, properly treated, primer coated & painted, securely fixed to supports by means of nuts and bolts/rawl bolts and brass machines screws.

9.5 **DRAWING OF CONDUCTORS**

While drawing insulated wires/cable into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. No joint shall be allowed in case of breakage of any conductor. No joint shall be shaved off like length of the conductors. Insulation shall be shaved off like sharpening of a pencil and it shall not be removed by cutting it square to avoid depression/cutting of conducting material.

Strands of wires shall not be cut to accommodate & connect to the terminals. Terminals shall have sufficient cross-sectional area to take all the strands.

No wire shall be drawn into any conduit until all work of any nature that may cause injury to wire is completed. Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction. Where wires are connected to detectors, or panel, sufficient extra length of wires shall be provided to facilitate easy connections and maintenance.

Only licensed supervisors/wiremen shall be employed for cabling and other connected work. Only approved make of cables shall be used. The cables shall be brought to the site in original packing.

9.6 **MODE OF MEASUREMENT**

Signal Cable

The cabling running between DDC controllers to the field devices shall be termed as signal cabling. This cabling along with conduits shall be payable on per I/O point basis.

LAN Cable

The cable connecting various system integration units to the control station shall be termed as LAN cable. These cable alongwith conduits shall be measurable on unit length basis.

10.0 SIGNAL CABLING & COMMUNICATION CABLING

The signal cable shall be of the following specifications:

a.	Wire	:	Annealed Tinned Copper
b.	Size	:	1.0 sq. mm, stranded type
c.	No. of conductors	:	Two (One pair)
d.	Shielding	:	Overall beld foil Aluminium polyester shield.
e.	Jacket	:	Chrome PVC
f.	Nominal DCR	:	17.6 ohm/km for conductor 57.0 ohm/km for shield
g.	Nominal capacitance at 1 KHz	:	130 pF/m between conductors 180 pF/m between one conductor and other Conductors connected to shield.

11.0 LOCAL AREA NETWORK CABLE

Depending on the type of LAN system being used by the contractor, standard, manufacturer's specification shall apply.

12.0 BMS DELIVERABLES-

The deliverables expected from the BMS in broadly defined here under. However it is understood that the I / O summary detailed in this specifications will be reckoned while designing the system.

Ventilation:

1. Timed scheduled operation ventilation fans.
2. Facility to bring into any of the additional fans into operation in the event of maintenance on any of the main in-line fans.
3. Status of fans
4. Status of Generator room, STP room, and toilet ventilation fans
5. Status of staircase pressurization and kitchen exhaust fans
6. Run Time Reports for above equipment
7. Trending of CO concentration levels.

Chillers:

The chiller supplier shall provide software interface by providing linking of all Chiller Microprocessor panel for communication between panels. Additionally, he shall provide single point gateway for high level integration with read/write capability to the BMS system.

1. Data logging of Chillers – operating parameters.

2. Fault history.
3. Cycle operation of Chillers on standby mode whenever applicable during night charge cycle.
4. Chiller sequencing and load sharing.
5. Status.
6. Customized Trends/Schedules etc. pertaining to various Chiller parameters
7. Maintenance Alarm Pop up

Pumps:

Primary and secondary Brine pumps:
1. Control and Status
2. Time totalizing- led/lag for standby operation.
3. Data logging
4. Pump status
5. Run Time of the pumps

Secondary Chilled water pumps with VFD:
1. Loading history
2. Pump Status
3. Run Time of the pumps

Air handling units (Standard AHU's)

1. Space Temperature Set point control
2. Actual space / RA Temperature
3. Filter status
4. Fan status
5. Auto/Manual operation status
6. Fan on/off status
7. Control valve status
8. Run Time for the Fan/Motors
9. PID Control for Valves

Air handling units (AHU's with return air fans, if applicable):

1. Emergency smoke evacuation:
2. Fans and damper control on actuation of smoke sensor.
3. Night purge / Free cooling:
4. Fans, Dampers and control valve control on ambient temperature sensing.
5. Balance deliverables as under iii. Above
6. PID Control for Valves
7. Run Time for Fan/Motors
8. Customized Control Strategy & Switching Logic

Plumbing system:

1. Monitoring of water levels in under ground tanks and overhead tanks
2. Pumps run hours
3. Pump on-off status
4. Run Time

STP:

1. Run hours pumps in the system
2. High water level alarm

Electrical monitoring and data logging:

Parameters relevant to Automatic Transfer Switches (ATS) at the origin of utility supply and standby sources and Multi Data Meters (MDM) in outgoing feeders as per following.
(Through integration as all MDMs shall be provided with communication ports)
Data Points to be monitored & trended for MDMs: kW, kWh, kV Ar.p.f, V, A, Power outages, DG run
Data Points to be monitored & trended for KWH Meters: kW, kWh

20. AUTOMATED PARKING MANAGEMENT & GUIDANCE SYSTEM

Scope of the Work

The Parking Management System will comprise the following:

1. Parking Ticketing/Revnue Management System (PMS)
2. Parking Bay Management/ Guidance System (PGS)

There are Two entry way and two exit lanes. The parking facility is spread over two levels. The payment collection is proposed to be thru manned payment collections at lift lobbies.

This is a turnkey project. The contractor has to Design, Supply, Install, Integrate, Test and Commission the project and provide necessary training to client. The scope of the work includes all the items required to complete the project even if it is not explicitly mentioned in the tender. Necessary document preparation and license procurement pertaining to the project will also come under the scope of the contractor. The entire work has to be finished to the complete satisfaction of the client engineer in charge.

Requirement

Each entry lane shall be provided with a ticket vending machine and a boom barrier system integrated with the ticket vending machine. The mechanism shall be such that the boom barrier remains closed always. At the entry lane, when a vehicle approaches the ticket vending machine, the driver shall press the button on the vending machine and tickets shall be issued automatically. The ticket shall have a barcode printed on it along with the ticket number, date and time of entry. The barcode shall be a combination of ticket number, date and time of entry. The ticket shall be paper based tickets. Reusable RFID cards/ tokens also are recommended. In case of reusable RFID card/ tokens, the token number, date and type of entry shall be tagged/ saved on to the card/ token at the time of issue. Once the ticket is issued and driver collects the ticket, the boom barrier opens are vehicle is permitted inside. The barrier opens only when the ticket is taken from the vending machine. Once the vehicle passes, the boom barrier is automatically closed. There shall be provision for manual override for opening the boom barrier for allowing VIP entry, entry of exempted vehicles etc. This opening shall be based on remote devices as well as push button switch wired to the appropriate position. The boom barrier shall be closed manually after the entry of VIP vehicles and the system shall be able to continue the normal operation. Number plate image capturing camera & driver image capturing camera shall also be installed at each entry lane so as to capture the images of the vehicle and driver.

Office staff shall be provided with proximity cards/ RFID tags. The system shall detect the proximity cards/ RFID tags and open the boom barriers. Validity period/ permission can be provided for proximity cards/ RFID tags on time/day/month wise manner. Once the validity period expires, the system shall block the cards/ tags from further entry/exit. The validity period shall be extended on requirement basis. Blocking/ Unblocking facility for smart card and RFID tags shall be available.

While coming back to get the vehicle, the driver shall produce the entry bar coded parking ticket to the operator at Manned Payment POS, located near the lift lobby, who shall scan the bar code to compute the parking duration and hence the total parking charges to be collected. The fare is calculated based on the duration of stay and type of vehicle. It is displayed for the passenger in LED/LCD display. On receipt of the payment, the operator shall issue a bar-coded payment receipt which shall have a grace period of 15-20 minutes (configurable) for the driver to drive out the vehicle from final exit lane.

At the exit lane, the boom barrier remains closed on each lane. Each lane will be provided with a Automatic Ticket Verifier. The bar-coded payment receipt is shown at the Verifier and read by barcode reader. If the duration of stay is within the allotted grace time, the barrier will automatically open and the vehicle is permitted outside. Else the manned hand held operator shall collect the balance payment along with applicable penalty charges is entered in the machine/software. Once the vehicle passes, the barrier is closed automatically.

There shall be provision at the exit lane for staff vehicle to exit using smart card reader and RFID tag reader. The boom barrier shall open automatically once the proximity/ RFID card is read and shall be closed after the vehicle moves out.

For the exit of VIP vehicles, exempted vehicles, vehicles on official visit etc, the POS counter staff shall have the provision to exit the vehicle without collecting the parking fee. However, all the free exit transactions shall be captured and the system shall not allow any free exit without capturing it. The counter staff shall mention the reason for free exit. The same can be selected from a drop down window or can be manually entered.

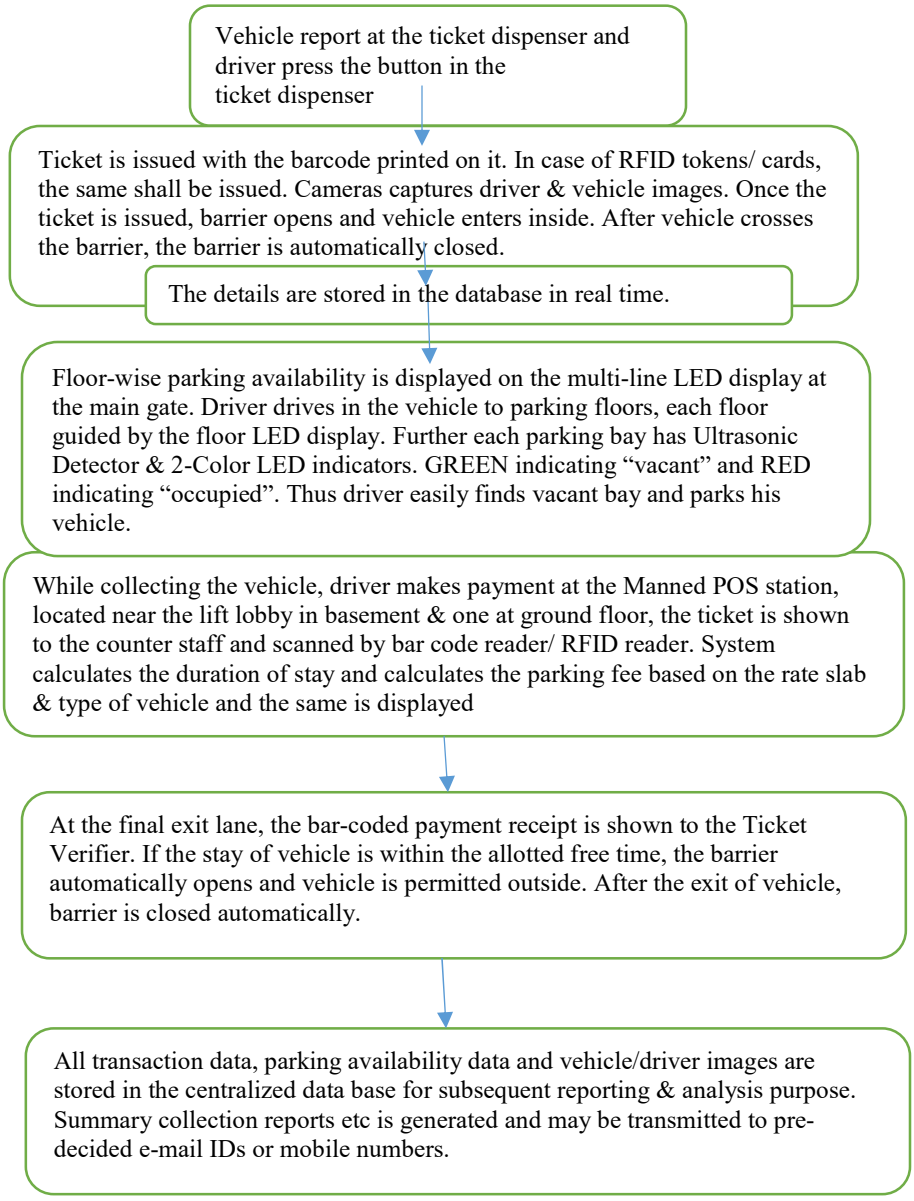
All the machines are networked to Central Management Software (CMS). The entry and exit points shall be interfaced with the CMS. When the tickets are issued at the entry point, the data is updated in real time in the CMS. At the exit counter based on this data the systems calculate the duration of stay and fare. The parking rates for different vehicles are normally calculated in the following format: free time allotted, hourly/ daily charge etc. This is based on the type of vehicle.

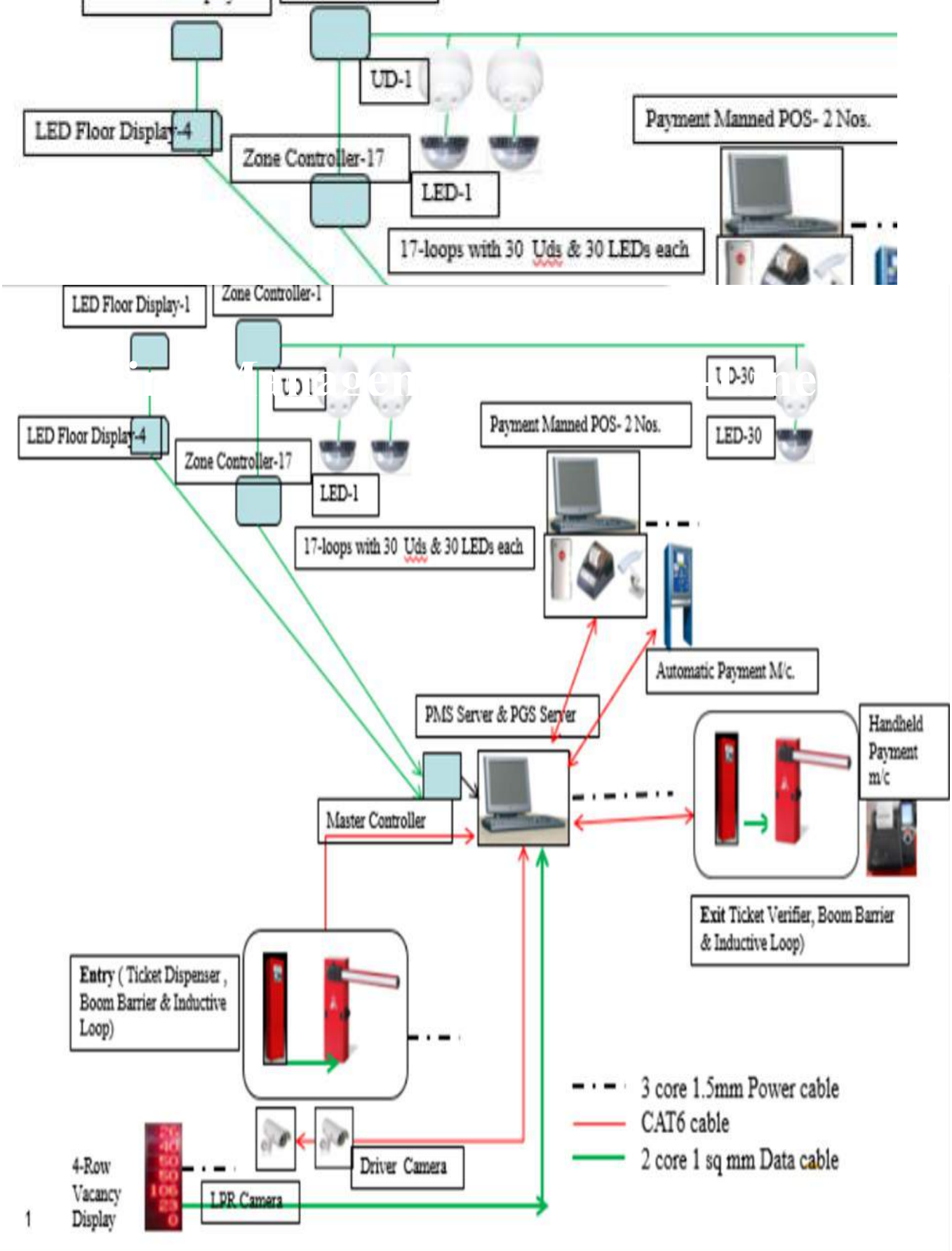
The system shall be scalable so that the same can be extended to additional lanes in the future with additional hardware for the lanes. The consumable paper roll for issuing ticket, receipt etc shall be of standard size easily available in the market. No proprietary material shall be used.

The system shall consist of the following:

- Automated ticket dispenser with proximity card, RFID tag readers
- Boom barrier with loop sensor
- Automatic Number Plate Image Capturing & Recognition System
- Cashier POS Station with proximity card, RFID tag readers
- Automatic Ticket Verifier System
- Server with Central Management Software
- Accessories (Data & power cabling, UPS Systems etc)

Process Flow




UD-1
LED Floor Display-4
Zone Controller-17
LED-1
Payment Manned POS- 2 Nos.
17-loops with 30 Uds & 30 LEDs each
LED Floor Display-1
Zone Controller-1
UD-30
LED-30
Payment Manned POS- 2 Nos.
LED Floor Display-4
Zone Controller-17
LED-1
17-loops with 30 Uds & 30 LEDs each
Automatic Payment M/c.
PMS Server & PGS Server
Handheld Payment m/c
Master Controller
Exit Ticket Verifier, Boom Barrier & Inductive Loop)
Entry (Ticket Dispenser , Boom Barrier & Inductive Loop)
3 core 1.5mm Power cable
CAT6 cable
2 core 1 sq mm Data cable
Driver Camera
4-Row Vacancy Display
LPR Camera
1

ITEM WISE SPECIFICATIONS:

Automatic Ticket Dispenser:

Specification for Automatic Parking Ticket Dispensers: Automatic Ticket Dispenser with in-build universal compatible proxy card reader. Options for wired systems and capable to communicate via RS485/ TCP-IP link. Ticket dispenser should have programing ability for configurating date, time, terminal number, etc. Entry level bar-code ticket dispenser printer. 125kHz proximity ISO card subscriber's reader, 2 channel loop detectors included, Electronically regulated interior heating and ventilation system, blinking high-visibility pushbutton (flush mounted + Anchor Base) with all required mounting connectors and its accessories.etc all Complete.	
Technical Specification	
Voltage rating	230 Vac
Current Rating	1A
Power Consumption	230W
Proxy Card Reader	Contact less Reader of passive transponders
Card detection frequency	125khz
Card format	ISO
Entry ticket	Barcoded with date time & parking lane information
Printing Unit	Consist of thermal printer with cutter
Printing Speed	140mm/s
Type of Paper	60mm x120GSM
Loop sensors	Dual channel
Push button	Illuminated
Communication port	TCP-IP
Size	315Lx310Wx1265H mm
Weight	55kg
Cabinet protective treatment	Cataphoresis
Certification	CE
Integration	Camera, Monthly/weekly Passes
Multiple Vehicle Type	Vehicle Identification Technology
Intercom Facility	Built-In
SOS Alert	Yes

1. Ticket exit is such a way that ticket does not fall down after auto cutting.
2. Ticket to be issued only if:

(i) Vehicle category button press is same as sensor sensing, otherwise audible warning and message on LCD.

(ii) Vacant slot is available to the category of the vehicle.

Boom Barrier

Voltage rating	24VDC
Power Consumption	100 W
Movement	Direct movement on the reduction gear output shaft
Opening & Closing time	2s
Drive	Electro-Mechanical
Power Supply	230V 50Hz
Clutch	Electronics (Torque adjustment)
Approaching at the end of the maneuver	With slowing down
Safety on impact	Encoder
Sensors input	Photo cell, loop sensors
Duty Cycle	100%
Reaction to impact	Reversal of movement
Travel	self-learning
Structure	Fe 360 - Pickled 2 plates mm; Joint-less Enclosure
Size	320Lx220Px1010H mm
Hand Operation	From outdoor with Key
Protection Level	IP54
Boom	Aluminum with LED light on Boom
Road passage	4M
Certification	CE

NPR (Number Plate/License Plate) Camera

Voltage rating	12Vdc
Current rating	1A
Power Consumption	<11.5W
Max. IR LEDs length	50M
Day/Night	Auto (ICR) /Color/ B/W
Focal length	2.7mm ~ 12mm
Max Aperture	F1.4
Focus Control	Motorized
Communication	TCP-IP
Resolution	1080P
Image sensor	1/2.7" 2 mega pixel
Overall Size	272x94x94mm
Weight	1.1kg
Operating Temp	-20 to +60°C

IP Grade	IP67
Certification	CE

Manned POS Station

Voltage rating	220Vac
Current rating	1.3A
Power Consumption	280 W
Processor	Intel Dual Core Processor
RAM	4GB
HDD	500GB
DVD	Inbuilt
Monitor	19"
Key board	Standard
Mouse	Optical
Handheld scanner	Zebra LS1203
Smart Card Reader	125khz ISO card reader
Interface	RS485 to USB
LCD Display	Posiflex PD320U
Thermal Printer	Epson TM-82
Operating System	Window7
Software	POS-1

Automatic Ticket Verifier:

Technical Specification	
Voltage rating	230 Vac
Current Rating	1A
Power Consumption	230W
Proxy Card Reader	Contact less Reader of passive transponders
Card detection frequency	125khz
Card format	ISO
Bar Code Scanner	Built-In
Loop sensors	Dual channel
Push button	Illuminated
Communication port	TCP-IP
Size	315Lx310Wx1265H mm
Weight	55kg
Cabinet protective treatment	Cataphoresis
Certification	CE
Intercom Facility	Built-In

SOS Alert	Yes

Central PMS Server

Voltage rating	220Vac
Current rating	1.3A
Power Consumption	280 W
Processor	Intel i3 Processor
RAM	4GB
HDD	500GB
DVD	Inbuilt
Monitor	19"
Key board	Standard
Mouse	Optical
Connectivity	To Ticket Dispenser, NPR Camera, Boom Barrier, Exit Ticket Verifier via RS-485/TCP-IP
Smart Card Reader	125khz ISO card reader
LCD Display	Posiflex PD320U
Thermal Printer	Epson TM-82
Operating System	Window7
Software	Custom Made Software: Central Server will connect to ticket machine, NPR camera and boom barrier. It also shares information with PGS server about vehicle in transit and exit verifier about vehicle exit details. Also contains details of proximity cards and their access rights along with new issue & recharge options. It will open the barrier and give command to ticket dispenser to print ticket depending upon access rights or card use classification of vehicle detected and corresponding button pressed at ticket machine. In case of error, a message will be sent to ticket dispenser machine display, manned booth and barrier shall not open.

UPS

Input Voltage	230V, -20% +15% single phase
Input Frequency	50Hz ±10%
Output Voltage	220/230V AC Single Phase
Voltage Regulation	±1%
Output Frequency	50Hz ±0.05Hz (Crystal Control)
Waveform	Sinewave
Harmonic Distortion	< 3%

Power Factor	0.08
Battery	12V
Battery Capacity	17AH
No. Of the Batteries	12
Backup time	10-12Minutes

Part-B Parking Bay/Guidance System

System Description:

1. The presence of car shall be detected using ultrasonic sensor wired with RS-485 to zonal controller for car.
2. Each car parking slot will have a visible LED lamp which glow RED when occupied and GREEN when free.
3. Each Zone controller will be connected to sensors of its zone, master controller and zonal display units using suitable interface.
4. Zonal display unit for driver guidance shall be installed wth 4 in height LED, 3 digit display.
5. The master unit will be connected to PGS Server through TCP-IP or USB. It will calculate the parking slot availablity based on the information received for both type of vehicle and pass the information to master display unit. Two wheeler slot availability will be calculated by taking infromation from Entry Dispenser and Exit Verifier.
6. The PGS server shall be connected to internet to show available slot on exported excel file for onward usage in mobile app.
7. Suitable UPS tp provide power to PGS server, master controller, zone controllers etc.
8. Necessary cable (4-core) cables to be provided for connecting ultrasonic detectors with zone controllers.

ITEM WISE SPECIFICATIONS:

Ultrasonic Detectors

Voltage rating	DC 15 - 24V
Current rating	2.0 mA
Power Consumption	0.5W
Operational principle	Ultrasonic
Communication port	RS 485
Detection Range	0.3 – 4.5 M
Detection range setting	Range tolerance 0.5m
Max error	0.05M
Detection angle	1 5°
Baud Rate	9600bps
Response time	30ms
Overall Size	105x105x61mm

Weight	300gms
Operating Temp	-20 to +60°C
Shell material	ABS
Certification	CE

LED Bay Indicator

Voltage rating	DC 15 - 24V
Current rating	1.7 mA
Power Consumption	0.38W
LED Quantity	4 RED, 4 GREEN/BLUE
Single LED Point luminance	Red 60cd/m2~80cd/m2; Green 125cd/m2~168cd/m2;
	Blue 60cd/m2~80cd/m2;
Visual Angle	360°
Visual Range	> 50 M
Overall Size	75x75x50mm
Weight	200gms
Operating Temp	-20 to +60°C
Shell material	ABS
Certification	CE

Zone Controllers

Voltage rating	AC 220V - 50Hz
Output Power Supply	DC 24Volt/3A
Current rating	45 mA
Power Consumption	<10W
Communication port	RS 485
Baud Rate	9600bps
Maximum Load Capacity	32 units of UD-11
Maximum Communication Distance	800M
Display Mood	LCD and LED indicators
Overall Size	300x400x140mm
Weight	300gms
Operating Temp	-20 to +60°C
Enclosure	Powder Coated MS Enclosure

Master Controller

Voltage rating	AC 220V - 50Hz
Current rating	45 mA
Power Consumption	10W

Communication	USB-RS232/RS485
Baud Rate	9600bps
Rate	Half Duplex
Display Indicator	Red power, Green Output ON
Input port	Upto 16 Channels (16 devices/channel); RS 485/ TCP-IP interface.
MS Enclosure	300x400x140mm
Mounting	Wall mount/Desktop
Operating Temp	-20 to +60°C
Enclosure	Powder Coated MS Enclosure

Master Display

Voltage rating	AC 230V - 50Hz
Current rating	1.2A
Power Consumption	250W
Communication	GSM
No. Of Rows	1
No. Of Dynamic Digits	3 digits
Height of Character	10"
LED Type	LED 5mm single row oval ultra bright RED led
No. Of the Fix Character	Configurable, 3M reflective tape
Enclosure	48"x30" (Approx)
Mounting	Pole/Wall mounting - Outdoor weatherproof
Operating Temp	20 to +60°C
Enclosure	MS powder coated Panel

PGS Server

1. PC i3 Processor, 4 GB DRAM, 500 GB HDD with 19" TFT and Windows 7 or higher OS.
2. PGS Server software to show vehicle occupancy in graphical mode for cars.
3. Suitable software and hardware for web interface for showing parking availability on different client nodes.
4. Connection to PMS server through TCP/IP and software support to extract information for vehicle in transit.
5. MIS Report generation as per requirment.

21.0 PROCUREMENT, INSPECTION OF EQUIPMENT & APPROVALS

Approved list of makes and vendors are given in the end of technical specifications. The makes of equipment/materials supplied shall be strictly as mentioned therein. For items not specially mentioned, prior approval shall be taken before procurement of the same. All equipments/material supplied shall be brand new and shall be procured directly from the manufacturers, dealers or authorised agents.

HSCC Electrical Engineer shall have access to the manufacturer's premises for stage inspection/final inspection of any item during its design, manufacturing, and assembly and testing. After carrying out the necessary factory tests and routine tests as per IS Standards, a copy of the routine test certificate shall be forwarded along with the call for carrying out the inspection at the manufacturer's works.

Based on the inspection certificate, HSCC Electrical Engineer reserves the right to carry out the inspection at a mutually agreed date and/or give inspection waiver. A minimum of two weeks will be needed after receipt of complete shop inspection report and other details to depute our inspector for inspection.

It is the responsibility of the contractor to ensure that all electrical works are carried out as per the IE Rules & regulations, National Building Code and IS Codes & Standards. All necessary drawings and details as required by Electricity Board, Electrical Inspector, Fire Department and other Local Statutory agencies, shall be prepared by the contractor. The contractor is responsible to submit the drawings and other details as required to the Local Authorities (refer above) and obtain necessary approvals including sanction of load/enhancement of electrical load from SEB before energizing and commissioning. All official fee required for getting the approval will be reimbursed on account of Client on submission of original documents.

23. LIST OF APPROVED MAKES FOR ELCTRICAL SYSTEM

Contractor shall use the materials of approved make as indicated below unless specified in BOQ or as approved by the HSCC engineer incharge. The contractor shall ensure the correct selection of the approved make meeting the specifications and application duties. Before placing order for procurement, the sample of approved make shall be got verified for its suitability to the specification and application duty. However, HSCC engineer incharge reserves the right to opt for the best preferred listed make.

Note- Approved Main LT Panel, Main HVAC Panel, APFC Panel, Active Harmonic Filter Panel will be fabricated in the workshop of OEM only.

S.No.	ITEM	MAKE
1	HT VCB Panel Board/ RMU	Siemens/L&T/ABB/Schneider
2	Transformer	ABB/GE prolac/ Schneider/Alstom
3	Main LT Panel/Main HVAC Panel / APFC panels / Active Harmonic Filter (AHF)	Siemens/L&T/ABB/Schneider/Legrand
4	Additional make for APFC Panel/ AHF	EPCOS, Ducati
5	Synchronization Panel/AMF Panel	OEM of the DG set or above panel manufacturer as mentioned against s.no.-3
6	Diesel Engine:	Cummins/ Caterpillar/MTU/ Perkins- Sterling /Kirloskar Oil Engine Ltd
7	Alternator:	Stamford/AVK/ Leroysomer/ Kirloskar
8	Fastener	Hilti/ Fisher or equivalent as approved by HSCC
9	Anti-vibration mounting:	Dunlop, Gerb, resistoflex
10	Bus Duct/Rising main	L&T/ABB/Siemens/Schneider/ Legrand/C&S

11.	Battery:	Panasonic/Hitachi/Cummins/Exide/Amar Raja
11a	Automatic Battery Charger	Max Power/Amara raja Batteries ltd./Chhabi Electrical/Statcon power control ltd.
12.	MV panels/Fire panel/AHU Panel	Sterling &Wilson / Control & Switchgear/SPC Electrotech Ltd/ Risha Control
13.	ACB	L &T 'U' Power(Omega)/ Siemens 3WL/ ABB/ Legrand(DMX)/ Schneider (NW- Master Pact)
14.	Moulded Case Circuit Breaker	L &T – (D sine/DL) / Siemens-VA/ ABB-TMA/ Schneider – (Compact-NSX/NS) /Legrand-DPX
15.	Power/auxiliary Contactors, timers, Relay, starters	ABB/ Schneider/ L&T/ Siemens
16.	AMF Relay	wood ward
17.	SFU with HRC	L&T/ Siemens/ ABB/ Schneider/GE
18.	Change over switches/Isolators	Schneider / Siemens/ABB/GE/L&T
19.	Instruments (Analog & Digital)	L&T/ AE/ Siemens/ Schneider/ ABB/Rishab /Conzerve
20.	Timers	Legrand/ L&T/ Siemens/ ABB
21.	Cast resin current Transformers:	AE/L&T/Rishab/Kappa
22.	Selector Switches:	L&T /KAYCEE/ Siemens
23.	Push button, Indicating Lamps LED:	L&T /Siemens/Schinder/Rishab
24.	Auto manual changeover switches (3Way)	Kaycee/L&T/ Schnieder/Siemens

25	MCB distribution Boards	L &T/Hager/Legrand/ Siemens/ Schneider/GE / Philips
26	RCCB/MCB	L & T / Legrand-DX3/ Siemens / Schenider –Acti 9/GE/ Hager/Philips
27	HT/LT- XLPE cables	CCI/Universal/Finolex/Rallison
28	Copper Control cable	CCI/ Finolex/ Rallison
29	Compression Glands & Lugs	Comet/ Dowells
30	PVC Tape	Steel Grip
31	Cable Jointing kit	Raychem / 3M
32.	Cable Trays/ Raceways	RMCON/OBO/ Legrand
33	Terminal Strips	Elmex/ Connectwell/ Technoplast
34	LED light fitting & Fixture	Philips / GE/ Crompton Greaves
35	MS conduit	RMCON/ Steel Kraft

36	PVC conduit	AKG/Supreme/Prince
37	Conduit accessories MS & PVC	RMCON/ Steel Kraft/ AKG/Supreme
38	Solar Power system(PV Cell)	TATA Power Solar, CEL, BHEL, BEL
39	Copper conductor PVC insulated wires, Co-axial , Telephone wires & cables	Batra Henlay/ AKG/Finolex/Havells
40	Additional make for telephone & LV wires and Cable	Delton/Fusion polymer
41	Modular Switches & sockets Outlets	Legrand-Myrius or Anti bacterial/L&T Oris/ Schneider -Livia / Philips -Sleek
42	Metal clad Socket outlets With boxes	L & T /Hager/ Siemens/ Schneider/ ABB/Legrand /HPL
43	Lighting protection	Erico/Galaxy electrode /Earth plus/OBO
44	UPS system	Schneider- MG , APC/ Eaton Power ware/ Emerson
45	High Mast poles & special Pole	Crompton Greaves /Phillips /Bajaj/Valmont
46	Ceiling fans	Crompton Greaves/ Orient/ Usha
47	PC with CPU and monitor etc	HP/ Compaq/Del/IBM
48	Auto Transfer switch	Cummins/Emerson-Asco/GE/ Russelectric
49	Public address system	Bosch/ Bose/ Honey well /Harman
50	CCTV camera	Pelco /Bosch/Sony/Axis
51	LCD/LED Monitor	Sony/Panasonic/Samsung/ Toshiba
52	Fire Detection System Addressable	Honeywell-Notifier/Edward/Bosch/ Siemens

53	FDA Conventional	Honeywell/Bosch or equivalent as approved by HSCC
54	Portable fire extinguisher	Minimax/Ceasefire/
55	EPABX system	Avaya/ Siemens-unify/Alcatel/Cisco
56	Nurse Call bell system	Honeywell/Schreak/Raulland
57	Capacitor	Epcos, Schenider, L&T, Ducati,ABB
58	APFC Relay	Epcos, L&T, Biluk, Ducati, Schneider
59	Occupancy Sensor	Philips/ Honeywell/ Schneider/Lutron/Legrand
60	Lifts/ Dumb Waiters/Escalators	Otis /Kone/ Mitsubishi/ Scheindler/Johnson
61	BMS, field devices etc	Honeywell-Trend/L&T-Atmos/Siemens/Schneider
62	Lighting Control	Lutron/ Philips/ ABB/ Schneider/ Legrand
63	Chemical Earthing	OBO Bettermann / Erico/Furse / Ingesco/
64	Access Control System	Honeywell-Pro-3000/Schneider/Lenel/Cardex
65	Boom barrier	Magnetic/ Somfy/ RIB/FAAC
66	CAT 6 UTP, CAT 6A UTP/STP, Optical Fibre-cable	Molex/Systimax/Panduit

END OF TECHNICAL SPECIFICATION