TENDER DOCUMENT

(ELECTRICAL SPECIFICATION)

VOLUME – 2

PROJECT DETAILS

Project : MIXED USE (RESI+RETAIL) G+2P+8

Client : NBCC OVERSEAS REAL ESTATE L.L.C

Location : PLOT NO IC1-CTYL-16_013 AT WARSAN 1 -621, DUBAI, U.A.E.

ايدماك للاستشارات الهندسية
EDMAC
ENGINEERING CONSULTANT

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PARTICULAR SPECIFICATIONS

ELECTRICAL

ELECTRICAL PARTICULAR SPECIFICATIONS

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1.0 SCOPE OF WORK

1.1 General

1.1.1 This Specification relates to the installation of Building Services. The Contractor shall be responsible for the supply, installation, testing and commissioning of all of the Electrical Services as detailed on the drawings in conjunction with specifications sections and contract documents.

1.1.2 The scope of work shall include supply installation, testing and commissioning the whole of the work and unless otherwise indicated, all the materials necessary to form a `complete installation' and such commissioning and testing as are prescribed in subsequent clauses and as may otherwise be required to give an effective and safe working installation.

1.1.3 The words `complete installation' above shall mean not only the major items of plant and equipment covered by the specifications, but also the supply and fixing of any and all incidental sundry components necessary for the complete execution of the Works and for the proper operation of the installation, whether or not these sundry components are mentioned in detail in the Contract Documents.

1.1.4 The Contractor shall include for the preparation of all necessary drawings. The Contractor shall be responsible for all dimensions, coordination and location of other services, and the correct setting out of the installation.

1.1.5 The words `as indicated', `where indicated' or `unless otherwise indicated 'refer to item requirements which are or may be given elsewhere in the Documents.

1.1.6 The Contractor shall be responsible to review and fully understand the specification, drawings and schedules and the scope of work. Furthermore, the Contractor shall be responsible to provide all materials, equipment, conduits, wiring, power supply, accessories, supplementary components, labor, etc., to provide complete and fully operational systems that are safe and able to be used properly.

1.1.7 The Contractors responsibilities include the following together with all additional duties outlined in the particular specification, drawings or schedules.

i. Check the design and accept full functional responsibility for all electrical services to meet the requirements of the Engineer and generally in accordance with the specification, drawings or schedules.

ii. All labor, equipment and materials required to complete the works according to the Design Intent. Provision means supply, installation, connect, test, commission and put to operation.

iii. Additional hardware, incidentals and any other work necessary for completion of the works and safe, correct operation of each system, whether such item or work is detailed in Specifications and on Drawings or not.

iv. Verification of existing conditions on site prior to tendering. Arranging with and paying for the Utility Companies having Jurisdiction to re-route their services should such services exist on site.

v. Temporary power supplies for construction purposes for the duration of the works.

vi. Arranging for and coordination of installation of new permanent supplies from Utility Companies having Jurisdiction, including submission of necessary documents and securing all approvals having relevance.

vii. Arranging for and carrying out necessary approvals with the Telephone and data/communications services provider for the necessary incoming lines

viii. Preparation of shop/construction/installation drawings for approval.

ix. Builder's work, ducts, inserts and sleeves required for the works.

x. On-site coordination with all other services and trades, liaison with members of the professional team, attendance on meetings as required.

xi. Testing, commissioning and certification that the work has been completed and inspected in accordance with the requirements of the relevant Regulations and Authorities.

xii. "As Built Drawings", Operation and Maintenance Manuals" and other project specific record documents.

xiii. Maintenance during the Defect Liability Period: refer to contract conditions specified elsewhere.

1.2 Definitions

1.2.1 For the purpose of this Specification:

The definitions given in the latest edition of IET Wiring Regulations (BS 7671) for Electrical Installations shall apply.

The following words shall have the meanings noted: -

i. Weather: the expected climatic conditions as described in the particular specification, schedules and drawings, together with all precipitation, air borne moisture, wind, wind borne sand/dust, ice, etc.

ii. Weatherproof (IP 66):

a. For equipment and materials: able to withstand exposure to the weather without damage or loss of function or reduction in working life.

b. For shelters/buildings: able to protect the stored or contained equipment from the weather so that the equipment suffers no damage, loss of function or reduction in working life.

iii. Dust protecting (IP 64): able to protect internal components from the effects of air and wind-borne dust and sand such that the internal components suffer no damage, loss of function or reduction in working life.

a. As applied to steel conduits and fittings with words "protection against corrosion in accordance with Class 2 (or with Class 4) shall have the meanings defined in BS 4568 as follows:

iv. Class 2: Medium protection both inside and outside (e.g., stove enamel; air drying paint).

v. Class 4: Heavy protection both inside and outside (e.g. hot-dip zinc coating, sherardizing).

a. As applied to cable trunking (steel, surface) the words "protection against corrosion according with Class 3" shall have the meaning

vi. Class 3 heavy protections both inside and outside (e.g. galvanized steel in accordance with BS EN 10143, Class 2A or 2B)

a. The words "complete installation" shall mean not only the major items of equipment and apparatus conveyed by the Specification, but all the incidental sundry components necessary for the complete execution of the work and for the proper operation of the installation, with their labor charges, whether or not these sundry components are mentioned in detail in the tender documents issued in connection with the Contract.

b. Wherever the words "install", "provide", or "supply and install", are used in Specifications, it shall be understood to mean "provide and install, inclusive of all labor, materials, sundries, commissioning, testing and connections" for the item to which it referred.

c. VOC: Volatile Organic Compound.

d. AFFL: Above finished floor level

1.3 SUBMITTALS

1.3.1 General: Comply with the requirements of this document and those documents noted in the summary above.

1.3.2 Post Contract Submittals

i. Shop Drawings.

ii. Product Data on materials and components for use.

iii. Supplementary Product Literature: Include a statement from the manufacturer for the design life of the system.

iv. List of tests included.

v. Certified test data.

vi. Outline technical specifications reflecting proposed materials and systems.

vii. A list of proposed suppliers and Subcontractors intended to be used.

viii. Preliminary Method Statement.

ix. Preliminary Quality Plan.

x. Summary of deviations from the Specification.

xi. Detailed Pricelist: The Contractor shall submit with his offer detail prices of the spare parts required to be provided under the Contract indicating the unit rate of each item.

1.3.3 Samples – Generally to be submitted prior to ordering of the items to be installed and before the Installation commences.

i. The Contractor shall provide labeled samples of all wiring accessories, switches, fittings and other like accessories described in this Specification or as specified by the Engineer.

ii. Such samples shall be submitted to the Engineer for his acceptance at his offices or elsewhere as directed, with all parts left loose, so that they may be taken apart for internal inspection by hand without the necessity of using spanners, screw drivers or wrenches.

1.4 CLOSEOUT SUBMITTALS

1.4.1 General: Comply with the requirements of this document and those documents noted in the summary above and submit the following:

i. Warranties

ii. Unless otherwise indicated in other sections, the Contractor shall provide a manufacture's full warranty covering all products of this Division Electrical Work Sections, wherever not mentioned warranty to be valid for 2 year from date of issue of Taking-Over Certificate.

iii. Refer to the requirements of both this document and those documents noted in the summary above.

a. Additional information and requirements.

b. All referencing used in the Operation and Maintenance information shall correlate to the symbols, presentation etc. used on the record drawings

c. The following information shall be included in the Operations and Maintenance (O+M) Manuals:

I. Name and address of local suppliers for all items included.

II. Details of design elements, construction features, component function and maintenance requirements to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of the installation.

III. Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and pans list. Advertising or sales literature shall not be acceptable.

IV. The Design Drawings, data and the As-Built Drawings, reviewed by the Engineer. The non-approved submissions of the Shop Drawings shall not be acceptable.

V. Warranty information.

VI. Commissioning, testing, repair, and cleaning information for all equipment including maintenance and cleaning schedules.

d. Provide 3 No. sets of Operations and Maintenance (O+M) Manuals.

e. Bind information neatly, in hard covers bearing the name of the Work/element, names of the Engineer, for submission to the Engineer.

f. Review information provided in the manufacturer's maintenance and instruction manuals with the Employer’s maintenance personnel to ensure a complete understanding of the electrical equipment and systems and their operation for the maintenance personnel’s continuing operation post Contract.

g. A list of spare parts and consumable's using the Engineer accepted format as recommended by the equipment supplier to cover an operation period of 2 years shall be submitted listing the following:

i) Catalog number, characteristics, quantity and price (in the local currency) of each item and a validity date.

ii) Source and alternative sources of supply.

iii) Details of required maintenance with suggested frequency of actions.

iv) Details of each item of equipment including the name and address of the manufacturer, type and model, serial number, duty and rating.

v) Indicate on a list, items that should be stocked by the Employer's maintenance personnel due to long delivery periods.

vi) Maintenance records to be kept by Contractor for equipment storage and operation from date of delivery until project Handover to client.

1.5 REGULATIONS

1.5.1 The whole of the work shall be carried out in accordance with the latest Regulations for Electrical Installations as issued by DEWA and relevant authority of each MEP services.

1.5.2 The contractor shall allow in his tender for all liaisons with the Dubai Electricity and Water Authority to enable the installation to be permanently connected to the supply. This shall include, but not limited to: Approval of shop drawings, any modifications to the equipment or the Electrical Design required by the Authorities (subject to the Engineer's prior approval) testing, retesting etc.

1.5.3 To this effect the contractor shall keep himself fully informed of all requirements and changes in requirements made by the Authorities during the whole of the contract period, which may affect the works and inform the Engineer as soon as possible of any variances from the specification and drawings.

1.5.4 Claims for extra costs or time will not be considered as a result of the above. Shop drawings shall be submitted to the Dubai Electricity and Water Authority for approval and shall be stamped approved by the Authority prior to ordering of equipment.

1.5.5 Programmed of submissions shall be consistent with the contract programmer to avoid delays and shall be to the approval of the engineer.

1.5.6 Testing and commissioning of all electrical and mechanical equipment to be done by contractor with full load current. If contractor use DEWA supply for testing and commissioning, which electricity bill to be paid by contractor. If DEWA electricity supply is not available in site, contractor to be arranged temporary generator supply for testing and commissioning, which temporary generator arrangement to be paid by contractor.

i. Execute work of this section only by skilled tradesmen regularly employed in commissioning of electrical systems. Prior to commencement of on-site commissioning submit CVs detailing experience and qualification of personnel assigned for this work. These shall be reviewed and accepted by the Engineer.

ii. Contractor shall provide testing equipment and accessories that are free of defects and are certified for use.

iii. Contractor shall provide testing equipment with current calibration labels.

iv. Contractor shall comply with commissioning procedures to NFPA IEC, BS and IEEE guidelines. In-corporate manufacturer's recommend commission procedures for equipment.

1.6 MATERIALS

1.6.1 All materials and installation shall be complied with green building regulations, refer attached green building regulation documents.

1.6.2 All materials shall be in accordance with the types and manufacture described in this Specification and as shown on the drawings.

1.6.3 Materials shall confirm to the appropriate British Standard Specification.

1.6.4 The Engineer reserves the right to inspect materials on site at reasonable times and to reject any materials not complying with the Specification.

1.6.5 The cost of any dismantling and re-erection of the installation occasioned by the removal of rejected materials shall be done by the Contractor.

1.6.6 Component parts of similar use and rating shall be inter-changeable with each other.

1.7 DEVIATIONS FROM SPECIFICATION

1.7.1 Any deviation from this specification is only acceptable where the Contractor has specified in his tender under the heading “Deviations from Specification” or "additional item" the requirements he cannot meet and the Engineer has accepted this deviation in writing.

1.7.2 Failure to detail items under “Deviations from Specification” will be interpreted by the Engineer as confirmation that the Contractor fully complies with the Specification.

1.8 EXISTING SERVICES TO BE MAINTAINED

1.8.1 Where applicable, existing services (including gas, water, electricity, soil, waste, irrigation and rainwater) to any existing premises are to be fully maintained during the progress of the works and additional work and materials to maintain flow at all times is to be included in this Contract and if necessary to provide any temporary diversions and supports for the same before any operations are commenced.

1.8.2 All existing services disturbed by the Works are to be fully reinstated in accordance with the quality defined in the specification. Allow for making all connections to existing services out of normal working hours where required.

1.9 ENGRAVING

1.9.1 The Contract shall include for engraving to switch plates, or other special plates in connection with special lighting, night lighting, clock system and fire alarm installations etc., as detailed on the attached drawing and/or Specification Section.

1.9.2 The form of the lettering shall be determined at a later date. For the purpose of Tendering, red filled engraved lettering 9mm high shall be included.

1.9.3 For Tender purposes, all engraving shall be in a minimum of two languages, including English. The “local language” where referred is Arabic.

END OF SECTION

2.0 LOW VOLTAGE DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 REFERENCE

1.2.1 This section forms part of every section of Division 26 for Electrical.

1.2.2 Conform to General Requirements for Electrical Services.

1.3 DESCRIPTION OF WORK

1.3.1 Supply and installation of main low voltage switch boards (MDB), sub main distribution boards (SMDB), final distribution boards (FDB), motor starters and motor control center (MCC) and related accessories.

1.3.2 This specification section covers the design and fabrication of low voltage switch gear including all items of equipment and materials necessary to complete the assembly and the information, documents and data required to be supplied by the supplier.

1.3.3 Any separate panels shall be as detailed hereafter. Separate panels shall comply with the requirements of this specification section.

1.4 QUALITY ASSURANCE

1.4.1 Design, manufacture, testing and method of installation of all assemblies and the associated equipment furnished under requirements of these specifications shall conform to latest publications or standard rules of the following codes and standards to the extent specified herein. When an edition date is not indicated for a Code or Standard the latest edition enforced at the time of proposal submitted shall apply.

1.4.2 Product selection for restricted space: Drawings indicate maximum dimensions for the equipment, including clearance between the equipment and adjacent surfaces and items. Switchboards having equal performance characteristics and complying with indicated maximum dimensions may be considered.

1.4.3 All panel boards shall be manufactured only by manufacturer having BSEN ISO 9001 Certificates.

1.4.4 The local panel manufacturer shall be an authorized agent of the principal switchboard manufacturer. A stamped certificate from the principal manufacturer shall be submitted along with the submittals confirming that all the equipment used in the panel boards by the local manufacturer is type tested and supplied by the principal and the assembly of the panel boards will be in accordance with the fully type tested panels which were certified by the independent testing laboratory.

1.5 CODES & STANDARDS

1.5.1 The assemblies and the associated equipment shall confirm to the requirements of the latest edition of the following standards and codes where applicable:

Low Voltage switchgear and: (IEC 61439-1& 2), (BSEN 61439-1&2), control Gear assemblies

Isolators/switch disconnections: IEC 60947-1, IEC 60947-3

Current transformers: IEC 60185

Voltage transformers: IEC 60186

Measuring instruments: IEC 60050-300

Contactors: IEC 60947-1, IEC 60947-4

Overload relays: IEC 60947-1, IEC 60947-4

Control relays: IEC 337-1, IEC 60947-1, IEC 60947-5

Indication lamps, Push buttons, Switches: IEC 60947-5-1, IEC 337-1, IEC-60536

Topicalization: IEC 68-2-30, IEC 68-2-1 &2, IEC 68-2-11

Automatic transfer switching: IEC 60947-6-1

Direct acting indicating analogue electrical measuring: BSEN60051 instruments and their accessories

Electrical apparatus for explosive gas atmospheres.: BSEN60079

Method for determining the comparative and the proof: IEC 60112 tracking indices of solid insulating materials under moist conditions.

Low voltage fuses.: BS 60269-3

Class 0.5,1 and 2 alternating current watt-hour meters. BS5685

Insulation coordination for equipment within: IEC 60664 low-voltage systems, including clearances and creep age distances for equipment.

"Electrical measuring transducers for converting: IEC 60688 AC electrical quantities to analogue or digital signals"

Low-voltage switchgear and control gear.: BSEN60947 Part 4: Contactors and Motor-Starters.

PVC Insulated cables for switchgear and control gear wiring: BS 6231

1.5.2 Applicable local laws and regulations:

1.5.3 Abu Dhabi Distribution Company (ADDC) latest revision/amendment of the Electricity Wiring Regulation issued by RSB (The contractor should be submitting a compliance for the project specifications as well as for ADDC Specification no. S-AAA-SWG-LV-AC-board)

1.5.4 Department of Civil Defense requirements

1.5.5 Etisalat standards and requirements

1.5.6 The Contractor shall also submit test certificates such as ASTA or as issued by any other independent testing authority confirming the declared short circuit ratings of Switch Boards and circuit breakers.

1.5.7 The switchboards shall be fully factory Type-Tested Assembly (TTA) as per the local authority's mandatory requirement and as per IEC 61439 – 1 & 2. In situations where, certain steps of assembly need to take place outside the factory of the manufacturer of the TTA conforming thereby to Clause 2.1.1.1 of the IEC 61349:2009, prior approval would be necessary. List of mandatory tests are as follows:

1. Strength of materials and parts (mandatory for typical enclosure construction and material)

2. Degree of protection of ASSEMBLIES (mandatory for all current ratings)

3. Clearances and creep age distances (mandatory for all current ratings)

4. Protection against electric shock and integrity of protective circuits (mandatory for all current ratings)

5. Dielectric properties (mandatory for all current ratings)

6. Verification of temperature rise (mandatory for all current ratings)

7. Short-circuit withstand test (mandatory for all current ratings)

8. Electromagnetic compatibility EMC (recommended as applicable)

9. Mechanical operation (mandatory)

1.5.8 Prior to placing order of the equipment, ensure that the physical dimensions of the equipment do not infringe the working space required by the applicable standards.

1.5.9 Single-Source Responsibility: Ensure that each category of selected material or equipment shall be of a particular range of one manufacturer who would take full responsibility of the product.

1.5.10 The switchboard manufacturer must have a previous record of satisfactory service for at least (10) years.

1.5.11 All main switchboards and motor control centers manufactured by overseas manufacturer shall be submitted for testing by an internationally approved laboratory testing agency and test certificates issued accordingly shall be submitted prior to delivery to shipment. Locally manufactured switchboards and control centers shall be tested at the manufacturer's testing laboratory witnessed. The tests shall be done in accordance with IEC 439 and shall include:

1.5.11.1. Mechanical test,

1.5.11.2. Voltage test,

1.5.11.3. Short circuit test,

1.5.11.4. Primary injection test for all circuit breakers and meters

1.5.11.5. Secondary test for all protective relays

1.5.11.6. Millivolt drop test

1.5.11.7. Insulation test

1.5.11.8. Function test

1.5.12 All test certificates shall be forwarded for the same.

1.5.13 All such tests shall be witnessed by CONSULTANT or it shall be carried out by an independent testing authority.

1.5.14 The contractor is responsible for complying with all codes, which apply to the equipment. Any special certification requirements or inspection by other authorities arising from the above shall be arranged by the contractor and the costs for the same included in this quotation.

1.5.15 The equipment to be provided by vendor must be in complete compliance with this specification and reference codes. Exceptions or deviations if any, shall be listed separately, with the quotation for THE CONSULTANT's approval. Any exception, which is not listed, shall not be considered.

1.6 PROJECT CONDITIONS:

1.6.1 Verify dimensions by field measurements.

1.6.2 Determine suitable path for moving switchboard into place considering project conditions.

1.6.3 Verify clearance requirements. Locate switchboard to meet installation tolerances

1.6.4 Revise locations and elevations from those indicated as required to suit project conditions.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Deliver in sections or lengths that can be moved past obstructions in delivery path.

1.7.2 Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7.3 If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchboards; install temporary cooling to prevent condensation.

1.8 SUBMITTALS

1.8.1 Manufacturers Technical Data

1.8.1.1 During the time of the contract and before Date of Taking Over Certificate of the electrical installation, submit to CONSULTANT three (3) copies of descriptive literature, technical data, maintenance recommendations (from the equipment manufacturer), catalogues etc.

1.8.2 Test Reports

1.8.2.1. Provide test reports prepared in accordance with ADDC requirements and to the CONSULTANT approval. Provide other tests reports as necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system.

1.8.2.2. The test reports to include the following:

i) Test procedures used.

ii) Test results that comply with requirements.

iii) Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.8.3 Installation Instructions

1.8.3.1 Submit the complete manufacturers installation instructions of all the products used.

1.8.4 Calculations

1.8.4.1 Forward the following calculations and data:

i) Calculations and charts proving that discrimination in the breaker characteristics is achieved.

ii) Detailed short circuit level calculation to select the short circuit rating of the various switchboards.

iii) Bus bar sizing calculation for each switchboard.

iv) Calculation for temperature rise inside switchboards

1.8.5 Shop drawings

1.8.5.1. The contractor shall furnish the following drawings and documents along this submittal for approval:

1. Fully dimensional drawing showing outline of the switchboard's arrangement and position of important external features. These drawings shall show masses, crane lift necessary for un-tanking and size of lifting lugs or eyes.

2. Power single line diagrams showing all auxiliary devices.

3. Original catalogues for various proposed components.

4. Drawings of nameplate and all termination arrangements.

5. Drawing giving typical mechanical and electrical details of the voltage control apparatus.

6. Details of cable terminations and fittings

7. Foundation plans, including foundation loading

8. Schematic and connection diagrams covering all equipment pertaining to the switch board.

9. Type and special test certificates as applicable

10. Approved test certificate / test report

11. Schedule of Accessories and Fittings

12. Technical Manual giving installation, operation and maintenance instructions

13. Schedule of recommended spare parts

PART 2 - PRODUCTS

2.1 MAIN LOW VOLTAGE SWITCH BOARD (MDB).

2.1.1 The specification hereunder shall be applied to all panel boards referred on the drawings (power layout, single line diagrams) as MDB.

2.1.2 The switchboards shall comply with the requirements of IEC 61439, multi cubicle type Factory Built Assemblies (FBA), Form4 type 6, construction. The assemblies shall be of front & rear access type forming an enclosed FBA with air insulated switching devices. Each incoming or outgoing circuit-switching device shall be housed in its own enclosure. The switchgear shall be completely compartmentalized and metal enclosed in accordance with Form 4B described IEC 61439. Assemblies shall be freestanding. All switchboards/MDB shall be single front & single rear access type.

2.1.3 The switchboards shall be rated 400V three phase and neutral 4 wire 50HZ with neutral solidly grounded at transformer side otherwise neutral is ungrounded. The equipment shall be suitable for operating on a system having Minimum fault level for the panel should be 50 KA for 3 sec for ACB

2.1.4 The minimum short circuit rating of MDBs shall be 50KA for 3 seconds.

2.1.5 The switchboards shall be fully factory Type-Tested Assembly (TTA) as per the local authority's mandatory requirement and as per IEC 61439 – 1 &2. The contractor shall submit valid test certificates such as ASTA or as issued by any other independent testing Authority to the Consultant for approval. List of mandatory tests are as follows:

1. Strength of materials and parts (mandatory for typical enclosure construction and material)

2. Degree of protection of ASSEMBLIES (mandatory for all current ratings)

3. Clearances and creepage distances (mandatory for all current ratings)

4. Protection against electric shock and integrity of protective circuits (mandatory for all current ratings)

5. Dielectric properties (mandatory for all current ratings)

6. Verification of temperature rise (mandatory for all current ratings)

7. Short-circuit withstand test (mandatory for all current ratings)

8. Electromagnetic compatibility EMC (recommended as applicable)

9. Mechanical operation (mandatory)

10. Internal Arc test to be done on the panel by independent testing authority.

2.1.6 Refer to the single line diagram for rating and type of feeder required.

2.1.7 Provide meters and CTs as shown in the single line diagram. Meters shall be mounted in separate compartment in each section.

2.1.8 Provide permanent lifting means on top of shipping sections.

2.1.9 Include an integral role-along lifting device for any switchgear equipped with draw out devices. Mount lifting device on top of switchgear.

2.1.10 All air circuit breakers shall be withdrawable type. The incoming air circuit breakers shall have manually and electrically operated spring charge mechanism while the outgoing air circuit breakers shall be manually operated. All MCCBs shall be fixed type.

2.1.11 Electrical characteristics

2.1.11.1. Rated operating voltage: 690V

2.1.11.2. Rated insulation voltage: 1000 V

2.1.11.3. Rated short circuit withstand current: 65 KA, 3 Sec for ACB and 65 KA/1S for other.

2.1.11.4. Rated peak withstand current: 105 KA

2.1.12 Special Tools

2.1.12.1. The contractor shall provide a complete set of all special tools and devices necessary for the operation and maintenance of the complete assembly.

2.1.12.2. The contractor shall provide a wall mounted panel to accommodate these tools and devices.

2.1.13 The switchgear assembler should have a valid ISO 9001 certification.

2.1.14 The switchgear system and devices shall originate from single reputed manufacturer.

2.1.15 In case of local assembly the authorized / approved assembler shall strictly follow the guidelines and standards laid down by the manufacturer.

2.1.16 The contractor shall provide fault level calculations to substantiate proper selection of all devices.

2.1.17 The contractor shall carry out routine tests at their works with the valid testing equipment calibrated by reputed laboratory.

2.1.18 All equipment and materials shall be new.

2.1.19 The assembly, including the framework, wiring, earth bar, etc., shall be suitable in all respects for extension at both ends such that only the minimum of work will be required to make such extensions.

2.1.20 The switchgear shall be painted inside and out. Unpainted galvanized coating of internal metal work will not be acceptable.

2.1.21 A space of 160 mm shall be provided at the bottom of each panel.

2.1.22 A vertical cable alley covering the entire height shall be provided. The cable alley shall be minimum 250 mm wide.

2.1.23 The panel shall be of uniform height of not more than 2450 mm.

2.2 CONSTRUCTION

2.2.1 The degree of protection, according to IEC 60529, shall be IP 54 with fixed front frame plus overall plain door and gasket.

2.2.2 The switchboard shall be built-up of individual freestanding cubicles to allow easy installation on site. The cubicles shall be made of electro-zinc coated sheet metal of 2mm thickness. The sheet metal shall be coated with a thermosetting powder of any epoxy resin base modified by polyester resin, which provide perfect finish and excellent protection against corrosion (standard "all climate" protection). The color shall be to RAL 7032/9002 and to CONSULTANT approval.

2.2.3 The switchboard shall be:

2.2.3.1. Provided with a metal sill frame made of structural steel channels section properly drilled for mounting the switchboard along with necessary mounting hardware. Hardware shall be zinc plated and passivated.

2.2.3.2. Provided with labels on the front and rear indicating the switchboard designation

2.2.3.3. Provided with cable entry facilities at bottom with 3mm thick removable gland plates and necessary cable glands. For 1 core cable these plates shall be nonmagnetic.

2.2.3.4. Provided with gaskets all-round the perimeter of adjacent panels, panel and base frame, removable covers art doors

2.2.3.5. Provided with bus-bar running at the top all along the Switchboard in a separate sheet steel enclosure.

2.2.4 Operating devices shall be incorporated only in the front of the switchgear with a hinged door.

2.2.5 Suitable barriers shall be placed between circuit breakers and all control, protective and indication circuit equipment including instrument transformers. External cable connections shall be carried in separate cable compartments for power and control cables.

2.2.6 After isolation of the power and control connections of a circuit, it shall be possible to safely carry out maintenance in a compartment with the bus bars and adjacent circuits live.

2.2.7 Cable entry shall be from front from a separate cable alley provided adjacent to each vertical section. Cable shall enter each module from the sides.

2.2.8 Cable alleys shall be provided with suitable hinged doors. The cable termination shall be completely shrouded. It shall be possible to safely carry out maintenance work on cable connections to any one circuit with the bus bars and adjacent circuits live. Adequate number of slotted cable support arms shall be provided for cleating the cables.

2.2.9 Each vertical section shall be equipped with thermostatically controlled space heaters, which may be located in the cable alley and with internal light.

2.2.10 Open metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchgear except for the horizontal bus-bar compartment. However, each shipping section shall have metal sheets at both ends.

2.2.11 All equipment associated with a single circuit shall be housed in a separate module compartment of the vertical section. The compartment shall be sheet steel enclosed at the sides and the rear with the withdrawable units in the position or removed. However, for front cable entry type switchboards, a plate cover with a slot to permit wiring connections shall be provided on the side corresponding to the cable alley

2.2.12 All doors shall be provided with concealed type hinges and captive screws.

2.2.13 All withdrawable chassis housing circuit breakers shall be of the fully draw out type.

2.2.14 It shall be possible to draw out the withdrawable chassis without having to unscrew or unbolt any connections to the equipment mounted on the withdrawable chassis. The power and control draw out type connections shall be of the slab-in or sliding type. All draw out contacts including for auxiliary and control wiring shall be of self-aligning type.

2.2.15 All identical equipment and corresponding parts including chassis of draw out modules of the same size shall be fully interchangeable, without having to carry out modifications. For trouble free interchangeability, the draw out arrangement shall be designed such that normal dimensional variations are taken care of by self-aligning feature of the modules.

2.2.16 All out-going breakers shall be fitted on prefabricated appropriate mounting plates and access to their operating toggles shall be provided through an appropriate front cover, fixed to the front frame.

2.2.17 The cubicle shall be divided into modules with a minimum of 15% of empty modules for extension.

2.2.18 All incoming cable entries shall be from bottom. Outgoing cable entries shall be from bottom or top as per the requirement.

2.2.19 Compartments for future breakers shall be complete with bus connections, plug-in base and mounting plates, ready for the insertion of a breaker.

2.2.20 ACBs shall be draw-out, motor operated with ratings, breaking capacity, etc. as mentioned elsewhere in this specification and contract drawings.

2.2.21 The draw out contact shall be only between copper/copper alloy faces, which are silver-plated.

2.2.22 All live parts shall be provided with suitable automatic shutter to cover all live parts when the section is in withdrawn position.

2.2.23 No cast iron or cast aluminium shall be used in any part of the assembly which is subjected to mechanical stress.

2.2.24 All incoming and outgoing switching devices shall have provision for locking in the 'off position.'

2.2.25 Where the F.B.A is required to bridge one or more civil work expansion joints in the substation construction, this requirement shall be detailed on the civil drawings.

2.2.26 Degree of Protection.

2.2.26.1. The degree of protection shall be a minimum of IP 54. IP 20 minimum shall apply within an isolated compartment or cubicle while the remainder of the assembly is live. Metallic barriers shall provide this protection. Unless otherwise approved this requirement shall apply to bus-bar shutters and to devices energized from external supplies, such as motor heater auxiliary switches.

2.2.27 Incoming and sectionalizing units

2.2.27.1. Incoming and sectionalizing units shall be air circuit breakers and shall be mounted in separate panels.

2.2.27.2. Air circuit breakers shall be four-pole or three-pole type as indicated in the single line diagram for three phase and neutral systems. They shall be provided with "In Service/Out of Service/Test Point" positions and suitable locking devices shall be provided for the "Out of Service" and "Test Point" positions.

2.2.27.3. A dedicated compartment shall be included for metering on the incomers.

2.2.27.4. Supplier shall supply details for incoming units and bus-bar standard earthing arrangements.

2.2.28 Outgoings

2.2.28.1. They shall be ACB or MCCB with type and ratings as indicated in the contract drawings and as specified in the relevant section of this specification.

2.2.28.2. All breaker 800A and above shall be ACB withdrawable type.

2.2.28.3. Suppliers shall provide a minimum 160mm space between the base of the switchgear and the underside of the lowest outgoing.

2.2.28.4. All incoming and outgoing circuit breakers shall be provided with a release to trip the breaker, instantaneously if closed onto a fault.

2.2.28.5 All compartments shall occupy the full cubicle width; a semi module compartment or vertical division between compartments is not acceptable.

2.2.28.6 Supplier shall ensure that the number of outgoing feeders in any vertical section of switchboard shall be such that there is adequate space in the cable alley for all power, and all control cables entering the panel. The number of feeders shall not exceed 8 numbers for each vertical panel.

2.2.29 Cable and Wire Terminations and Terminals

2.2.29.1 All internal control and auxiliary wiring shall terminate in suitable spring loaded, clamp type terminals and shall be provided with a permanent, easily read numbering system at both ends in accordance with the wiring diagram. Wires shall be identified by means of numbered and or lettered sleeves.

2.2.29.2 Formal blocks shall be arranged and positioned to afford easy access for carrying out external cabling, testing, inspection and maintenance.

2.2.29.3 Cable Glands shall be of the double sealed compression type with position armor bond suitable for XLPE and PVC insulated cables.

2.2.30 Safety Shutters

2.2.30.1 Where shutters are provided to maintain IP 20(minimum), they shall automatically cover all bus bar and cable spouts or isolating contacts whenever removable or withdrawable units are removed.

2.2.30.2 The safety shutters shall be automatically opened and closed by action of the removable or withdrawable unit movement. A positive drive to the shutters shall be provided in both directions.

2.2.30.3 They shall be capable of being padlocked in the closed position.

2.2.31 Interlocks

2.2.31.1 All units shall be provided with a complete set of electrical and mechanical interlocks to prevent incorrect operation and to provide safety for personnel in addition to any external interlocks specified for operational reasons.

2.2.31.2 On removal of withdrawable units, mechanical interlocks shall be provided to prevent the following operations and any other operations which could cause danger or damage: -

1. The unit being closed unless it is correctly located in the service, isolated or earthed positions or unless it is removed from the fixed part of the assembly.

2. The unit being withdrawn from or inserted into the feeder spouts or isolating device when it is in the closed position.

3. The unit being moved to any position other than that selected by means of the mechanical selector.

4. The unit being withdrawn or inserted into the fixed part unless it is in the correct state for withdrawal or insertion.

5. The unit being closed in the service position unless all auxiliary circuits between fixed and removable parts have been completed.

6. Means shall be provided to prevent opening of cubicle doors or covers before disconnection of supply to exposed live parts within.

2.2.32 Interlocks and Transfer Functions

2.2.32.1 The general philosophy of the required inter-trips and interlocks shall generally be as indicated hereunder. The vendor shall submit all logic diagram and interlocking line diagram to THE CONSULTANT for approval.

2.2.32.2 The main switch board incoming transformer feeders, and the bus section circuit breaker shall be provided with the required electromechanical interlock for auto transfer in case of failure of an incoming supply facility shall be provided for manual transfer.

2.2.32.3 The various interlocking schemes shall generally as indicate on the drawings and to THE CONSULTANT approval.

2.2.33 Nameplates shall be engraved on traffalyte sheet, with white letters on black background. Nameplates for main breaker, tie breaker, section and outgoes modules identification and for the entire switchboard shall have letters not smaller than 13 mm high. Nameplates for branch breakers, switches, push buttons, control devices, pilot lights and metering shall have letters not less than 3 mm high. All nameplates shall be mechanically fixed with non-ferrous metal screws with round heads.

2.2.34 Warning signs on doors and access panels shall be engraved traffalyte with white letters on red background.

2.2.35 Control contacts, auxiliary contacts, relays and small or light mechanisms shall be enclosed and protected, and shall be accessible for repair or adjustment.

2.2.36 Engraved traffalyte/aluminum mimic of the SLD shall be provided on the front face of the switchboard. The same shall be mechanically fixed with non-ferrous metal screws.

2.2.37 Anti condensation heaters shall be provided within the assembly and shall be controlled by a panel-mounted hygrostat with a 50% to 100% setting range, All MDB's to accommodate PMU for the monitoring of complete Electrical parameter including Theda & Th.D. also.

2.3 Busbar:

2.3.1 Bus bars shall be made of 99.9 electrolytic copper (type Cu ETP as defined by standards ISO1190-1), tinned (5mm thickness) to ensure correct thermal and electrical conductivity.

2.3.2 The busbars shall be uniform cross section throughout their length and shall be securely supported and braced to withstand the system fault rating specified.

2.3.3 Busbars shall be of copper and shall be sized to carry continuously the current specified on the drawing and shall be covered by PVC heat shrinks. However, the vertical (dropper) busbars in withdrawable columns can be enslaved nickel-plated busbar.

2.3.4 All copper busbars shall be high-pressure bolted joints.

2.3.5 To facilitate the connection and cable access, main bus bar shall be located at top or bottom of the section, and shall enable an easy connection to the bus bar in the adjacent vertical section. In case of bottom mounted HBB, prior approval from utilities should be available, to avoid rejection of panels at site by the utility authorities. Type test certificate shall be available for both top & bottom mounted HBB design, for all rating of switchboards.

2.3.6 Neutral busbar size and rating shall be same as phase busbars. Earth busbar size and rating shall be 50% of phase busbar size.

2.3.7 Only rectangular shape busbars shall be used. Profile and liberty type busbars are not acceptable.

2.3.8 The busbars shall be fully insulated throughout the length, except busbar joints. The interconnection of the main bus bars will be done by means of pre-installed sliding fish-plates designed to limit the number of fastening points of tightening. The main busbar shall be spliced at each column level in order to achieve simplicity and flexibility in transportation, installation and maintenance. For maintenance, the extraction and the reintegration of a column in the middle of a switchboard can be done without displacement of the adjacent columns.

2.3.9 To facilitate the connections and cable / pre-fabricated bus raiser termination access, main busbar should be installed at the top or bottom of the columns, with the design allowing for front or rear cables / busbar trunking connection, via top or bottom plates. All these interfacing possibilities should remain available even with no busbar position change & without modification of height of the switchboard.

2.3.10 Main horizontal busbars installed at the rear side of the panel / rear side of the functional unit shall not be acceptable.

2.3.11 Busbars shall be extended till both extreme end of the switchboard. Each transport section width shall not exceed 2.0m and it shall be coordinated with the site condition.

2.3.12 Phases & neutral busbars of HBB shall be placed one-after-the-another. Phase busbars placed one below the other shall not be acceptable.

2.3.13 In the fixed type columns, complete interconnection between breaker to Horizontal busbar / Vertical busbar (dropper) shall be carried out using solid, rigid copper busbar only. Flexible busbars / power cables are not accepted.

2.3.14 The minimum clearance between phases, phase to neutral, neutral to earth busbar shall be 14mm.

2.4 Busbar supports:

2.4.1 Comparatives tracking index (CTI) for the supports shall not be less than 175. Necessary technical supporting documents shall be furnished as part of the material submittal. Busbar support shall be made of polycarbonate glass fibers fire protected material.

2.4.2 All supports of copper bus bar and the distance between supports shall be exactly the same as the type tested design as per IEC 61439-1/2 standards.

2.4.3 The bus bars shall be designed for mounting on insulated supports that are sufficient in number to withstand electrodynamics forces resulting from the flow of the peak asymmetric short- circuit current.

2.4.4 All kind of insulating materials should have been type tested successfully for Glow wire test for 650 / 960 deg. c as per IEC 60695-2-11 standards.

2.5 SUB MAIN DISTRIBUTION BOARDS

2.5.1 These shall be self-contained, rust-proof, durable stoves silver-grey hammered enameled, cubicle pattern sheet steel units complete with circuit breakers of the size and ratings required to meet the power demand. The color shall be to RAL 7032 /9002 and to CONSULTANT approval.

2.5.2 The sub-switch boards shall comprise of integral main MCCB, meters, busbars, branch circuit moulded circuit breakers, earth leakage relays, ammeters, voltmeters, indicating lamps etc. all housed in a sheet steel cabinet, rust-proof stove enameled, equipped with a hinged door fitted with a suitable locking device. All MCCB's shall be of appropriate capacity as shown on the drawings.

2.5.3 Where shown on the drawing the MCCB's shall be provided with an integral earth leakage relay of adjustable sensitivity.

2.5.4 The short circuit capacity of the Main busbar system shall be 35kA, 1 Sec, the panel shall be type tested to withstand the short-circuit level of the position it is installed. A short circuit level calculation shall be submitted to the CONSULTANT and the short circuit level of the distribution board shall be sized accordingly. Breakers of MCCB distribution boards shall be fixed type and have a minimum short circuit rating of 35 Ka@1S.

2.5.5 A sub-feed neutral assembly with a removable link for isolation shall be available as an integral part of the distribution board. Earthing bar assembly shall also be available to facilitate the connection of earth continuity conductors.

2.5.6 Door locks shall be fitted as standard to all distribution boards and all the locks shall be keyed alike. The degree of protection of the switchboard shall comply with BS EN 60529and IP 42 minimum for indoor installation or upgraded to meet the requirement of particular location.

2.5.7 Sub-main MCCB distribution boards shall comply with IEC 61439 Form 2B Type 2.

2.6 DISTRIBUTION BOARDS

2.6.1 Description

2.6.1.1 The specification hereunder shall be applied to all panel boards referenced on the drawings/load schedules as DBs. The distribution board shall be flush / surface mounted and shall be provided with standard extension box to allow cable glanding if required.

2.6.1.2 Distribution boards 3phase (DB) shall be split busbar type with two section minimum, OR single phase with independent split busbar as appropriate. Distribution boards 3phase (DB) shall have isolator as main incomer and RCD type earth leakage protection device shall be provided for each section, with a sensitivity of 10, 30 or 100 mA, for land landlord Distribution Boards (DB) Every Busbar (Section) of DB to be provided with independent monitoring meters if the end-use different section as indicated on the approved load schedules & Schematic Diagram. Final Distribution board shall have different levels of earth leakage protection as recommended by Authority regulations.

2.6.1.3 Outgoing breakers shall be either MCB or RCBO as indicated on the approved load schedule.

2.6.1.4 As a standard item, all MCB boards shall be provided with permanent circuit identification charts to the approval of the CONSULTANT.

2.6.1.5 MCBs shall comply with BS EN – 60898-1&2 and RCBOs shall comply with BSEN 61009. ELCBs shall comply with BSEN 61008.

2.6.1.6 DBs inside electrical rooms shall be surface mounted type fixed onto a U channel support, and shall be flush mounted elsewhere (Apartments)

2.6.1.7 Short circuit calculation shall be submitted for Consultant approval.

2.6.1.8 All DBs shall meet ADDC requirement.

2.6.1.9 For Panel & Distribution Board Schedule, refer to Volume 3 – Technical Specification – Part G – G.8 – Appendix H – Panel & Distribution Board Schedule.

2.6.2 Enclosures

2.6.2.1. The MCB Distribution Boards shall be surface/flush mounted type. The enclosures within Electrical rooms must be surface mounting type. Powder coated rustproof sheet steel units, complete with circuit breakers providing thermal overload and magnetic short-circuit and earth fault protection as shown on the drawings. The enclosure protection shall be IP 31, while the complete assembly shall comply with IEC – 61439-1.

2.6.2.2. Enclosures outside electrical room shall have key-lock opening. Local enclosure is not accepted.

2.6.3 Busbar

2.6.3.1. The MCBs shall be mounted on either 3 phase or single phase or split busbars as appropriate. All spaces which are not provided with breakers shall be covered with blank plates.

2.6.3.2. A final sub-circuit neutral assembly and an earthing bar assembly shall be available to facilitate the connection of neutral conductors and protective conductors respectively.

2.6.3.3. To be of appropriate current carrying capacity at least equal to the rating of the main incoming MCCB isolator.

2.6.3.4. To be of copper.

2.6.4 Miniature Circuit Breakers

2.6.4.1. Miniature circuit breakers, and earth leakage circuit breaker and shall be provided as indicated on the load schedules.

2.6.4.2. The short circuit rating for the MCBs shall be 17KA, 0.25 Sec for DB's.

2.6.4.3. All circuit breakers (rather than SMDB & MDB) shall be factory calibrated to ambient temperature of 50 deg. C.

2.6.4.4. MCB shall comply with IEC 947-2 or IEC 60898 and shall be symmetrical rail mounted type available in one, two, three or four poles version.

2.6.4.5. They shall be trip free type with quick make and quick break mechanism.

2.6.4.6. The rated ultimate breaking capacity (Icu) of the MCB's shall be at least equal to the prospective fault level at the point of the distribution system where they are installed.

2.6.4.7. The minimum rated ultimate breaking capacity (Icu) of the MCB shall be 17kAif not indicated on the drawings.

2.6.4.8. It shall be possible to reverse feed the MCB without reduction in performance.

2.6.4.9. Trip ratings as indicated on the schedules of points.

2.6.4.10. The MCB shall have thermal overload trip to accept 5% overload and to trip at 30% of rated current as per IEC 60947-2.

2.6.4.11. The instantaneous magnetic trip shall operate at 5 to 10 times the rated current for 1P, 2P, 3P or 4P breakers, unless otherwise indicated on the drawings.

2.6.4.12. It shall be possible to replace 3 single-phase units with one 3-phase unit.

2.6.4.13. The breakers shall be of DIN type.

2.6.4.14. Evidence of the ultimate breaking capacity (Icu) shall be produced by test certificates from one of the internationally recognized High Voltage Laboratories (ASTA, CESI, ESEF/ASEFA, KEMA, PEHLA).

2.6.4.15. The operating mechanism shall be mechanically trip free from the operating handle so as to prevent the contacts from being held closed against short circuit and overload conditions. It shall be "automatic resetting type".

2.6.4.16. The operating handle shall be of the toggle type with possibility of padlocking facility and rotary handle.

2.6.4.17. Each pole shall be provided with bi-metallic thermal element for overload protection and magnetic element for short circuit protection.

2.6.4.18 Current discriminations tables shall be provided for each rating of the breaker.

2.6.4.19 The terminals shall be of the tunnel type (IP-20) in order to minimize the risk of direct contact.

2.6.4.20 It shall be possible to fit at the site auxiliaries like shunt trip coil, under voltage release, ON-OFF switch, alarm switch or residual current device 30 or 300 mA with remote tripping possibility.

2.6.4.21 Distribution will be provided with 10% of spare protective Device or blank positions.

2.7 DISCONNECT SWITCH

2.7.1 Disconnect switches (isolators) shall be manufactured to IEC and British standards

2.7.2 Disconnect switches shall be heavy duty (AC23) with operating handle interlocked with the switch cover, in general purpose rust proof aluminum enclosure and to IP44 finished in gray stove finish.

2.7.3 Switches shall be quick make, quick break action. Provision shall be made for padlocking in either the “On” or “Off” position.

2.7.4 Switch blades shall be fully visible when in the “Off” position

2.7.5 Operating handles shall be interlocked to prevent doors from being opened when switch is closed. Provision shall be made to defeat this interlock with a screwdriver

2.7.6 Fuse clips shall be designed for HRC BS 88/IEC 269 fuses without adapters and shall reject standard code fuses.

2.7.7 Switches mounted outside, in damp or dusty locations and unconditioned areas shall be supplied in weather resistant enclosures IP 65 made of aluminium with double wall construction

2.7.8 The enclosures shall be provided with ON and OFF indication lights with test facility.

2.7.9 Sample and catalogues with installation details shall be submitted for approval by THE CONSULTANT prior to ordering

2.7.10 Provide a disconnect switch ahead of all motors, starters and electrical equipment where shown on the drawings and where required to meet Code regulations and jurisdictional authorities, whether the equipment is supplied or installed under the Electrical Division or any other division.

2.7.11 All disconnect switches shall be provided with tag to THE CONSULTANT approval to indicate equipment connected to the switch. The feeding circuit reference and the related distribution board number.

2.8 MOULDED CASE CIRCUIT BREAKERS (MCCB)

2.8.1 Moulded case circuit breakers shall conform to the latest editions of BSEN60947-2.

2.8.2 The MCCB's shall have a minimum service short circuit capacity similar to the panel board where the same is installed.

2.8.3 MCCB's shall be of the heavy-duty quick make quick break type. Each breaker shall have adjustable type thermal over current and magnetic release and also an instantaneous magnetic trip.

2.8.4 Three pole breakers shall have a common trip with a single operating handle and designed so that any overload in one pole automatically causes all poles to open. Breakers shall be trip free and each shall have a trip indication independent of ON or OFF positions.

2.8.5 The MCCB's at the MDB's shall be provided with the necessary number of changes over auxiliary switch and with signaling unit which shall be connected to the BMS system in order to provide information on the breakers conditions and alarms where required.

2.8.6 Withdrawable MCCB's shall be provided with safety shutter to cover the live parts when the breaker is withdrawn

2.8.7 Wherever shown on the drawings or required by ADDC, MCCBs shall be provided with earth leakage alarm relay or earth leakage relay of fixed/adjustable sensitivity.

2.8.8 MCCB from 100 To 630 A

2.8.8.1 The moulded-case circuit breakers shall comply with IEC 60947-1 and 60947-2 standards. They shall be of category A with a rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) - on all the operational voltage range for the ratings up to 630 A.

2.8.8.2 The moulded-case circuit breakers shall be designed for both vertical and horizontal mounting, without any adverse effect on electrical performance. It shall be possible to supply power either from the upstream or downstream side.

2.8.8.3 The moulded-case circuit breakers shall provide class II insulation (according to IEC 60664 standard) between the front and internal power circuits.

2.8.9 Construction

2.8.9.1. For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries

2.8.9.2. The operating mechanism of the moulded-case circuit breakers shall be of the quick make, quick-break type with fault tripping over ridding manual operation. All poles shall operate simultaneously for circuit breaker opening, closing and tripping.

2.8.9.3. The moulded-case circuit breakers shall be front operated by a toggle or handle that clearly indicates the three positions: ON, OFF and TRIPPED.

2.8.9.4. The moulded-case circuit breakers shall be equipped with a "push to trip" button in front to test operation and the opening of the poles.

2.8.9.5. Where required, motor operated mechanism, shunt trip, under voltage release, auxiliary switches up to four change over contacts and a tripped signal contact shall be provided. Each of these units shall incorporate a pre-wired terminal strip, which is accessible from the front of the breaker without removing the cover.

2.8.10 Current Limiting

2.8.10.1 The moulded case circuit breakers shall be capable of greatly limiting currents.

For short circuits, the maximum thermal stress it shall be limited to

2.8.10.2 106 A2 s for ratings up to 250A.

2.8.10.3 5 x 106 A2 s for ratings between 400A and 630A.

2.8.10.4 Amps and S: Seconds

2.8.10.5 These characteristics will allow high cascading performance with moulded-case or miniature circuit-breakers.

2.8.11 Auxiliaries and Accessories

2.8.11.1 The addition of motor mechanism or a rotary handle shall in no way affect circuit breaker characteristics:

2.8.11.2 Only three stable tripping mechanism positions (ON, OFF and TRIPPED) shall be possible with the motor mechanism.

2.8.11.3 Suitability for isolation shall be provided by positive contact indication (ON and OFF) in front of the motor mechanism module

2.8.11.4 The moulded case circuit breakers shall be designed to enable safe on-site installation of auxiliaries such as voltage releases (shunt and under voltage releases) and indication switches.

2.8.11.5 The addition of a motor mechanism, module or a rotary handle, etc., shall not mask or block devise setting

2.8.11.6 It shall be possible to equip the moulded case circuit breakers with devices indicating faults without tripping the circuit breaker

2.8.11.7 Indication lights ON/OFF/Fault with lamp test facility.

2.8.11.8 2 NO and 2 NC spare contacts.

2.8.12 Protection Function General Recommendations

2.8.12.1 Moulded case circuit breakers with ratings up to 250A shall be equipped with inter changeable Thermal-magnetic trip units.

2.8.12.2 Moulded case circuit breakers with ratings over 250A shall be equipped with electronic trip units. The trip units shall not augment overall circuit breaker volume.

2.8.12.3 Electronic trip units shall comply with appendix F of IECIEC 60947-2 standard (measurement of RMS current values, electromagnetic compatibility, etc.,)

2.8.12.4 Electronic and thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorized access to the settings.

2.8.12.5 Protection settings shall apply to all circuit breaker poles.

2.9 MINIATURE CIRCUIT BREAKERS

2.9.1 MCBs shall comply with BSEN 60898

2.9.2 MCBs shall be 35mm symmetrical rail mounted type and available in one, two, three or four poles version.

2.9.3 MCBs can be reverse fed without reduction in performance.

2.9.4 Minimum short circuit rating of the breakers shall be 17KA/0.25 S.

2.9.5 Construction

2.9.5.1 The operating mechanism shall be mechanically trip free from the operating handle so as to prevent the contacts from being held closed against short circuit conditions. It shall be of the "automatic resetting type".

2.9.5.2 The individual operating mechanism of each pole of a multi-pole MCB shall be directly linked within the MCB casing and not by the operating handles.

2.9.5.3 The operating handle shall be of the toggle type.

2.9.5.4 Each pole shall be provided with bi-metallic thermal element for overload protection and magnetic element for short circuit protection.

2.9.5.5 Terminals shall be of the tunnel type (IP20) in order to minimize the risk of direct contact.

2.10 METERING

2.10.1 Meters (indicating instruments) shall be provided as shown in the schematic diagram.

2.10.2 All meters shall be moving iron type, minimum of 72 sq. mm square shape and 90 deg. scale.

2.10.3 All meters (indicating instruments) shall be of class 1.5.

2.10.4 Instruments shall temperature compensated to operate between -25 deg. C and + 55 deg. C and shall be tropical version.

2.10.5 All meters shall comply with IEC 60050-300.

2.10.6 Kilowatt-hour meters (kwh meters) shall be provided as per the requirements of the local Electrical Power Authority. They shall be dust and vermin proof and shall be of robust

construction so that they will keep their accuracy over many years of service under the local climatic conditions.

2.10.7 The counters shall be of the cyclometer type with six digits to give direct reading of power consumptions, the lowest figure being units and not tenths of units. Pointer type counters are not acceptable. The calibrating adjustment should be operated by screwdriver only.

2.10.8 kWH Meters should have not less than 5-mm diameter terminal holes and shall be operated through three suitably rated current transformers and the counter of the meter should be calibrated to read the primary KWH.

2.10.9 All kWH meters shall be handed over to the Power Supply Authorities for calibration prior to final installation and connection.

2.10.10. All kWH meters shall be equipped with a pulse output (equivalent to the metered energy), to provide an energy consumption scheme at a remote control and monitoring system.

2.10.11. All kWH sub-meters shall be provided with data logging capability and be connected to the Building Management system so that the information on the building's energy consumption can be monitored, recorded and analyzed.

2.10.12. The energy metering monitoring system shall be able to provide hourly, daily, weekly, monthly and annual energy consumption for each end use.

2.10.13. The energy metering monitoring system shall be able to compare consumption to previous days, weeks, months and years for trend analysis.

2.10.14. The energy metering monitoring system shall be able to determine 'out-of-range' values and alert building operators to any unusually high consumption.

2.10.15. The energy metering monitoring system shall be able to record peak energy consumption for each end use.

2.11 CURRENT TRANSFORMERS

2.11.1 Current transformers shall comply with IEC 61869-2.

2.11.2 The conditional ratings of current transformers shall correspond with the switchboard rating and shall be such as to maintain the overall metering accuracy as is necessary to operate relays within the tolerances specified by the manufacturer.

2.11.3 Current transformers secondary ratings shall be:

2.11.3.1 for protection 1A

2.11.3.2 for metering 5A

2.11.4 Current transformers shall have the following accuracy as a minimum, for protection Class 5P

2.11.5 (Except for REF Protection which will have PS class CT) for indication Class 1 for metering Class 1

2.11.6 The manufacturer shall ensure that the current transformers are such that the relays will operate correctly when set at any point within their ranges.

2.11.7 Current transformers secondary wiring shall be earthed on one side through a removable link. Where current transformers are connected in star, the star point shall be earthed through a removable link.

2.11.8 Shorting links shall be provided for each current transformer.

2.11.9 Current transformers shall be cast resin insulated.

2.12 VOLTAGE TRANSFORMERS

2.12.1 Voltage transformers shall comply with IEC 61869-3.

2.12.2 Voltage transformer shall be suitable in rating and accuracy for their functions, loads and duties.

2.12.3 As a minimum they shall have following accuracy,

2.12.4 Protection applications Class 5P

2.12.5 Indication and metering applications Class 1

2.12.6 The primary and secondary circuits of the voltage transformers shall be protected by fuses and the secondary winding shall be earthed at one point through a removable link.

2.12.7 Voltage transformers shall be cast resin insulated.

2.12.8 The manufacturer shall provide MCBs with auxiliary contacts or alternatively 4-pole MCBs on the secondary side of the voltage transformers.

2.13 CONTACTORS

2.13.1 All contactors shall comply with IEC 60947-4-1.

2.13.2 Duty category for lighting contactors shall be AC1 and for inductive load shall be AC3.

2.13.3 Contactors shall be protected against direct finger contact, mechanical life shall be 15 to 20 million operating cycles shall be suitable for 1200 operating cycles per hour.

2.13.4 The contactors shall be of 3 pole construction capable of handling high rush currents and suitable for operating up to 55 deg. C ambient temperature without any derating.

2.13.5 Coils shall operate between 85% to 100% of the nominal voltage

2.14 EARTH LEAKAGE CIRCUIT BREAKERS (ELCBS)

2.14.1 Current operated earth leakage circuit breakers shall be in accordance with BSEN 61008 providing the functions of isolation, switching and earth leakage protection of electrical circuits.

2.14.2 The ELCB's shall have a residual current operated electro mechanical release.

2.14.3 The ELCB's shall incorporate a filtering device to eliminate unwanted tripping due transient voltage.

2.14.4 A test push button is to prove operation

2.14.5 A trip free mechanism is required to ensure that the unit cannot be held closed against an earth fault.

2.14.6 The tripping device is connected directly to the secondary of the current balance transformer

2.14.7 No amplifiers or rectifiers are to be used.

2.14.8 The breaker shall be double pole when used for single phase and 4 poles when used for three phase circuit protection.

2.14.9 The ELCB's shall have 30mA or 100mA sensitivity as indicated in the drawings.

2.15 TIME SWITCH CONTROL

2.15.1 Each time switch shall be of the quartz movement type with minimum 24-hour battery reserve or operated by a 220-volt synchronous motor and of the type incorporating separate motor supply and control switch terminals and be with a minimum of a 24-hour self-winding clockwork spring reserve.

2.15.2 Unless more sophisticated operation is specified elsewhere, then each time clock shall be capable of two 'on' and two 'off' operations every twenty-four-hour period. Also, any control time switch incorporated within the panel, shall be complete with an associated bypass selection facility to manually override 'on/off'.

2.17 CONTROL RELAYS

2.17.1 Shall be of the encapsulated plug-in type and incorporate visual indication that the operating coil is energized.

2.17.2 Bases for relays shall be mounted horizontally, to ensure relay is vertical above the base when the control cabinet is in its intended location, with screw type terminals, suitable for receipt of spade type crimped/soldered lugs.

2.17.3 Adjustable timer delay relays used for the star delta starter shall ensure precise reproducibility of the timing function. The relay shall have a linear setting scale over a 350-deg. rotation by means of knurled knob with timing guide marks. The relay shall be equipped with two electrically separated time delayed contact one normally open and one normally close.

2.18 INDICATION LAMP

2.18.1 These are generally used to indicate main's presence, run, trip, fault and to give fault alarm or indicate any other function.

2.18.2 Indicator lamps shall be of the low voltage 24-volt transformer with twin LED lamp type and accord with the signaling colours laid down in BS. 4099. Minimum lens diameter shall be 12.5mm and all lenses on a panel shall be of a matching size and appearance and removable from the front for lamp replacement.

2.18.3 Terminations shall be screw grip to receive spade typing crimpled/soldered lugs.

2.19 SELECTOR SWITCH

2.19.1 They shall be of the complete rotary cam type rated to suit item controlled and fitted with pointer type switching knob. Terminations shall be screw grip to receive spade type crimped/soldered lugs.

2.19.2 Hand off auto selection switch shall have three positions with center position off and shall be key operated wherever necessary.

2.19.3 Selector switch when used along with the voltmeter it shall have 8 positions, i.e. phase to phase, 3 phase and 2 off position.

2.20 ACCESSORIES

2.20.1 Furnish the following accessories,

2.20.2 Set of extension rails, if required

2.20.3 Hoisting device for removing breakers

2.20.4 Set of test plugs

2.20.5 Levering out device, if required

2.20.6 Manual maintenance closing lever, for electrically operated breakers

2.20.7 Set of special tools and hardware

2.21 PUSH BUTTON

2.21.1 All the push buttons shall be made of non-hygroscopic material, non-swelling and fitted to avoid any possibility of sticking. Unless otherwise specified, they shall be of momentary type. All push buttons shall be 22mm dia, and have minimum IP54 ingress protection rating.

2.21.2 The contacts of all push buttons shall be rated at 250V 5A.

2.22 ANTI-CONDENSATION HEATERS

2.22.1 Anti-condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch and adjustable thermostat operating range from 25~350C, and suitable for electrical operation at 230 volts A.C. 50 Hz single phase. The heater shall have of sufficient capacity to maintain the switchboard internal temperature at 350C.

2.22.2 As a general rule, the heaters shall be placed at the bottom of the cubicle.

PART 3 - EXECUTION

3.1 GENERAL

3.1.1 Comply with the applicable installation requirements of the BS 7671:2002 – Requirements for Electrical Installations.

3.1.2 Conform to the requirements of the local power supply authorities having jurisdiction.

3.1.3 Install Low voltage panel as indicated in accordance with equipment manufacturer's written instructions and with recognized industry practices to ensure that the equipment fulfils requirements. Provide earthing connections for the switchboards as indicated on the drawings. Tighten connections to assure permanent and effective grounding.

3.1.4 Prior to energization of the switchboards, check with megger tester to ensure requirements of IEE Wiring Regulations are fulfilled.

3.1.5 Frame and mount printed, basic operating instructions for switchboards, including control and key interlocking sequences, and emergency procedures, fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on the front of the switchboards.

3.2 INSTALLATION

3.2.1 After installation and leveling, render the entire switchboard rodent proof by any means of steel plates,

3.2.2 Provide full length rubber mat in front of switchboard

3.2.3 Installation of switchboard shall be fully in accordance with THE CONSULTANT requirements.

3.2.3.1 Switchgear and distribution boards shall be surface mounted/free standing type and shall be mounted on the building structure by means of suitable mild steel straps or angle iron frames. Where distribution boards or switchgear are required to be directly attached to brickwork etc., the fixing shall be by means of grouted in bolts, or bolts of the expansion type.

3.2.3.2 Any live metal in the distribution board shall be screened with insulation material, so that circuit breakers can be replaced without any danger to the operator.

3.2.4 The circuit breakers shall be situated to allow wiring to be carried out with sufficient slack to enable them to be removed for inspection without disconnecting any circuit wiring.

3.2.5 All main, sub main and final distribution boards shall have a spare capacity and shall also be provided with enough spare breakers as shown on the drawings.

3.2.6 All panel board and distribution boards shall consist of adequately rated circuit breakers. Circuit breakers shall be temperature compensated at the manufacturer's works to give the design current rating at 50 deg. C. Non-compensated breakers will not be approved and a formal certificate will be required from the manufacturer confirming that the breakers have been suitably temperature compensated.

3.2.6.1 The contractor shall supply and install all panel board with the related voltmeters, ammeters and energy meters of a type that meets with ADDC approval.

3.2.6.2 Where single core cables enter or leave any item of metal clad switchgear, distribution gear, etc., the cable cores shall all pass through the same aperture in the enclosure or case of the unit concerned, to avoid the setting up of eddy currents. Where separate holes are provided by the manufacturer for the cables, the holes shall either be cut out to form a continuous slot, or alternatively the holes shall all be

joined together with saw cuts through the solid metal separating the holes. In all cases end plates shall be of non-ferrous metal.

3.2.6.3 A special termination arrangement shall be provided to CONSULTANT and ADD approval at the submain and main panel boards wherever the cable size exceeds the breaker terminal capacity.

3.3 TESTS AT WORK

3.3.1 Routine tests to standards shall be carried out. Evidence that type test have been carried out provided they are relatively to the configuration of the equipment offered, may be acceptable to THE CONSULTANT and shall be made available.

3.3.2 "A full visual check and electrical functional test shall be carried out on all apparatus and every circuit. All wiring shall be inspected. It shall be verified that the FBA is fully in accord with the requisition. Circuit breakers shall be closed and tripped at their rated minimum and maximum trip and close supply voltage. Primary and secondary injection tests shall be done on protection relays and CT circuits and indicating and metering instruments. All labels shall be checked.

3.3.3 The test procedure shall be as follows:

3.3.3.1. Visual inspection to verify degree of protection creepage and clearance distances.

3.3.3.2. All conductors and cables are checked for proper routing and all devices for proper mounting.

3.3.3.3. Check effectiveness of all mechanical devices, e.g. handles, locks, interlocks, operating devices, etc.

3.3.3.4. Check panel conformity to drawing and CONSULTANT requirements

3.3.3.5. Megger test all main circuit through to final terminals. Insulation resistance shall exceed 10 meghoms. Record all measurements

3.3.3.6. Flash test all main circuit at 2.5 KV for one minute. Record leakage current

3.3.3.7. Repeat megger test to verify insulation resistance has not been affected by the dielectric test.

3.3.3.8. Continuity tests of each circuit

3.3.3.9. Function test of all circuit breakers switches, contacts, etc. and every circuit to verify correct operation.

3.3.3.10. Primary and secondary injection tests of all relays, CT's and indicating and metering instruments.

3.3.4 Prior to energizing the switchboards, perform the following checks on site:

3.3.4.1. Operate the equipment through all design functions, including remote operation, actuation of alarm and indicating devices, mechanical and electrical tripping and closing and operation of the protective devices.

3.3.4.2. Insulation resistance measurements on the buses, phase to phase and phase to ground, with all breakers in the fully connected position and contacts open

3.3.4.3. Control circuit insulation resistance to ground

3.3.4.4. Inspect all relays and protective devices, and verify settings in accordance with the manufacturer's instructions or the information in the Coordination study.

3.3.4.5. Inspect current transformers and relays for correct polarity of connections and the installation of jumpers on unused current transformer circuits.

3.3.4.6. Simulate the operations and check the logic of interlocks.

3.3.4.7. Manually close and trip each breaker checking and adjusting the main contact alignment and wiring action in accordance with the manufacturer's instructions

3.3.4.8. Check the phasing on each side tie breaker, before closing.

3.3.4.9. Test protective relay operation for incomer air circuit breakers.

3.3.5 Routine Tests

3.3.5.1. Following routine tests are to be carried out by the switchboard assembler

3.3.5.2. Inspection of assembly including inspection of wiring and electrical operation

3.3.5.3. Dielectric test:

3.3.5.4. Checking of protective measures and of the electrical continuity of the protective circuits.

3.3.5.5 Verification of insulation resistance.

3.3.6 Test on site

3.3.6.1. Include infrared thermos-graphic survey primary injection and secondary injunction, the thermographic analysis to be done with minimum 50% loading of the panels.

3.3.6.2. Contractor has to conduct a power analysis simulation prior to installation and decide the actual rating of the active filter and redo the analysis study after energization of panel and installation of active filters to observe the performance and correct accordingly to engineer's recommendation.

END OF SECTION

3.0 AUTOMATIC TRANSFER SWITCHES

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Read this Section in conjunction Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section. The Contractor shall become familiar with other sections of the Specifications affecting work of this trade.

B. Conform to General Requirements for Electrical Services

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.

2. Bypass/isolation switches.

3. Remote annunciation systems.

4. Remote annunciation and control systems.

1.3 SCOPE OF WORKS

A. The Contractor shall furnish and install, transfer switches having ratings, features/accessories, enclosures, etc., as indicated on drawings or noted herein.

B. The Transfer switches shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity of power without de-rating, either open or enclosed.

C. The Transfer Switches shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity of power, without de-rating, either open or enclosed.

D. Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of Transfer Switches. The experience shall include applications of equipment and materials of the same detail and/or rating as the Transfer Switches specified.

E. Any request for substitution(s) must be submitted ten (10) business days before the scheduled bid date, and must include a technical proposal of adequate detail to fully define the system offered.

F. The technical proposal shall include the following:

1. A description of the configuration and operation of the proposed system.

2. A complete specification review indicating compliance with each subparagraph. By noting the term "comply," it is understood the manufacturer is in full compliance with the item

specified and will provide exactly the same. Any requested deviation must be documented in sufficient detail to allow a complete understanding of the bidder's intent. Detailed information to support the proposed substitute product, material or method shall accompany any deviations.

3. Bill of Materials.

4. Catalog cut sheets and other descriptive material of all major components.

5. A list of like systems previously delivered.

6. Outline drawings of all proposed equipment in both plan and elevation view, including overall dimensions, weights and installation clearances required. Also include single-line drawings illustrating supplied equipment.

G. The listing of specific manufacturers in the list of approved manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.

H. The design drawings include details, equipment dimensions, and space requirements based on the first listed "acceptable product". If the Contractor selects a different supplier, some redesign, including location of conduits and terminations may be required. Additional cost incurred for these changes shall be borne by the Contractor

1.4 RELATED SECTIONS

A. SWITCHGEAR.

B. DIESEL ENGINE GENERATOR.

1.5 REFERENCES

A. The Automatic Transfer Switch shall be engineered and constructed in according with the standard specified for the respective circuit breakers.

B. The Transfer Switches shall be UL 1008 listed.

1.6 POST CONTRACT SUBMITTALS

A. General: Comply with the requirements of Division 1, Submittal Procedures and submit the following.

B. Complete list of equipment and materials proposed, with an adequate description of each item, shall be submitted prior to approval.

C. Submit sufficient information to demonstrate compliance with drawings and specifications.

D. Include voltage rating, continuous current rating, number of phases, withstand and closing

rating, dimensions, weights, mounting details, conduit entry provisions, front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.

E. For automatic transfer switches that are networked together to a common means of annunciation and/or control, submit interconnection diagrams as well as site and building plans, showing connections for normal and emergency sources of power, load, control and annunciation components, and interconnecting communications paths. Equipment locations on the diagrams and plans shall match the site, building, and room designations on the drawings.

F. Complete nameplate data, including manufacturer's name and catalog number.

G. A copy of the markings that are to appear on the automatic transfer switches when installed.

H. The following information shall be submitted to the Engineer as a minimum:

1. Master drawing index

2. Front view elevation

3. Floor plan

4. Top view

5. Single line diagram

6. Controls One-Line diagram

7. Nameplate schedule

8. Component list

9. Conduit entry/exit locations

10. Assembly ratings including: a) Short-circuit rating b) Voltage c) Continuous current d) Basic impulse level for equipment over 600 volts

11. Major component ratings including:

a) Voltage

b) Continuous current

c) Interrupting ratings

12. Breaker Schedule

a) Cable terminal sizes.

13. Product data sheets.

14. Sequence of operation description

15. Certified production test reports

16. Installation information

Where applicable the following additional information shall be submitted to the Engineer:

1. Busway connection

2. Connection details between close-coupled assemblies

3. Composite floor plan of close-coupled assemblies

4. Key interlock scheme drawing and sequence of operations

5. Descriptive bulletins

1.7 MATERIAL SUBMITTALS

1. Contractor shall submit three (3) copies of material submittal for the approval.

1.8 CLOSE OUT SUBMITTALS

A. General: Comply with the requirements of Division 1, Closeout Submittals and submit the following information shall be submitted for record purposes:

1. Final as-built drawings

2. As-built wiring diagrams

3. Installation information including equipment anchorage provisions

B. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

C. Warranties.

1. Warranty shall be 5 years from the date of provisional handover of all the works.

2. Warranty shall include all parts, labor, and the service technician's travel and living expenses for the entire 5 years period.

3. Contractor shall warrant that the Work shall be free of defects in material and workmanship for a period of five years from the date of Taking-over. Contractor shall promptly and at its own cost and expense correct Work that is rejected by Engineer or Work

that fails to conform to the requirements of the Specification.

4. Contractor shall assign to Engineer all manufacturers' warranties relating to any of the equipment and materials, specifically the respective manufacturers' extended warranties. Contractor shall deliver to Engineer copies of all such warranties.

5. Contractor shall warrant that it has obtained all applicable licenses for Employer to use the Materials and has paid all required royalties for use of the system for its expected useful life.

D. Operation and Maintenance Manuals: Equipment operation and maintenance manuals, test report and the point-to-point wiring diagram shall be provided with each Transfer switch shipped. It shall include results from factory functional testing on the identical the identical unit and shall show each Feature/Accessory as being tested satisfactorily in accordance with the requirements of this specification. The test report shall indicate the manufacturer's Shop Order Number and Serial Number of each Transfer Switch supplied.

1.9 QUALITY ASSURANCE

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Provide testing and inspections in accordance with Division 1, Quality Requirements.

1.10 CODES AND STANDARDS

A. The automatic transfer switches and controls shall conform to the requirements of:

1. UL 1008 -Standard for Transfer Switch Equipment

2. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment

3. NFPA 70 -National Electrical Code

4. NFPA 99 -Essential Electrical Systems for Health Care Facilities

5. NFPA 110 -Emergency and Standby Power Systems

6. IEEE Standard 446 -IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

7. NEMA Standard ICS10-1993 (formerly ICS2-447) -AC Automatic Transfer Switches

8. UL 508 Industrial Control Equipment

1.11 PROJECT CONDITIONS

A. The Switchboard shall be suitable for continuous operation in desert locations under high ambient temperatures and humidity. The atmosphere is to be considered saliferous, sulphurous, dusty, and with high concentrations of windburn sand as commonly encountered in the UAE. The possibility of condensation, as experienced during large temperature fluctuations in humid atmosphere, shall be considered

1. Unless specified otherwise the following site conditions shall apply:
   a) Design temperature (Outdoor) + 50° C
   b) Surface temperature due to solar radiation + 85° C
   c) Maximum ambient air temperature -shaded + 55° C
   d) Minimum ambient air temperature + 5° C
   e) Altitude not exceeding 1000m AMSL
   f) Maximum relative humidity at 46° C 100%
   g) Ground temperature + 35° C
   h) Soil thermal resistively 2.5° C m/ w

1.12 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to Site under provisions of Section 01600 Product Requirements.

B. Deliver, store, protect and handle products to Site with particular reference to Dubai, UAE climatic conditions.

C. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

D. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.

E. Switchgear shall be equipped to be handled by crane. Where cranes are not available, switchgear shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

F. Switchgear being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition. If stored outdoors, indoor gear shall be covered and heated, and outdoor gear shall be heated.

G. Each switchgear assembly shall be split into shipping groups for handling as determined during the shop drawing phase jointly with the installing contractor. Shipping groups shall be designed to be shipped by truck, rail or ship. Shipping groups shall be bolted to skids, and covered with tarps for protection from weather. Accessories shall be packaged separately.

PART 2 -PRODUCTS

2.1 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

D. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

F. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

G. Where neutral conductors must be switched as shown on the plans, the ATS shall be supplied with a full ampere/voltage rated 4th/neutral pole. The neutral pole shall have the same withstand and closing and operational ratings as the phase poles, and shall be arranged for break-last and make-first to minimize neutral switching transients. To ensure that the neutral pole operates reliably with the phase poles, the neutral pole shall be operated directly from the same mechanism and shaft as the phase poles. This construction shall provide complete disconnect of the Emergency and Normal source neutrals in the mid position, after the phase contacts are disconnected. Overlapping neutral and other neutral poles that do not have identical construction to the phase poles and/or do not operate directly from the main ATS transfer mechanism and shaft are not acceptable.

H. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

I. The automatic transfer switch must be equipped with self-diagnostic programmable solenoid protection. This protection shall remove power from the solenoid after a maximum

of two (2) unsuccessful transfer attempts to prevent the solenoid from overheating This condition shall be latched and annunciated on the microprocessor controller screen, and capable of annunciation via a communication port, and configurable as an alarm status output signal. Reset shall require manual intervention by an operator.

2.2 BYPASS-ISOLATION SWITCH

A. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

B. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control inter-wiring shall be provided with disconnect plugs.

C. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.

D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.

E. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.

G. Designs requiring operation of key interlocks for bypass isolation or ATSs which cannot be completely withdrawn when isolated are not acceptable.

2.3 MICROPROCESSOR CONTROLLER

A. The controller’s sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. Voltage sensing shall be true RMS type and shall be accurate to + 1% of nominal voltage. Frequency sensing shall be accurate to + 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.

D. The contractor shall bundle factory wiring and shall label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.

E. Automatic Transfer Switches shall be capable of utilizing fiber optic connectors, or provide data to fiber converter at each ATS. Provide all required hardware for a functional system.

F. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

G. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

1. EN 55011:1991 Emission standard -Group 1, Class A
2. EN 50082-2:1995 Generic immunity standard, from which: EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity ENV 50140:1993 Radiated Electro-Magnetic field immunity EN 61000-4-4:1995 Electrical fast transient (EFT) immunity EN 61000-4-5:1995 Surge transient immunity EN 61000-4-6:1996 Conducted Radio-Frequency field immunity
3. IEEE472 (ANSI C37.90A) Ring Wave Test.

2.4 ENCLOSURE

A. The ATS/BPS shall be furnished in a NEMA1 enclosure unless otherwise shown on the plans.

B. All standard and optional door-mounted switches and pilot lights shall be 16-mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.

2.5 CONTROLLER DISPLAY AND KEYPAD

A. A four lines, 20-character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

1. Nominal line voltage and frequency
2. Single or three phase sensing
3. Operating parameter protection
4. Transfer operating mode configuration (Open transition, Closed transition or Delayed transition)

B. All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

2.6 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

B. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.

C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal & emergency to pro-vide digital readout of voltage on all 3 phases, frequency, and phase rotation.

2.7 TIME DELAYS

Parameter	Sources	Dropout / Trip	Pickup / Reset
Under voltage	N&E,3-phase	75 to 98%	85 to 100%
Overvoltage	N&E,3-phase	105 to 110%	103 to 108%
Under frequency	N&E	45.0 to 59.9Hz	45.1 to 60Hz
Over frequency	N&E	50.1 to 63Hz	50.1 to 63Hz 50.0 to 62.0Hz
Voltage unbalance	N&E	5 to 20%	4 to 19%

A. Controller shall include an adjustable time delay of 0 to 10 seconds to momentarily override a normal source failure and delay the operation of the transfer switch for a user-specified time period. Controller shall be capable of being programmed for an ex-tended time delay

up to 259 minutes if an external power supply is provided to the ATS control. All ATS supplied shall have wiring and provisions for the connection of a customer supplied external 120VAC power supply source for extended time delay.

B. Controller shall include an adjustable time delay on transfer to emergency, adjustable from 0 to 259 minutes, for controlled timing of transfer of loads to emergency allowing emergency source to stabilize prior to transfer.

C. Controller shall include two independent time delays on retransfer to normal – one adjustable 0 to 259 minutes for re-transfer from an outage of the normal source and one for re-transfer after a Fast Test operation. Time delays after a Fast Test operation shall correspond to minimum values to reduce testing time. The time delay on transfer to normal shall be automatically bypassed if the normal source is available and the emergency source fails during the time delay period.

D. Controller shall include a time delay to override momentary emergency source outages or swells and delay all retransfer signals allowing initial loading of engine generator set. Time shall be adjustable from 0 to 30 seconds.

E. Controller shall include a time delay for cool down of the engine ahead of engine shutdown. Time shall be adjustable from 0 to 60 minutes.

F. Controller shall include fully user-configurable load control relays and contacts for control and signaling of loads before and after switch transfers. These Capabilities shall include:

1. The configuration of up to (6), programmable load control relays -each with a Form-C contact output pair wired to a terminal block for customer use, rated at 10A, 24VDC/120VAC.

2. Each load control relay shall be independently programmable as either an elevator pre-signal, or load control (connect/disconnect) signal.

3. Each relay shall have a customer-programmable time delay period, from 0 to 60 minutes.

4. Controller shall permit field adjustability of the type and time delay settings, without the need for field wiring or hardware changes.

G. All Closed Transition and Delayed (programmed) transition-type ATS shall also include the following time delays and capabilities:

1. Delayed (programmed) transition-type ATS shall include a time delay for the center-off/neutral position when transferring from source-to-source. Time shall be adjustable from 0 to 10 minutes.

2. Closed transition-type ATS shall include a Failure to Synchronize time delay, fixed at 1 minute, for failure to synchronize normal and emergency sources prior to closed transition transfer.

3. Closed transition-type ATS shall include a two-stage, backup time delay system for protection against unintended extended paralleling of both sources beyond 100ms. System shall operate independently as a redundant backup to the main controller. Should this time

delay expire, a contact shall be provided to trip a remote source breaker to ensure extended parallel time does not exceed the local utility maximum parallel time, typically 100ms.

4. Closed transition-type ATS shall include a digital synchro scope for display of the phase difference, in electrical degrees, between the two sources. Display shall indicate fast/slow phase relationship of Genset source in relation to Utility source. Digital synchro scope shall indicate numbers of degrees sources are out of sync as real time values. Synchro scope data must be displayed and accessible from transfer switch main microprocessor controller.

H. All time delays shall be adjustable in 1second increments. All time delays shall be adjustable by using the graphical display, the front USB port, or manufacturer supplied free configuration software connected to the local USB, Serial, or Ethernet communication ports.

2.8 ANNUNCIATION, CONTROL AND PROGRAMMING INTERFACE COMPONENTS

A. Devices for communicating with remote programming devices, annunciators, or control panels and paralleling switchgear shall have open-protocol communication capability matched with remote device.

B. Provide contacts for connection to elevator controllers, one closed when automatic transfer switch is connected to the normal source, and one closed when automatic transfer switch is connected to the emergency source.

C. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to the automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit in-rush and seal currents are rated for actual currents to be encountered.

2.9 ADDITIONAL FEATURES

A. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

B. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

C. Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

D. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

E. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

F. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

G. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

H. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.

XII. An In-phase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer.

J. Provide advanced transfer contacts to signal loads of transfer from normal to emergency and emergency back to normal.

K. Provide load dump relay capable of removing the ATS/BPS from generator service upon receiving a signal from the synchronizing switchgear.

L. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.

M. Engine Exerciser -The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

1. Enable or disable the routine.

2. Enable or disable transfer of the load during routine.

3. Set the start time,

 time of day day of week week of month (1st, 2nd, 3rd, 4th, alternate or every)

1. Set the duration of the run.

2. At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies

power to the real time clock in the event of a power loss will maintain all time and date information.

N. System Status -The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example,

- Normal Failed
- Load on Normal
- TD Normal to Emerg

O. Self-Diagnostics -The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

P. Communications Interface – The controller shall be capable of interfacing, through a serial communication module or TCP/IP with a network of transfer switches, locally (up to 4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.

Q. Event Logger – The controller shall have the ability to log data and to maintain the last 256 events, even in the event of total power loss. Time and data stamping of events shall be accurate to within 1ms. Controller shall be capable of synchronizing it’s date/time setting with a main PC via Network Time Protocol (NTP) over an Ethernet TCP/IP network connection.

The following events shall be time and date stamped and maintained in a non-volatile memory:

Statistical Data

a. Last Primary Source Failure – Date & time

b. Last reason for transfer (source fail, test)

c. Last transfer to alternate source -Date & time

d. Last re-transfer to primary source -Date & time

e. Time load without power (last event) – Seconds

f. Time ATS powered up -days

g. Total (accumulated) time on Source 1 – Hours

h. Total (accumulated) time on Source 2 – Hours

i. Total # of Primary Source failures

j. Total # transfers [Primary, Alternate, Primary]

R. Communications Module –

1. Serial Communications: Controller shall support RS485 communications port to enable serial communications. Controller shall support communication baud rates up to an including 115.2Kbps. The baud rate shall be user configurable. The serial communications shall be capable of a direct connect or multi-drop configured network. All serial communications parameters shall be accessible from the front display without the use of additional programming tools. Controller shall support the addition of communications in the field without field wiring modifications.

2. Ethernet Communications: Controller shall support Ethernet TCP/IP communications via an internally mounted and self-powered communications card. Ethernet shall be 10/100 Mbit, auto-sensing and shall include an RJ45 network connector. All Ethernet communications parameters shall be accessible from the front display without the use of additional programming tools. Controller shall support the addition of communications in the field without field wiring modifications. Ethernet communication modules/cards requiring an external power supply source are not acceptable.

3. Open Protocol: Both Serial and Ethernet communications shall be Modbus protocol. Non-Open/Proprietary communication protocols shall not be acceptable.

2.10 WITHSTAND AND CLOSING RATINGS

A. The ATS/BPS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS/BPS terminals with the type of overcurrent protection shown on the plans.

B. The ATS/BPS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1-1/2 and 3 cycle, long-time ratings. ATS/BPSs which are not tested and labeled with 1-1/2 and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

2.11 POWER QUALITY METERING

A. The ATS shall be able to provide metering for current, voltage, real power, reactive power, energy use, power factor, and frequency. Metering shall be true RMS type, 1% accuracy for voltage and 0.5% for currents with 5 A secondary current transformer (CT).

B. The following parameters shall be provided:

1. Phase and Neutral Current: Ia, Ib, Ic, In, and average Current (Iavg)

2. Voltage: Va, Vb, Vc, Vab, Vbc, Vca

3. Voltage and Current unbalance

4. Hz, PF, W, Var, VA

5. Wh, VARh

6. Voltage and Current Harmonics (%THD up to 8th order)

2.12 DATA LOGGER

A. In addition to logging system events, the ATS shall be capable of logging digital and analog measured parameters and storing the data in non-volatile memory.

1. Controller shall contain a 20-channel Data Logger. Each channel shall be capable of being configured to monitor a digital (on/off) or analog measured parameter.

2. The sampling rate of each channel shall be configurable from 1 cycle to 60 minutes per sample.

3. Data shall be stored in nonvolatile memory, in a FIFO (First In, First Out) sequence.

2.13 WAVEFORM CAPTURE/OSCILLOGRAPHY

A. The ATS shall be capable of monitoring and capturing waveform data in the event of utility power outages or other user-specified events.

1. Up to 10 active channels of waveform capture may be user-configured.

2. Each channel shall be capable of capturing up to 256 cycles of waveform information.

3. Analog channels may be configured for 4, 8, 16, or 32 samples/cycle.

4. Digital channels shall be configured for 1 sample/cycle.

5. Waveform triggers shall be user configurable.

6. Waveform data shall be stored in industry-standard COMTRADE format (IEEE C37.111) for broadest compatibility and ease of downloading to a PC.

2.14 Customers-Configurable Alarms

A. The ATS shall be capable of being configured to display customer-configured alarm events.

1. Controller shall be capable of being user-configured for up to ten (10) Digital and eleven (11) Analog alarms.

2. Each Digital Alarm shall be user-assignable to an available digital input (dry contact input), and shall include a user-configurable alarm name and time delay.

3. The following measured parameters shall be available for configuration as Analog Alarms, with user-specified pickup values and time delays:

a. Low (load) PF Alarm

b. Source 1 (or 2) Voltage Harmonics Alarm (%THD)

c. Load Current Harmonics Alarm (%THD)

d. KW Overload Alarm

e. Overcurrent Alarms (A, B, C, or N)

f. Source 1 (or 2) Voltage Unbalance Alarm

g. Load Current Unbalance Alarm

4. All alarms shall also be capable of being reset via a remote dry contact input to the controller or a network-activated reset signal.

2.15 Flexible Feature Re-Assignment

A. The ATS shall be factory pre-configured in accordance with the project specifications.

B. The ATS shall utilize flexible controller inputs and outputs to permit re-configuration after installation, without the need for re-wiring, software upgrades, or factory service support.

C. Each ATS shall be configured with [SPECIFIER TO SELECT ONE] [4] [8] [12] field reconfigurable Digital Inputs and [4] [8] [12] field-reconfigurable Digital Outputs.

D. Configurable Digital Outputs: Each Digital Output may be assigned to one of the following features:

1. Common/Any Alarm Active

2. Self-Diagnostics Alarm

3. Switch Exercising

4. Control Disconnect Switch in Inhibit position

5. ATS Not in Auto Mode

6. Fail to Transfer to Source 1

7. Fail to Transfer to Source 2

8. Engine Start Active

9. Source 1 Failure

10. Source 2 Failure

11. Load Connected to Source 1

12. Load Connected to Source 2

13. ATS in Center/Neutral Position (delay type ATS only)

14. Bypass Switch connected to Source 1 (bypass type ATS only)

15. Bypass Switch connected to Source 2 (bypass type ATS only)

16. Auto Transfer Occurred – Source 1 to Source 2

17. Auto Transfer Occurred – Source 2 to Source 1

18. Programmable Load Control (up to 6 stages) – Each individually configurable for either Elevator Pre-signal or Load Disconnect/Connect signal. Each with independent timer adjustment.

E. Configurable Digital Inputs: Each Digital Input may be assigned to one of the following features:

1. Bypass Time Delay on Transfer to Source 2

2. Bypass Time Delay on Re-Transfer to Source 1

3. Engine Start

4. Test with or without Load

5. Inhibit Transfer to Source 1

6. Inhibit Transfer to Source 2

7. Selection of Preferred Source

8. Auto/Manual Re-Transfer to Source 1

9. Auto/Manual Re-Transfer to Source 1 and Source 2

10. Commit/No-Commit to Transfer to Source 2

2.16 FLEXIBLE LOGIC EDITOR

A. The ATS shall be capable of being configured to execute customized protection and control schemes.

B. The following logical operations shall be supported:

1. Gates: AND, NAND, OR, NOR, NOT, XOR, LATCH

2. Positive/Negative edge triggered One-Shot

3. Dual edge triggered One-Shot

C. Control logic shall be constructed using any of the measured parameters (analog) in the controller, the customer-configured Alarms, plus any of the controller's hardwired inputs or outputs (digital).

2.17 SURGE ARRESTORS

A. The switchgear meets the relevant IEC international standards with respect to system voltages and currents. When required, surge arresters can be mounted in the cable connection compartment.

2.18 NAMEPLATES AND IDENTIFICATION LABELS

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background and shall be provided by the same manufacturer as listed and as agreed with the Engineer

B. Furnish master nameplate for each switchgear and controls lineups. Circuit nameplates shall be provided with circuit designations as shown on purchaser's single-line diagrams.

C. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.19 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

2. Switch position.

3. Switch in test mode.

4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

1. Indicating Lights: Grouped for each transfer switch monitored.

2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.

3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.20 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Functional Description: Include the following functions for indicated transfer switches:

1. Indication of sources available, as defined by actual pickup and dropout settings of

transfer-switch controls.

2. Indication of switch position.

3. Indication of switch in test mode.

4. Indication of failure of digital communication link.

5. Key-switch or user-code access to control functions of panel.

6. Control of switch-test initiation.

7. Control of switch operation in either direction.

8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.

C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

1. Touchscreen type operator interface

2. Controls and indicating lights grouped together for each transfer switch.

3. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.

4. Digital Communication Capability: Matched to that of transfer switches supervised.

5. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

2.21 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 -EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.

1. Concrete Bases: 100 mm high, reinforced, with chamfered edges. Extend base no more than 100 mm in all directions beyond the maximum dimensions of switch, unless otherwise indicated.

B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

C. Identify components according to Division 26 Section "Electrical Identification."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Provide control and monitoring wiring and make all necessary connections at the transfer switches, synchronizing switchgear, and generator sets. Provide all wiring required. Coordinate requirements with synchronizing switchgear, ATS/BPS, and generator manufacturer.

F. The ATS/BPS and synchronizing switchgear manufacturer shall coordinate all requirements with the engine/generator manufacturer. Provide qualified field service technician to oversee installation and completely test the system.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 TESTS AND CERTIFICATION

A. The complete ATS/BPS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are following the specification requirements.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

C. The ATS/BPS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

3.4 SERVICE REPRESENTATION

A. The ATS/BPS manufacturer shall maintain a national service organization of company-employed personnel located throughout the UAE. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

END OF SECTION

4.0 WIRING

The wiring to be employed and the manner of installation shall be as described in this Specification and/or as indicated on the drawings. All electrical pipes shall be 3/4" must be covered with mortar and heavy PVC/GI must before plastering UPVC mark as BS andto be approved by DEWA.

The wiring of the installation must be in strict accordance with the descriptions, cablesizes and circuit breaker details given in the Specification and Schedules and/or drawings issued for the project.

All wiring of multi-point sub-circuits must be carried out as looping-in system, and jointsor connectors other than those required for the connection of special fittings and other purposes particularly mentioned will not be allowed. On all AC supplies, care must be taken to ensure that both the live lead and the neutral are contained in the same conduit, and that every switch or circuit breaker in a 2-wire, 3-wire or 4-wire circuit or supply must be fitted in the phase conductors of the supply.

4.1 TESTING

4.1.1 Except where otherwise provided in the Contract detailed in this document, the Contractor shall provide all labor, materials, power, fuel, stores, apparatus and properlycalibrated and certified instruments for carrying out tests of the plant, materials, work or workmanship in accordance with the Contract, on the site or at the place of manufacture.

4.1.2 Execute work of this section only by skilled tradesmen regularly employed in commissioning of electrical systems. Prior to commencement of on-site commissioningsubmit CVs detailing experience and qualification of personnel assigned for this work. These shall be reviewed and accepted by the Engineer.

4.1.3 The Engineer must be given three (3) days' notice, in writing, of the date on which test or commissioning will be carried out. The notice shall be given by the Contractor who shall ensure that all setting up and adjustments have been carried out before the day ofthe test.

4.1.4 Contractor shall comply with commissioning procedures to NFPA IEC, BS and IEEEguidelines

4.1.5 The whole of the installation shall be tested at completion (in the presence of theEngineer or his representative).

4.1.6 The Contractor shall submit the results of the tests to the Engineer on a certificate ofthe type described in the above Regulations.

4.1.7 The test certificate shall also be signed by the Engineer or his representative.

4.1.8 Polarity and phase sequence shall be certified by inspection or test and this shouldcomply with the marking of fuse boards etc.

4.1.9 Insulation resistance tests shall be carried out using a minimum test voltage of 500 voltsDC.

4.1.10 Earth fault loop tests shall be carried out using a 50 Hz supply circulating a current ofapproximately 5 amps.

4.1.11 Cables shall be subjected to the test voltage as laid down in the appropriate BritishStandard.

4.1.12 The Contractor shall be responsible for 'ringing through' and testing all cables before finally making off ends and connecting up. The correct phase rotation of motors etc. shall be the responsibility of the Contractor. Phase rotation tests will be carried out by the Engineer and if found necessary, the Contractor shall carry out any reversal of phaseconnections. This work shall be included in the Works.

4.2 VOLTAGE DROP

The cable sizes are specified to accord with the IEE Regulations in respect of voltage drop, but if the sizes are not given (such as where the Contractor is, in an emergency,acting without a Specification), the cables shall be of sufficient cross section area to carry the full load without exceeding a drop of 4% of the Supply Authority's declared voltage between the main services termination and any part of the installation.

4.3 POINTS POSITION

4.3.1 All lighting and power points, control gear and other specified items of equipment shall be located in the positions indicated on the drawings, or described in this Specification.If the Contractor is in doubt as to the intended position of any items or the interpretation of any symbol used, he shall apply to the Engineer for a decision.

4.3.2 The Engineer reserves the right to make alterations to positions without incurring extracharges, providing such alterations do not involve the Contractor in additional expensefor labor and materials.

4.4 LABELLING

4.4.1 Switch panels, distribution boards and similar distribution units shall, unless specified otherwise, be designated in accordance with the reference letters or numbers used inthis Specification and/or shown on the drawings.

4.4.2 All distribution boards shall be provided with a copy of load distribution schedule whichis approved by DEWA and should be laminated & placed inside the front cover.

4.4.3 Duplicate copies of DEWA approved load distribution schedule shall be binded and handed over as directed by the Engineer. Spare ways shall not be printed "SPARE" butbe left blank.

4.4.4 On AC systems the phase sequences shall be maintained throughout the installation andall phase connections shall be in the order Red, Yellow, Blue from top to bottom and/or left to right. Neutral connections, links and/or bus bars shall always be located above, below or to the side, not between the phase connections, links or bus bars.

4.4.5 The particular phase connected to circuit breaker banks and bus bars shall be clearlyindicated by marking with the appropriate color.

4.4.6 The Contractor shall provide and install in each main switch room a framed andglazed schematic diagram indicating the distribution arrangement of the

installation.The frame shall be fabricated from standard section hard-drawn aluminum.

4.5 GENERAL FIXING

4.5.1 All fixing devices shall be of such a type and construction to safely carry the loading intended, Screws and bolts shall be of ample size and shall be in all cases be of their quested diameter to suit the orifice intended, fixing to “hollow pot” and similar floorsand walls, shall in all cases be by means of

4.5.2 "Raw bolt” or similar approved fixing devices,

4.5.3 Where fixings demand special brackets etc. "details of the proposed design shall besubmitted to the Engineer for approval prior to manufacture.

4.5.4 Self-taping screws shall not be used for fixing to metal partition in gun less permitted bythe Engineer.

END OF SECTION

5.0 CABLE

PVC Wires: Cu/PVC 450/750V

Manufactured to BS6004 & EN 50525-2-31

Conductor

Stranded bare copper class2 to BS EN 60228

Insulation

PVC-Polyvinyl Chloride

Installation

In conduit, insulated supports, ducts in covered and dry place

Marking:

450/750V Cu/PVC 1X SIZEmm2 HO7V-R EN 50525-2-31

Characteristics

Construction Characteristics:

Conductor Material	: Bare Copper
Conductor Flexibility	: Stranded Class2
Insulation	: PVC
Rated Voltage	: 450/750V
Mechanical Resistance to impact	: Low
Cable Flexibility	: Rigid

Usage Characteristics:

Max.Conductor Temperature in Service	: 70° C
Short-Circuit Max Conductor Temperature	: 160° C

Cabling will be as detailed in this specification or on the drawings.

All cable must comply with the relevant British Standards Specifications / Local Authorities and be by an approved manufacturer.

The Contractor shall be responsible for ascertaining the lengths of all cable covered by the Specification.

All cable and conductors shall be copper unless otherwise specified.

Ducts and pipes shall be of the PVC type, with spigot joints.

Operating Temperature Range	: -5 to 60° C
Flame Retardant	: Yes
Weather Resistance	: Good
Bending Factor When Laying	: 12(xD)
Bending Factor When installed	: 6(xD)

BS Cu/ PVC 450/750V Class 2 HO7V-R

Nexans ref	Name	Nom.Outer Diam [mm]	App. Weight [Kg/km]	Max.DC Resist Cond.20°C [Ohm/Km]	Voltagedrop Single Phase [V/A/km]
210022YVZOUZ09ADY	1x1.5	3.0	21	12.1	22.8
210032YVZOUZ09ADY	1x2.5	3.6	32	7.41	14.0
210042YVZOUZ09ADY	1x4	4.0	47	4.61	8.7
210052YVZOUZ09ADY	1x6	4.6	67	3.08	5.9
210062YVZOUZ09ADY	1x10	5.9	109	1.83	3.5
210102YVZOUZ09ADY	1x16	6.8	166	1.15	2.2
210162YVZOUZ09ADY	1x25	8.4	260	0.727	1.5
210252YVZOUZ09ADY	1x35	9.4	340	0.524	1.1
210502YVZOUZ09ADY	1x50	11.0	470	0.387	0.81
210702YVZOUZ09ADY	1x70	12.8	665	0.268	0.58
210952YVZOUZ09ADY	1x95	14.8	925	0.193	0.44
2101202YVZOUZ09ADY	1x120	16.3	1150	0.153	0.37
2101502YVZOUZ09ADY	1x150	18.0	1420	0.124	0.31
2101852YVZOUZ09ADY	1x185	20.0	1770	0.0991	0.27
2102402YVZOUZ09ADY	1x240	23.0	2300	0.0754	0.23
2103002YVZOUZ09ADY	1x300	25.0	2860	0.0601	0.19
2104002YVZOUZ09ADY	1x400	29.0	3660	0.047	0.17
2105002YVZOUZ09ADY	1x500	32.5	4740	0.0366	0.16
2106302YVZOUZ09ADY	1x630	36.0	5976	0.0283	0.15

Power Cables: Cu/XLPE/SWA/PVC 600/1000V
Manufactured to BS5467 & IEC 60442-1
Conductor
Stranded bare copper class2 to BS6460 and IEC60228
Insulation
XLPE-Cross Linked Polyethylene
Inner Sheath or Bedding
Extruded PVC
Armour

GSWA-Galvanized steel Wire Armour
Outer Sheath
PVC-Polyvinyl Chloride Flame Retardant to BS4066 or Equivalent
Installation Conditions:
Air Temperature: 40 Deg
Ground Temperature: 20 Deg
Soil Thermal Resiostivity:2.5k.m/W
Depth of Lay: 0.7m
Marking:

No of cores Conductor sizes mm2 Cu/XLPE/SWA/PVC 600/1000V BS5467.
Characteristics
Construction Characteristics:

Conductor Material	: Copper
Insulation	: XLPE(Chemical)
Inner Sheath	: PVC
Armour Type	: Galvanized Steel Wire
Outer Sheath	: PVC
Color	: Black
Halogen Free	: No

Usage Characteristics:

Max. Conductor Temperature in Service	: 90° C
Short-Circuit Max Conductor Temperature	: 250° C
Flame Retardant	: Yes
Bending Factor When Laying	: 15(xD)
Bending Factor When installed	: 8(xD)

BS LV, XLPE Insulation, SWA PVC 0.6/1KV,2C

Ref	Name	Nom. Outer Diam [mm]	Approx. Weight [Kg/km]	Max.DC Resist Cond.20°C [Ohm/Km]	Perm. Current Rating Open Air [A]	Current Rating, Buried [A]	Voltage drops 4 conductors [V/A/km]
22002FXZVSB09BD0	2x1.5	12.0	260	12.1	25	24	22.8
22004FXZVSB09BD0	2x2.5	14.0	440	7.41	44	40	14.0
22004FXZVSB09BD0	2x4	14.0	490	4.61	44	49	8.7
22006FXZVSB09BD0	2x6	15.0	475	4.08	56	49	5.9
22025FXZVSB09BD0	2x25	19.0	950	0.727	141	107	1.65
22016FXZVSB09BD0	2x16	20.0	910	1.15	99	84	2.2
22045FXZVSB09BD0	2x45	22.0	1420	0.524	162	129	1.15
22050FXZVSB09BD0	2x50	25.0	1660	0.487	197	154	0.89
22070FXZVSB09BD0	2x70	28.0	1860	0.268	251	188	0.6
22095FXZVSB09BD0	2x95	41.0	2540	0.194	404	226	0.45
22120FXZVSB09BD0	2x120	44.0	4020	0.154	454	257	0.47
22150FXZVSB09BD0	2x150	47.0	4590	0.124	406	287	0.4
22185FXZVSB09BD0	2x185	42.0	4660	0.0991	464	424	0.26

BS LV, XLPE Insulation, SWA PVC 0.6/1KV,3C

Ref	Name	Nom. Outer Diam [mm]	Approx. Weight [Kg/km]	Max.DC Resist Cond.20°C [Ohm/Km]	Perm. Current Rating Open Air [A]	Current Rating, Buried [A]	Voltage drop4 conductors [V/A/km]
23002FXZVSB09BD0	3x1.5	12.0	280	12.1	25	24	22.8
23004FXZVSB09BD0	3x2.5	14.0	460	7.41	44	40	14.0

23004FXZVSB09BD0	3x3	15.0	450	4.61	44	49	8.7
23006FXZVSB09BD0	3x6	16.0	540	4.08	56	49	5.9
23010FXZVSB09BD0	3x10	19.0	810	1.84	78	65	4.5
23016FXZVSB09BD0	3x16	21.0	1080	1.15	99	84	2.2
23025FXZVSB09BD0	3x25	24.0	1440	0.727	141	107	1.65
23045FXZVSB09BD0	3x35	26.0	1770	0.524	162	129	1.15
23050FXZVSB09BD0	3x50	28.0	2200	0.487	197	154	0.89
23070FXZVSB09BD0	3x70	41.0	2500	0.268	251	188	0.6
23095FXZVSB09BD	3x95	46.0	4440	0.194	404	226	0.45
23120FXZVSB09BD0	3x120	49.0	4160	0.154	454	257	0.47
23150FXZVSB09BD0	3x150	44.0	5410	0.124	406	287	0.4
23185FXZVSB09BD0	3x185	48.0	6480	0.0991	464	424	0.26
23240FXZVSB09BD	3x240	52.0	7980	0.0754	546	475	0.21
23300FXZVSB09BD0	3x300	57.0	9620	0.0601	628	419	0.18
23400FXZVSB09BD0	3x400	64.0	12040	0.047	741	449	0.17

BS LV, XLPE Insulation, SWA PVC 0.6/1KV,4C

Nexans ref	Name	Nom. Outer Diam [mm]	Approx. Weight [Kg/km]	Max.DC Resist Cond.20° C [Ohm/Km]	Perm. Current Rating Open Air [A]	Current Rating, Buried [A]	Voltage drop 4 conductors [V/A/km]
24002FXZVSB09BD0	4x1.5	13.0	320	12.1	25	23	22.8
24004FXZVSB09BD0	4x2.5	15.0	410	7.41	33	30	14.0
24004FXZVSB09BD0	4x4	16.0	510	4.61	44	39	8.7
24006FXZVSB09BD0	4x6	18.0	720	3.08	56	49	5.9

24010FXZVSB09BD0	4x10	20.0	960	1.83	78	65	3.5
24016FXZVSB09BD0	4x16	23.0	1240	1.15	99	84	2.2
24025FXZVSB09BD0	4x25	25.0	1720	0.727	131	107	1.65
24045FXZVSB09BD0	4x45	28.0	2160	0.524	162	129	1.15
24050FXZVSB09BD0	4x50	31.0	2750	0.387	197	153	0.89
24070FXZVSB09BD0	4x70	36.0	3400	0.268	251	188	0.6
24095FXZVSB09BD	4x95	40.0	4310	0.193	304	226	0.45
24120FXZVSB09BD0	4x120	45.0	5640	0.153	353	257	0.37
24150FXZVSB09BD0	4x150	48.0	6670	0.124	406	287	0.3
24185FXZVSB09BD0	4x185	53.0	8080	0.0991	463	324	0.26
24240FXZVSB09BD	4x240	59.0	10200	0.0754	546	375	0.21
24400FXZVSB09BD0	4x400	64.0	12360	0.0601	628	419	0.18
24400FXZVSB09BD0	4x400	73.0	16170	0.047	731	439	

3.0 CABLE INSTALLATION

3.0.1 General

i. Full technical details of each type of wire and or cables, the purpose of use.

ii. Copy of test certificate from an independent testing authority or the manufacturer's confirming that the wires and / or cables comply with therelevant clause of this specification.

iii. All flat DBs are to be connected with single core CU/PVC cable from SMDB to DBwhich has to be laid through the conduit in embedded slab.

3.0.2 No cable installation work shall be carried out in temperatures at which the cable beinginstalled is likely to suffer damage.

3.0.3 Each drum length of cable shall be allotted a distinctive and separate reference number.This number shall appear on the test sheets covering the respective length of cable and shall also be clearly marked on the cable drum. The

Contractor shall advise the Engineerupon delivery to site of each drum length, quoting this reference number, which shall also appear on the invoices.

3.0.4 All cables shall be delivered to site with the manufacturer's seals, labels or other proofor origin intact. These labels and seals shall not be removed until the cable is required for use and shall be retained for inspection by the Engineer.

3.0.5 The arrangement of cables and all methods of installation shall be approved by theEngineer.

3.0.6 Cables shall be installed from terminal point to terminal point and straight through joints shall not be made unless approved. Where a run of MICC cable is of a length thereadios of each bender recharge indirection of the route of shall not be less than that laid down in the relevant able of current issues of lEE regulations and the which exceeds the maximum to which the cable can be manufactured, a through joint of approved pattern will be permitted.

3.0.7 Relevant British Standard Specifications, and shall generally not be less than eight timesthe overall diameter of the cable.

3.0.8 The spacing of cable support shall be those laid down for the relevant size and type of cable in the current issue of the lee Regulation sand the manufacturer’s recommendations, but the horizontal longitudinal distance between wire armored cablesupport centers shall not exceed 16metre, the horizontal distance between support centers of unarmored cables shallot exceed command the distance between support centers for either type of cable on vertical runs is not to exceed16 meter. Cable not less than50mm external diameter shall be supported at not more than800mmcenter.

3.0.9 The cables may be installed in a number of different ways:

a. Laid direct in the ground
b. Laid in ducts
c. Installed in covered concrete trenches
d. Installed on cable ladders
e. Installed on perforated steel trays
f. Fixed to concrete and brickwork
g. Fixed to steelwork

3.0.10 Single core cables forming a three-phase group shall be fixed in trefoil cleats of a British Insulated Calendars Cables Limited alloy pattern or similar. Flat formation may be usedwhere specified or approved.

3.0.11 Unarmored PVC cables and wires shall be enclosed in trucking or conduit unlessotherwise stated.

3.1 Cables Direct in Ground

3.1.1 Cable shall be laid in prepared trenches and the Contractor shall satisfy himself as to thesuitability of the trenches.

3.1.2 All cables shall be supplied by the Contractor.

3.1.3 All cables shall be laid at depth of not less than 600mm for LV cables and 900 for H.V. cables at all points and where this depth is not possible approved mechanical protectionshall be provided.

3.1.4 All underground cable routes shall be marked at 165-meter intervals, at changes of direction and at straight through cable joints by approved markers.

3.1.5 The Contractor shall supervise and be responsible for all trenching and backfilloperations irrespective of who carried out the work.

3.1.6 The Contractor shall, before laying any power cable satisfy himself that the conditionson Site are such that the maximum current carrying capacity is maintained over the whole route.

3.1.7 If the Contractor considers that the conditions are such as to reduce the maximum current carrying capacity, he shall before install the cable notify the Engineer as to what the current capacity would be under these conditions and shall not proceed withthe work until the Engineer has given his permission in writing or otherwise instructedthe Sub-Contractor to alter the cable. Before any section of the work is taken over, theSub-Contractor shall confirm to the Engineer, in writing, the maximum continuous current carrying capacity of the cables.

3.1.8 When the cables are laid into trenches, they shall be drawn by cable pulling grips withrotating eyes from drums supported on stands, on to the rollers throughout their length. All rollers must be removed from the trench before the covering of sifted sand islaid over the cables. All cables shall be inspected by the Engineer before backfilling.

3.1.9 Where more than one horizontal layer of covers is laid, the level of the upper layer of cable shall be gauged from the level of the finished bottom of the trench and marked onthe side of the trench at frequent intervals before the installation of the lower layers, toensure that the correct vertical spacing is maintained.

3.2 Cable on Trays

3.2.1 All cables shall be saddled to tray work. MICC cabling shall be saddled at not more than500mm centers and all other cabling at not more than 16m centers.

3.2.2 All cables, other than pilot or control, when installed on trays shall not be more thanone layer.

3.2.3 The saddling of MICC or FP200 type cable to tray work shall be by 162mm PVC coatedcopper strip unless otherwise specified or approved.

3.2.4 All cable trays shall be of the heavy duty hot dipped galvanized to BS2989 16982, returnflange type unless approved otherwise for specific locations only.

3.2.5 Cable tray mounted externally on roofs etc. shall be provided with heavy duty sunshields made of galvanized steel or aluminum. The sunshields shall be arranged toallow adequate ventilation of the cables on the tray.

3.2.6 All external fixings and brackets shall be galvanized steel, galvanized after fabrication.

3.2.7 All internal fixings shall be either proprietary galvanized channel or a galvanizedfabricated channel or angle steel to the Engineers approval.

3.3 CABLE TERMINATIONS

3.3.1 All jointing materials to be used shall conform to the relevant requirements of British Standards and the Contractor shall state the quality of the compounds he proposes touse, which shall be entirely suitable for the site conditions.

3.3.2 The Contractor shall be responsible for ringing through and testing all cables before finally making off ends and connecting up. The correct phase rotation of motors etc. shall be the responsibility of the Contractor. Phase rotation tests shall be carried out bythe Contractor and, if found necessary, the Contractor shall carry out any reversal of phase connections. This work shall be included in the works.

3.3.3 During the maintenance period, the Contractor shall be responsible for maintaining thefilling medium at correct level in all terminal boxes or other apparatus to be filled by him, and shall inform the Engineer when action has been necessary

3.3.4 All cables shall be color coded in accordance with the IEE Regulations current editionand amendments.

3.3.5 All sealing and jointing work shall be in accordance with the best current practice and offirst-class workmanship.

3.3.6 Where cable sheaths are used as earth continuity conductors, glands shall have thenecessary contact surfaces or straps to provide a low resistance path under fault conditions.

3.3.7 All cable connections to plant shall be made with approved cable lugs, compression type lugs being used, together with tools supplied by the lug manufacture.

3.4 Identification

3.4.1 All cable ends shall be marked to identify the cable connection. Identification labels forall cables shall give the cable an approved reference number.

3.4.2 All cables shall have a label fixed to them below each cable joints, also where the cable passes through ducts and trenches at each exit from or entry to such ducts and trenchesand where the cable enters a room or building. The label shall indicate the cable potential and destination as well as the cable number

3.5 GLANDING

3.5.1 Associated plant will not be supplied with the compression gland sand the Contractor shall include in his price for the supply and fitting of compressing land sand for drillingand tapping for the installation of the glands. Back nuts shall be fitted where no tapedholes are available and are to be ordered with the glands.

3.5.2 All glands in outdoor situations and where ever else specified, shall be of weatherproofand/or water tight as required. Gland manufacturers shall be subject to approval.

3.5.3 All compression glands shall be fitted with PVC shrouds filled with weatherproof plastic compound and made fast to the cable with PVC tape. Where necessary, the cable underthe armoring shall be taped to ensure good fit in the body of the gland.

Earthling tags shall be fitted to each gland, on assembly, prior to the lugs beingattached

END OF SECTION

6.0 CABLE TRAY / TRUNKING

6.0 Metal trucking shall consist of butting sections not less than 2m long, manufactured from galvanized sheet steel (Heavy Duty), nominal thicknesses follows:

50x 50mm to be 16.0mm
75x 50mm to be 16.2mm
75x 75mm to be 16.2mm
1600x 50mm to be16.2mm
1600x 75mm to be 16.2mm
1600x1600mm to be 16.2mm
1650x 75mm to be16.6mm
1650x1600mm to be16.6mm
1650x1650mm to be16.6mm
200x1650mm to be16.6mm
225x1650mm to be16.6mm
300x1650mm to be16.6mm

6.1 Trucking runs shall be determined by the Contractor and agreed by the Engineer before any work is started. Trucking shall be run at least 1650mm clear of plumbing and mechanical services.

6.2 Trucking runs shall be so arranged that the lid or cover plate is always on the top or sideand not underneath, unless instructions to the contrary on the Drawings. Where trucking faces downwards or side wards, cable retaining straps shall be fitted at not more than 750mm. Cover plates shall be secured by metal screws and fixed nuts, or turnbuckle type clips. Covers held by' self-tapping' screws or spring tension will not be accepted. Every entry into the trucking shall be placed to prevent in grass of water and be so fixed such that joints are mechanically sound and that cables drawn in are not subject to abrasion.

6.3 The electrical continuity of any complete trucking system from end to end from any point on the system to the main earth connection shall not exceed a resistance value of16 ohm.

6.4 At each joint between trucking, bends, tees and inter sections copper bonding strapsshall be fitted, and be visible from floor level.

6.5 Lengths of trucking shall be connected by internally fixed rectangular coupling units of sufficient width to provide a minimum bearing face of 25mm to which the lengths shall be welded or bolted, except where long span occur between supports. In this instance, the couplings shall be of sufficient length and rigidity to prevent any sagging. The lengths of the lids shall be so arranged that the joints always coincide with the center ofthe coupling unit.

6.6 Due allowance shall be made in long runs of trucking for expansion and contraction forthe supporting structure and a suitable flexible coupling shall be provided in all instances where the trucking crosses an expansion joint in the building structure.

6.7 Tee pieces and bends shall be provided with similar means for connection and the inner radius shall be such that the cables will not be set through a bend of

fewer radiuses thanthat prescribed in the IEE Regulations for the particular cable concerned. Wherever possible, bends, tees and intersection shall be of the gusset type.

6.8 Where a change in direction of a trucking run occurs, the deviation must be affected bya purpose-made unit, manufactured on similar lines to the bends and tee pieces described above, not by manipulation of the trucking, unless otherwise specified.

6.9 Trucking shall be firmly attached to the respective equipment either by bolted flanges or by hexagonal male bushes and lock-nuts, according to the requirements of the equipment concerned. Flared sections shall not be used.

6.10 Where trucking does not terminate in equipment, the otherwise open end shall becapped with a flanged cover suitably bolted in position.

6.11 Vertical runs of trucking exceeding 2 meters in length shall be fitted with pin racks orother approved type of support at a spacing of not more than 16 meters, to take theweight of the cables and prevent under tension.

6.12 Trucking that is intended for the accommodation of cables for various services shall bedivided into various compartments in order that complete segregation of the differentservice cables can be affected. Telephone wiring, computer telemetry wiring and lighting and power shall each be in an independent compartment.

6.13 Where trucking passes through walls and/or floors that normally constitute a fire barrierin a building, care should be taken to see that no orifice is left between the trucking andthe building structure through which fire might spread. In addition, a suitable barrier of incombustible material shall be provided and fitted inside the trucking to prevent thepassage of internal fire. See British Standard Code of Practice CP 16003.

6.14 Any steel trucking installed in basements or areas subjected to dampness shall begalvanized after manufacture and then painted.

6.15 Where holes are cut into the base of trucking at intersections to allow passage of cables,protective PVC beading shall be provided around the edge of the hole.

6.16 Cable joints will not be permitted within the trucking.

6.17 The Engineer reserves the right to reject any trucking arrangement not conforming to the above clauses. The cost of removal and replacement of such rejected trucking shallbe borne by the Contractor.

6.18 Where connection is made between trucking and distributor board, the cable entry orentries shall be sized to accept all cables from all used and 'spare' ways, all unused conduit holes to be sealed with PV solid grommets.

6.19 Holes in trucking shall be drilled, punched or cut by ring saw

6.20 Individual pieces of trucking shall be independently supported. On straight runs fixingshall be at regular intervals not exceeding 16.5m, fixing screws shall be •of steel and brackets shall be of an approved design. Where weatherproof trucking is used, fixing screws shall be zinc plated (electro-galvanized)

complying with BS 16706, Class B coating.

6.21 Trucking systems erected outside a building shall be weatherproof.

6.22 The wiring capacity of trucking shall be determined from the standard tables issued bythe manufacturer of the trucking.

6.23 **Cable Trays / Cable Ladders**

6.23.1 Cable tray and cable ladder shall be produced to BS 729 and shall be hot dip galvanized.

6.24 Prefabricated mild steel cable trays shall be constructed of steel and finished hot dippedgalvanized. All trays supporting power cables shall be folded edge heavy duty tray with return flange and those supporting fire alarm and telephone cables shall be medium duty.

6.25 Cable trays sheet steel gauge shall be as indicated hereunder for the different sizes andtypes:

Heavy Duty	:	100mm to 300mm	1.5mm
		450mm to 600mm	2.0mm

6.26 Cable trays, bends and junctions shall be provided as necessary and shall be similar typeand finish. The trays shall be of adequate widths to support the necessary cables. They shall be adequately supported throughout the length or run at intervals not exceeding 1200mm. All cables will be fixed to the cable utilizing cable ties. Ventilated covers to beprovided for all cable trays exposed to direct sunlight.

6.27 Cable ladder shall be produced of 2mm hot dipped galvanized mild steel.

6.28 Only 40% of the cable tray and the cable ladder space shall be occupied. A calculation shall be forwarded for approval and the tray size shall be increased if required to meetthe above without any extra cost.

6.29 Trucking and lid joints shall be staggered thereby increasing the strength at couplingjunctions. Joints shall be kept to the minimum.

6.30 Where earthed metal work is connected to the PVC trucking system care shall be takento ensure that earth continuity is maintained by installing suitable PVC insulated (green/yellow) cables.

6.31 If agreed by the Engineer, trucking sets may be fabricated on site to meet a particularrequirement. Where this is necessary all cuts shall be straight, clean and sealed with adhesive or other approved method of present a rigid and clean line joint.

6.32 The internal free area of the trucking will be such that the quantity of specified cableswill not occupy more than 40% of the available capacity.

6.33 Contractor should provide Warrantee Certificate of (24 months) for Cable Tray & Trunking System from the T.O.C. date of the Project.

END OF SECTION

7.0 SUB MAIN DISTRIBUTION BOARD

7.1 General

7.2 MCCB distribution boards shall comply with IEC 61439-2 Form 2, type 2 Enclosures:

A. MCCB distribution boards must be totally enclosed.

B. The panels should be fully type tested panels

C. The degree of protection according to IEC 439.1 shall be IP 41 minimum for indoor installation and IP 55 for outdoor installation.

D. The enclosure shall be manufactured from minimum 1.5 mm thick electro-zinc coated sheet steel with Epoxy polyester powder finish and color to COMPANY approval.

E. A hinged door fitted with lock and key has to be opened for operating the switchgear. Access to the cabling space and to the switchgear shall be obtained by removing a front cover bolted fastener.

F. Ample-wiring space shall be provided. Detachable blank gland plates shall be provided at the top and bottom.

G. Anti-condensation heater shall be provided wherever shown in the SLD.

7.3 Breakers:

A. Incoming breakers shall be isolator and out-going breakers shall be MCCBs of fixed type. Breaking capacity of the MCCBs shall be in line with the prospective fault level of the installation but shall not be less than fault level calculation. Ratings and capacity shall be as given elsewhere in this specification.

B. Short circuit calculations shall be submitted to the engineer for approval.

C. Breaker selection shall be made to achieve maximum discrimination between the upstream and downstream breakers.

D. Miniature circuit breakers and earth leakage circuit breaker and shall be provided as indicated on the load schedules.

E. The short circuit rating for the MCBs shall be 6KA for DB’s.

F. All circuit breakers shall be factory calibrated to ambient temperature of 40°C.

7.4 Electrical Characteristics:

A. Rated insulation voltage: 600V (AC)

B. Maximum rated current of bus-bars: up to 630 A

C. The short circuit capacity of the distribution boards shall be 35 kA minimum and shall be rated to withstand the short circuit level of the position it is installed. A short circuit level calculation shall be submitted and the short circuit level of the distribution board shall be upgraded accordingly.

END OF SECTION

8.0 DISTRIBUTION BOARD

8.1 Description

8.1.1 The specification here under shall be applied to all panel boards referenced on the drawings/load schedules as DBs. Distribution Boards Shall be as per DEWA standard.

Distribution boards shall be provided with an isolator incomer with common ELCBs for group of lighting circuits and common ELCBs for group of power circuits for each section of MCBs for each power circuit as shown on schedules.

8.1.2 As a standard item, all MCB boards shall be provided with permanent circuit identification charts to the approval of the engineer.

8.1.3 MCBs shall comply with IEC – 898 and RCBOs shall comply with BSEN 61009. ELCBs shall comply with BSEN 61008.

8.2 Enclosures

8.2.1 The MCB Distribution Boards shall be surface/flush mounted type. The enclosures within Electrical rooms must be surface mounting type. Powder coated rustproof sheet steel units, complete with circuit breakers providing thermal overload and magnetic short circuit and earth fault protection as shown on the drawings. The enclosure protection shall be IP 31, while the complete assembly shall comply with IEC – 439-1.

8.2.2 Surface wall mounted DBs shall be fixed on U channel support and not direct to the wall.

8.2.3 Each switch panel shall be in accordance with the preceding LV Switchboards - General together with the items identified below.

8.2.4 Each switchboard shall be so designed and constructed that it shall withstand for three seconds without damage, the thermal and mechanical stresses which might arise under short circuit conditions for a prospective bus bar short circuit current of 50KA unless otherwise specified on the drawings or in the particular specification. The fault rating shall apply to the whole of the bus bar system up to the connection to outgoing protection devices.

8.2.5 The panel shall be front and rear access, with top cable entry for incoming bus bars, and top entry for outgoing cables and bus bars.

8.2.6 Main incoming circuit breakers shall be of the air insulated type ACB in accordance with EN60947.2 having enclosure protection in accordance with IP54. Each unit shall have a nominal voltage rating of 400Volts and a minimum short time rated current of 50 KA for 1 second with appropriate short circuit breaking and making currents calculated in accordance with the requirements of EN60947.2.

8.2.7 Each circuit breaker shall be totally enclosed in sheet steel and be provided with a 3 phase isolating device suitably interlocked to prevent isolation except when the circuit breaker is open. It shall not be possible to withdraw the breaker or remove the front cover until it is in the ISOLATED position, and provision shall be made for locking the isolator in this position. When isolated, the bus-bar and C.T. chamber orifices shall be guarded by automatic covers.

8.2.8 Each ACB shall be complete with an approved power assisted closing device mounted at a convenient height and the breaker shall be opened by means of a separate hand trip device. The operating mechanism shall be accessible for inspection without withdrawing the breaker.

8.2.9 The ACB shall be of the horizontal with draw able, load making and breaking type with the contacts being of the double break pattern, operated by a vertical motion. The main arcing

contacts shall be of the high-pressure butt type with wipe and roll action on opening and closing. The main contacts shall be silver alloy faced with the arcing contacts copper alloy faced. Removable arc-shuts shall be fitted, together with a hand operated circuit breaker and isolating mechanism, complete with a mechanical ON/OFF position indicator.

END OF SECTION

9.0 VARIABLE FREQUENCY DRIVE CONTROLLER

9.1 General Description

This Specification describes the requirements for the 400V Variable Frequency Drive Controllers (VFD). The 400V Variable Frequency Drive Controllers shall be designed andprovided in accordance with this Specification and the attached data sheets. The proposed Manufacturers installation requirements should be complied by the Manufacturers as part of the Contract including shielded power cables (if required),
enclosure for VFD's, earthing requirements, etc to achieve EMC Compatible installation.All details shall be furnished as part of the submittal.

9.2 Scope of Supply

The scope of supply includes the design, manufacture, testing and delivery of the 400VVFDs as described above. The VFDs shall comply with EMC directives and provide with filters. All VFDs shall be communicating type using LON / Modbus.

9.3 Supplied by Contractor

Equipment unloading and storage at the Job Site.

9.4 Codes and Standards

9.4.1. All equipment shall be designed, manufactured and tested in accordance with the latestedition of the applicable:

NFPA 70

IEC 146

EN Standard/CE marked for EMC directives:

Emissions	Immunity
EN 50081-1	EN 50082-1
EN 50081-2	EN 50082-2
EN 55011 Class A	IEC 801-1, 2, 3, 4, 5, 6, 8
EN 55011 Class B	EN 50178

9.4.2 EN 60204-1

9.4.3 The manufacturer shall furnish the product as listed and classified by underwriter'slaboratories as suitable for the purpose specified and indicated.

9.5 Environmental Conditions

9.5.1 The VFD product line shall be capable of operating normally in an environment with anambient temperature range of 0 °C to 50 °C with a relative humidity of up to 95% (non-condensing). The enclosed current rating shall be derated by 10% for each 5 °C above 50°C not exceeding 60°C.

9.5.2 The product line shall be capable of being shipped and stored in an environment

with anambient temperature range of 0 °C to 65 °C.

9.5.3 The nominal operating altitude shall be less than 1000 m above sea level.

9.6 Product Delivery and Handling

9.6.1. Ship controllers in convenient sections crated and protected, bearing in mind thehazards of transportation.

9.6.2. All necessary bus connections, wire jumpers, bolts, nuts, etc. shall be suitably packedand identified to facilitate field assembly.

9.7 Products

9.7.1. General

9.7.1.1. The variable speed drive controllers' technical requirements shall be in accordance with the data sheets. Seller shall be responsible for ensuring that under all operating conditions:

1. The controllers and their characteristics shall be compatible with their respective driven production motor and the plant control system. Seller shall obtain speed (frequency) range required and maximum frequency permitted for each type of controller from the load equipment supplier.
2. The VFD shall be suitable for use with high efficiency Design B, 400 V motors.
3. The total harmonic distortion (THD) voltage in the plant electrical and local DEWA systems shall not exceed 5% and no individual harmonic shall exceed 3%during normal plant operation.
4. Computerized harmonic analysis studies to IEEE Standard 519; copies of thestudies shall be provided with the proposal.
5. The VFD shall be fully digital pulse width modulated type (PWM) using latestgeneration IGBTs with isolating contactors and line reactors.

9.7.2. Design Requirements

9.7.2.1. The VFD Controllers shall be suitable for operation on 400 volts 15% 3 phase 50 hz input power supply and 0-400 Volt, 3 phase, 0.5 to 400 Hz output. No transformer shallbe used on either the input or output of the VFD.

9.7.2.2. Each controller shall comprise:

1. Enclosure with filters and gaskets construction, mounted on steel sills.
2. Incoming supply terminals complete with cable lugs.
3. Pad lockable line disconnect switch with bolt on HRC fuses in each phase.
4. 110% overload capacity above motor service factor demand (115%) for 30minutes.
5. Short circuit and current limit protection.

6. Surge (TVSS) protection wherever shown in the SLD.
7. Stop / Start contactor to ensure when the motor is not running, no voltage ispresent on the motor power terminals wherever shown in the SLD.
8. Wireways with removable gland plates.
9. Each phase and filters to limit on the plant 400V bus THD to 5%; no singleharmonic to be more than 3%.
10. Drive operation man machine interface (MMI) keyboard.
11. Stepless non-reversing minimum and maximum motor speed adjustments, adjustable ramp up rates, minimum/maximum speed limits for pump motors. Adjustments to be password protected.
12. Man / Auto select switch via keypad, with locking via password in both positions(see Note).
13. Local/Remote selector switch via keypad with locking via password in bothpositions (see Note).
14. “Drive Ready” with remote signal.
15. Stop and start pushbuttons via keypad, in remote mode.
16. Speed control: Local / Remote / Automatic via keypad.
17. Motor speed indication via LED display.
18. Motor On / Off indication via LED display.
19. Emergency stop pushbutton, local at controller and local to plant provision.
20. Drive status and failure diagnostic feature via LED display. Feature to log, timeand date the last 30 fault conditions.
21. Indication of output to drive current on each phase.
22. Isolated I/O control signals.
23. Motor multi-function protection, providing short circuit (51), overvoltage (59),undervoltage (27), thermal (49), stalling (49S) and phase unbalance (46) protections, complete with ground fault (51G) protection device to trip the incoming supply.
24. Bolted and shrouded bolted type terminals for terminating load cables.
25. Weid muller or Wieland type terminal blocks shall be provided to connection ofexternal wiring and cables.
26. Interposing relays as required.
27. 110V AC control voltage or manufacturers standard.
28. Microprocessor based electronic self-diagnostics and fault detection system.
29. Each cubicle shall be provided with an earthing bus, complete with two connectors for connecting to the plant earthing system. Drilled holes shall be provided for connecting cable earth conductor.
30. VFD controllers shall be provided with a lamacoid engraved nameplate, minimum size 150mm x 75mm, engraving details to be provided by Purchaser.
31. In “Man” mode, two modes shall be functional: Local or Remote. In “Local” mode, motor shall be started from Start/Stop pushbuttons via controller’s keypad. In “Remote” mode, motor shall be started from pushbutton stationlocated near motor (if required).

9.7.2.3 Performance

The VFD shall have the following features as a minimum:

1. Minimum efficiency of 97% at maximum load and speed.
2. Minimum line side displacement power factor of 0.95 to 1.0 logging at all speedsand loads.
3. Adjustable motor frequency of 0 to 400 Hz.
4. Separately adjustable acceleration and deceleration ramps from 0 to 999seconds.
5. Rotating motor restart feature.
6. Capable of running without a motor connected for set-up and testing.
7. Skip frequency reject point to prevent operating of the equipment at a resonantspeed.
8. Ride through for power outage of at least 2 seconds duration
9. Load loss detection
10. Overload protection
11. Auto economizer
12. The flying start feature operable with or without encoder feedback

9.7.2.4. Discrete Operation

1. Inputs
2. Start
3. Stop
4. Outputs
5. Ready to start
6. Running
7. VFD general fault alarm status
8. VFD Auto and Man/Local/Remote operation status

9.7.2.5. Analog Operation

1. Inputs
2. Speed control signal
3. Outputs
4. Speed signal feedback
5. Phase currents (percent)
6. Frequency (percent)

10.7.2.6. Verification of Interface

Vendor shall demonstrate functional testing and operational verification of the controlinterface with the Building Management System via Modbus, Bacnet, LON, or equal asrequired.

9.7.3 Inspections and Factory Test

9.7.3.1. Controllers shall be inspected at all stage of manufacture in accordance with the Seller'sQuality Assurance Program and shall be completely assembled in the works. Seller shallprovide a production

schedule, which shall give details of the production processes. Seller shall provide a QA

9.7.3.2. Manual, which shall detail the inspections, testing to referenced standards, and burn in deficiencies shall be corrected before shipment.

9.8 Painting

All metal surfaces that are to be painted or coated shall be cleaned to an equal of a commercial finish as defined in the Steel Structures Painting Council's manual - SSPC SP663, modified to exclude wet sandblasting and painted to manufacturer's standard finish.Internal surfaces shall be painted white.

9.9 Nameplates

Nameplates shall be provided for each VFD controller.

9.10 DISCONNECT SWITCH

A. Disconnect switches (isolators) shall be manufactured to IEC and Britishstandards.

B. Disconnect switches shall be heavy duty (AC23) with operating handle interlocked with the switch cover, in general purpose rust proof aluminum enclosure and to IP44 finished in gray stove finish.

C. Switches shall be quick make, quick break action. Provision shall be made forpadlocking in either the "On" or "Off" position.

D. Switch blades shall be fully visible when in the "Off" position.

E. Operating handles shall be interlocked to prevent doors from being opened when switch is closed. Provision shall be made to defeat this interlock with ascrewdriver.

F. Fuse clips shall be designed for HRC BS 88/IEC 269 fuses without adapters andshall reject standard code fuses.

G. Switches mounted outside, in damp or dusty locations and unconditioned areasshall be supplied in weather resistant enclosures IP 65 made of aluminum with double wall construction.

H. Sample and catalogues with installation details shall be submitted for approvalby THE ENGINEER prior to ordering.

I. Provide a disconnect switch ahead of all motors, starters and electrical equipment where shown on the drawings and where required to meet Code regulations and jurisdictional authorities, whether the equipment is supplied orinstalled under the Electrical Division or any other division.

J. All disconnect switches shall be provided with tag to THE ENGINEER approval toindicate equipment connected to the switch. The feeding

circuit reference and the related distribution board number.

9.11 MOTOR STARTERS

9.11.1 Description

Starters shall be manufactured and type tested in accordance with IEC 947-4 and IEC947-4-1

All motors shall be provided with heavy duty contactor type motor fuseless starters selected for coordination type 1 in accordance with IEC 947-4 generally complying withthe following and protected through circuit breaker.

A. 4KW direct on line starting

B. 5.5KW to 25KW Star Delta starting

C. 25KW and above reduced voltage electronic soft or VFD as appropriate asindicated

Each starter panel shall be provided with a main incoming Non-Auto MCCB / isolatorcapable of carrying the full load current.

Each starter shall comprise as a minimum:

A. On load triple pole MCCB with two normally open and one normally closed auxiliary switches wherever shown in the SLD. The MCCB to be mechanically interlocked with the starter component door and capable of breaking the motorstarting current and of making onto a fault at the motor terminals.

Provision to be made for padlocking the MCCB in the 'OFF' position.

B. Three pole contactors to be fitted with required normally open and requirednormally closed auxiliary contacts to obtain the specified starter type.

All the auxiliary contacts to be wired down to the starter terminal block.

C. One triple pole thermal over current relay incorporating over current, phasesequence and single-phase protection with adjustable trip settings.

External mechanical hand reset to be provided.

D. One control circuit MCB or fuse and one copper link.

E. Each starter shall be fitted with one set of local start/stop push buttons and a local/remote/auto selector switch or hand/off/auto switch as required. Eachstarter control wiring terminal block shall include control terminals for connection of remote push buttons, auto circuits and local and remote emergency stop push buttons.

F. Where more than one motor with a duty/standby or duty/backup functions used, the starter control wiring shall be arranged to automatically change duty upon the fault tripping of the selected motor. A duty/standby or sequence selector switch shall be provided.

G. Each starter shall be fitted with twin led indication lamps indicating:

i. Motor running (green)

ii. Motor Overload Tripped (red)

H. Each starter shall be fitted with an ammeter and selector switch for motors 30KW and above.

I. Each starter to be equipped with labels giving drive designation, plant numberand control operation.

J. Each starter control wiring shall include control terminal and control relays asnecessary to achieve any interlocking specified elsewhere or to achieve any control or monitoring through the BMS where specified.

K. Adjustable time delay devices for Star Delta Starters.

L. Earth leak relays/ Breakers as required by DEWA.

Starter units for manual operation shall have push buttons for starting and stopping, together with auxiliary contacts for remote indicator lights where specified. Starter units arranged for automatic operation shall have hand/off/auto controls and remote push buttons.

All Star Delta starters shall be provided with mechanical and electrical interlocks **for star delta contactor assembled to prevent short circuiting.**

10. METERING

All MDB's, SMDB's, MCC's etc shall have dedicated ammeter, voltmeter & digital energy meter for monitoring purpose. All capacitor banks shall have ammeter, voltmeter and power factor meter.

All meters should comply following specifications.

A. Meters (indicating instruments) shall be provided as shown in the schematicdiagram. Or as mentioned in the specification

B. All meters shall be moving iron type, minimum of 72 sq. mm square shape and90 deg. scale.

C. All meters (indicating instruments) shall be of class 1.5.

D. Instruments shall temperature compensated to operate between -25 deg. C and + 55 deg. C and shall be tropical version.

E. All meters shall comply with IEC 51.

F. Contractor responsibility to provide KWHr meter for each flat, shop and commonarea as per DEWA standards.

END OF SECTION

11. COMPACT (SANDWICH) BUSBAR TRUNKING (BUSWAY)

11.1 GENERAL

11.1.1 The contractor shall supply and install the bus feeders and/or bus risers as a complete system at the locations as shown on the drawings.

11.1.2 The contractor shall be responsible for routing the bus way to co-ordinate with other services. Final measurements shall be made by the contractor prior to release the bus way for fabrication.

11.1.3 Bus way shall be 1000V rated insulation voltage, 3-phase 4,5wire with 100% neutral and 50% internal copper ground bus bar (4,5W-3P+%100N+%50PE copper conductor + Housing). Housing should not be considered as PE if 4,5W proposed. System should be suitable for operation on a 415V/60Hz supply.

11.1.4 Each proposed Busbar trunking shall be manufactured in same factory premises with all processes, accessories and all manufactured ratings should be tested and certified for same factory's products.

11.1.5 Those products are type tested individually and comply with recent IEC 61439-6 standards for all type tests and shall be certified by independent authorized testing laboratory in KEMA/DEKRA from Holland or ASTA. All required type tests and certificates as per this standard should be performed for same factory products. All type tests certificates obtained in last 2-3 years shall be presented for the approval of Engineer along with the technical proposal.

11.1.6 The entire bus way assembly shall be designed and manufactured to withstand short circuit current in accordance with IEC standard. The minimum short circuit rating of the bus way shall be 50kA R.M.S. symmetrical.

11.1.7 All bus way products shall be manufactured in same facility, which is Quality Systems Registered by to ISO 9001 and 14001 Environmental Management system and OHSAS ISO 18001. Recent certificates for this manufacturing premise should be attached.

11.1.8 The bus bar trunking system shall be supported throughout the entire length as per manufacturer's recommendation to withstand the mechanical load and abnormal forces created under short-circuit conditions. Maintenance-free fixed expansion joints should be used through the bus bar system, and should be fixed to the building by ridged supports to prevent future adjustment necessary with other methods following building settlement and thermal conductor/housing expansion & contraction.

Horizontal expansion fittings shall be provided at places, where the busbar trunking crosses building expansion joints and every 40m straight length for thermal expansion, building settlement and earthquake. Vertical expansion modules should be provided at every floor and fixed to the building slab, to compensate for thermal expansion/building movement. The use of spring hanger supports are not acceptable.

11.1.9 Panel Flanges & Transformer flanges shall be provided from same manufacturer to be compatible to all kind of brands, type of panel's top entry & transformers. Internal bar connection should be done by Panel manufacturer in order to avoid any warrantee issue for panel manufacturers. Panel's connections can be provided by Adaptation boxes as well if required as per panel top size. Required size of flexible should also be provided for Transformer connection.

11.1.10 External fire barriers as required to maintain the fire rating of the adjacent areas, where the bus riser passes through fire rated walls, floors and openings in both horizontal and vertical runs, shall be provided by the civil contractor.

The busway to be installed indoor shall be of minimum IP55 against sprinkler system, fire reel hose system and fire fighter hose pressurised extinguishing system. IP 65 or IP67 or 68 shall be proposed for outdoor application with a proper shade if busbar should be installed at outside.

KEMA KEUR or ASTA DIAMOND program should be utilised in manufacturer's factory with an agreement.

Indoor feeder, plug-in and bolt-on feeder busways shall be compatible with each other.

All busbars should have been tested for fire resistance, with a circuit integrity of 950 degree centigrade for 3 hours, as per IEC 60331 standards from KEMA/DEKRA or ASTA.

The busbar system should be tested for Seismic environment as per IEC 60068-3-3/60068-2-57 and IEE 693-1997 and IBC-2006 for very strong earth quakes with Richter magnitudes greater then 7, UBC zone-4, and MSK Intensity IX seismic conditions. The contractor shall submit test certificates for Engineer's verification.

11.2 HOUSING

11.2.1 The busway housing shall be constructed of extruded 2.5mm thick aluminium profile to reduce hysteresis and eddy current losses, and shall be provided with a durable protective electro statically deposited epoxy polyester paint finish.

11.2.2 The busway housing shall be of high efficiency compact (sandwiched) design, totally enclosed, non-ventilated, for protection against mechanical damage and dirt accumulation.

11.2.3 The totally enclosed housing shall be manufactured by the busway manufacturer in same premise. Modifications of busway to make it totally enclosed by other than the busway manufacturer shall not be acceptable.

11.3 JOINT

11.3.1 The busway joint shall be of the one-bolt type, block assembly for each way up to 2000A, which utilises a high strength steel bolt and a pair of large diameter spring steel cupped Belleville washers on conductors to maintain proper pressure over a large contact area.

11.3.2 Access to only one side of the busway shall be required for tightening the joint bolts.

11.3.3 Each joint should be provided with a self-aligning pin to ensure that the busbar is correctly aligned during installation and prior to energize.

11.3.4 It shall be possible to remove any joint connection assembly to allow electrical isolation or physical removal of a busway length without disturbing adjacent bus way lengths.

12.3.5 The joint construction should ensure the earth continuity of the housing.

11.4 BUS BARS

11.4.1 The bus bars shall be fabricated from round edged above 99.90% hard drawn high conductivity (HDHC) copper with 100% conductivity. Project specific mill certificates should be submitted for each particular project.

11.4.2 All bus bars shall be fully insulated throughout its entire length with each conductor coated with a Class B rated (130oC) Epoxy Resin, then wrapped in a Class B rated (130oC) polyester film between each conductor. Application of the Epoxy coating to each conductor should be a fully automated process to ensure a consistent coating thickness of 400 microns. Polyester film should be further wrapped around each epoxy insulated phase/neutral conductor in order to have double protection between each conductor.

On plug-in busway (bus riser) lengths, all insulation shall be notched at the openings to allow plug-in unit mounting. Moulded glass-reinforced polyester and polypropylene shall be added at the joint and plug-in opening areas to provide continuous joint integrity. All insulation materials between conductors and joints should be halogen-free and self-extinguished type.

11.4.3 The temperature rise of busway shall not exceed 55oC rise above an ambient temperature of 50oC as per DEWA regulations, when operating at rated load current.

11.4.4 Both feeder and plug-in busway shall be of sandwich (compact) construction, meaning no air gap shall exist between bus bar, to provide superior voltage drop characteristics even at low power factors.

The three-phase, line to line voltage drop shall not exceed 3% at full connected load on the busbar system as per project's design criteria.

All contact points of busbar joints should be tin plated with an automated process with several steps for proper surface and acidic treatment. Chemical process should be done in 15-20 different pools.

Busbar manufacturers should have at least 5 years of successful and regular installation experience on projects in same environmental areas with full load operation.

Busbar manufacturers should have a local dealer/supervision team who have min 5 years' experience with same manufacturer.

11.5 STORAGE AND HANDLING

11.5.1 Delivery to site shall be in original manufacturers packing and carefully stored and suitably protected in a dry, dust free area until ready for installation.

11.5.2 Each section of the busbar shall have the ends mechanically protected by the manufacturer prior to delivery. The protection shall comprise of heavy-duty plastic covers securely fixed over each end of the busbar to provide mechanical protection and shall be securely wrapped overall in a tough polythene film to exclude dust and moisture. The protection shall be only removed immediately prior to installation.

11.5.3 Each section of the busbars and the joints shall be identified according to the installation drawings. The sections shall be arranged and stored in groups according to the installation location.

11.6 EXECUTION

11.6.1 Ensure that final installation of busway assembly is fully co-ordinated with aspects of building construction and with the work of other services. Final field measurements shall be made by the contractor prior to release the busways for fabrication.

11.6.2 Install busway, accessories and associated fittings, as indicated on the drawings and in accordance with manufacturer's recommendations and Manual strictly. Supports and hanger spacing shall be noted on layout drawings and shall not exceed manufacturer's recommendations.

11.6.3 Provide curb around interior floor penetrations.

11.6.4 Install busway with integral weather seal located where busway penetrates exterior wall and/or roof. Provide wall and/or roof flange and seal around opening to maintain weather tight installation.

11.6.5 Tightening the joint bolts to the required torque in accordance with manufacturer's recommendation using a calibrated torque wrench. The installation shall be supervised by the busbar supplier fully trained engineer, who will check alignment and installation then shall conduct the final torque test, prior to immediately installing the joint covers.

11.7 TESTING

11.7.1 Submit a detailed method statement of Testing and Commissioning for engineer's approval.

11.7.2 All testing and commissioning shall be carried out by the manufacturer authorized and trained representative.

Pre-Commissioning Tests

11.7.3 Check the entire busbar for its proper alignment. Verify the alignment of busbar using laser, plumb bob, spirit and/or water level.

11.7.4 Ensure that final installation of busway assembly is fully co-ordinated with aspects of building construction and with the work of other services. Final field measurements shall be made by the contractor prior

11.7.5 Conduct the torque test on each joint and mark each joint after its torque test.

11.7.6 Conduct insulation resistance test of the entire busbar at 1000V. The minimum value of insulation resistance should be no greater than 200M Ohms. De-energise the busbar after the insulation resistance test.

11.7.7 Conduct continuity test of entire busbar system.

11.7.8 Conduct contact resistance test across each joint with a suitable micro-ohm's resistance meter and compare with the manufacturers reference value. Any significant variations shall be noted and investigated.

Post-commissioning Tests

11.7.9 Conduct the load test by energising the busbar using the utility company power supply or a generator supply as per the site conditions. Using the building load and/or a resistive load bank. The connected load should be greater than, or equal to 50% of

the busbar capacity for at least 2 to 2.5 hours before conducting thermal scanning. Refer to the manufacturer's recommendations for saturation times of the busbars.

Scan each joint for busbar hot-spots and record the temperature of each joint. Also record the ambient temperature during the test.

11.7.10 the net temperature rise should not exceed 55 degrees centigrade over an ambient of 50 degrees centigrade.

If any hotspots are identified, address the joint (s) as per the manufacturers' recommendations. After addressing the hotspot joint (s), repeat the test to confirm correction.

Submit all test reports to the consultant for approval.

END OF SECTION

12. DIESEL GENERATOR

PART 1- GENERAL

12.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

12.2 SUMMARY

DEFINITIONS

A. Emergency Standby Power (ESP): Per ISO 8528: The maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 200 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.

B. Prime Power (PRP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously whilst supplying a variable electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the PRP unless otherwise agreed by the RIC engine manufacturer.

C. Limited Time running Power (LTP): Per ISO 8528: The maximum power available, under the agreed operating conditions, for which the generating set is capable of delivering for up to 500 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers.

D. Continuous Operating Power (COP): Per ISO 8528: The maximum power which a generating set is capable of delivering continuously whilst supplying a constant electrical load when operated for an unlimited number of hours per year under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer.

E. Data Center Continuous (DCC): The maximum power which a generating set is capable of delivering continuously whilst supplying a variable or constant electrical load when operated for an unlimited number of hours in a data center application under the agreed operating conditions with the maintenance intervals and procedures being carried out as a prescribed by the manufacturer. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 100 percent of the DCC rating.

F. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

ACTION SUBMITTALS

G. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.
3. Sound test data, based on a free field requirement.

H. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
2. Wiring Diagrams: Control interconnection, Customer connections.

I. Certifications:

1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for No Preference.
2. Submit statement of compliance which states the proposed product(s) are seismically certified in compliance with local requirements signed and sealed by a qualified professional engineer.
3. Product(s) shall be preapproved for California's Office of Statewide Health Planning and Development (OSHPD) seismic certification of equipment. Justification for preapproval shall be based on calculations as well as physical dynamic testing.

PROJECT CONDITIONS

J. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 50.0 deg C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 150.0 feet (45.72 m).

WARRANTY

K. Base Warranty: Manufacturer shall provide unconditioned base warranty coverage on the material and workmanship of the generator set for a minimum of three (3) years for Standby product and five (5) years for Prime/Continuous product from registered commissioning and start-up.

PART 2 - PRODUCTS

12.3 MANUFACTURERS

A. Manufacturers: The basis for this specification is Power Generation equipment, approved equals may be considered if equipment performance is shown to meet the requirements herein.

12.4 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.

C. Capacities and Characteristics:

1. Power Output Ratings: Electrical output power rating for Prime operation of not less than 480.0kW, at 80 percent lagging power factor, 240/416, Series Wye, Three phase, 4 -wire, 60 hertz.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components. The engine-generator nameplate shall include information of the power output rating of the equipment.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.
3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Not more than 15 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.
6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
8. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.
9. Noise Output: Engine generator shall be tested by the manufacturer per ANSI S12.34. Data documenting performance shall be provided with submittal documentation.
10. Load Sharing: Engine generator shall share real and reactive load proportionally within plus or minus 3 percent with all other engine generators in the system.

12.5 ENGINE

A. Fuel: ASTM D975 #2 Diesel Fuel

B. Rated Engine Speed: 1500RPM.

C. Lubrication System: The following items are mounted on engine or skid:

1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions

E. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

F. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.

G. Cooling System: Closed loop, liquid cooled

1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 50 deg C.

2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.

H. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.

I. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.

J. Starting System: 12 or 24V, as recommended by the engine manufacturer; electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
3. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.

12.6 CONTROL AND MONITORING

A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.

B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down

generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.

E. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

12.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

B. Electrical Insulation: Class H

C. Temperature Rise: 120C / Class H environment.

D. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

E. Enclosure: Drip-proof.

F. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.

G. The alternator shall be provided with anti-condensation heater(s) in all applications where the generator set is provided in an outdoor enclosure, or when the generator set is installed in a coastal or tropical environment.

H. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding. Alternators operating at voltage higher than 690VAC shall be provided with form-wound stator coils.

I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

12.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Sound Attenuated Steel housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.

B. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 7 dBA measured at any location 10 m from the engine generator in a free field environment.

C. Site Provisions:

1. Lifting: Complete assembly of engine generator, enclosure, and sub base fuel tank (when used) shall be designed to be lifted into place as a single unit, using spreader bars.

12.9 FINISHES

A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer’s standard color or as directed on the drawings.

12.10 SOURCE QUALITY CONTROL

A. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Simulated safety shutdowns.
6. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

B. Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks' notice for testing.

PART 3 -EXECUTION

12.11 INSTALLATION

A. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

D. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.

E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

F. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

12.12 ON-SITE ACCEPTANCE TEST

A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:

B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two-hour full load (resistive). Provide a resistive load bank and make temporary connections for full load test, if necessary.

12.13 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

12.14 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

END OF SECTION

13.0 MOTOR CONTROL CENTERS (MCC)

13.1 Motor control centers shall be of similar construction to the main low voltage switchboard in addition shall comply with the following specification:

A. Motor control centers shall be in accordance with IEC 947-4-1 with type 1 coordination.

B. All power and control devices shall be mounted in separate compartments. All power and control wiring shall be segregated. Separate color-coded wires shall be used for power and control wiring; the same shall be properly ferruled.

C. All motors shall be provided with phase failure, under voltage, phase sequence over current and earth fault protection wherever shown in the SLD.

D. Run/Trip indication shall be provided for all pumps with lamp test facility.

E. Hand/Off/Auto selector switches and On/Off push buttons shall be provided for all motors.

F. The degree of protection of the switch board enclosure shall be IP 54 (minimum).

G. All MCC panels must have digital energy meter, ammeter and voltmeter.

H. All major outgoing loads must have BMS compatible digital energy meter.

13.2 OUTGOERS

13.2.1 Motor starters and contactors shall have a utilization category of AC-3 (starting of squirrel-cage motors, switching off motors during running) and AC-4 for motors withinching or reversing duties.

13.2.2 Motor starter components i.e. breakers, contactors, relays etc. shall be selected in accordance with IEC 947 947-4-1 type 1 coordination.

13.2.3 Ammeters shall be fitted to all starters for motors greater than 30.0kW. On-off fault indication of contractors shall be fitted on the front of the starter compartment with a red light for “ON”, green light for “OFF” and an amber light to indicate motor overload or fault conditions.

13.2.4 Suppliers shall provide a minimum 160mm space between the base of the switchgear and the underside of the lowest out goers.

13.2.5 All incoming and outgoing circuit breakers shall be provided with a release to trip the breaker, instantaneously if closed onto a fault.

13.2.6 All compartments shall occupy the full cubicle width; a semi module compartment or vertical division between compartments is not acceptable.

13.2.7 Supplier shall ensure that the number of outgoing feeders in any vertical section of switchboard shall be such that there is adequate space in the cable alley for all power, and all control cables entering the panel. The number of feeders shall not exceed 8 numbers for each vertical panel.

13.3 MOULDED CASE CIRCUIT BREAKERS (MCCB)

13.3.1 Moulded case circuit breakers shall conform to the latest editions of BSEN 60947-2.

13.3.2 The MCCB's shall have a minimum service short circuit capacity similar to the panel board where the same is installed.

13.3.3 Three pole breakers shall have a common trip with a single operating handle and designed so that any overload in one pole automatically causes all poles to open. Breakers shall be trip free and each shall have a trip indication independent of ON or OFF positions.

13.3.4 Wherever shown on the drawings or required by DEWA, MCCBs shall be provided with earth leakage alarm relay or earth leakage relay of fixed/adjustable sensitivity.

13.3.5 MCCB from 100 To 630 A

A. The moulded-case circuit breakers shall be designed for both vertical and horizontal mounting, without any adverse effect on electrical performance. It shall be possible to supply power either from the upstream or downstream side.

B. The moulded-case circuit breakers shall provide shunt trip provision with class II insulation (according to IEC 664 standard) between the front and internal power circuits.

13.3.6 Construction

A. For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries.

B. The operating mechanism of the moulded-case circuit breakers shall be of the quick make, quick-break type with fault tripping over ridding manual operation. All poles shall operate simultaneously for circuit breaker opening, closing and tripping.

C. The moulded-case circuit breakers shall be front operated by a toggle or handle that clearly indicates the three positions: ON, OFF and TRIPPED.

D. The moulded-case circuit breakers shall be equipped with a "push to trip" button in front to test operation and the opening of the poles.

E. Where required, motor operated mechanism, shunt trip, under voltage release, auxiliary switches up to four changes over contacts and a tripped signal contact shall be provided. Each of these units shall incorporate a pre-wired terminal strip, which is accessible from the front of the breaker without removing the cover.

13.3.7 Current Limiting

The moulded case circuit breakers shall be capable of greatly limiting currents. For shortcircuits, the maximum thermal stress it shall be limited to

106 A^2 s for ratings up to 250A.

5 x 106 A^2 s for ratings between 400A and 630A.

A: Amps and S: Seconds

These characteristics will allow high cascading performance with moulded-case orminiature circuit-breakers.

13.3.8 Auxiliaries and Accessories

A. The addition of motor mechanism or a rotary handle shall in no way affect circuit breaker characteristics:

B. Only three stable tripping mechanism positions (ON, OFF and TRIPPED) shall be possible with the motor mechanism.

C. Suitability for isolation shall be provided by positive contact indication (ON and OFF) in front of the motor mechanism module.

D. The moulded case circuit breakers shall be designed to enable safe on-site installation of auxiliaries such as voltage releases (shunt and under voltage releases) and indication switches.

E. The addition of a motor mechanism, module or a rotary handle, etc., shall not mask or block devise setting.

F. It shall be possible to equip the moulded case circuit breakers with devices indicating faults without tripping the circuit breaker.

G. All MDB's, SMDB's and MCC PANELS must have ammeter, voltmeter and energy meters for meter the capacitor bank must have dedicated voltmeter ammeter and power factor meter the power factor meter and energy meter must be compatible with BMS.

13.3.9 Protection Function General Recommendations

A. Moulded case circuit breakers with ratings up to 250A shall be equipped with inter changeable Thermal-magnetic trip units.

B. Moulded case circuit breakers with ratings over 250A shall be equipped with electronic trip units. The trip units shall not augment overall circuit breaker volume.

C. Electronic trip units shall comply with appendix F of IEC 947-2 standard (measurement of RMS current values, electromagnetic compatibility, etc.,)

D. Electronic and thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorized access to the settings.

E. Protection settings shall apply to all circuit breaker poles.

13.4 MINIATURE CIRCUIT BREAKERS

A. MCBs shall comply with BS EN 60898,10 KA as per SLD.

B. MCBs shall be 35mm symmetrical rail mounted type and available n one, two, three or four poles version.

C. MCBs can be reverse fed without reduction in performance.

13.4.1 Construction

A. The operating mechanism shall be mechanically trip free from the operating handle so as to prevent the contacts from being held closed against short circuit conditions. It shall be of the "automatic resetting type".

B. The individual operating mechanism of each pole of a multi-pole MCB shall be directly linked within the MCB casing and not by the operating handles.

C. The operating handle shall be of the toggle type.

D. Each pole shall be provided with bi-metallic thermal element for overload protection and magnetic element for short circuit protection.

E. Terminals shall be of the tunnel type (IP20) in order to minimize the risk of direct contact.

13.5 EARTH LEAKAGE CIRCUIT BREAKERS (ELCBS)

A. Current operated earth leakage circuit breakers shall be in accordance with BSEN 61008 providing the functions of isolation, switching and earth leakage protection of electrical circuits.

B. The ELCB's shall have a residual current operated electro mechanical release.

C. The ELCB's shall incorporate a filtering device to eliminate unwanted tripping due transient voltage.

D. A test push button is to prove operation.

E. A trip free mechanism is required to ensure that the unit cannot be held closed against an earth fault.

F. The tripping device is connected directly to the secondary of the current balance transformer.

G. No amplifiers or rectifiers are to be used.

H. The breaker shall be double pole when used for single phase and 4 poles when used for three phase circuit protection.

I. The ELCB's shall have 30mA or 100mA sensitivity as indicated in the drawings.

13.6 TIME SWITCH CONTROL

Each time switch shall be of the quartz movement type with minimum 24-hour batteryreserve or operated by a 220-volt synchronous motor and of the type incorporating separate motor supply and control switch terminals and be with a minimum of a 24-hour self-winding clockwork spring reserve.

Unless more sophisticated operation is specified elsewhere, then each time clock shall be capable of two 'on' and two 'off' operations every twenty-four-hour period. Also, anycontrol time switch incorporated within the panel, shall be complete with an associated bypass selection facility to manually override 'on/off'.

13.7 OVERLOAD RELAYS

These are to be used in conjunction with motor starters to provide protection against overloads, phase sequence, phase failure (single phasing) and under voltage conditions.

The relays shall be selected such that the full load current of the equipment protectedfalls at the center of the relay's adjustment range.

In-case of Star Delta starter, the overload relays shall be placed on the main's contactor.

13.8 CONTROL RELAYS

Shall be of the encapsulated plug in type and incorporate visual indication that theoperating coil is energized.

Bases for relays shall be mounted horizontally, to ensure relay is vertical above the basewhen the control cabinet is in its intended location, with screw type terminals, suitable for receipt of spade type crimped/soldered lugs.

Adjustable timer delay relays used for the star delta starter shall ensure precise reproducibility of the timing function. The relay shall have a linear setting scale over a 350-deg. rotation by means of knurled knob with timing guide marks. The relay shall be equipped with two electrically separated time delayed contact one normally open and one normally close.

13.9 INDICATION LAMP

These are generally used to indicate main's presence, run, trip, fault and to give faultalarm or indicate any other function.

Indicator lamps shall be of the low voltage 24-volt transformer with twin LED lamp typeand accord with the signaling colours laid down in BS. 4099. Minimum lens diameter shall be 12.5mm and all lenses on a panel shall be of a matching size and appearance and removable from the front for lamp replacement.

Terminations shall be screw grip to receive spade typing crimpled/soldered lugs.

13.10 SELECTOR SWITCH

They shall be of the complete rotary cam type rated to suit item controlled and fittedwith pointer type switching knob. Terminations shall be screw grip to receive spade type crimped/soldered lugs.

Hand off auto selection switch shall have three positions with center position off

andshall be key operated wherever necessary.

Selector switch when used along with the voltmeter it shall have 8 positions, i.e phaseto phase, 3 phase and 2 off position.

13.11 ACCESSORIES

A. Furnish the following accessories,

B. Set of extension rails, if required

C. Hoisting device for removing breakers

D. Set of test plugs

E. Levering out device, if required

F. Manual maintenance closing lever, for electrically operated breakers

G. Set of special tools and hardware

13.12 EXECUTION

13.12.1 INSTALLATION

1. After installation and leveling, render the entire switchboard rodent proof by any means of steel plates,
2. Provide full length rubber mat in front of switchboard
3. Installation of switchboard shall be fully in accordance with THE ENGINEER requirements.
4. Switchgear and distribution boards shall be surface mounted/free standing type and shall be mounted on the building structure by means of suitable mild steel straps or angle iron frames. Where distribution boards or switchgear are required to be directly attached to brickwork etc., the fixing shall be by means of grouted in bolts, or bolts of the expansion type.
5. Any live metal in the distribution board shall be screened with insulation material, so that circuit breakers can be replaced without any danger to the operator.
6. The circuit breakers shall be situated to allow wiring to be carried out with sufficient slack to enable them to be removed for inspection without disconnecting any circuit wiring.
7. All main, sub-main and final distribution boards shall have a spare capacity and shall also be provided with enough spare breaker as shown on the drawings.
8. All panel board and distribution boards shall consist of adequately rated circuit breakers. Circuit breakers shall be temperature compensated at the manufacturer's works to give the design current rating at 50 deg. C. Non- compensated breakers will not be approved and a formal certificate will be required from the manufacturer confirming that the breakers have been suitably temperature compensated.
9. The contractor shall supply and install all panel board with the related voltmeters, ammeters and energy meters of a type that meets with DEWA approval.

10. Where single core cables enter or leave any item of metal clad switchgear, distribution gear, etc., the cable cores shall all pass through the same aperture in the enclosure or case of the unit concerned, to avoid the setting up of eddy currents. Where separate holes are provided by the manufacturer for the cables, the holes shall either be cut out to form a continuous slot, or alternatively the holes shall all be joined together with saw cuts through the solid metal separating the holes. In all cases end plates shall be of nonferrous metal.
11. A special termination arrangement shall be provided to Engineer and DEWA approval at the sub main and main panel boards wherever the cable size exceeds the breaker terminal capacity.

13.12.2 TESTS AT WORK

1. Routine tests to standards shall be carried out. Evidence that type test has been carried out provided they are relatively to the configuration of the equipment offered, may be acceptable to THE ENGINEER and shall be made available.
2. A full visual check and electrical functional test shall be carried out on all apparatus and every circuit. All wiring shall be inspected. It shall be verified that the FBA is fully in accord with the requisition. Circuit breakers shall be closed and tripped at their rated minimum and maximum trip and close supply voltage. Primary and secondary injection tests shall be done on protection relays and CT circuits and indicating and metering instruments. All labels shall be checked.
3. The test procedure shall be as follows:
    a. Visual inspection to verify degree of protection creepage and clearance distances.
    b. All conductors and cables are checked for proper routing and all devicesfor proper mounting.
    c. Check effectiveness of all mechanical devices, e.g. handles, locks,interlocks, operating devices, etc.
    d. Check panel conformity to drawing and DEWA requirements.
    e. Megger test all main circuit through to final terminals. Insulation resistance shall exceed 10 mega ohms. Record all measurements.
    f. Flash test all main circuit at 2.5 KV for one minute. Record leakagecurrent.
    g. Repeat megger test to verify insulation resistance has not been affectedby the dielectric test.
    h. Continuity tests of each circuit.
    i. Function test of all circuit breakers switches, contacts, etc. and everycircuit to verify correct operation.
    j. Primary and secondary injection tests of all relays, CT’s and indicating andmetering instruments.
4. Prior to energizing the switchboards, perform the following checks on site:

a. Operate the equipment through all design functions, including remote operation, actuation of alarm and indicating devices, mechanical and electrical tripping and closing and operation of the protective devices.

b. Insulation resistance measurements on the buses, phase to phase and phase to ground, with all breakers in the fully connected position and contacts open.

c. Control circuit insulation resistance to ground.

d. Inspect all relays and protective devices, and verify settings in accordance with the manufacturer's instructions or the information in the Coordination study.

e. Inspect current transformers and relays for correct polarity of connections and the installation of jumpers on unused current transformer circuits.

f. Simulate the operations and check the logic of interlocks.

g. Manually close and trip each breaker checking and adjusting the main contact alignment and wiring action in accordance with the manufacturer's instructions.

h. Check the phasing on each side tie breaker, before closing.

i. Test protective relay operation for incomer air circuit breakers.

5. Routine Tests

a. Following routine tests are to be carried out by the switchgear assembler,

b. Inspection of assembly including inspection of wiring and electricaloperation

c. Dielectric test:

d. Checking of protective measures and of the electrical continuity of theprotective circuits.

e. Verification of insulation resistance.

13.12.3 HARMONIC ANALYZER

Digital harmonic analyzer shall be provided in each LV panel and MCC panel.

END OF SECTION

14. WIRING DEVICES

14.1 Local Switches

14.1.1 The local switches shall be 10A, 13A, 15A & 20 AMP, Grid type one-way, two-way, and intermediate or double pole as indicated on the drawings. Where more than one switch is indicated at any position multiple gang units shall be used.

14.1.2 Switches shall be of the quick start make, slow break type specially designed for AC circuits to BS Standards 3676. The operation of the switch shall not depend wholly on the action of the spring. The switches shall generally be of the rocker operated type.

14.1.3 All switch boxes shall be supplied with adjustable steel grids and earthling terminals.

14.1.4 Generally, switch units shall be of the adjustable grid pattern and to be secured to the adjustable grid by means of screws. For flush mounting switches, the switch-plate shall overlap all edges of the box by not less than 7mm. For surface mounting switches, the switch-plate shall finish flush with the edges of the switch boxes. Switches for water heaters and fan coil units shall be complete with neon indicator lights.

14.1.5 Local switches shall be arranged in convenient positions for switching the various circuits and generally as indicated on the drawings.

14.1.6 The switches shall be of the same manufacture for a particular type of switch throughout the installation. All accessories in wet and damp areas shall be of the splash-proof type to IP 54 protection standard.

14.1.7 All switch boxes should be galvanized steel.

14.1.8 To ensure easy and correct connection of the conductors during installation, the necessary terminal shall be easily identified, grouped in line, upward facing, and captive and backed out prior to the installation.

14.2 Power Outlets

14.2.1 The switch socket outlets shall be in accordance with BS Standard 1363 as appropriate and shall be of the three-pin grounding type.

14.2.2 Live contact of the socket shall be completely shuttered such that it is not possible to engage any pin of the plug into a live contact whilst any other pin of the plug is exposed.

14.2.3 All outlets shall be of the same manufacturer throughout the installation

14.2.4 The sockets should provide a double earth terminal.

14.3 Fuse Connection Units/ DP Switches

14.3.1 These shall be of flush or surface mounting type as manufactured in compliance with BS Standard as appropriate. The fuse connection units shall incorporate integral switch, neon indicator and 20-amp fuse links. The DP switches supplied for water

heaters shall be incorporated with neon indicator lights, and these also shall be engraved “Water Heater”.

14.3.2 These shall be of the same manufacturer for a particular type of switch throughout the installation and shall be complete with the other accessories installed.

14.4 Accessories Plate Finish

14.4.1 All the wiring accessories shall be vandal proof.

14.4.2 The accessories plate shall have the following finishes depending on the location where it is installed and on the feeding arrangement.

14.4.3 Telephone outlets in the rooms and common area should have the same finish as switches and sockets and should be supplied from the same manufacturer.

14.4.4 All external switches and socket outlets shall be weatherproof to IP 56.

14.5 GENERALPURPOSE SOCKET OUTLETS

1. The Contract shall include for the supply and installation of the general purpose sheltered 13 amp switched socket outlets positioned as shown on the drawings, the sockets being wired in accordance with the circuit details indicated on the attached drawings. Each socket outlet shall fully comply with BS 1363. Cartridge fuses shall comply with BS 1362.
2. The 13 Amp socket outlets shall comprise single or twin units as shown on the drawings. Each outlet shall be complete with a plug top from the same manufacturer as the switch socket, unless otherwise stated and manufactured in accordance with an approved sample.
3. Each socket outlet shall be finished either in metal or made from white amino plastic urea powder mouldings to BS 1322 as detailed in the finishes schedule in Section16050 with cover plate to match the lighting switches, suitable for flush or surface mounting as necessary. Where metal plates are used they shall be fitted with white back elite inserts.
4. Each 13 Amp socket outlet shall be complete with a pressed steel box to BS 4662 or BS5733.
5. EP66 protected type dolly and galvanized finish shall be supplied and installed as detailed in the following Specification Sections and/or drawings.
6. Each socket shall be of the rectangular three pin type complete with line and neutral shutters. The shutters shall be manufactured from unbreakable insulating material which shall be non-ignitable and track resistant.
7. The shutters shall effectively screen and isolate the line and neutral socket outlets to exclude dust and interference and shall only be operable when the interlocked earth pin in the associated plug top has been inserted.
8. Each switch associated with a socket outlet shall be complete with adequate ON and OFF markings.

9. Switch socket outlets complete with red neon indicating lamps shall be provided in the positions indicated on the attached drawings and/or Specification Section.
10. All socket plug tops shall be in accordance with BS 1363. Live and neutral pins shall be complete with safety sleeves and fitted with appropriate rated fuses to BS 1362.

14.5.1 FUSED SPUR OUTLETS

1. Fused spur outlets shall be of the switched or unswitched type, incorporate flex outlet facilities, complete with a red neon indicator light and the equipment/device name to be permanently engraved and positioned as indicated on the attached drawings and/or specification section.
2. Each outlet shall be manufactured in accordance with BS 5733.
3. Each unit shall be complete with a sheet steel box adjustable top grid and plate finished to match the lighting switches
4. White molded inserts and fuse holders shall be fitted to each unit, together with an appropriately rated cartridge fuse to BS 1362.
5. Where spur units serve remote items, the contract shall include for the supply of an independent flex outlet with each unit. The flex outlet shall be located adjacent to the terminals of equipment being supplied.
6. Industrial plugs and sockets to B S 4343/IEC 309
   A. Round pin socket outlets shall be provided where shown on the attached drawings and shall 'be of the 16, 32 or 63 Amp 230 or 400-volt, 50 Hz patterns required, manufactured in accordance with BS 4343 and/or IEC 309.
   B. The socket outlets shall generally be surface mounting with polycarbonate body, spring cover and top/rear conduit entry facilities, as appropriate, unless specified otherwise on the drawings or Particular Specification section. Panel mounting type shall be employed where outlets are fitted to steel cable trunking, enclosure sand suchlike.
   C. Outlets for use on single phase supplies shall be of the 2 pole and earth pin type and those for use on three phase supplies shall be 4 pole and earth.

14.6 SWITCHES

A. 10 A, 240 V, single pole, one-way, two-way and intermediate switches.

B. Manually-operated general purpose ac switches with following features:

   i) Silver alloy contacts.

   ii) Urea or melamine molding for parts subject to carbon tracking.

   iii) Suitable for back and side wiring.

C. Local lighting switches for the control of lighting circuits shall be of the following types:

D. For single and multi-gang units in general locations like offices, corridor, entrance lobby, etc. where installation work is concealed, light switches shall be of the grid switch moulded white plastic flush type and shall be mounted in suitable metal boxes.

E. The switches shall be insulated 'rocker' type generally single pole rated 10 amps as a minimum.

F. For areas where switches are shown connected to different phases, in the same location, multi gang switches are to be used with an approved phase barrier and warning label.

G. For single and multi-gang units in damp or wet areas, process areas and for all external applications, switches shall be to IP56, with high impact polycarbonate housing and shall be seal Compact (White). The switches shall be recessed as far as practical. For recessed installation provide recessed mounting bezel from original manufacturer.

H. The Contractor shall provide lighting switches of the correct rating to suit the size and nature of the lighting load controlled. Switches shall be suitable for inductive or resistive loads, generally single pole and shall have a minimum current rating of 10 amps.

I. Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

J. Switches of one manufacturer throughout project.

14.7 RECEPTACLES

A. Switched socket outlets shall generally comprise 13 Ampere 3-pin 250V shuttered socket outlets, with following features:

i) Ivory urea molded housing.

ii) Suitable for 6 sq. mm for back and side wiring.

B. 20AMP DOUBLE POLE SWITCHES

C. 20 Amp rated double pole switches shall be provided where shown and shall be suitable for use on 220-volt 50 Hz supply.

D. Each 20 Amp DP switch shall be manufactured in accordance with BS 3676

E. Each unit shall be either flush mounting complete with recessed pressed steel box or surface mounting, as appropriate, with front plate matching the local lighting switch and small power outlets.

F. The switch plate shall incorporate, where shown, on the drawings flex outlet and/or indicator light units in addition to the 20-amp double pole switch assembly.

G. Switches for use with water heaters shall have the plate engraved water heater.

H. Wiring terminals shall each be capable of accepting a minimum of 2 No.4mm sq. conductors.

14.8 FLEX OUTLET PLATES

A. Flex outlet plates shall be suitable for flush or surface mounting, as required, and be complete with pressed steel box and cover plate.

B. The flex outlet plates shall be finished to match the local lighting switch and small power outlets, as indicated.

C. Each unit shall be fitted with three pairs of terminals, each being able to accommodate the required size of conductor.

D. A cord grip shall be fitted into each unit.

14.9 MISCELLANEOUS ACCESSORIES

A. Where specified and indicated on the drawings miscellaneous accessories shall be provided. Each unit shall be finished either in metal or made from white amino plastic urea powder mouldings to BS 1322 with cover plate to match the lighting switches and small power outlets.

B. Each unit shall be manufactured in accordance with the relevant British Standards

END OF SECTION

15.0 LIGHTING SYSTEM

This product specification specifies all components comprising an energy conservation system for the control of lighting and other loads that integrates daylight sensors, occupancy sensors, wall controllers, scheduling with astronomical time clock, a softwareinterface.

15.1 Lighting control system components

15.1.1 Listed by [CE] [CSA] [UL] specifically for the required loads, or certified by recognized independent testing organizations that test to [CE] [CSA] [UL] standards.

15.1.2 UL508

15.1.3 If ballasted loads are or will be controlled by any relay cabinet on this project, all cabinets must carry a UL listing that directly addresses ballasted loads. UL916-listed cabinets are not acceptable when ballasted loads are controlled LCP to be placed nearto respective lighting electrical DB. Each Lighting circuit should be connected with lighting control panel for sensor controls.

15.1.4 Relay cabinet enclosures

15.1.5 NEMA 1 rating

15.1.6 NEMA 3R rating

15.1.7 Source Limitations

15.1.8 To assure compatibility, obtain all system components from a single source with complete responsibility for all lighting controls and accessories specified. The use of subcontracted component assemblers is not acceptable.

15.1.9 Supply ballasts that:

A. Are compatible with the network lighting control system.

B. All conduit, wire, connectors, hardware, and other incidental items necessary for the complete and properly functioning network lighting control system as described herein and shown on the plans.

15.2 PROJECT CONDITIONS

Do not install equipment until the following conditions can be maintained in spaces toreceive equipment:

- Ambient temperature: 0° to 50° C (32° to 122° F).
- Relative humidity: Maximum 90 percent, non-condensing.
- Lighting control system must be protected from dust during installation.
- Site visit activities:
- Verify connection of power feeds and load circuits.
- Verify connection of controls.
- Verify system operation control by control, circuit by circuit.

- Obtain sign-off on system functions.
- Review and provide installer with instructions to correct any errors in thefollowing areas:
- Low voltage wiring requirements
- Separation of high and low voltage wiring runs
- Wire labeling
- Load schedule information
- Switching cabinet locations and installation
- Physical locations and network addresses of controls
- Ethernet connectivity
- Computer-to-network connections
- Load circuit wiring
- Connections to other systems and equipment
- Placement and adjustment of Occupancy Sensors
- Placement and adjustment of Photocells
- After system installation
- Check and approve or provide correction instructions on the following:
- Connections of power feeds and load circuits
- Connections and locations of controls
- Connections of low voltage inputs
- Connections of the data network
- Turn on system control processor and upload any pre-programmed systemconfiguration
- Verify cabinet address
- Upload pre-programmed system configuration and information to switchingand/ Check load currents and remove bypass jumpers
- Verify that each system control is operating to specification
- Verify that each system circuit is operational according to specification
- Verify that manufacturers' interfacing equipment is operating to specification
- Verify that any computers and software supplied by the manufacturer areperforming to specifications
- Verify that any remote WAN (Wide Area Network) connections are operatingproperly
- Turn-On: Upon completion of all line, load and interconnection wiring,

and afterall fixtures are installed and lamped, Manufacturer's Certified Technician shall completely check the installation prior to energizing the system. Each installed relay system shall be tested for proper ON/OFF operations, and proper LED illumination. Each installed control cabinet shall be tested verifying that each controlled load adjusts to the selected setting and that all switch LED's illuminateproperly.

15.3 Lighting Control Concept

Control CONCEPT

15.3.1 Typical corridors need to be controlled via occupancy sensor

15.3.2 Typical floor corridors need to be dimmed up and dimmed down based on occupancy

15.3.3 When no occupancy lights to be dimmed down to 20% and on occupancy lights on the corridors need to be dimmed up to 90%

Driveways & Parking area

15.3.4 All the driveways need to have alternate circuits with the min once circuit need to be ON

15.3.5 One circuit out of two in the driveway need to ON for all the day and the circuits kept ON need to be swapped for every 12 hours to uniform lifetime of lights.

Stairwells

15.3.6 All the stairwells need to switch on based on occupancy

15.3.7 Facade light and External light

15.3.8 All the Facade light and External light need to have alternate circuits with the min once circuit need to be ON. Facade light and external light selection as per perspective view. All light and lighting circuit to be controlled by LCP with KNX cable for ON/OFF/Dimming.

15.4 MODULAR DIGITAL NETWORK LIGHTING CONTROL SYSTEM

System Description: provide a modular digital network lighting control system that includes:

- Configurable relay cabinets
- Remote low voltage input cabinets
- Digital switches
- Low voltage control devices
- Cabinets continue to operate on last established schedule in the event of anetwork malfunction
- Network interruption alarm is displayed on Handheld Display Unit (HDU) and/orremote computer connected to Internet

- Configuration, programming and monitoring via HDU
- Remote configuration, programming and monitoring available with Internetconnection
- System to be fully functional without a connected HDU
- Provide a system with a Relay Insert Panel that:
- Provides data bus and data intercommunication between all Relay Modules andCommand Module.
- Is shipped and installed separately from the enclosure
- Provide a system that has an integral power supply for Command Module, RelayInsert Panel, HDU, and other accessories.
- 70W (2.9 amperes) output at +24VDC.
- Provide a system that can simultaneously use Ethernet
- Command Modules only
- Can be configured as a bridge between LumaCAN branches
- Can be used as an Internet connection
- Remote firmware upgrades, monitoring and programming possible via Internet
- Ethernet switches can be used to extend system coverage area by linkingCommand Modules
- Provide a system that can simultaneously use BACnet IP
- Separate Priority Array for each relay
- 1 is highest, 16 is lowest
- Higher priority maintains control until a “relinquish” command is issued
- Top three priority levels permanently assigned to Internal Main Bypass,Emergency Power and Internal Relay Bypass
- Individual control of all other priorities
- Support 252 Analog / Binary Outputs
- Support 240 Analog / Binary Inputs
- As easily terminated, cost-effective CAT 5 and / or CAT 6 cable for the network physical layer. Systems that mandate specialized networking cabling will increasethe Owner’s costs and should not be acceptable on this project.
- Network cable AND CONNECTORS
- Supply the following types of twisted pair shielded cable and connectors toconnect the system:
- LumaCAN: Cat 6

- Ethernet: Cat 5 or better
- BACnet IP: Cat 5 or better
- Terminations: RJ-45 connectors

15.5 Component Parameters to be resettable within each Behavior

- B1: Lights turned ON with the switch; can be turned OFF with the switch;Occupancy Sensor will turn OFF upon vacancy.
- B2: Lights turned ON with the Occupancy Sensor; can be turned ON or OFF withthe switch; Occupancy Sensor will turn OFF upon vacancy.
- B3: Occupancy Sensor turns lights ON or OFF.
- B4: Switch turns lights ON or OFF.
- B5: Astronomical Clock Time triggers a Blink Warn sequence; Switch interrupts sequence and starts an interval timer; Relay will automatically turn OFF when interval timer reaches zero.
- B6: Astronomical Clock Time turns lights ON.
- B7: Astronomical Clock Time turns lights OFF.
- B8: When measured light level exceeds trigger point, Photocell turns lights OFF;When measured light level is below trigger point, Occupancy Sensor turns lightsON upon occupancy, OFF upon vacancy.
- B9: When measured light level exceeds trigger point, Photocell turns lights OFF;When measured light level is below trigger point, Switch turns lights ON or OFF,Occupancy Sensor turns lights OFF upon vacancy.
- B10: When measured light level exceeds trigger point, Photocell turns lights OFF;When measured light level is below trigger point, Occupancy Sensor turns lights ON upon occupancy and OFF upon vacancy, Switch turns lights ON or OFF, over- riding Occupancy Sensor.
- B11: When measured light level exceeds trigger point, Photocell turns lights OFF;When measured light level is below trigger point, Switch turns lights ON or OFF.
- B12: When measured light level exceeds trigger point, Photocell turns lights OFF;When measured light level is below trigger point, Astronomical Clock Time turns lights ON.
- Provide a system that allows the designer or operator to define Agendas asseries of up to 24 Behavior transitions occurring during a 24-hour period

15.6 RELAY CABINETS

Remote input and relay modules can be installed in the field without voiding the cabinet's UL listing. This provides flexibility both during and after the construction process, reducing the cost of modifying the cabinet to address any issues that may

ariseduring installation. Systems that cannot be modified after delivery to the job site without voiding the UL listing should not be acceptable on this project.

Provide [a] relay cabinet[s] that allows Command Modules, Remote Input Modules and Relay Modules to be installed in the field without voiding the cabinet's UL listing.

15.7 COMMAND Modules

Provide a system with command modules that:

Are field-installable and/or replaceable self-contained units with Emergency inputs Have integral overload and short circuit protection.

As provides separate overload protection for the Command Module (system processor) and all LumaCAN devices including the Low Voltage Input card. This enables the system to continue functioning even if one or more external devices should fail. Systems that donot provide independent overload protection for the system processor make every connected device into a single failure point, which greatly reduces overall reliability, turns even minor equipment failures into system-wide emergencies, and can increase the Owner's operating costs. Such systems should not be acceptable on this project. Provide separate overload protection for:

System processor

LumaCAN devices including the Low Voltage Input card.Supply power to all electronics in the Relay Cabinet

Supply power to digital switches and Handheld Display Unit via LumaCAN can supply +24 VDC to other low-voltage inputs
Can contain an optional Low Voltage Input (+24VDC) card suitable for termination of eight (8) or sixteen (16) low voltage inputs.

Include an Emergency Signal Input for a hardwired emergency override signalRequires external contacts

Activates Emergency status when a signal of +24VDC is present Releases Emergency status when signal falls to zero (0 VDC).

Controls all relays as assigned by the user regardless of processor operation. Provides +24VDC to external contacts

Accept a Low Voltage Input Card option with: User-configurable inputs, as follows:

0 – 10VDC analog

+24VDC switched Contact closure.

Compatible with the following devices Occupancy sensors

Photocells GE switches

External Contacts

Multi-button low voltage switches

ON/OFF dedicated button low voltage switches A

+24 VDC power supply

70W (2.9 amperes) capacity

Input devices can use external power supplies Have the following controls:

A Handheld Display Unit that displays and programs the following functions:

Current Operating Status

Errors Current Time Alarms

Astronomical Time Clock settings Monitor Menus

Control Menus Configuration Menus

Remote Manual operation of all system relays Inspection of both digital and low voltage inputs State

Status

Current value

Schedule monitoring and adjustment

Temporary override of schedule on a day by day basis A high resolution color graphic display screen

LED Status Indicators for the following:

Individual Relays

Manual Actuator indicating ON/OFF state Microprocessor Online

Ethernet Link

Relay Communication

+5 VDC Power Supply Normal Operation LumaCAN communication

Provide a grounding point in the left wire-way can be tilted forward for easy access to digital connection points without removal from relay cabinet. Physical as programmed and operated from a Handheld Display Unit (HSU). The HSU can be connected to the system at a wide variety of easily accessible locations. This makes it easy, for instance, to set occupancy sensor and daylight harvesting options in the location affected. The HDU can be stored inside any cabinet door, or in the special purpose docking station. Since relay cabinets are typically installed in remote areas of the building in order to minimize the noise for the occupants, docking the HDU in an easily accessible and frequently occupied location makes it easy for system operators to monitor, upgrade and adjust the lighting controls from their usual workspaces. Systems without this feature make programming and adjusting lighting controls, as well as monitoring and operating the system, more difficult, time-consuming and expensive, and should not be acceptable on this project.

Handheld display unit (HDU) Provide a system with an HDU that:

Performs system programming, configuration and monitoring from any LumaCAN or Ethernet port

Ethernet ports

As indicated on drawings (system must be interconnected with lighting control network) LumaCAN port locations:

Relay cabinets Digital switches

Low voltage input cards Remote Input Cabinets

Can be stored in any relay cabinet door, or at a remote docking station Has a high-resolution color graphic display screen

As specified uses RJ-45 connectors, which are widely available and easy to make in the field. This industry-leading design lowers the material cost of the lighting control system and makes installation simpler, faster, and more cost-effective. Systems that require more complicated and expensive connectors should not be acceptable on this project.

Accepts the following network interfaces:

LumaCAN

Green RJ-45 input Ethernet

Black RJ-45 input

As specified includes automatically rechargeable batteries that allow nine hours of operation while disconnected from a network charging station. The user can monitor, adjust and program the system from any network location. Systems that fail to offer this flexibility and ease of use will raise the Owner's costs for operation and maintenance, and should not be acceptable on this project.

Operates using rechargeable batteries

Nine (9) hours of operation under battery power

Batteries are recharged automatically via network connection

As accepts low voltage inputs through either an optional low voltage input card installed in the relay cabinet at the factory, or remote low voltage input cabinets. You can delete the following article if your project does not require remote low voltage input cabinets.

Includes Remote Low Voltage Input Cabinets. This allows the designer greater flexibility in lying out the system. It also reduces wiring labor and materials costs, since network connection points are located closer to the low voltage inputs. Systems that do not provide this flexibility and cost-effectiveness should not be acceptable on this project.

15.8 QUALITY ASSURANCE

Provide factory-direct technical support hotline 24 hours per day, 7 days per week. Maintain a quality system that is registered to the ISO 9001:2000 Quality Standard.

15.9 WARRANTY

Manufacturer's Warranty

Warrant all equipment free of defects in materials and workmanship. Warranty Period

Warrant shall be unconditioned and shall cover all system components for 36 months from date of TOC

15.10 COMMISSIONING

Lighting control system requires site visit for proper commissioning. the first ensures that the contractor is trained to install the system correctly. On the second, the factory engineer will start up the system, ensure that it is operating according to specification, and perform initial programming. The third visit is for the purposes of refining the

programming, and training the owner/end user on the system.

NOTE TO SPECIFIER: Delete the commissioning option you DO NOT want in this specification.

Provide factory-certified field service engineer to ensure proper system installation and operation under following parameters:

Certified by the equipment manufacturer on the system installed.

Control Gear (Drivers)

The type of drivers (control gear) used to power and control LED light sources (i.e. LED lamps or LED modules) and LED luminaries for lighting applications.

This specification covers LED light source requiring external control gear for facade light and external light through lighting control system

LED Control Gear (Drivers)

For proper operation of LED lamps and LED modules, an appropriate control gear is required. This control gear or driver (the word “driver” is often used as a synonym) is a power supply device which may provide additional functions like dimming control or interfaces for comprehensive light management systems. For safe operation and optimum performance of a LED lighting application, the LED control gear has to fulfill the relevant lighting standards, which are different to “off the shelf” power supplies and match with the specific conditions and components of that application. Selection of correct driver should be done carefully.

The selection of control gear (Drivers) should be fulfill the following categories.

15.10.1 Constant Current control gear: these are mainly designed for power LED light sources with a constant current, typically 350mA or 700mA. The current depends on the specification for the LEDs which are operated. In case of multi-chip packages, these forward currents can also be much higher. If the current output of the driver does not match the rated current of the LED light source, lumen output and lifetime can be negatively affected. It is also important that the output voltage range of the constant current control gear is in line with the forward voltage of the light source. The total forward voltage of the LED light source depends on the number of LEDs connected in series as well as their forward voltage distribution at the chosen current. The maximum outdoor power alone is not adequate in order to ensure that LEDs and control gear match with each other

15.10.2 Constant Voltage control gear:

These are designed to supply a specific voltage to the LED light source. Accordingly, they are suitable for LED lamps and modules which can be operated on constant voltage supplies. This type of LED light source is provided with an internal current regulator to provide the correct current to the LEDs. When using this type of driver, it is important that a unit with the correct voltage is used. If several voltage driven LED modules are connected in parallel, the driver must have sufficient current (output power) capacity for all the modules

connected to it. Care should also be taken in considering that, if an output voltage of greater than 25Vrms (34Vpeak) is required, the luminary has to fulfill certain additional requirements concerning wiring, creep age distances, clearances and isolation (electric strength test). There are different requirements specified for the insulation of ELV systems depending on the voltage (34Vpeak, 60V DC, 120V DC), which lead to reduced requirements concerning the isolation levels.

The effect of power factor correction should also be clarified for the actual combination of control gear and luminaries(s) respectively lighting system. A driver designed to operate multiple and/or different LED modules may not have the same power factor over this entire output power range. In commercial buildings the power factor may affect the maximum demand tariffs. You should refer to the manufacturer's minimum and maximum power loading recommendations to ensure best operation of the driver.

15.10.3 Energy Efficiency

Drivers have an important impact on the system efficacy of a luminary. Individual LEDs and modules are quoted as "x" lumens per watt, referring directly to the wattage of the LED and not the total circuit wattage of the system. What is important is the total lumen per watt output available from the LED luminary. This will consider the losses in the control gear in addition. Note that generally the control gear efficiency is indicated for full load conditions. It could decrease significantly in case it is operated at lower loads, hence in this case particular information from the supplier or own tests are requisite.

The key is to ensure that the system specification clearly states the power requirements that have been allowed for at the project design stage and that the correct driver (control gear) type, current and voltage are matched to the LED luminary or module.

15.10.4 Dimming

Continuous (analogue) current reduction (CCR), which decreases the forward current, or

Pulse-width modulation (PWM), which changes the duty cycle of the applied current at a modulation frequency of several hundred Hz. PWM is necessary for LEDs in case a wide dimming range and a linear relationship between light output and duty cycle is required.

15.10.5 Complete System Operation

Care should be taken not to overload the control gear as LED control gear are rated for a maximum load and output voltage. One of the most common mistakes is to connect too many LEDs in series. The wiring topology of whether to use a Series or Parallel circuit should also be confirmed prior to installation. The IP rating of the control gear should be specified to suit the actual mounting location and that the thermal characteristics of the driver (control gear) are suitable for the chosen location. It is also advisable to position drivers (control gear) in a location that will allow ease of maintenance.

15.10.6 Lifetime

The lifetime of the LED system is not only limited by the lifetime of the LEDs, but also by the electronic circuits and corresponding lifetime of the control gear. Maximum life of the LEDs will only be achieved with appropriate heat sinking. Safe operation and maximum lifetime of the driver may also require respecting certain temperature limits.

A validation of the driver's case temperature in the assembled luminaries is necessary. It is therefore important to carefully study corresponding recommendations and instructions of the module and driver manufacturer and to correctly identify the life of the system (and not the LED alone).

15.10.7 Electro Magnetic Compatibility (EMC) compliance

As the EMC compliance is highly dependent on the interaction between the luminary and the control gear it is extremely difficult to predict the EMC compliance of a luminary system, even if the control gear itself has a large margin. Hence it is generally recommended to test the complete system in order to validate if the control gear is an appropriate solution for a particular luminary design.

END OF SECTION

16.0 STRUCTURED CABLING SYSTEM

The contractor shall allow for the supply, installation, testing and commissioning for any builders works such as plinths, Service shafts, penetrations, grill fixing frames, ceiling and containment word such as cable tray & trench, electrical power point wherever is required (13A socket), necessary supports and other required accessories items, carpentry works and interior works.

16.1 Telephone Outlets & Installations

16.1.1 Complete installations of telephone network shall be carried out as per the requirement of ETISALAT/DU and it is contractor's full responsibility to get approval from ETISALAT/DU for the installations.

16.1.2 Where telephone outlets are indicated remote from the main rising duct, P.V.C. conduits shall be installed to the trunking in the rising duct.

16.1.3 Galvanized trunking PVC conduits or as indicated in the drawings or as per ETISALAT/DU requirement shall be installed.

16.1.4 Telephone outlet general positions have been shown on the layout drawings.

16.1.5 The Contractor shall be responsible for supply installation testing and commissioning of whole telephone system including major and accessories and to ensure that a trunking and/or conduit route is available from all outlet box positions to connection junction boxes positioned in the electrical cupboards and any other telephone point indicated by the telephone symbol.

16.1.6 Draw wires shall be left in all conduits and ducts. A complete network shall be provided linking the building with the site telephone network to the Local Telephone Authority's approval. Looping between rooms will not be allowed. It shall not be necessary to enter an adjacent room to repair a fault in any room. All telephone outlets shall be equipped with the local Telephone Authority approved telephone socket outlets with the same finish as the light switches in that room.

16.2 Incoming telephone service

16.2.1 PVC ducts shall be connected from the external ducts to the telephone connection cabinet. The ducts shall terminate outside the villa as detailed on the drawings. From this external termination point a telephone distribution system shall be laid via ducts and manholes as indicated on the site plan and to the approval of the Local Telephone Authority.

16.2.2 The Contractor shall be responsible for trenching and providing and installing ducts, manholes and manhole covers to the Local telephone Authority's specification and approval.

16.2.3 Nylon draw ropes (6mm dia) shall be installed in all ducts to facilitate later cable installation by the Local Telephone Authority.

17.0 IPCCTV SYSTEM

17.1 GENERAL

17.1 REFERENCE

Conform to General Requirements for Electrical Services of Division 26.

17.2 DESCRIPTION OF WORKS

17.2.1 Contractor shall allow for the supply, installation, testing and commissioning of the complete IP based CCTV system as specified and as shown on related drawings and as per Dubai Police requirements without any additional cost.

The system shall be designed for ultimate reliability and maximum operating efficiency using only the highest quality, fully field proven products.

The system components shall be of modular design to allow ease of installation, service, future expansion, upgrades and addition to the system.

The system components shall have operating environments to allow complete functionality at a temperature of 0 to 50 degree centigrade and a relative humidity of 90%(non-condensing).

1. Must be colored.

2. Must be visible and not hidden. SIRA approval is required for hidden/covert cameras.

3. Cameras must be intended for security applications only and are manufactured to work for extended periods without interruption.

4. Outdoor cameras, the housing must be of at least IP66 rating, or cameras can be contained in special housings not less than IP66 rating and should be suited to the Gulf region environment, i.e., high temperatures, humidity and dust.

5. It is required that any camera facing a natural or artificial light source, whether directly or reflected from polished surfaces, must be a Wide Dynamic Range (WDR) camera, with at least 110 dB gain ratio, or the equivalent.

6. Auto Iris must be used for sites where there are changing lights conditions.

7. IR Cut Filter is required with the ability to self-switch to monochrome night imaging when the visible light disappears.

8. Cameras installed at height of 4 meters and above must have remote zoom and focus ability.

9. Cameras fitted with audio facilities (microphone) are prohibited and cannot be used unless permission obtained from SIRA.

17.3 SCOPE OF WORK

Provide complete closed-circuit surveillance system including but not limited to the components and equipment as specified in this document and as per Dubai Police Requirements.

It is contractor's responsibility to hire a third-party specialist authorized by SIRA to get the final design and necessary sign off / stamp on shop drawings for SIRA approval.

The IP based CCTV system shall provide visual images from the cameras located throughout the facility to the security/FCC control located in Ground floor. The cameras shall be connected to switch and then to Network Video Recorder.

The system shall consist of but not limited to the following:

A. IP based Fixed dome cameras
B. IP based Wall Mounted
C. 32" LCD monitor with PC work station
D. Network Video Recorder (NVRs) with storage media for 1 month recording.
E. Active Switches
F. Joy stick keyboard
G. All other related accessories and equipment including camera mounts, various camera lenses, etc.
H. Accessories for interfacing with the building fire alarm system.
I. Video transmission / control cabling and linking cables
J. Power supplies as required to the various system components.
K. Latest release of multiuser version system software.
L. Integration with Monitoring System via volt free contacts.

The control room shall have a custom-built control desk to accommodate the colour LCD monitors and PC's as well as all related accessories.

At the time of installation and commissioning the contractor shall provide all additional components required to eliminate any noise and video signal attenuation problems found at site. All specific CCTV camera locations shall be selected to provide a view of the maximum amount of space.

Also, minimum storage recording should be one month of all cameras.

All CCTV system equipment supplied shall be compatible to include similar characteristics of bandwidth, impedance synchronization, polarity and sensitivity.

The system shall be an integrated CCTV control system based on an open protocol communications network.

The works under this specification shall include all shop drawings and submittals as required for the CCTV surveillance system. Further, the works shall include such items or details as testing, adjusting, identification tags on equipment, training and manuals for operation, training and maintenance of this system.

All CCTV equipment and components shall be capable of operating from a power source of 240 volts AC. Single phase. 50 Hz. unless noted otherwise. All components and equipment shall be supplied with the appropriate power supply to operate from this voltage.

17.4 CODES AND STANDARDS

The following Codes and Standards to the extent specified herein, form a part of this specification. When an edition date is not indicated for a code or Standard the latest edition enforces at the time of proposal submitted shall apply.

Under writer laboratories listing or equally approved international listing laboratories.

17.5 SUBMITTALS

1.5.1 Contractor shall submit all items in accordance with the requirements of Division 1, Submittals and shall include but not be limited to the following:

A. Model numbers of all components furnished on the job.

B. Manufacturers original catalog and technical data sheets for all components.

C. Input power requirements for all system components.

D. Complete engineered drawings indicating:

1. Manufacturer model numbers and specifications.
2. Dimensions, layouts, installation details.
3. Point-to-point wiring diagrams for all system devices.
4. Termination details for all system devices.
5. Single-line system architecture drawings representing the entire system.
6. Interfaces with all sub-systems.

E. Four (4) sets of the Manufacturer's User's Manuals and Installation Manuals.

F. Course outlines for each of the end user training programs. The course outlines shall include the course duration, location, pre-requisites, and a brief description of the subject matter.

G. Sample for the proposed cameras.

H. Certificate for the country of origin.

I. Heat Map

17.6 PRODUCTS

17.6.1 SYSTEM DESCRIPTION

The contractor shall supply and install complete IP BASED CCTV system as shown on the drawings and as specified in this section.

Specification included in the section is indicative as minimum, equipment & software that shall be delivered at the time of implementing the project shall be latest versions available in the market.

The contractor shall verify the designed system compliance with the latest Dubai Police requirements and regulations, and allow for any modification may require to comply with DP regulation.

The contractor shall allow for the supply, installation, testing and commissioning of a CCTV Monitoring system as herein specified and as indicated on the drawings.

The installation shall include IP color cameras, lenses, monitors, NVR, Cat6 network cabling backbone with active equipment's and all necessary accessories.

The complete system shall be supplied by a specialist Subcontractor having at least five years' experience in the field. All equipment shall be from one reputed manufacturer; mixing up of equipment from various manufacturers is not acceptable.

The cameras shall be located as shown on the drawings. All external cameras shall be provided with weatherproof housing complete with blower thermostat assemblies. Indoor

cameras shall also be provided with tamperproof housings. All cameras facing varying light intensity shall be provided with auto-iris lenses. Ceiling mounted cameras, both fixed base and Pan & Tilt shall be provided with dome type housing to match adjacent light fittings.

The locations of the cameras shown in the tender drawings are indicative only. The specialist subcontractor shall propose exact locations and quantities of the cameras in co-ordination Dubai Police regulations. Focal lengths of the lenses selected shall be to achieve optimum coverage of the area under observation.

The video out of the cameras shall feed direct to the IP network. The control room shall be equipped with a dedicated server controller and necessary software to control and record all the or the selected cameras or on motion detection. An intelligent mapping software shall be provided to map any camera onto any monitor, selecting a camera for remote controls, panning, tilting and zooming the cameras.

A network video recording software shall be included in the system for centralized recording or distributed recording at local nodes.

17.7 SYSTEM COMPONENTS

17.7.1 FIXED IP CAMERA DOME

Fixed IP dome cameras shall be with HD 10S0p resolution designed for indoor security installations. It should deliver crisp clear images to fit any installation need. The camera shall be equipped with 2.S-12 mm varifocal lens. The camera should allow dual-streaming video and supports H.264 compression technology to drastically reducing file sizes and conserving valuable network bandwidth.

The cameras should be POE based and at the same time provision to accept 12 VDC shall be available. The camera dome should provide 3-axis adjustment for any angle of view.

Image Sensor	1/2.5-inch progressive scan CMOS
Min Resolution	1080p
Image Settings	Adjustable bit rate. Flip and mirror. Configurable
	brightness, contrast, color, hue, sharpness. White
	balance. AGC. AES. Automatic or manual day/night
	mode. BlC (Backlight Compensation). Digital
	zoom. Motion. Slow Shutter.
Shutter Speed	1/4, 1/10, 1/12.5, 1/15, 1/20, 1/25, 1/30, 1/50, 1/60,
	1/100, 1/120, 1/240, 1/4S0,1/960, 1/1024,1/2000 sec
Electronic Zoom	3 - 30X (client software)
Day/Night Performance :	IR cut filter, True Day/Night
SIN Ratio:	Greater than 50 dB
Focal Length	2.S-12 mm
Max. Aperture	f/l.6
Horizontal Field of View:	21° - 76.6°
Image Compression:	H.264 (Main Profile); M-lPEG available for 2nd stream
Resolution	1920xl080
Frame Rate	2.5 - 30 fps
Input Power:	12 VDC, 24 VAC, PoE (IEEE S02.3af Class 0)

Power Consumption	4.SW
Operating Conditions	Temp:14to122"F (-10 to 50° C)
Humidity	less than 90%, non-condensing

Image Sensor	1/2.5-inch progressive scan CMOS
Min Resolution	1080p
Image Settings	Adjustable bit rate. Flip and mirror. Configurable
	brightness, contrast, color, hue, sharpness. White
	balance. AGC. AES. Automatic or manual day/night
	mode. BlC (Backlight Compensation). Digital
	zoom. Motion. Slow Shutter.
Shutter Speed	1/4, 1/10, 1/12.5, 1/15, 1/20, 1/25, 1/30, 1/50, 1/60,
	1/100, 1/120, 1/240, 1/4S0,1/960, 1/1024,1/2000 sec
Electronic Zoom	3 - 30X (client software)
Day/Night Performance:	IR cut filter, True Day/Night
SIN Ratio:	Greater than 50 dB
Focal Length	2.S-12 mm
Max. Aperture	f/l.6
Horizontal Field of View:	21° - 76.6°
Image Compression:	H.264 (Main Profile); M-JPEG available for 2nd stream
Resolution	1920xl080
Frame Rate	2.5 - 30 fps
Input Power:	12 VDC, 24 VAC, PoE (IEEE S02.3af Class 0)
Power Consumption	4.SW
Operating Conditions	Temp:14to122"F (-10 to 50° C)
Humidity	less than 90%, non-condensing

17.7.2 EXTERNAL FIXED VANDAL-RESISTANT IP CAMERA DOME

Fixed vandal resistant IP dome cameras shall be with HD 10S0p resolution designed for indoor security installations. It should deliver crisp clear images to fit any installation need. The camera shall be equipped with 2.S-12 mm varifocal P-iris lens. The camera should allow dual-streaming video and supports H.264 compression technology to drastically reducing file sizes and conserving valuable network bandwidth.

The cameras should be POE based and at the same time provision to accept 12 VDC. The camera dome should provide 3-axis adjustment for any angle of view.

In order to adapt to constantly changing outdoor lighting conditions, the camera shall feature an auto iris varifocal lens to protect from damage induced by direct sunlight. The true day/night camera shall include a removable IR-cut filter for superior image quality around the clock.

For protection against the elements, the camera dome should be IP66 - rated with a vandal proof casing to withstand rain, dust, and vandalism.

Image Sensor	1/2.S-inch progressive scan CMOS
Min Resolution	1080p
Image Settings	Adjustable bit rate. Flip and mirror. Configurable
	brightness, contrast, color, hue, harpness. White
	balance. AGC. AES. Automatic or manual day/night
	mode. BlC (Backlight Compensation). Digital zoom.
	Motion detection. Slow Shutter.
Shutter Speed	1/4, 1/10, 1/12.5, 1/15, 1/20, 1/25, 1/30, 1/50, 1/60,
	1/100, 1/120, 1/240, 1/480,1/960, 1/1024,1/2000 sec
Electronic Zoom	3 - 30X (client software)
Day/Night Performance:	IR cut filter, True Day/Night
SIN Ratio	Greater than SO dB
Focal Length	2.8-12 mm
Max. Aperture	f/1.6
Horizontal Field of View:	21° - 76.6°
Image Compression:	H.264 (Main Profile); M-JPEG available for 2nd stream
Resolution	192Oxl080
Frame Rate	2.5 - 30 fps
Input Power	12 VDC, 24 VAC, PoE (IEEE 802.3af Class 0)
Power Consumption	4.8W
Operating Conditions	Temp:14to122"F (-10 to 50° C)
Humidity	Less than 90%, non-condensing

17.7.3 FIXED IP BOX CAMERA

Fixed IP BOX cameras shall be with HD 1080p resolution designed for indoor security installations. It should deliver crisp clear images to fit any installation need. The camera shall be equipped with 2.8-12 mm varifocal P-iris lens. The camera should allow dual streaming video and supports H.264 compression technology to drastically reducing file sizes and conserving valuable network bandwidth.

The cameras should be POE based and at the same time provision to accepts 12 VDC. The camera dome should provide 3-axis adjustment for any angle of view.

Image Sensor	1/2.5-inch progressive scan CMOS Min
Resolution	1080p
Image Settings	Adjustable bit rate. Flip and mirror. Configurable
	brightness, contrast, color, hue, sharpness. White
	balance. AGC. AES. Automatic or manual day/night
	mode. BLC (Backlight Compensation). Digital zoom.
	Motion detection. Slow Shutter.
Shutter Speed	1/4, 1/10, 1/12.5, 1/15, 1/20, 1/25, 1/30, 1/50, 1/60,
	1/100, 1/120, 1/240, 1/480,1/960, 1/1024,1/2000 sec
Electronic Zoom	3 - 30X (client software)
Day/Night Performance :	IR cut filter, True Day/Night SIN
Ratio	Greater than 50 dB

lens Mount Max. Aperture	CS-mount; C adapter provided f/l.6
Horizontal Field of View:	21° - 76.6°
Image Compression	H.264 (Main Profile); M-JPEG available for 2nd stream
Resolution	192Oxl080
Frame Rate	2.5 - 30 fps
Input Power	12 VDC, 24 VAC, PoE (IEEE 802.3af Class 0)
Power Consumption	12 VDC: 4.7 W; 24 VAC: 4.B W
Operating Conditions	Temp:14to122·F (-10 to 50· C)
Humidity	less than 90%, non-condensing

17.7.3.1 ANPR CAMERA

ANPR cameras and related equipment shall be provided as shown in the drawing as per SIRA requirements and for the control of gate barrier.

17.7.3.2 MEGAPIXEL HD NETWORKED WDR CAMERA.

The network camera shall feature up to 2 Mega Pixel Full HD (1080p) resolution in a 16:9 format. 4:3 format shall also be available in smaller resolutions. The camera shall be capable of simultaneously streaming two 10BOp video streams, each at 30 images per second. It shall also be possible to configure other low-resolution streams apart from two 1080 streams. The camera shall feature a day / night mode that incorporates an infrared cut filter removal mechanism for true color reproduction and the best possible low light performance.
The camera shall feature multi exposure true Wide Dynamic Range with a gain of 120db. This feature will work at 30 images per second at 1920 x 1080 resolution. The WDR function shall feature an adaptive motion system to eliminate motion blur. The camera shall feature an automatic back light compensation technology that detects and enhances dark areas in the field of view and increases the gain in those areas. The network camera shall provide video transmission in an open format with H.264 or MJPEG compression.

Image Sensor	1/2.8-inch progressive scan CMOS Min
Resolution	1080P
Image Settings	Adjustable bit rate. Flip and mirror. Configurable
	brightness, contrast, color, hue, sharpness. White
	balance. AGC. AES. Automatic or manual day/night
	mode. BIC (Backlight Compensation). Digital zoom.
	Motion detection. Slow Shutter.
Shutter Speed	1/4, 1/10, 1/12.5, 1/15, 1/20, 1/25, 1/30, 1/50, 1/60,
	1/100, 1/120, 1/240, 1/4BO,1/960, 1/1024,1/2000 sec
Electronic Zoom	3 - 30X (client software) Wide
Dynamic Range	WDR,120dB
SIN Ratio	Greater than 50 dB
lens Mount	CS-mount; C adapter provided
Max. Aperture	f/1.6
Horizontal Field of View:	21· - 76.6·

Image Compression	H.264 (Main Profile); M-JPEG available for 2nd stream
Resolution	1920xl080
Frame Rate	2.5 - 30 fps
Input Power	12 VDC, 24 VAC, PoE (IEEE S02.3af Class 0)
Power Consumption	12 VDC: 4.7 W; 24 VAC: 4.S W
Operating Conditions	Temp:14to122"F (-10 to 50· C)
Humidity	Less than 90%, non-condensing

17.7.4 LENSES

The lenses for the fixed base cameras shall be fixed -focal-length lens with automatic iris operation the lens shall bel/2.7" Megapixel varifocal with a focal length of 5-50mm, f1.4, direct drive, IR pass optics. It shall have a CS-type mount.

The exact focal length and aperture of each camera shall be proposed by the specialist supplier to the approval of the Engineer.

17.7.5 ENVIRONMENTAL HOUSING

Environmental housing shall be of compact weatherproof designed for smaller outdoor CCTV applications. A spring cover and latch shall be provided for easy access, and a weatherproof seal shall protect the camera/lens assembly from moisture. The housing shall be equipped with a strip heater that provides 25 watts of power and a sunshield.

The thermostatically-controlled heater shall go on when the temperature drops to 50· F (10· C) and turns off when the temperature reaches 60· F (16· C). The sunshield shall provide long-term protection from UV radiation and corrosion.

Input Voltage	24VAC.
Power Consumption	25W.
Construction: Housing:	Aluminum, painted light gray. Window: 0.125 in.
	(0.32 mm) hick clear Lexan polycarbonate.
Clear Window Area	2.75 in. (W) x 2.6 in. (H) (70 mm x 66 mm).
Moisture	Rainproof elastomer seals and gaskets. Wind
Resistance	Up to SO mph (130 kph).
Temperature Range	-40 to 150· F (-40 to 65° C).
Storage Humidity	Up to 90% relative, noncondensing.

17.7.6 SYSTEM MANAGEMENT SERVER.

System management server equipped with video management system acts as a central station that connects all devices running the IP CCTV platform. It enables the entire system to work together virtually as a single entity. Each Networked Video Recorded (NVR) and workstation maintains a current copy of the system management server configuration settings, so that in the event there is a failure, the system will continue to operate without disruption.

The information on the system management server is always sent to all devices (after any update), so in a case where the system management server fails, they can use that data to operate until the system management server is restored. In such cases, only "new" actions that require the system management server will not work (such as adding a new site).

The control software shall enable simultaneous viewing and recording of stream devices up to 100. The software shall be capable of centralized recording or distributed recording at local nodes. It shall be hardware free and will be able run on any industry standard host Pc. Streaming of devices shall initiated by a job or an event i.e., alarms or operator key press. There shall not be any limit to the number of jobs or alarms that can be enabled.

Minimum System Specifications:

Minimum PC Requirements	Microsoft Windows, 7 or Server 2008 operating system or latest version; Intel- Core~ i5processor;
DVD Drive	4GB RAM; 250 GB hard drive; 1GB LAN card; video card with128 MB memory.
Network Interface	Internal DVD drive.
Software Features	100/1000 Base

Software Features

- Access and configure all devices connected to the system management server
- Time synchronization
- View live and playback video as needed for configuration
- Configure User and Group Management
- Configure Central Failure Notification mechanism
- Configure the Web Server
- Reset the system management server
- Add 3rd party I-Onyx cameras

Electrical Specifications

Input Voltage	115-230 ±10% VAC, 50/60 Hz. Current 0.6 A @ 115 VAC; 0.3 A @ 230 VAC.
Power Consumption	69 W nominal.
Heat Output	242 btu/hour. CPU
Memory	Intel8 Core'" is.
OS	4GB.
Network Interface	Windows 7 Embedded*, 64 bit.
Certifications	100/1000 Base T Ethernet interface on main board. CE and FCC, Class A.

17.7.7 NETWORKED VIDEO RECORDED (NVR)-

The Networked Video Recorded (NVR) shall be a high-capacity Video Recorder that enables to simultaneously capture, view and store high-quality, high resolution voice, video and data for a comprehensive security solution.

The Networked Video Recorded (NVR) shall feature an embedded operating system designed for enhanced security and superior reliability. The Networked Video Recorded (NVR) shall provide an open platform that allows integration with IP cameras, including mega pixel cameras, encoders and IP edge devices from numerous, industry-leading manufacturers. The internal RAID 5 storage shall provide abundant capacity and the assurance that the data will always be secure and protected. The NVR shall be connected to Video Guard System.

The Video Management System software shall provide outstanding functionality and an intuitive interface for administrators, security managers and system operators anywhere on the network. Multi-site users, in particular shall benefit from the efficiency of enterprise management options.
The Networked Video Recorded (NVR) shall provide scalable, internal RAID-5 storage for medium and large-scale installations. The system shall be suitable to scale to thousands of cameras with additional NVR. The Networked Video Recorded (NVR) shall be equipped with removable drive configuration to hot-swap drives without having to remove the unit from the rack.

All the cameras shall be recorded in mega pixel resolution on M-JPEG, MPEG-4 and H.264 compression.

Operating System	Microsoft" Windows" XP Professional.
CPU	Intel· Core'" 2 Duo 3.0 GHz or Intel Xeon Core 2 Quad 2.4 GHz.
Memory	2-4 GB.
DVD Drive	Internal DVD drive.
Ports	7 USB (1 front, 6 back), PS-2 mouse, PS-2 keyboard, serial (COM), VGA, RJ-45, parallel.
Display Adapter	VGA adapter with 128 MB onboard RAM.
Storage	Internal RAID 13 TB usable
Network Interface	100/1000 Base T Ethernet interface on main board.
Certifications	FCC Class A.
Input Voltage	105-240 ±10% VAC, 50/60 Hz.
Current	1.75 A @ 115VAC; 0.875 A @ 230 VAC.
Power Consumption	202 W nominal.
Heat Output	707 btu/hour.
Power Connector	Standard 3-conductor female socket.
Spare Capacity	20 % for ports for cameras and storage.

17.7.8 MONITORS

LED monitors shall be used for the monitoring and viewing of the video streams. All the monitors shall support FULL HD resolution signal. 21" and 42" LED monitors shall be used for spot viewing and live viewing respectively.
Actual arrangement! quantity of monitors shall be submitted for the Engineer's approval. Life of the monitors shall be calculated for 24x7x365 for 3 years.

Panel Size	21" & 42"
Aspect Ratio	Widescreen (16:9) Panel Type
	TN with LED backlight Maximum
Resolution	Full HD 1920 x 1080 @60 HZ
Contrast Ratio	8,000,000:1 (estimated)
Brightness	250 cd/m2 (typical)
Response Time	5ms typical
Viewing Angle	(160 vertical / 170 horizontal)
Color Support	82% (CIE1976) / 72% (CIE1931)
Pixel Pitch	0.248mm
Device Type	HD Monitor with LED
Connectivity	VGA, DVI-D (HDCP), HDMI

17.7.9 Cable

Cat6 data cables shall be used from the operation of the system. The maximum distance to the camera shall be limited to 90m from the network consolidation point (lDF).

17.7.10 UPS

Contractor shall supply and install UPS complete with UPS equipment and batteries to feed the CCTV system as per DPS/SIRA requirements. Refer to CCTV system drawings for further details. A minimum of 30 minutes of back up capacity is required. The system shall provide a signal when the battery charge depletes to 75% in order to have smooth shut down.

17.7.11 SWITCHES AND ACTIVE COMPONENTS:

Gigabit managed switches shall be used for interconnecting the cameras and networked components.

17.8 EXECUTION

17.8.1 INSTALLATION

Location of the cameras shall be as per the detailed design and minimum requirements of Dubai Police.

17.8.2 TESTING AND COMMISSIONING

The Contractor shall be responsible for testing and commissioning of the installation in

accordance with all applicable documents in the Contract set.

17.8.2.1 Testing shall be comprehensive and sufficient to demonstrate compliance with each requirement and as per system manufacturer recommendations.

17.8.2.2 a proposed test plan shall be submitted to the CONSULTANT or Owner's representative for approval before commencement of final test.

17.8.2.3 Final tests shall be conducted in the presence of the CONSULTANT and Owner's representative.

17.9 TRAINING AND INSTRUCTION

17.9.1 Operator training shall consist of a two days course conducted on-site by a factory trained professional instructor. Training conducted by installers, technicians, or project managers is unacceptable.

17.9.2 Training materials shall consist of the following:

A. Formal course outline and agenda.

B. Operator training student guide for each student.

C. Hands-on practice with on-line equipment.

D. Written examinations.

The training course shall be a minimum of two continuous business days.

Additional equipment Video Imaging training sessions shall be made available to the CONSULTANT/PROJECT MANAGER if necessary, at no additional cost.

17.10 WARRANTY

17.10.1 All equipment furnished under this contract hall be warranted for a period of 24 months from the date of TOC.

A. Respond to service requests on-site, if required.

B. Replace or repair defective components as required.

17.11 POWER SUPPLY

1. Security systems must be powered by Uninterruptible Power Supply (UPS) devices, so that the systems can operate on their own when main power cut occurs for minimum period of 30 minutes.

2. All recording devices in VSS systems must be connected to UPS devices. The connection of the rest of the VSS devices to the UPS devices is detailed in the relevant annexes.

3. The recording devices and UPS devices must be integrated so that UPS devices can signal for safe shut down once the remainder of the UPS power supply batteries reaches 25% of the total charge.

END OF SECTION

18.0 FIRE ALARM SYSTEM

18.1 DESCRIPTION

The work shall consist of supply, installation, testing & commissioning of a complete high-quality advanced technology early detection Intelligent Analogue Soft Addressable fire alarm system as shown on the drawings and specified herein.

18.2 REFERENCES FOR INSTALLATION

British Standard Institute / European Standards

All Applicable codes and standards including BS EN 54 **German Standard VDE (Verband Deutcher Electrotechniker)** DIN VDE14675 and VDE 0833 Fire Alarm System

NFPA – National Fire Protection Association

NFPA 72

The system shall be supplied and installed in full compliance with Local Civil defenseAuthorities requirements in all aspects.

18.3 SUBMITTALS

A. Product data for fire alarm system components including dimensioned plans, sections, and elevations showing minimum clearances, installed features and devices, and list of materials and data.

B. Shop drawings

C. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs. Description shall cover this specific project.

Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with any one of the referenced standards, completely with specifications and Vds approval or equal

18.4 TRANSPORTATION, HANDLING AND STORAGE:

A. All the components of fire alarm system shall be provided in manufacturer's original new and unopened packing bearing manufacturer's name and label.

B. Store materials, not in actual use, in covered and well-ventilated area and protect them from dirt, dust, moisture, direct sunlight and extreme temperatures.

C. For further requirements follow manufacturer's written instructions regarding storage and handling.

18.5 WARRANTY

Submit written guarantee signed by the contractor, manufacturer and installer of firealarm system for the period of 5 year from the date of TOC. The guarantee shall cover the repair and replacement of material with manufacturing defects and workmanship as directed by the engineer.

18.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems and components, whose products have been in satisfactory use in similar services for not less than 3 years period, and be subject to approval of engineer.

B. Installer Qualifications: An experienced specialist sub-contractor who is authorized by the system manufacturer, and subject to approval of the engineer.

All the components and installations shall comply with the requirements of DIN VDE 14675 & VDE 0833 for design & installation.

C. Provide system and components specified in this section that are listed and approved by Vds& conform to equivalent DIN/EN standards.

D. Single source responsibility: All components and accessories shall be product of single manufacturer.

18.7 SYSTEM DESCRIPTION

A. The fire detection and alarm system shall comprise of Automatic Soft Addressable Modular Design Main fire alarm control panels, Heat Detectors, Optical Smoke Detectors, Manual call points, Conventional Sounder, Transponder interface units, each with its own short circuit built-in isolators. All loop cabling and any other components and accessories deemed necessary for a safe, reliable and satisfactory system shall conform to the relevant and applicable requirements and recommendations of DIN EN 54. The system shall be fully programmed to accommodate fire alarm zones. The system shall be configured to allow on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to existing buildings/network on site.

B. The fire alarm and detection system shall provide the following facilities as a minimum:

The system shall be intelligent in operation with advanced decentralized intelligence technology. Each detector shall have its own processor with algorithms built in the device to take a fire or fault decision. System with centralized intelligence by providing signal levels to the control panel is not acceptable.

The system will be capable of providing fire, fault disablement and supervisory monitoring facilities as required by DIN EN 54 Pt 2. All devices on a loop shall have built in SHORT CIRCUIT LINE ISOLATORS for wiring fault isolation to protect the system. "Group Circuit Monitors" which isolate/protect sections of a loop circuit, i.e. a group of field devices are not acceptable.

18.8 BATTERIES

Batteries shall be provided and shall be the dry sealed lead-acid type. The batteries shall have ample capacity. With primary power disconnected, to operate the fire alarm system.

Period of 24 hours backup. Following this period of operation via batteries. The batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 30 minutes.

18.9 WIRING

All cables associated with Fire Alarm installation shall be of fire resistant 2 core 1.5 sq. mm twisted pair. Cables shall comply with BS 6207 Part 1. The cable is to BS 6207: Part 1

having, typically no more than 2 cores each core having 1.5 sq. mm cross sectional area, A red cover sheath (preferred for alarm applications), Having continuous metal sheath encapsulation, Fire resistant tested to BS6387 categories CWZ.

18.10 INSTALLATIONS

The entire fire alarm system shall be installed in accordance with DIN / BS EN54 Standards and manufacturer's approved shop drawings, written instructions and recommendations.

18.11 TESTING

Fire alarm system shall be tested in accordance to Local Civil Defense regulations and put into operation by the manufacturer or his authorized representative in the presence of Engineer. Fault and alarm conditions shall be simulated and all data and alarm indicators checked with full events recorded on system printer according to the testing procedure.

18.12 FIRE ALARM CONTROL PANEL

- UL 864 9th Edition listed
- FM Approved
- Multi-Loop 2 Analog Addressable Loops Field upgradable to 4
- 126 primary points per loop
- Powerful, network wide cause and effect (500 total). Fully user programmable bypoint or zone.
- 800 points per panel when using devices with sub points
- Up to 10,000 ft. wiring length on SLC loop
- 64 Panels on a network
- Programmable through a PC connection to the panel, or through keypad
- Programmable relays – 5
- Supervised Powered Outputs – 3
- Programmable Notification Appliance Circuits: 4
- Power per NAC: 1.6 Amps Max
- Programmable outputs on SLC loop
- Programmable Function button on front display

- Fire Drill button on front display
- Day and night sensitivity settings (user programmable)
- Power Supply: 5.25 Amp, regulated & integrated
- LCD Display: 8x40
- Access levels: 3
- Access key switch: Yes
- One man walk test – Fire Test Mode

a. The FACP shall incorporate a number of features to allow easy operation through a user-friendly menu. It shall have a Graphical LCD display and non-tactile membrane type switches/keypad in durable plastic. For reliability it shall have its own on-board circuit protection and multiprocessor architecture. The keypad shall include means to enter of two minimum level passwords to prevent unauthorized manual control. The system shall be on and off-site programmable by using the keypad and, also by connecting a PC to the communication port on the main processor/display board.

b. The FACP shall be of modular construction, and shall have repeated code facility to learn if the loop has duplicated address. Each loop shall be capable to accommodate a minimum of 126 addressable devices. Each loop length maximum 1.2Km.

c. Detectors (Smoke, heat, flame), manual call points, modules, sounder strobe shall be connected on the same two wire loop.

d. Each device and zone shall have its own 40-character text message allocation; also each device shall be linked to a software zone. Can be edited the device detailed and type, sensitivity and address on the control panel.

e. The FACP shall have a one man walk test facility to periodically test the detectors without having to continually manually reset from the panel. The test feature shall have silent mode option.

f. The FACP shall automatically program to switch the sounders to Day/Night mode whereby any alarm condition is recognized outside normal hours shall provide an evacuation signal throughout the entire premises.

g. The FACP shall have internal memory lock to prevent unauthorized data entry and shall also have 1000-memory event log for system information and shall be stored in non-volatile memory.

h. The FACP shall have the facility to networking on RS485 to other panels and repeaters, while communication to color graphics shall be via RS232.

i. Alarm and faults shall be indicated as for a fire alarm via the LCD along with an associated LED. A buzzer shall sound in the event of an alarm, pre-warning of fault.

j. The FACP shall have verification facility to delay acceptance of alarms until they can be confirmed, and shall meet the applicable standard. All the devices in the zone can be

configuring for verification through the panel. Manual call point or contact devices connected to a loop will be separated and will not be verified.

k. The Batteries and charger shall maintain the entire system, plus 20% for a minimum period of 24 hours stand-by in the event of mains failure. After 24 hours has elapsed the system shall be capable of initiating a full global alert and evacuate for a minimum period of 30 minutes.

l. The network shall be peer to peer with each panel generating command to other panel as required. The network shall be class a wiring up to 1.2Km between two panels.

m. Each control panel shall operate independently by performing its own specific control, alarm supervision and history gathering. The system which requires master or slave is not acceptable.

18.13 FIRE DETECTION LOOP CIRCUIT PARAMETER

- The “loop” shall be a two-wire circuit starting at and returning to the same set ofterminals at the control indicating equipment (CIE).
- The loop shall be capable of driving up to 126 field addressable devices over atotal loop distance of up to 2km.
- All analogue addressable devices shall have a unique address. Each device maybe polled as often as is required up to a maximum of 100 times per second, depending on the amount of information required for each device.
- Isolators shall be fitted to ensure compliance with BS5839-1. The isolators shallprotect against short circuits on the loop by isolating that section of the loop where the short circuit occurred, thus maintaining the integrity of the remainderof the system.
- Fire condition LED indicators fitted to the devices and any remote indicators shallbe remotely and separately operated from the control panel.
- All fire condition LED indicators shall be reset from the control panel withoutremoving power from the loop.
- The manual call points shall each have their own unique address and the CIE shall be capable of identifying and responding to the operation of a call point inless than one second.
- The address data for each device shall be stored in the base of any smoke or heat detector, but this shall be achieved purely by mechanical and not electronicmeans. These bases shall have this coding feature fitted as standard. One base terminal shall be provided for cable shield continuity. The terminals for the supply wires shall be two separate screws for individual cables.
- The loop shall be capable of receiving information in addition to that from heatand smoke detectors e.g. operation of a sprinkler system. The source of this information shall be identified by its own unique address.

Any interface equipment used to achieve this requirement shall be from the product range ofthe same manufacturer as the detectors.

- Only two loop wires shall be required to power the detectors, address and carrydata to and from the field devices by digitally encoded signals superimposed onthe supply voltage.
- The CIE shall be able to identify what type of device is located at each address inorder to protect against accidental fitting of an inappropriate device.
- The CIE shall be able to identify the absence and address of a field device.
- Any interface equipment installed on the loop shall be identified by a unique address, set by a DIL switch at the commissioning stage, and will communicate with the CIE by means of the data transfer protocol specified in Paragraph 1.5. All interface equipment shall be supplied by the manufacturer of the detectors.

18.14 REPEATER PANELS

Repeater panels shall be connected via panel RS 485 repeater output and installed at each fireman's entrance (2 No.). The repeater panel shall have basic control, and have an LCD large display. The repeater panels shall be installed in slim line, aestheticallypleasing enclosures.

18.15 GRAPHICAL MONITORING CENTRE

The graphical monitoring centre shall pictorially represent Fire, Fault, Action and Disableevents on a monitor display. The purpose of this facility shall be to provide the user withthe additional visual information. The system shall operate on the Windows environment and required to have full control or monitor, up to 8 users with multi-level password control, user friendly, direct and complete user graphics view interface, switching between device layouts of different monitoring zones. Pop out layout of abnormal information automatically. Flash the abnormal device(s) in different colors foralarm, action, fault and isolation.

18.16 INTELLIGENT PHOTOELECTRIC SMOKE SENSOR

- UL / FM approved
- The Photoelectric Smoke Sensor shall operate on a 'Fuzzy Logic Technology', by the use of a minimum of an 8-bit processor, to enable the sensors to store and analyze fire scenarios, thereby reducing susceptibility to false alarms and improve the sensitivity. The sensitivity of the device shall be variable. The deviceshall compress with remote indicator output. The addressable code for the device shall be electronically programmed and stored in the sensor and be non- volatile
- The photoelectric (optical) smoke detectors shall be suitable for detecting visible smoke such as is produced by slow smoldering fires including burning PVC. They shall be of the light scattering type using a pulsed internal LED light source and aphoto-diode sensor.
- A clear indicator LED shall be provided on the detector which

illuminates redwhen the detector has reached a pre-set alarm level. The indicator shall be operated independently of the detector from the CIE.

- Provision shall be made for an output from the detector suitable for operating aremote indicator or other device with a current limitation of typically 4 milliamps. The output shall be operated independently of the smoke detector from the central control panel.
- Separate mounting bases shall be required which enable ready removal of thedetectors for maintenance.
- The construction of the detector and bases shall be in white self-extinguishing polycarbonate plastic. All circuitry must be protected against moisture and fungus. Smoke entry points must be protected against dust and insect ingress bycorrosion resistant gauze. The optical chamber must be of conductive plastic andhave a snap-lock fit for ease of removal when cleaning. The detectors must be unobtrusive when installed, having a dimension not exceeding 100mm diameter maximum including the mounting base.
- The detector shall incorporate a feature enabling it to be locked securely to itsbase.
- Data transmissions to and from the CIE from the detector shall be via communications circuitry which is factory fitted to the detector by the original detector manufacturer and forms a complete and integral part of the detector.The detector shall be supplied complete, fully tested and calibrated.
- The unique address of the detector shall be set by the installer by means of acoded plastic card fitted to the detector base.
- The detector shall be capable of being remotely tested from the control panel bythe transmission of an output command bit to the addressed detector. This shall result in a healthy detector transmitting back an analogue value in excess of the recommended fire alarm threshold. The CIE will recognize this as a test signal and shall not raise an alarm against this signal.

18.17 INTELLIGENT HEAT SENSOR

- UL / FM approved
- The Heat Sensor shall incorporate a highly linear thermistor circuit. A voltage isproduced proportional to temperature which shall be scaled, linearized and transmitted as an analogue value.
- The heat detector shall be electronic in operation and suitable for connecting to a 24V central system which can operate within the voltage range of 17V -28V DC.
- The device shall detect temperature by means of an NTC thermistor. A red indicator LED shall be provided on the detector which illuminates when thedetector has reached a pre-set alarm

level. The indicator shall be operated independently of the detector from the CIE.

- Separate mounting bases shall be required which enable ready removal of thedetectors for maintenance. The bases shall be fitted with dual finger stainless steel contacts.
- The construction of the detector and bases shall be in white self-extinguishing polycarbonate plastic. Full circuitry must be protected against moisture and fungus. The detectors must be unobtrusive when installed, having a dimension not exceeding 50mm x 100mm diameter maximum including the mounting base.
- The detector shall incorporate a feature enabling it to be locked securely to itsbase.
- Data transmissions to and from the control panel from the detector shall be via communications circuitry which is factory fitted to the detector by the original detector manufacturer and forms a complete and integral part of the detector.
- The unique address of the detector shall be set by the installer by means of acoded plastic card fitted to the detector base.

18.18 MULTISENSOR DETECTOR

- UL Listed
- Dual LED for 360-degree view
- Multisensor detectors shall be analogue addressable, suitable for detection ofvisible products of combustion (smoke).
- The detector shall be capable of being remotely tested from the CIE by the transmission of an output command bit to the addressed detector. This shall result in a healthy detector transmitting an analogue value in excess of the recommended fire alarm threshold. The control panel will recognize this as a testsignal and shall not raise an alarm against this signal.

18.19 INTELLIGENT BEAM DETECTOR

- UL Listed
- The analogue addressable reflective beam smoke detectors shall be able todetect the presence of smoke within internal open spaces.
- The analogue addressable reflective beam smoke detectors shall be designed toprovide coverage in open areas of up to 100m in length and up to 15m wide, giving an effective protection area of 1500sq m.
- The analogue addressable reflective beam smoke detectors shall have the transmitter and receiver in single housing with a reflector to return the infra-redbeam from the transmitter to the receiver (reflective optical beam detector).
- The transmitter/receiver shall project a modulated beam of infra-red

light to a reflective prism opposite which shall convert it to an electrical signal for processing. The received signal shall be continuously analyzed, and in the event of the smoke obscuring the light by a pre-selected minimum level for a period of8 to 10 seconds, a fire alarm condition shall be activated.

- The analogue addressable reflective beam smoke detectors shall provide selectable detection smoke levels to suit different environments. These levelsare to be selectable via the interface.
- The analogue addressable reflective beam detectors shall be given a uniqueaddress.

18.20 MANUAL CALL POINTS

- UL Listed
- Manual call point shall be with polycarbonate enclosure and easily resettable.
- The Manual Break Glass Call Point shall have response time of less than 1 secondand shall have a very low standby current, incorporating a status LED, which flashes when, polled or is continuously lit when operated. An additional set of volt free change over contacts shall be incorporated for additional local signalingas required. The addressable code for the device shall be electronically programmed and stored in the sensor and be non-volatile.
- All circuits used in data communication will be designed and manufactured bythe original manufacturer and will be a complete and integral part of the MCP.
- Each MCP installed on the loop shall have a unique address, set at thecommissioning stage by means of a seven-segment DIL switch.
- MCPs shall contain electronic circuits similar to those in detection equipment, sothat the communication protocol and fast response to the alarm state of the device are monitored. The MCP housing and electronic circuits will be supplied by the manufacturer of the detection and interface units.
- A single alarm LED shall be provided on the MCP. This LED will be controlled,independently of the device, by the CIE.
- MCPs shall be able to flash their LEDs each time they are polled.
- MCPs shall be capable of being remotely tested from the CIE by transmission of asingle bit in the communication protocol. MCPs shall respond by providing an analogue value of 64 to indicate a healthy test condition. The CIE shall recognize this response as a test signal and should not raise a general alarm.
- The MCP housing shall be a red plastic molding and will have dimensions notexceeding 87mm x 87mm x 52mm.

18.21 OUTPUT UNIT

- UL Listed.
- Loop powered. (External power supply are not required)
- The output unit shall provide a volt free changeover relay contact operated by command from the control and indicating equipment (CIE).
- The contacts of the relay output unit shall be rated at a minimum of 1A at 24 VDC.
- The output unit shall be capable of deriving its operating power from theaddressable loop.
- The output unit shall provide a red LED indication that the relay has operated.

18.23 SWITCH MONITOR

- UL Listed
- Loop powered. (External power supply are not required)
- The switch monitor shall provide status monitoring of one or more single pole,volt-free contacts connected on a single pair of cables, to the CIE.
- The switch monitor shall provide the facility to monitor the input wiring for openand short circuits and transmit the necessary fault signal to the CIE.
- The switch monitor will communicate four input states to the CIE - 'Normal','Fault', 'Pre-Alarm' and 'Alarm'.
- The switch monitor shall provide a red LED indication for an 'Alarm' conditionand a yellow LED for a 'Fault'.
- The switch monitor shall be capable of deriving its power directly from theaddressable loop.
- A version with identical functionality but smaller dimensions shall be availablefor use where space is limited.
- A version with additional functionality shall be available for use where a delay inresponse is required.

18.24 ADDRESSABLE MINI SWITCH MONITOR

- UL Listed
- Loop powered. (External power supply are not required)
- The mini switch monitor (interrupt) shall provide status monitoring of one or more single pole, volt-free contacts connected on a single pair of cables, to theCIE.
- The mini switch monitor (interrupt) shall provide the facility to monitor the inputwiring for open and short circuits and transmit the necessary

fault signal to the CIE.

- The mini switch monitor (interrupt) will communicate three input states to theCIE - 'Normal', 'Fault' and 'Alarm'.
- The mini switch monitor (interrupt) shall provide a 'priority interrupt' where afast response to the signal is required.
- The mini switch monitor (interrupt) shall provide an integral red LED and provision for a remote LED which is switched automatically with the integral LED.

18.25 SOUNDER CONTROL UNIT

- UL Listed
- Loop powered. (External power supply are not required)
- The sounder control unit shall be capable of monitoring and driving a circuit ofalarm sounders.
- The output of the sounder control unit shall be rated at 1A.
- The sounder control unit shall be capable of operating the sounders in a pulsingor continuous mode as determined by the CIE.
- The sounder control unit shall provide the facility to monitor the wiring to the alarm devices for open or short-circuit and transmit the necessary fault signal tothe CIE.
- The sounder control unit shall provide the facility to monitor for failure of the local power supply and transmit the necessary fault signal to the CIE.
- The sounder control unit shall provide a red LED indication that the sounder circuit has been actuated. It shall also provide a yellow LED indication for anydetected faults.
- The sounder control unit should be capable of being addressed into a group bymeans of a separate 4-bit DIL switch.
- The sounder control unit should have the facility for synchronizing the output forcontinuous and pulsed operation with other addressable alarm devices.

18.26 INPUT/OUTPUT UNIT

- UL Listed
- Loop powered. (External power supply is not required)
- The input/output unit shall provide a volt free changeover relay contactoperated by command from the CIE.
- The contacts of the input/output unit shall be rated at a minimum of 1A at 24 VDC.
- The input/output unit shall be capable of deriving its operating power from theaddressable loop.

- The input/output unit shall provide a red LED indication that the relay hasoperated.
- The input/output unit shall provide a yellow LED to indicate a 'Fault' condition;open and short circuit on the input wiring, and a red LED to indicate when the switch input is closed.
- The input/output unit shall provide monitoring of the status of a single pole, voltfree contact connected on a single pair of cables, to the CIE.
- The input/output unit shall provide a further opto-coupled input for monitoringan external voltage.
- The input/output unit will communicate three input states to the CIE: 'Normal','Fault' and 'Switch Closed'.

18.27 MAINS SWITCHING INPUT/OUTPUT UNIT

- UL Listed
- Loop powered. (External power supply is not required)
- The mains switching input/output unit shall provide a single-pole voltage freerelay contact operated by command from the CIE.
- The relay contact of the mains switching input/output unit shall be rated at aminimum of 5A at 250V AC and 2A at 48V DC.
- The mains switching input/output unit shall be capable of deriving its operatingpower from the addressable loop.
- The mains switching input/output unit shall provide a red LED indication that therelay has operated.
- The mains switching input/output unit shall provide a yellow LED to indicate a'Fault' condition; open and short circuit on the input wiring, and a red LED to indicate when the switch input is closed.
- The mains switching input/output unit shall provide status monitoring of one ormore single pole, volt-free contacts connected on a single pair of cables, to the CIE.
- The mains switching input/output unit will communicate three input states tothe CIE: 'Normal', 'Fault' and 'Switch Closed'.

18.28 SHORT-CIRCUIT ISOLATORS

- UL Listed
- Loop powered. (External power supply are not required)
- Short-circuit isolators shall be of the stand-alone type with a mounting base thatis unique to the isolator or may be incorporated into the mounting base of a detector. Isolators may also be incorporated into interfaces.
- In the event of a short-circuit fault on the loop wires the isolators shall be capable of sensing the short circuit and disconnecting the affected part of theloop within 50µs.

- The isolators on either side of the short-circuit fault shall test the integrity of thatpart of the loop. If the short-circuit fault is no longer present, the affected part ofthe loop shall be re-connected.
- The isolators shall be supplied by the supplier of the detectors and interfaces.The mounding's of the isolators and the isolating bases shall be of the same material as the detectors and bases.

18.29 ADDRESSABLE REMOTE SENSOR INDICATOR

The remote indicators shall be addressable linked to any number of detectors within the given location. The remote indicator shall be installed in a clearly identifiable location.
The remote indicator shall fit onto a standard electrical accessory box.

18.30 ADDRESSABLE SOUNDER

- UL Listed
- Loop powered. (External power supply is not required)
- The sounder has been designed for use in open areas.
- The addressable sounder shall be self-test trouble monitoring.
- The addressable shall provide two volume settings 92 db (a) and 100 db (a).
- The addressable sounder shall have individual and group addressing.
- The addressable sounder shall be capable of synchronizing the tones.

18.31 ADDRESSABLE SOUNDER BASE

- Loop powered. (External power supply is not required)
- Group addressing
- The addressable base sounder shall provide an output of 85 dB(A) at 1m and willhave a low current consumption at this level.
- The addressable base sounder shall have a DIL switch selectable option ofchanging the output to 92 dB(A) at 1m.
- The addressable base sounder shall be supplied as a sounder base only, so that adetector can be fitted, or with a cover for use as a stand-alone sounder.
- The addressable base sounder shall produce either a continuous alternating toneof 0.5s 610Hz, 0.5s 510Hz or a pulsed tone of 1s 510Hz, 1s off, on command fromthe CIE.
- The addressable base sounder shall be capable of deriving its power directlyfrom the addressable loop.

18.32 ADDRESSABLE SOUNDER BEACON BASE

- UL Listed
- Loop powered (External power supply are not required)

- Group addressing
- The Intelligent Addressable Programmable Sounder Beacon Base shall have twoVolume Ranges, 55-75 dB(A) and 75-91dB(A).
- The Intelligent Addressable Programmable Sounder Beacon Base shall havesynchronization of Alert and Evacuate tones and flashes.
- The Intelligent Addressable Programmable Sounder Beacon Base shall becapable of individual and group addressing.
- The Intelligent Addressable Programmable Sounder Beacon Base shall be supplied as a base only, so that a detector can be fitted, or with a cover for useas a standalone sounder.
- The Intelligent Addressable Programmable Sounder Beacon Base shall be capable of deriving its power directly from the addressable loop.
- The Intelligent Addressable Programmable Sounder Beacon Base shall beequipped with a self-test fault monitoring feature.

18.33 ADDRESSABLE OPEN-AREA SOUNDER BEACON

- UL Listed
- Loop powered (External power supply are not required)
- The Intelligent Addressable Open-Area Sounder Beacon shall have two VolumeRanges, 92 dB (A) and 100dB (A).
- The Intelligent Addressable Open-Area Sounder Beacon shall havesynchronization of tones and flashes.
- The Intelligent Addressable Open-Area Sounder Beacon shall be capable ofindividual and group addressing.
- The Intelligent Addressable Open-Area Sounder Beacon shall be capable ofderiving its power directly from the addressable loop.
- The Intelligent Addressable Open-Area Sounder Beacon shall be equipped with aself-test fault monitoring feature.

18.34 ELECTRICAL INSTALLATION

18.34.1 The Fire Alarm system shall install used fire rated cable. The fire rated cable shall be a minimum of 1.5 mm and shall be red Low Smoke and Fume (LSF) outer sheaf. The Fire rated capable shall be clipped directly to the building fabric for single and double cable runs. The Clips shall be fire rated metal with an LSF Coated Red finish. The clips shall be fixed suitably and shall be no greater than 300mm between fixings. Where there are more than 2 cables, the cables shall be installed on suitable galvanized tray or in trunking. Where cables run below 2.4 meters from finished floor level then all cables shall be installed within galvanized conduit.

18.34.2 In the event of a fire it is important that all cables used within a fire alarm system are able to withstand attack by the fire. All cables, including those carrying the mains supply to the control panel, should be fire resistant. BS

5839 recognizes that there may be circumstances in which a higher level of fire resistance is required which only certain

types of cable can provide. This is referred to as 'enhanced' fire resistance. It is particularly necessary for tall buildings (over 30m in height) and buildings in which there is phased or delayed evacuation. However, the enhanced grade is not necessary in these situations if the building has sprinkler protection.

18.34.3 Not only should fire detection and alarm system cables be able to resist fire, they should also be sufficiently strong to avoid mechanical damage. For some types of cable, this means that they must be provided with additional mechanical protection. However, this is not necessary in the case of steel wire armored (SWA) and mineral insulated (MI) copper sheath cables. All cables for the fire alarm system should have conductor cross sectional areas of no less than 1sq mm.

18.34.4 Standards normally require that there is suitable segregation between fire detection and alarm system cables and cables of other services. The purpose of segregation is to minimize any potential for the other circuits to give rise to malfunction of the fire detection and alarm system as a result of:

- Breakdown of the cable insulation of the other circuit and/or the fire alarmsystem circuits.
- A fire caused by a fault on the other circuit.
- Damage resulting from the need for other circuits to be installed in, or removedfrom, conduit, ducts or trunking containing the fire detection and alarm systemcircuits.
- Electromagnetic interference to the fire detection and alarm system circuits as aresult of the proximity of another circuit.

18.34.5 Correct corresponding termination devices and boxes shall be used. All devices shall be terminated using a compression lock gland colored red manufactured in LSF material. Where devices are fixed surface a suitable LSF shroud shall be used.

Before any devices are connected the contractor must fully demonstrate and prove the quality of the installation for loop integrity, continuity, resistance and capacitance.

18.34.6 The system specialist shall install all devices; this shall include 2nd fix and 3rd fix. Prior to completion of the project the system specialist must demonstrate the entire system to the approval of the Engineer. The entire system shall have been 100% tested independently prior to the demonstration to the Engineer. Should any items fail during the test a new and complete 100% re-test shall be carried. The specialist will be responsible for any costs involved with re-testing of the system.

18.34.7 The system specialist will be responsible for providing complete and detailed manuals for the entire system. The manuals shall be fully detailed and shall describe the operation and function of each part of the system.

18.35 FIRE RATED CABLE

Fire rated cable should comply with latest industry standards and tested by LPCB to comply with BS 5839-1:2013 to meet all fire and fume emission testing details. Fire rated cable shall be fully approved to the Low Smoke & Zero Halogen requirements asper BS 5839-:2013 & BS7629-1:2008.

Design and construction of fire rated cable including Outer Sheath, Aluminum Foil, Silicone Insulation and Conductor Cores should be certified by LPCB and meet with BSstandard codes BS EN 50200:2006 + Annex E 30 minutes, BS EN 50200 PH30, PH60 & PH120 & BS 6387 CWZ.

The fire rated cable shall have high flexibility and must have ability to bear sharp bendsduring installation. It should not require any special tool while stripping. The fire rated cable shall withstand stress three times as compared to normal electric cables and shallbe highly resistant to damage.

18.36 Voltage and design

Cable shall be designated by the rated voltage U0 and U, expressed in the form U0IU.For the purpose of British standard, the rated voltage is 300/500 V

18.37 Conductor and drain wire

The conductor shall be shall be plain or tinned annealed copper. The uninsulated circuit protective conductor shall be tinned annealed copper and shall be of the same nominal cross- section area as the insulated conductors. The class of conductor shall be the samefor all insulated conductors in any cable.

Drain wire shall comprise one or more annealed copper wires with a total nominalcross-section area of not less than 0.5mm2 shall meet the relevant resistance requirements specified in BS 6360.

18.38 Insulation

The insulation shall be applied closely to the conductor or conductor taping by the extrusion process and cross-linked to form a compact and homogeneous layer. It shall be possible to remove the insulation without damage to the insulation itself, the conductor, or the tin coating, if any. The thickness of any tape(s) over the conductor orover the insulation shall not be included in the measurement of thickness of insulation.

18.39 Cable marking

The cable shall be marked with the number of this British Standard1' on the outer surface by printing, indenting or embossing. All cables shall be provided with an indication of origin consisting either of an identification threads or the continuous marking of the manufacturer's name or trademark. The colors shall be easy to recognizeor shall become recognizable by cleaning if necessary. The marking of the manufacturer's name or trademark, if used, shall be by printing, indenting or embossingon the sheath.

18.40 Test conditions

Fire rated cable shall retain continuity for a minimum of 30 minutes under fire

conditions at 830°C, this demands the fire rated cable test include a final 15 minutes under fire & water spray conditions while a mechanical shock is to be applied every 5minutes throughout the full 30-minute test.

In condition of 950°C temperature, the fire performance cable shall have tendency towithstand for 3 hours and if fire and mechanical shock is applied every 5 minutes at 830°C, it should have stability for a minimum of 2 hours.

END OF SECTION

19.0 EMERGENCY LIGHTING SYSTEM

19.1 GENERAL

19.1.1 The contractor shall supply, install, test and commission of Emergency Fluorescent lamps are to be fixed as shown in the approved Civil Defense drawings to work when the electrical power gets disconnected. Maintained Exit Lights also shall be fixed as shown in the drawings.

19.1.2 The Emergency lighting equipment shall be designed and manufactured as per relevant BS standard and relevant NFPA Standards and codes. All the equipment's and accessories including Panels, Drives, Luminaries, Modules and Optional Software shall be certified by BSI.

19.1.3 The contractor shall ensure that the final system shall include the following designrequirements in addition to that shown on the tender drawings:

1. Each compartment of an escape route or open area must have at least 2luminaries to guard against total darkness.
2. Emergency lighting facilities shall be arranged to provide initial illumination that is not less than an average of 1ft candle (10.8 lux) and, at any point, not less than 0.1 ft candle (1.1 lux), measured along the path of egress at floor level.
3. Illumination levels shall be permitted to decline to not less than an average of 0.6 ft candle (6.5 lux) and, at any point, not less than 0.06 ft candle (0.65 lux) at the end of 90 mins. A maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceed Emergency power systems for emergency lighting shall be at least type 10, class 1.5, level 1, in accordance with NFPA 110, Standard for Emergency and standby power system.
4. Large open toilet areas and changing rooms which are greater than 8m2 orwhich have multiple closet facilities to 0.5 Lux minimum.
5. High risk work areas shall be illuminated to 10% of the normal lighting level.
6. In addition, emergency luminaries shall be sited as follows:
   a. Near changes of level.
   b. Near each change of direction.
   c. To illuminate Exit doors and safety signs.
   d. Near firefighting equipment and call points.
   e. Near every final Exit.
   f. Near each first aid point.
   g. Near each intersection of corridors.

All Exit luminaries shall be maintained type, and Emergency /Safety luminaries shall of non-maintained type. The battery capacity shall be calculated to provide a minimum of3 hours operation at 100% light output. Where indicated on the drawings, local lighting circuits shall be monitored for failure via sub-circuit

monitoring/changeover relays.

19.2 Philosophy of Operation

Addressable Self-Contained Luminaries

Luminaries providing maintained or non-maintained emergency lighting in which all elements, such as battery, the lamp the control unit and the test and monitoring facilities, where provided are contained within the luminaire. Self-Contained luminaries,Lamps and Batteries status shall be notified through the local LED installed in case of monitoring panel failure. The self-contained units shall constantly monitor their mains charging input for failure. In the event of mains failure, both the maintained and non- maintained circuits shall be switched over to the self-battery found on each luminaire.

19.3 Description of Components

The light fixtures and addressable monitoring panel covered by the present specificationrefer to all expansion project buildings and include the following types:

- Safety lighting fixtures equipped with fluorescent, LEDs and halogen lamps.
- They and their various components must comply with the following standards:
- IEC 60598-2-22.5 Marking on devices.
- IEC 60598-2-22.8 Provision for earthing.
- IEC 60598-2-22.10 External and internal wiring.
- IEC 60598-2-22.11 Protection against electric shock: safety rules;
- IEC60598-2-22-13 Resistance to dust, solid objects and moisture.
- IEC60598-2-22-14 Insulation resistance and electric strength.
- IEC 60598-2-22-15 Resistance to heat, fire and tracking.
- EN50172: Installation of emergency lighting.
- EN 1838: Lighting applications – emergency lighting.
- EN 4844-1: Graphical symbols – safety color and safety sign.

19.4 Emergency / Exit Luminaires

Emergency and Exit luminaires are to be provided as shown on the drawings. The type and IP rating of the luminaire shall be as per the lighting schedule. Additional luminaries shall be considered in order to fulfill the design requirements.

19.5 Addressable Touch Screen Monitoring Panel

Automatic testing of all emergency luminaries shall be carried out via the Addressable Touch Screen Monitoring Panel. Addressable modules shall be provided within every luminaire to be connected to the Addressable Monitoring Panel. The panel shall be programmable via a PC or via the front controls, and should be able to produce accuratetest reports as and when required. At the same time the panel, software, model, and addressable luminaries have to be approved as a complete system software and hardware by international laboratory BSI.

Addressable Touch Screen Monitoring Panel shall monitor only the luminaries connected to that unit. The Addressable Monitoring Panel shall be networkable

to allowcomplete monitoring and testing from a single location. In addition, the following features are required as a minimum:

- Reporting of luminaire number, location, and nature of fault detected.
- Constant communication with luminaires to prove system integrity.
- Background status lighting.
- Disabling of loops, zones and luminaries to carry out maintenance.
- Fully automatic daily, weekly, quarterly, and annual testing.
- Manual testing of entire system shall be possible at any time.
- On-board power supply to maintain memory if power fails. Compliant withrequirements of PR/EN62034.
- 2 addresses for external status controls.

19.6 Batteries (NiCd and NiMH)

The battery cells shall be designed to comply with the IEC international standard and tested according to the normative permanent charge endurance test described in theIEC 61951-2 standard. This performance is mandatory for use in Emergency Lighting Units to comply with the IEC 60598 2.22.

The batteries shall have the following properties:

- High-temperature NiCd Or Nimd cells for use with emergency lighting
- Constant high-temperature operation at 55 °C
- Good charging properties at high temperature
- 4 year life in operation
- Certified quality manufacture In various configurations (suitable for differentfixture bodies)
- Simple connection with blade terminal
- With polycarbonate fixing caps and connecting cable
- Electrical connection with mounted end caps possible
- Complies with IEC 61951-2 (constant charging load test)
- Suitable for emergency lighting equipment as per IEC 60598-2-22

19.7 Wiring

All wiring of the Emergency Lighting and Monitoring system shall be done using fireresistant cabling approved by the Civil Defense. The diameter of the cable shall be selected as per the estimated loading of each circuit.

END OF SECTION

20.0 GATE BARRIER SYSTEM

20.1 SCOPE

a. The contractor shall supply, install, test and commission a Parking Barrier System as specified in this section and as shown on the drawings from an approved supplier.
b. contractor shall be providing the electrical point and containment works for gate barrier system
c. The system shall be supplied by the authorized dealer of the system with more than five years' experience in the market.
d. Specification included in this section are indicative and is to be considered as the minimum requirement, equipment & software that shall be delivered at the time of implementing the project shall be the latest versions available in market and shall form a complete system.

20.2 General Description:

Comply with General conditions of contract, conditions of particular Application and the Requirements in the Specifications. This includes, but is not limited to, the following works:

- Parking control system limiting traffic entry to the Building by means of automatic gate arms, magnetic loops, and the associated electrical controls including remote controls. Supply and install long parking gate arms for the required quantity as shown in the drawings. Exact locations shall be as shown in the drawing.
- Gate barrier arm shall be available in two types either a rectangular or tubular boom. Gates shall be opened using the Remote Control or Proximity Access cards as per Employer requirements.
- Gate Barrier will have a compact body & it will be made of steel frame & should be covered by anodized hot painted aluminum panels to grant higher resistance to the atmospherically agents. It shall have a smooth movement of arm while going up & down.
- Exit gate barrier to be connected with loop detection for without card access.
- Gate Barriers shall have built-in receiver (rolling and fix code), shall come with built-in flashing light & fixing supports for photocells and/or key-pads. Unblocking

Technical Specification for Barriers of 3 — 4 meters	
Power Supply	230 Vac/50Hz
Motor Power Supply	24 Vdc
Max. Input Power (A)	6
Max. Motor Power (W)	120-150
Opening Time (sec)	2-4 seconds
Working Temperature (°C)	-30<>+60
Average Cycle/24h	3000 — 3500 cycles
IP Protection Level	44
Weight (Kg)	40-50
Max. boom length (m)	3-4

Technical Specification for Barriers of 6 meter	
Power Supply	230 V ac/50Hz
Motor Power Supply	24 Vdc
Max. Input Power (A)	6
Max. Motor Power (W)	120-150
Opening Time (sec)	10 - 12 seconds
Working Temperature (°C)	-30<>+60
Average Cycle/24h	1500 — 2000 cycles
IP Protection Level	44
Weight (Kg	70-90
Max. boom length (m)	6

20.3 Fabrication

Fit joints and junctions between components tightly, in true planes, and to prevent entry of water to collect in component voids. Fabricate work switch materials and components sizes, metal gauges, reinforcing, anchors, and fastenings of adequate strength to ensure that it will remain free of warping, buckling, opening of joints and seams, and distortion within limits of intended and specified use. Conceal and weld connections. Cleanly and smoothly finish exposed edges of materials including holes.

END OF SECTION

21.0 MOTION SENSOR

PIR OCCUPANCY/ MOTION/PRESENCE SENSORS (for CORRIDORS, LIFT LOBBIES AND STAIRCASES)

1. The presence detectors shall have a built-in lux sensor with an adjustable set point between 5-1000 LUX so as not to switch 'On' circuits even after detecting presence due to sufficient natural light. There shall also be an adjustable 'Off' time delay on the movement sensor from 1min to 1 hour, to ensure that lighting circuits are not switched 'Off' immediately.
2. The sensors shall be ceiling and flush mounted type and also possible to use surface mounting accessory in case of concrete ceiling.
3. When ceiling mounted at 2.5m- 3.5m height from finished floor level presence sensor detecting range shall be 360° with a diameter varies from 7m – 9m at floor level.
4. Presence sensor shall be having both absence (semi-automatic mode) and presence detection (automatic mode) function.
5. A manual override function shall be possible via handheld user remote control. Parallel operation of movement sensors shall be possible if required to extent the coverage area
6. Comply to standards IEC 60669-1, IEC 60669-2-1
7. IP rating of movement/occupancy sensors shall be minimum IP41 with Class of insulation (II IK03)
8. Supply voltage: 230VAC +10% -15%, 50-60 Hz and no-load consumption of 2.4VA/270mW

END OF SECTION

22.0 AUDIO INTERCOM SYSTEM

22.1 Scope

The contractor shall supply, install, test and commission an Audio Intercom System as specified in this section and as shown on the drawings from an approved supplier.
Contractor shall be providing the electrical point and containment works for Audio intercom system
The system shall be supplied by the authorized dealer of the system with more than five years' experience in the market.
Specification included in this section are indicative and is to be considered as the minimum requirement, equipment & software that shall be delivered at the time of implementing the project shall be the latest versions available in market and shall form a complete system.

22.2 General Description:

Wall phone with electronic call and confidentiality feature for Installations of both digital door entry systems and digital video door entry systems.

- 2wire digital system without connection polarity. The telephone has a side pushbutton to operate the electronic lock and a call volume Control.
- For its operation it is necessary to assign a code to each phone that Can identify it within the installation (programming the telephone).
- This code is stored in the non-flash memory of the telephone.
- The telephones on stand-by until a call is received. In that moment, the audio and door opening functions are activated during a time Period controlled by the audio unit.
- It is possible to install up to 4 digital telephones per house or flat on the same call line. This way, if a call is received, the first telephone in which the receiver is picked up is activated, remaining Deactivated the rest of the telephone

22.3 Characteristics:

- Wiring: 2 non-polarized wires, flexible topology.
- Cable types:
  - Parallel 2x1mm2 ALCAD Optimized CAB-307.
  - Common Parallel (2x1mm2, 2x0,5mm2…).
  - Twisted pair.
  - UTP CAT5.
  - Replacing of a doorbell (2 wires).
  - 4+N cable
    Note: Performance may vary depending on the cable used. Recommended cable: Parallel 2x1mm2 ALCAD Optimized CAB-307.
- Max. distance outdoor entrance panel to indoor unit: 600 meters.
- No. of homes: 1,500.
- Terminal connections: 2 un polarized wires. Possibility of connection in derivation or cascade (from housing to housing).
- Supply voltage: 18Vcc.

- 2-wire concierge (audio):
- The digital concierge system with audio is based on a 2-wire bus compatible with the 201 Line range of entrance panels.

22.4 Electronic telephone

Terminal with housing made of white ABS plastic, with gloss finish. The telephone cord that connects the headset to the base is removable using RJ15 connectors. Wall mounting with multiple anchor points. It has 1 button for door opening. Conventional 4 + N system with electronic call.

Description Entrance panel with keypad for calling by numerical code. Aluminum panel profile

entrance panel stands out for the elegance of the tempered glass and its simple and discreet lines, which add an air of sophistication to any property. USOA is an innovative entrance panel, both in its aesthetics and in its technology, designed from its conception to be modular; in this way, it is able to offer total freedom when configuring and combining its different elements.

Its backlit tactile buttons, with capacitive technology, and its aluminum frame that hides all the hardware, result in a flat and compact device, with a minimalist and modern appearance.

The delicate appearance of its exterior, thanks to its high-quality tempered glass surface, hides a great resistance to shocks and inclement weather, which guarantees its resistance without losing any of its aesthetic or technological qualities.

END OF SECTION

23.0 LIGHTNING PROTECTION SYSTEM

23.1 General conditions-

1. The Early Streamer Open Area against Lightning Using Early Streamer Emission Air Terminal) Emission Air Terminal (ESEAT) must be in full observance with French standard NFC 17-102 (Protection of Structure and the installation of Down Conductor & Earthing shall follow NFC 17-102 (Protection of building and allied structures against lightning code of practice.)

2. To ensure the effective system and satisfactory long-term performance, all fittings need to be mechanically sound and good corrosion resistance in condition of 600c and 95 % relative humidity.

Basic Components of Early Streamer Emission Air Terminal (ESEAT) Comprises of the following items

1. Advance Early Streamer Emission Air Terminal.
2. Lightning Strike Counter.
3. Down Conductor.
4. Earth termination network

23.2 Advance Early Streamer Emission Air Terminal (ESEAT)

- The intelligent air terminal system shall comply to NFC 17:102.
- It should be sealed in a 304L stainless steel to guarantee high resistance to impact, corrosion and chemical agent. It should be preferably suitable for chlorinated environment in high humidity climate or in exposed industrial sites.
- The weight of the device shall be not more than 10 Kgs.
- Air terminal should have test terminal blocks for testing its performance at any given point of time.
- The air terminal should have an ozone generator which has alternating grounded and floating plates and pushes into a venture for charge acceleration.
- The tip voltage at the time of lightning should raise up to 11kv.
- The air terminal must be sensitive to approaching lightning and send the upward streamer using VENTURI EFFECT.
- Radius of Protection as per NFC 17-102 divides into 3 Levels. Level-1is 79m, Level-2 is 97m and Level-III is 107m.
- The air terminal should be able to produce the upward streamer of 25 to 60 meters.
- Impulse device for the tracer release and power device to maintain healthy tracer propagation.
- The air terminal should be fixed on the top of the freestanding ground/terrace. It should be mounted on a support tower within the area to be protected. The height

of the tower depends on the protection radii, and it must be at the required height from the highest point on the top of the structure to be protected.

- Any Arial mast present on the top of the structure within 10 meters from the air terminal or any metallic structure within 1.5 meter from the air terminal must be interconnected to the air terminal mast at roof level, using copper tape of the same cross section area as the down conductor.
- ESEAT shall be tested in high voltage laboratory like BAZET (France), COFRAC certified laboratory.
- The ESE system must be tested for Environmental conditioning in accordance with NFC 17-102 (09/2011)- C3.3.1 & C3.3.2
- The excitation advance should be 60 microseconds as per NFC 17:102-2011 edition 9.
- The ESE system should be tested for triggering advance as per NFC 17-102 2011 Annex C and IEC 60060-1/2010
- While designing for lightning protection system, position and radius of coverage of ESEAT shall comply to NFC 17 102.
- Commissioning shall be carried out by experienced professionals.

23.2 Lightning Strike Counter

1. Lightning strike counter shall be designed in conformity of NFC 17 102.
2. The starting threshold shall be from 1 to 10 KA for 8/20 wave.
3. Degree of protection shall be IP 65.
4. Display shall be 6 digits.
5. The counter device shall be electromechanical type and should work without any power supply.

23.3 Down Conductor:

- The ESE air terminal should be equipped with at least two down conductors as per NFC 17-102.
- The down conductor should be of high conductivity copper, tape (25x3) or 70Sq.mm cable of equal cross section.
- The down conductor should be connected to the air terminal by means of specific clamp, which do not damage the building waterproofing. It should then take shortest viable path down the outside of the building to the earth termination system avoiding any sharp corner, thereby providing the low impedance path from air termination system to earth termination system.
- Any metal works locate in the way of down conductor within distance of 1.5 meter must be connected for equipotential bonding between down conductor and metal work.

- A disconnection clamp should be installed at a suitable location on the down conductor so that down conductor can be disconnected from earth termination network to check the earth resistance value at a regular interval or for any necessary maintenance purposes.
- A Lightning Strike Counter to be installed on down conductor, at a suitable location. This
- counter must be electromagnetic and shall work without any external power supply.
- The down conductor should be installed in such a way that it is protected from
- accidental knock and other damages.
- If column torr steel is used as down conductor, then it is mandatory to use galvanized torr steel and the construction of this column to be of welded type. No tie wires should be used to join the torr steel for this column, as per clause 16.6 of BS 6651. All torr steel bars in this column shall be welded together for equipotential bonding at every 15 meters.

23.4 Earth Termination Network:

- The down conductor should be connected to its own earth termination network as per NFC 17-102 and the combined resistance value of each termination should be 10 ohms or less.
- Each earth electrode should be a housed in suitable chamber in order to facilitate inspection. The pit should be complete with lid and assembly level should be flushed with area finish floor level.
- The earthing is made of conductors of same material and cross-sectional area as the down conductor of installation. Each earth pit must be separated from other by distance equal to at least driven depth and interconnected by conductor identical to that use in down conductor or equivalent in cross section.
- The Earth pit soil needs to be artificially treated with such compound which contains, Ionic compound, Dispersion compound, Expansion compound, Diffusion compound, Hygroscopic compound & should offer 6.9 to 7.2 PH value of 1000/gms/liters at 200C. This earth termination network must be Maintenance free & shall offer constant below 10 Ohm value.

END OF SECTION

24.0 EARTHING SYSTEM

24.1 Description of Work

Design, Supply, Installation, testing and commissioning of complete earthing system as specified hereafter and as indicated in the related electrical system drawings. Scope of work shall include but not limited to the following for each building:

1. Main earthing system of the building consists of ECC conductors, earth bars, earth pits, all related accessories including bonding and terminations.
2. Earthed equipotential bonding of all exposed and extraneous conductive parts.
3. Clean earthing system for the telephone and data communication system including ECC conductors, earth bars, earth pits, all related accessories including bonding and terminations.
4. Clean earth arrangement for the power distribution and power outlets feeding computer terminals and related equipment.
5. Substation earthing system including transformer neutral earthing.
6. Earthing system for Generator sets.
7. Earthing system for the external electrical services including Pump rooms of water features, external lighting poles, etc.
8. Quality Control/Assurance
9. Design, manufacture, testing and method of installation of all apparatus and materials furnished under requirements of these specifications shall conform to latest publications or standard rules of the following:
10. (DEWA), regulations for electrical installation works and Department of Civil Defense requirements, Etisalat Standards and requirements.
11. Regulations for the Electrical Equipment of: Buildings (IEE), (BS) London.
12. British Standards.

24.2 Earthing system materials

Earthing system materials shall include the following:

a) Bonding Conductors

b) Earth continuity conductors

c) 240mm2 earth bar risers.

d) 240mm2 copper tape, earth pits & wells.

e) Earth grid bar.

f) Thermal welding kits and accessories.

g) Lugs, terminals, clamps, accessories etc.

h) Any other material indicated on the drawing or required by BS7430, BS7671.

i) Copper earth rods.

24.3 Technical Requirements

The complete installation covered by this specification shall be efficiently bonded back to the main switchboards through the metal sheathing of cables, the steel conduit, the trunking system and earth wires/bars.

The nominal cross-sectional area of all earth continuity conductors shall be in accordance with the IEE regulations and to DEWA approval. The earth wires.

End of Section

25.0 Photocell Sensor

Light sensitive switch (photo cell) with built in time delay

Light sensitive switches can prevent the unnecessary use of lighting circuits where sufficient daylight exists.

1. It shall be two separate parts: output device and photo cell, to ensure the correct performance and achieve the optimum energy efficiency.

2. The output device shall be digital, modular type and to be fitted at the distribution panel to prevent unauthorized tampering.

3. The remote photo cell unit shall be surface mounted on a separate location to able to sense the natural light luminosity without any hinderance. It shall be mounted up to a distance of 50 meters from the device.

4. The device shall have a built-in time delay which avoids unnecessary switching due to temporary factors such as car headlights beams etc.

5. The output during programmed ON time period shall be ON when the measured level is lower than the preset light level and the output during ON time period shall be OFF when the measured level is higher than the preset light level

6. The output during programmed OFF time period shall be OFF regardless of the lighting level.

7. The user shall be possible to set desired brightness level (lux level)

    a. The photocell shall be IP54 rated and having working temperature range of -30 deg C to +60 deg C.
    b. The modular device shall have lighting range selector switch between 5-100 lux and 50-2000 lux range, to choose the range based on site requirements
    c. It shall have override selector switch to allow permanent ON or OFF, auto or test mode
    d. It shall have status LED on itself to show output switching status.
    e. The output shall be parameterized for weekly cycle operation and device having lithium battery to back up the setting during power failure.
    f. The characteristics of the output contact:
        i. Voltage rating: 230VAC +10% -15% 50 Hz
        ii. Max breaking capacity: AC1 16A 250VAC
        iii. Output: 1x voltage free changeover contact
        iv. Consumption: 1.5VA max

End of Section

26.0 Gas Detector

26.1 GENERAL INFORMATION

H-400.CH4/LPG are flammable domestic gas leakage detectors. When flammable gas is present in concentrations higher than the dangerous threshold alarm level is activated. Red indicator burns and buzzer is turned on. Relay output can be used to close gas pipe electro valve.

H-400.CH4/LPG features a button with the following functions:

If-short pressed “SILENCING” mode is activated. Yellow LED flashes and buzzer and relay are disabled for 5 min. After 6 seconds gas detector emits 2 short sounds and leaves “TEST” mode.

If pressed more than 5 seconds “TEST” mode is activated. In this case, green and red LEDs are activated. Relay and buzzer are activated, too. After “TEST” mode the device returns to normal state.

H-400.CH4/LPG has auto diagnostic function. Gas detector continuously checks sensor and -+electronics status. If problem with sensor or electronics yellow LED is activated, green LED is lit and sound signal is activated.

26.2 INSTRUCTIONS FOR USE

Choosing the mounting place

It depends from the relative weight of the detected gas:
-for CH4 detection H-400.CH4 must be mounted within 30cm from the ceiling;
-for LPG detection H-400.LPG must be mounted within 30cm from the floor.
Avoid to install gas detector in the position in which its normal operation could be compromised:
-directly over the cooking stoves;
-in an area where the temperature may drop below -10°C or exceed +40°C;
-directly above a sink;
- in an enclosed space (e.g., in a cupboard or behind a curtain);
-next to a door or window;
-next to an extractor fan;
-where dirt and dust may block the sensor;
-in a damp or humid location.
Do not use the following substances near to the device:
-solvents and diluents;
-alcohol, fuels;
-silicones products and colours;
-perfumes;
-cleaning detergents;
-spray products;

End of Section

27.0 BUILDING MANAGEMENT SYSTEM

PART 1: OVERVIEW

1.1 Definitions

A. Algorithm: A software procedure for solving a recurrent mathematical or logical problem.

B. Analogue: A continuously varying signals or values (temperature, current, velocity, etc.).

C. Binary: A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level.

D. Building Management System (BMS): The entire system of hardware and software specifically designed to centrally manage building HVAC and related utilities. The BMS includes the DDC subsystem, open system ports, and open protocol bus or integrators and network routers for connection to information networks.

E. BMS Contractor: The Building Management System Contractor responsible for the installation of the Building Management System specified herein.

F. Control Process: The software required to perform a complete control loop from input signal to interlock logic, process calculation to final output signal control.

G. Control Wiring: Includes conduit, wire and wiring devices to install a complete Control System including motor control circuits, interlocks, thermostats, PE and EP switches and like devices. Includes all wiring from a DDC cabinet to all sensors and points defined in the Points List summary or specified herein and required to execute the sequence of operation. Includes necessary power wiring to all BMS devices, digital controllers including terminal units and actuators.

H. Dead band: A temperature range over which no heating or cooling energy is supplied, such as 72-78 degrees F, i.e. as opposed to single point changeover or overlap, or a range from setpoint over which no control action is taken.

I. Direct Digital Control System: The portion of the BMS, which provides closed loop control of all HVAC equipment.

J. Distributed Control: A system whereby all control processing is decentralized and independent of a central computer. The control system is built up of stand-alone controllers. A single controller failure shall not impact more than one system.

K. Integration: The ability of control system components from different manufacturers to connect together and provide coordinated control via real-time data exchange through a common communications data exchange protocol. Integration shall extend to the operator's workstation software, which shall support user interaction with all control system components. Methods of integration include industry standard protocols such as BACnet, LonMark/LonTalk, COM/DCOM, ActiveX, OLE for Process Control (OPC) or integrator interfaces between co-operating manufacturer's systems.

L. Network: A system of distributed control units that are linked together on a communication highway. A network allows sharing of point information between all control units. Additionally, a network provides central monitoring and control of the entire system from any distributed control unit location. First tier networks shall

provide “Peer-to-Peer” communications. Second tier networks shall provide either “Peer-to-Peer”, Master-Slave or Supervised Token Passing communications.

M. Open Protocol Bus (OPB): A pre-programmed communications integrator that allows devices from one manufacturer to communicate and interact with those of another.

N. Open System Port (OSP): A user programmable communications port that provides the ability to develop custom communications processes to integrate other operating systems with the BMS System.

O. Operator-Machine Interface: A method by which an operator communicates with a BMS System. Operator-machine interfacing allows an operator to command, monitor, and program the system.

P. Peripheral: Input/output equipment used to communicate with the computer and make copies of system outputs, peripherals include LCD, printer, DVD-RW, etc.

Q. PID Control Loop: A mathematical calculation used to evaluate a control input and determine the control output value required to maintain the input value at setpoint. The PID (Proportional, Integral and Derivative) control loop shall have operator adjustable maximum rate of change, P and D gains and loop response time delay. The loop shall be self-integrating so that no integral constant is required and the loop shall not be subject to “Integral Windup”

1.2 Submittals

A. Each submittal shall have a cover sheet with the following information provided: submittal ID number; date; project name, address, and title; BMS Contractor name, address and phone number; BMS Contractor project manager, quality control manager, and project engineer names and phone numbers.

B. Each submittal shall include the following information.

1. BMS riser diagram showing all DDC controllers, operator workstations, networks repeaters, and network wiring.
2. One-line schematics and system flow diagrams showing the location of all control devices.
3. Points list for each DDC controller, including: Tag, Point Type, System Name, Object Name, Expanded ID, Display Units, Controller Type, Address, Cable Destination, Module Type, Terminal ID, Panel, Slot Number, Reference Drawing, and Cable Number.
4. Vendor’s own written description for each sequence of operations, to include the following:
    a. Sequences shall reference input/output and software parameters by name and description.
    b. The sequences of operations provided in the submittal by the BMS Contractor shall represent the detailed analysis needed to create actual programming code from the design documents.
    c. Points shall be referenced by name, including all software points such as programmable setpoints, range limits, time delays, and so forth.
    d. The sequence of operations shall cover normal operation and operation under the various alarm conditions applicable to that system.

e. Control Valve Schedules. This spreadsheet type schedule shall include a separate line for each valve and a column for each of the valve attributes, including: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Calculated CV, Design Pressure, Actual Pressure, and Actuator Type.

f. Catalogued cut sheets of all equipment used. This includes, but is not limited to, the following: DDC panels, peripherals, sensors, actuators, dampers, control air system components, and so forth.

g. Hardware data sheets for all operator workstations, local access panels, and portable operator terminals.

1.3 O&M Manuals

A. Submit three sets of each manual.

B. Include the following documentation in the Hardware Manual:
1. General description and cut sheets for all components.
2. Detailed wiring and installation illustrations and complete calibration procedures for each field and panel device.
3. Complete trouble-shooting procedures and guidelines.
4. Complete operating instructions for all systems.
5. Maintenance Instructions: Document all maintenance and repair/replacement procedures.

C. Include the following documentation in the DDC Software Manual:
1. Sequence of Operations
2. Program Listing of Software Source Code OR Flow Chart Diagrams of Programming Objects.
3. Printed listing of controller and operator workstation database files.
4. Software Point Name Abbreviation List. Include Name, Description, Controller Where Located, Point Type and Point ID.
5. I/O Point List. Include Point Name, Controller Location, Point Number, Control Device, Range and Span.
6. Printouts of all; Reports, Group Listings and Alarm Messages.
7. Index of all DDC point names with documentation manual page number references.

D. Provide three copies of all manufacturers manuals covering the installed system. This shall include, as a minimum:
1. System Engineering Manual
2. System Installation Manual
3. Programming Manual
4. Engineering and Troubleshooting Bulletins
5. Operator Workstation Software Manual
6. All other pertinent manuals published by the control system manufacturer.

E. Record Drawings

1.4 Warranty & Manufacturers

A. The Control System shall be free from defects in material and workmanship under normal use and service. If within three (3) years from the date of completion any of the equipment herein described is defective in operation, workmanship or materials, it will be replaced, at the option of the BMS Contractor free of charge. The BMS system proposed shall be directly from a manufacturer & not a local system integrator to ensure quality services and responsibility of their brand image during project execution & reliable maintenance support for the end user/client after handing over.

B. Approved Manufacturers
   1. Vendor list if any
   2. Johnson (JCI)
   3. Siemens

PART 2: BUILDING MANAGEMENT SYSTEM

The Integrated Building Management System shall comprise of three levels as follows:
Field Level: consists of field sensors, volt-free contacts and intelligent standalone DDC controllers. All the operation associated with particular equipment shall be achieved in this level itself without intervention of any higher network devices.

Building Automation Level: consists of system controller shall be capable of handling and storing the Building Automation functions like Trend, History, Totalization, Alarm Routing, Co-ordination with field devices for alarms or any information, optimum start/stop etc.

Information Management Level: consists of person machine interface like Operator Workstations, Graphics User Interface, Information Management to format in user preferred way, open protocol availability for ActiveX, ODBC, OLE for Process Control (OPC), COM/DCOM, BACnet, BACnet Network Integrators etc.

2.1 System Architecture

A First Tier Network

1 The first tier network (BMS server) shall be based on a high security LINUX based industrial grade dedicated and specialized system using standard of BACNET TCP/IP while operator station shall be windows based PC Workstation a standard “off the shelf” products available through normal PC vendor channels.

2 The BMS shall network multiple operator workstations, network controllers, system controllers, and application-specific controllers. The first tier network shall provide communications between operator workstations and first tier controllers (Network Controllers).

3 It shall be possible to connect up to 10 Operator work stations simultaneously.

4 The first tier network shall operate at a minimum communication speed of 10 M baud, with full peer-to-peer network communication.

5 Network Controllers shall reside on the first tier. All Network Controllers should be directly connected to BACNET TCP/IP network at 10 M baud.

6 The first tier network will be compatible with other facility-wide networks. The first tier

shall be connected to a facility network by way of standard networking practices.

7 The first tier network shall be configured using UTP (Category-6) or Fiber Optic Backbone similar to the standard networking practices.

8 The first tier network shall operate on distributed control manner. The network shall be independent of any single point of failure. If the manufacturer system has master/slave or server/client architecture, a redundant set of Network Controllers or/and Operator Workstation shall be provided.

9 All the first tier devices shall have a capability of getting connected to structured cabling & building IT network if client wish so.

B Second Tier Network

1 DDC System Controllers shall reside on the second tier.

2 Other Application Specific Controller (e.g. Fan Coil Unit Controller, VAV Controller etc) shall reside on the second tier.

3 Devices like 3rd party integrators (e.g. Chiller Integrators), Energy Monitoring Units shall also reside on the second tier network.

4 All the controllers mentioned above shall be LON Marc certified and shall able to communicate on LON communication bus (i.e. one second tier network). Various buses for various types of controllers at various communication speeds will not be acceptable.

5 The second tier network shall operate at a minimum communication speed of 9600 baud.

6 The second tier network shall follow NC RS485 or LonTalk as the communication protocol.

PART 3: BMS Features

3.1 General

A BMS server shall be based on a high security LINUX based industrial grade dedicated and specialized system using standard of BACNET TCP/IP. Core OS of the server should not be susceptible to virus threats, malicious spyware and accidental data corruption.

B The BMS shall have two servers in hot redundant configuration

C The BMS shall have fully redundant first tier network architecture.

D The BMS shall have, if so desired, an option of fully redundant second tier network and redundant DDC controllers

E Apart from server and network redundancy the BMS shall have other levels of failure protection e.g.:

1 In addition to the BMS server, the system shall have separate Data Storage Server. In case of BMS server failure, historical data such as trend graphs, alarms and reports shall be retrievable from this data Storage server.

2 The Server and data storage server shall be supported by built inn battery backup apart from UPS which shall facilitate automatic server backup and systematic shutdown in case of sudden power failure and auto recover mechanism upon power restoration

3 Gateway between first tier and second tier network shall be intelligent and shall be capable of storing at least 24 hrs field controllers data so that all the field controllers can still be accessed and managed from the gateway in case first tier network fails

F The BMS shall have web based operator workstation. Any standard off the shelf web enabled device such as PC, iPad, tablets should be able to function as workstation without requiring proprietary BMS SW.

G A dedicated Energy data server which integrates with BMS server shall be supplied to accumulate energy related data for up to 10 years. The Energy Data Server shall facilitate user customizable templates and graphs to plot and analyses energy performance of the Building HVAC system. The Energy Data Server shall also facilitate to generate various energy analysis reports

H VAV controllers shall control in conjunction with parent VAV AHUs by way of flow totalization without necessitating duct static pressure sensor

I Contractor shall provide and install a personal computer workstation for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS controllers to facilitate greater fault tolerance and reliability. The system shall be completely web based and allow remote use through Internet. The system shall allow the graphical view of IBMS on Internet via the same system software.

J Workstation System Architecture – The architecture of the workstation shall be implemented to conform to industry standard APIs (application specific interfaces), so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.

1 All historical information contained in Time Series Databases and all configuration data contained in relational databases must be accessed via ODBC (utilizing ANSI SQL database query specifications).

2 All real-time, online building data must be accessible by all applications (including, but not limited to, graphics, reports, etc.) via OPC (OLE for Process Control).

3 All real-time event data (including alarms, change of state events, warning events, etc.) shall be accessible by all applications via OPC (OLE for Process Control).

4 The BMS Contractor shall provide all necessary OPC servers for communicating to the DDC controllers that are provided as part of this contract. In addition, the system shall accommodate installation and registration of OPC servers provided in the future by other equipment suppliers.

5 PC Hardware – The PC for Operator Workstation shall be supplied from Compaq, IBM or HP. The personal computers shall be configure as follows:

a Memory – 4 GB (Minimum)

b CPU– Intel i5 or greater.

c Hard Drive – 500 GB or greater hard drive

d Hard drive backup system – OMEGA JAZ 1.3 Optical Drive;

e DVD ROM Drive – 52X performance

f Ports – (2) Serial and (1) parallel Ports, ESP/

g Keyboard – 101 Keyboard and 2 Button Mouse

h LCD configuration as follows:

- Each LCD – 19” SVGA Monitor 1280 x 1024 NI resolution minimum. 26 or better dot pitch and 72 Hz. minimum vertical refresh rate or max resolution; 65k colors.
- LCDs can be configured and operated as either individual monitors or as a single console system, with a resolution of 3840 x 1024.
- LAN communications – Ethernet communications board; 3Comm or equal.
- Operating System Software
  - Windows XP, or Windows 7.
  - Complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all

included software, device drivers, and Peripherals.
- Provide software registration cards to the Owner for all included software.

♦ Peripheral Hardware
- Alarm printers:
  - Printer Make – Epson or equal
  - Printing Method – 24-Pin Impact Dot Matrix, 132 column
  - Print Speed – 270 Characters Per Second, Per Line
  - Buffer – 64 K Input Print Buffer
- Reports printer:
  - Printer Make – Hewlett Packard Desk Jet
  - Print Speed – 600 DPI Black, 300 DPI Color
  - Buffer – 64 K Input Print Buffer
  - Color Printing – Include Color Kit

3.2 Workstation Application Components

A Operator Interface

1 An integrated software package shall be used as the operator interface program.

2 All Inputs, Outputs, setpoints and all other parameters as defined within part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.

3 The operator workstation software shall provide context-sensitive help menus and instructions for each operation and/or application currently being performed.

4 All controller software operating parameters shall be displayed for the operator to view/modify from the operator workstation. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.

5 The operation of the control system shall be independent of the operator workstation, which shall be used for operator communications only. Systems that rely on the operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

B Alarms

1 Each workstation shall receive and process alarms sent to it by the control system. The alarm management portion of the operator workstation software shall, at the minimum, provide the following functions:

a Log date and time of alarm occurrence.

b Generate a “Pop-Up” window informing an operator that an alarm has been received.

c Allow an operator, with the appropriate security level, to acknowledge, delete, or disable an alarm.

d Provide an audit trail for alarms by recording operator acknowledgement, deletion, or disabling of an alarm. The audit trail shall include the name of the operator, the alarm, the action taken on the alarm, and a time/date stamp.

e Record all alarms received at an operator’s workstation to that workstation’s hard drive.

f Allow the operators to view/manage the alarm data archived to hard disk. Selection of a single menu item or tool bar button shall allow the user to acknowledge, disable, delete, or print the selected alarm.

g Alarms shall be generated by the operator workstation for any controller that is “off-line” and is not communicating, or that does not have an active control program loaded.

h Changes made to alarm setpoints from the Operator Workstation shall directly modify the controller alarm management database.

i Selection of a single menu item or tool bar button shall print any displayed alarm report on the system printer for use as a building management and diagnostics tool.

C Reports

1 Reports shall be generated and directed to one of the following: workstation displays, printers, or disk. As a minimum , the system shall provide the following reports:

2 All points in the network.

a All points in a specific controller.

b A listing of a user-defined group of points in the network. There shall be no limit to the number of user-defined groups

- ♦ All points currently in alarm.
- ♦ All points in hardware override.
- ♦ All disabled points.
- ♦ All weekly schedules.
- ♦ All or selected point attributes, including, but not limited to:
  - Values
  - Setpoints
  - Alarm Limits
  - Statistics
  - Run Times
- ♦ All programmed holidays and associated schedules.
  - All disabled alarms.
  - All active, unacknowledged alarms.
  - All active, acknowledged alarms.
  - Any and all other controller operating parameters.

3 Reports shall be provided for specific point types, for each logical point group, for user-defined groups, or for the entire facility without restriction due to the hardware configuration of the control system or communications network.

a The system shall allow for the creation of custom report point groups that shall be capable of including points from multiple controllers. Systems limiting point report displays to only a single controller's point database shall not be accepted.

b The number of custom reports or display groups shall be limited by the amount of available system memory.

c Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report on the system printer for use as a building management and diagnostics tool.

D Schedules

1 A spreadsheet-type schedule input form for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following spreadsheet types shall be provided:

a Weekly schedules, by system.

b Temporary override schedules, by system.

c Special "Only Active If Today Is A Holiday" schedules, by system.

d Monthly calendars.

e Holiday scheduling system, including the ability to define floating holidays.

2 Weekly schedules shall be provided for each piece of equipment with a specific time use

schedule. Each schedule shall include columns for each day of the week, as well as holiday and special day columns for alternate scheduling on user-defined days. Equipment scheduling shall be accomplished by simply inserting use and non-use times into appropriate information blocks on the spreadsheet.

3 It shall be possible to define one or more master holiday schedules to allow the operator to define in one location the holidays for all associated schedules. Systems requiring the operator to change holiday definitions on a schedule by schedule basis shall not be accepted.

4 Standard weekly schedules shall be inactive on a holiday. The system shall allow the user to include in a schedule group a schedule that will only be active if today is a holiday.

5 In addition, temporary override schedules may be inserted into schedule groups for modifying operating schedules. After overrides have been executed, the original schedule will automatically be restored.

6 Schedules shall be provided for each system or sub-system in the facility. Each schedule shall include all commendable points residing within the system. Each point may have a unique schedule of operation relative to the system use schedule, allowing for sequential starting and control of equipment within the system. Scheduling and rescheduling of points shall be accomplished easily via the system schedule spreadsheets.

7 Monthly calendars for a 12-month period shall be provided that allows for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

8 Changes to schedules made from the Operator Workstation shall directly modify the controller schedule database. Systems that require permanent schedule changes to be made with a program editor shall not be acceptable.

9 Formatted schedule displays shall be provided for each system. These shall include all schedule data and associated parameters.

10 Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.

E Password

1 Multiple-level password access protection shall be provided to allow the user/manager to limit workstation control, display, and database manipulation capabilities as he or she deems appropriate for each user, based on an assigned password.

2 Each user shall have the following: a user name (12 characters minimum); a password (12 characters minimum), and an access level (from 1 - 5).

3 The system shall allow each user to change his or her password at will.

4 When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.

5 A minimum of five levels of access shall be supported as follows:

a Level 1 = Data Access and Display

b Level 2 = Level 1 and Operator Overrides

c Level 3 = Level 2 and Database Modification

d Level 4 = Level 3 and Database Generation

e Level 5 = All privileges, including Password Add/Modify

6 A minimum of 100 unique passwords, including user initials, shall be supported.

7 Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.

8 The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgement and deletion of alarms.

9 User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving the operator workstation logged on.

F Graphics

1 The graphics application program shall be supplied as an Active-X control and as an Active-X document server. The document server shall be able to contain other Active-X controls.

2 The graphics applications shall include a create/edit function and a runtime function. An unlimited number of graphics documents (graphic definition files) shall be able to be generated and executed.

3 The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered. The data values shall be provided by support of the following variable types:

a OPC item – A real-time value acquired from any field controller or device as supported by the installed OPC-compliant communication servers.

b Local variable – A variable defined as part of the graphic object, and either calculated during graphic runtime execution or entered by the operator.

c A real-time calculation – A calculation whose expression is defined as part of the graphic object. Each expression shall be able to contain constants, local variables, OPC items, or simulation variables.

d Graphics runtime functions – Up to a maximum of 16 graphic applications shall be able to execute at any one time on a single workstation. Each graphic application shall be capable of the following functions:

4 All graphics shall be fully scalable to any display geometry.

5 On a per graphic basis, the user shall be able to configure the graphic to force a maintained aspect ratio, or float the aspect ratio.

6 All Microsoft TrueType fonts shall be supported.

7 On a per graphic basis, the user shall be able to enable or disable font scaling.

8 Background color shall be on a per graphic basis, selectable to any available color (64,000 minimum color capability).

9 Enabling/disabling the shadow color of all objects on the graphic shall be available.

10 The ability to highlight valid entry object on a graphic shall be available.

11 The ability to configure the color of all animations and values displays to indicate if the data is no longer valid because of system failure shall be available.

12 The user shall be able to configure the fastest speed at which data will be updated on the specific graphic.

13 Window setting – The user shall have the ability to determine how the window containing the specific individual graphic application will appear and operate when the graphic is displayed in the runtime mode (for example, scrollbars, buttons, menus).

14 Animation – Any Basic object, any group of basic objects, or any symbol or group of symbols, shall be capable of being animated.

15 Historical trending and data collection

16 Each Network Controller shall store trend and point history data for all analog and digital inputs and outputs, as follows:

17 Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed:
   a Defined time interval.
   b Upon a change of value.
   c Whenever a value is out of range.
18 Each network controller shall have a dedicated RAM-based buffer for trend data, and shall store 96 samples for each physical point and software variable, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
19 Trend and change of value data shall be stored within the controller and then uploaded to the trend database(s). Uploads shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full.
20 The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in either Microsoft Access or SQL database format.
21 To enable users to easily access stored data, the system shall provide the capability to store historical data in more than one file system (i.e., removable media, separate hard drives, or a remote network file system). Provide the capability to perform statistical functions on the historical database without having to design special queries. On a specified data interval, provide functions for calculating:
   a Average.
   b Arithmetic mean.
   c Maximum/minimum values.
   d Range – difference between minimum and maximum values.
   e Standard deviation.
   f Sum of all values.
   g Variance.

G Trend data viewing and analysis
1 Provide a trend viewing utility that shall have access to all database points.
2 Provide database access through an Open Database Connectivity (ODBC) interface – a standard Application Programming Interface (API) for accessing data from relational databases. Client applications can reside within a, Windows 7, Windows XP or Windows NT environment.
3 It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name.
4 The trend viewing utility shall have the capability to view up to 32 data sources at one time in a tabular or graphical format.
5 Graphic displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
6 It shall be possible to display trend data in histogram (X-Y plots) format as well as area and bar graphs.
7 Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
8 Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed. This function shall also be operator selectable.
9 The display range shall consist of magnitude and units fields. The units are seconds, minutes, hours, days, and months.
10 Provide a wild card capability when specifying a display range for data retrieval within the historical database. Wild carding will allow the user to easily specify relative time

based date ranges for the retrieval of data. The following wild cards will be used:

a NOW - This keyword specifies the current date/time. The value is set at the exact time the database request is made.
b TODAY - This keyword specifies the current date.
c D - This keyword indicates a specific number of days. Example: TODAY-8D
d H - This keyword indicates a specific number of hours. Example: NOW-3H
e M - This keyword indicates a specific number of minutes. Example: NOW-5H30M
f 12/12/97 12:00:00 PM - This keyword indicates a specific date/time.
g 12/12/97 23:00:00 - This keyword indicates a specific date/time.
h A time offset capability shall be available to assist in a user's analysis. The offset visually shifts the data being displayed to allow a user to concurrently view information without having to scroll the display.
i The system shall be capable of printing a hard copy record of the trends as they are displayed on the workstation.

H Web Based Operator Interface

1 A graphical interface shall be provided that allows customers to access their BMS data via the Internet or Intranet. This interface shall use HTML-based pages to send and receive data from a BMS system to a web browser. All the data shall be available in the graphics format; same as of the operator workstation.
2 The software shall run on the Microsoft Internet Explorer (8.0 or higher) and the Google chrome browsers.
3 The interface shall provide four levels of user access. Users will range from read-only access to BMS data (level 1) to having complete access to view and modify BMS data and user accounts (level 1).
4 The interface shall provide a user account utility, complete with a user profile database that includes user ID, encrypted password, access level, and language preference. Operators with the appropriate access level shall be able to add, modify, and delete users within the user profile database, as well as change users' access levels.
5 The interface shall provide a means by which the user can collect items (BMS data points) into "summary" groups. This functionality shall allow authorized users to perform actions ranging from viewing summary groups, to adding items to or deleting items from groups, to creating new summary groups.
6 The web-based interface shall provide the following four screens (or views) and the indicated functionality for each:
a Logon screen – allows the user to enter his or her user name and password for logging into the system.
b System view – provides the following three panels:
c Browser – the user can browse the available OPC servers and view the branches of information (BMS data points) registered within each.
d Items – the panel displays the items (BMS data points) associated with the server selected in the Browser panel.
e Operation – displays the operation and its value associated with the item selected in the Items panel, and allows authorized users to modify the item or to add the item to a summary.
f Summary view – allows the user to view items that have been grouped together into summaries, and allows authorized users to modify or delete groups or items within a group.
g User Account view – displays a list of the currently defined users and the

corresponding user information. Users with level 2 access can change their passwords. Users with level 1 access can also modify and delete other users' information.

h The interface shall provide navigation tools for moving between the System, Summary, and User Account views. In addition, it shall provide tools for gaining access to help and for logging out of the system.

3.3 Special Reporting and Displays:

A All data will be manipulated within the Windows environment and translated / transferred to reports / documents through the use of Microsoft DDE / Active X applications.

B The Building Management System software and Windows™ environment will work in conjunction to provide the owner one interface to all information supplied by field devices and all calculations required to facilitate monitoring and control of the HVAC system and tenant energy consumption, and subsequent billing.

C The following Windows™ applications shall be able to run concurrently with the Building Management System software, utilizing the same data, transferred seamlessly through DDE / Active X applications.

D Microsoft Excel™ and / or Microsoft Word™ worksheet / document application that gathers data and creates a monthly energy usage report and line graph.

E Visual Basic, or equivalent, custom user interface applications.

F Telephone interface software for touchtone control of specific HVAC, lighting, and security features (optional).

G Pager interface (optional) software utilized to page building operators and maintenance personnel when user specified alarms occur.

H Alarm Management

1 Point Change Report Description

a All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.

b Prioritization

- The installer shall set up all system analog points with high and low alarm limits. All digital system points shall be associated with a status feedback point and all exceptions shall be reported as alarms. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized and filtered to minimize nuisance reporting and to speed operator response to critical alarms.
- The user shall also be able to define under which conditions point changes need to be acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.

c Critical and Non-Critical Alarm Routing

- Critical alarms shall be defined as chiller, boiler, generator, critical space temperature or humidity, and kilowatt demand approaching threshold. Critical alarms shall be displayed at the workstation, printed at the alarm printer, and alpha paged to the on-duty maintenance person over the owners alphanumeric paging system. Alpha pages shall provide sufficient information to identify the equipment and the point in alarm and the time and date of occurrence.
- All other alarms shall be considered non-critical and shall be displayed and acknowledged before being sent to the alarm log.

d Report Routing

- ♦ Alarm reports, messages, and files will be directed to a user-defined list of operator devices, or PCs used for archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.

e Alarm Messages

- ♦ In addition to the point's descriptor and the time and date, the user shall be able to print, display, or store a 65-character alarm message to more fully describe the alarm condition or direct operator response.
- ♦ Each standalone DDC panel shall be capable of storing a library of at least 250 Alarm Messages. Each message may be assignable to any number of points in the panel.

f Auto-Dial Alarm Management

- ♦ In Dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request is made, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.

PART 4: DIRECT DIGITAL & APPLICATION SPECIFIC CONTROLLERS

4.1 Standalone DDC Panels (General)

A Standalone DDC panels shall be microprocessor-based, multi-tasking, multi-user, real-time digital control processors. Each standalone DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules. A sufficient number of controllers shall be supplied to fully meet the requirements of this Specification and the attached point list.

B Point types – Each DDC panel shall support the following types of point inputs and outputs:

1 Analog inputs shall monitor the following analog signals:
   a 4-20 mA Sensors
   b 0-10 VDC Sensors
   c 100 ohm 3 wire RTDs

2 Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."

3 Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.

4 Analog outputs shall provide the following control outputs:
   a 4.20 mA – Sink or Source
   b 0-10 VDC

5 Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays. Inductive loads (i.e. solenoids) shall be controlled by pilot relays.

6 TriState outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays.

C Local Status Indicator Lamps – The DDC panel shall provide local status indication for each binary input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. This feature shall be applicable to the controllers provided for the control of AHU or Central Plant.

D Surge and Transient Protection – Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard 587-1980.

4.2 Air Handling Unit (AHU) Controllers

A Each Air Handling Unit (AHU) controller shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each AHU controller shall be a microprocessor-based, multi-tasking, real-time digital control processor and Real Time Clock.

B AHU controller must follow the specifications mentioned in the section 5.1 Paragraph D & E for the local display and keypad.

C AHU controllers shall support, but not be limited to, the following configurations of systems to address current requirements as described in the "Execution" portion of this Specification, and to address future expansion.

D Air Handling Units:
1 Mixed Air-Single Path
2 Mixed Air-Dual Path
3 100% Single Path
4 100% Dual Path

E Each AHU controller shall have sufficient memory to support its own operating system and databases, including:
1 Control Processes
2 Energy Management Applications
3 Operator I/O (Portable Service Terminal)

F Point types – Each AHU controller shall support the following types of point inputs and outputs:
1 Analog inputs shall monitor the following analog signals:
a 4-20 mA Sensors
b 0-10 VDC Sensors
c 1000ohm RTDs
2 Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
3 Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.
4 Analog outputs shall provide the following control outputs:
a 4.20 mA – Sink or Source
b 0-10 VDC
5 Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays. Inductive loads (i.e. solenoids) shall be controlled by pilot relays.
6 Tristate outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays.
a AHU controllers shall have a library of control routines and program logic to perform the sequence of operations specified in the "Execution" portion of this Specification.
b AHU controller shall have a in-built (non-detachable) program & data memory chip. Every controller shall be able to take program upload/download from central workstation or from the laptop computer locally.

c AHU controllers shall directly support the “temporary” use of a portable service terminal. that can be connected to the AHU via zone temperature or directly at the controller.
d The capability to extend the input and output capacity of the controller via Point Expansion Modules shall be provided.

7 The Point Expansion Modules shall communicate to the main controller over a local RS-485 expansion bus.
8 The Point Expansion Modules shall have available a range of configurations of 4, 8, 12, or 16 data points:
a Analog Inputs – 0-10V, 4-20mA, 1000 ohm RTD
b Analog Outputs – 0-10V, 4-20Ma
c Digital Inputs w/ digital counter
d Digital Outputs – triacs or relay contacts

G Expansion module data points shall be available for inclusion in all control strategies. Maximum of 94 points shall allowed per DDC controller all-inclusive of expansion points.
H Power fail Protection – All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the AHU.

4.3 Central Plant (HEAT EXCHANGER) Controller

A Each Central plant controller shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each controller shall be a microprocessor-based, multi-tasking, real-time digital control processor.
B Central plant controller must follow the specifications mentioned in the section 5.1 paragraph D & E for the local display and keypad.
C Central plant controllers shall support, but not be limited to, the following configurations of systems to address current requirements described in the “Execution” portion of this Specification, and to address future expansion.
1 Pump logic.
2 Heat exchanger.
3 Pressurization unit
4 Chemical posing pot
5 Generic system interlocking through hardware.
D Point types – Each controller shall support the following types of point inputs and outputs:
1 Analog inputs shall monitor the following analog signals:
a 4-20 mA Sensors
b 0-10 VDC Sensors
c 100 ohm 3 wire RTDs
2 Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”
3 Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.
4 Analog outputs shall provide the following control outputs:
a 4.20 mA – Sink or Source
b 0-10 VDC
5 Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays. Inductive loads (i.e. solenoids) shall be controlled by pilot relays.

6 TriState outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays.

E Central plant controllers shall have a built-in status, and adjust panel interface to allow for the local adjustment of all setpoints, temporary override of any input or output points, and status of any points in alarm.

F Power fail Protection – All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the CONTROLLER.

G Central plant controller shall have a in-built (non-detachable) program & data memory chip. Every controller shall be able to take program upload/download from central workstation or from the laptop computer locally.

H The capability to extend the input and output capacity of the Central plant controller via Point Expansion Modules shall be provided. Maximum of 94 points shall allowed per DDC controller all-inclusive of expansion points.

I The Point Expansion Modules shall communicate to the main controller over a local RS-485 expansion bus.

J The Point Expansion Modules shall have available a range of configurations of 4, 8, 12, or 16 data points:

1 Analog Inputs – 0-10V, 4-20mA, 1000 ohm RTD
2 Analog Outputs – 0-10V, 4-20mA
3 Digital Inputs w/ digital counter
4 Digital Outputs – triacs or relay contacts
5 Expansion module data points shall be available for inclusion in all control strategies.

4.4 VAV Terminal Unit Controller (For VAV/CAV Applications)

A The VAV shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. VAV controllers shall be compact units with integrated actuator built in flow pickup type

B All VAV controllers shall work with associated Variable speed AHU controller as one system

C Total air volume required from variable speed AHU hence the speed of AHU supply fan shall be determined by the total required air volume calculated from individual VAV units and not by the duct static pressure.

D The VAV shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.

E The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.

F The VAV shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.

G Each VAV shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.

H The VAV shall utilize a Pattern Recognition Adaptive Control (PRAC) algorithm for the space temperature control loops.

I Each VAV shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces

commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

J The VAV shall provide the ability to download and upload VAV configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.

K VAV control setpoint changes initiated over the network shall be written to VAV non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.

L The VAV firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.

M The VAV shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.

N reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.

O The VAV shall be compatible with the U.S. EPA Energy Star Buildings recommendations for fan energy reduction via demand-based static pressure reset down to 2/3 of duct static pressure set point, "VSD 2/3 Reset.

P Inputs:

1 Analog inputs shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:

a 0-10 VDC Sensors

b 100 ohm 3 wire RTDs

2 Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."

3 For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.

Q Outputs

1 Analog outputs shall provide the following control outputs:

a 0-10 VDC

2 Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.

3 For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

4.5 Terminal Unit Controller (For Fan Coil Unit and Zone Control Applications

A Each Terminal Controller shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each Controller shall be a microprocessor-based, multi-tasking, digital control processor.

B Terminal Unit Controllers shall support, but not be limited to, the control of the following configurations of applications to address current requirements described in the "Execution" portion of this Specification, and to address future expansion:

1 Single Duct Only (Cooling Only, or Cooling with Reheat)

2 Fan Powered (Parallel/Side Pocket, Series/On-Off Logic, Series/Proportional Fan)

3 Dual Duct (Constant Volume, Variable Volume)

4 Lighting Controls

5 General Configurations for I/O monitoring and control

6 Point types – Each Terminal controller shall support the following types of point inputs and outputs:

a Analog inputs shall monitor the following analog signals:
b 0-10 VDC Sensor's
c 1000ohm RTDs

7 Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
8 Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.
9 Analog outputs shall provide the following control outputs:
10 0-10 VDC
11 Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays. Inductive loads (i.e. solenoids) shall be controlled by pilot relays.
12 TriState outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays.
13 Terminal Controllers shall have a library of control routines and program logic to perform the sequence of operations specified in the "Execution" portion of this Specification.
14 Power fail Protection – All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the application.

4.6 Local Control Panels (DDC Panels)

A All control panels shall be constructed, incorporating the BMS manufacturers standard designs and layouts. Control panels shall be fully enclosed, with sub-panel, hinged door and key-locking latch.
B In general, the control panels shall consist of the DDC controller(s), display module, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. The display module shall be flush mounted in the panel face unless otherwise noted.
C All I/O connections on the DDC controller shall be extended to a numbered, color-coded, and labelled terminal strip for ease of maintenance and expansion. Wiring to I/O devices shall be made from this terminal strip.

D All other wiring in the panel, internal and external, shall be made to additional line or low voltage color-coded and labelled terminal strips. Low and line voltage wiring shall be segregated. All terminal strips and wiring shall be UL listed 300-volt service and provide adequate clearance for field wiring.
E All wiring for every control panel shall follow a common color-coded format. All terminal strip color coding and numbering shall follow a common format. All wiring shall be neatly installed in plastic trays or tie-wrapped.
F The DDC controllers with digital display shall have a facility of panel facia mounting so that the data can be viewed without opening the panels.
G A convenience 240 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

PART 5 - FIELD LEVEL DEVICES

5.1 Input Devices

A General Requirements

1 Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B Temperature Sensors

1 General Requirements:

a Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.

2 The temperature sensor shall be of the resistance type, and shall be 100 ohm platinum RTD 3 wire type with cable loss compensation for better accuracy

3 Room Temperature Module (Applicable to VAV/CAV)

a Room sensors shall be constructed for either surface or wall box mounting.

b Room sensors shall have the following options when specified:

c Setpoint reset slide switch providing a ±3 K (adjustable) range.

d Individual heating/cooling setpoint slide switches(as applicable)

e A momentary override request pushbutton for activation of after-hours operation.

f Analogue thermometer.

4 Room Command Modules (Applicable to Fan Coil Units)

a Room Command Modules shall be constructed for either surface or wall box mounting.

b Room Command Module shall have the following as specified:

c Space Temperature Sensor

- Setpoint dial switch providing a 12-28 degree C (adjustable) range.
- Auto – Low – Medium – High and OFF switch
- A momentary override request push button for activation of after-hours operation.

5 Room Temperature Sensors with (wherever applicable)

a Room sensors shall be constructed for either surface or wall box mounting.

b Room sensors shall have an integral LCD display and four button keypad with the following capabilities:

- Display room and outside air temperatures.
- Display and adjust room comfort setpoint.
- Display and adjust fan operation status.
- Timed override request push button with LED status for activation of after-hours operation.
- Display controller mode.
- Password selectable adjustment of setpoint and override modes.

6 Outside Air Sensors

a Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.

b A perforated plate that surrounds the sensor element shall shield sensors exposed to wind velocity pressures.

c Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

7 Duct Mount Sensors

a Duct mount sensors shall mount on a bracket from which sensor can be easily

attached or detached for easy installation and maintenance. The sensor shall be mounted on the bracket at the time of commissioning to avoid construction damages. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.

b For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

8 Thermowells

a All Immersion temperature sensors shall be complete with thermo well from factory, no locally made thermo well should be required to be attached with the sensor.

b Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.

c Thermowells and sensors shall be mounted in a thread outlet or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.

d Thermowells shall be constructed of brass or 316 stainless steel.

C Humidity Sensors

1 The sensor shall be a solid state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.

2 The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20mA, 0-100% linear proportional output.

3 The humidity transmitter shall meet the following overall accuracy of $\pm$4%RH for the range of 10% to 90% RH & $\pm$6%RH from 0 to 10 %R.H. and 90 to 100%R.H., including lead loss and Analogue to Digital conversion.

4 Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.

5 A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.

6 Duct type sensing probes shall be constructed of polycarbonate lexan 950 and anodized aluminum 6061-F.

D Differential Pressure Transmitters for General Air and Water Pressure Transmitter:

1 Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.

2 Pressure transmitters shall transmit a 0-5VDC, 0-10 VDC, or 4-20mA output signal.

3 Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.

4 The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover

E Differential Pressure Switches for Air

1 Pressure switches shall be diaphragms operated. It shall be supplied with air connections permitting their use as static or differential pressure switches.

2 The switch shall be of differential pressure type complete with connecting tube and metal bends for connections to the duct. The housing shall be IP54 rated.

3 The pressure switches shall be available in minimum of 3 ranges suitable for applications like Airflow proving, dirty filter, etc. The setpoint shall be concealed type. The contact

shall be of the automatic reset type with SPDT contacts rated for 2 amps at 250VAC.

4 A complete installation kit shall be provided, including static pressure tops, tubing, fittings, and air filters.

F Differential Pressure Switches for Water:

1 Pressure switches shall be selected for the correct velocity and pipe size and mounting conditions.

G Flow Switches for Water:

1 Flow switches shall be selected for the correct velocity and pipe size and mounting conditions.

H Water Line Pressure Sensor

1 Water line pressure sensor shall be available in following ranges:

a Low Pressure range - (-1) to 8 bar

b High pressure range – 0 to 30 bar

2 Material – Stainless steel 1.4435, IP Class 65. It shall comply with IEC 68 standard for vibration/shock resistance.

3 It should use the principle of Piezo-resistive principle pressure sensitive chip for great longtime stability and highly reliable.

4 The detector shall have sensitivity such that a change of 0.2% from the stabilized condition shall cause modulation of the corrective element.

I Smoke Detectors

Ionization type air duct detectors shall be furnished as specified elsewhere in Division 16 for installation under Division 15. All wiring for air duct detectors shall be provided under Division 16, Fire Alarm System.

J kWh Meter

It shall be either pulse type or communicable type for interfacing with BMS.

K BTU Meter

- A self-contained BTU meter shall be used with a flow meter and the matched pair of temperature sensors. The BTU meter shall be a standalone unit manufactured by reputed company. Use of DDC controllers to calculate the BTU's will not be acceptable. The BTU meter shall be communicating type and shall get connected to second tier network either directly or via M-bus interface.
- Empower BTU meter to be as per EMPOWER requirements

L Refrigerant Leak Detectors

1 The refrigerant leak detector shall be a standalone device and shall provide a SPDT output to directly energize the refrigeration room exhaust ventilation fans. The detector shall include a sensor or sensors connected to a control panel. Two relay contacts at the control panel shall provide trouble and alarm indication to the Facility Management System. The alarm relay contact shall also directly energize the exhaust fans.

2 The refrigerant leak detector shall sense the type of refrigerant used in the specified chillers. Multiple sensors shall be required to detect different refrigerants and/or provide proper sensing coverage for the area of the refrigeration room.

5.2 Output Devices

A Actuators

1 General Requirements

a Damper and valve actuators shall be electronic as specified in the System Description part.

b Thermal Valve/Damper Actuators are not acceptable.

c In case of modulating Actuators, floating Valve/Damper Actuators are not acceptable.

B Electronic Damper Actuators

1 Electronic damper actuators shall be direct shaft mount.

2 Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators shall have external adjustable stops to limit the travel in either direction, a gear release to allow manual positioning and should have mechanical spring return facility.

3 Modulating actuators shall accept 24 VAC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

4 Two-position or open/closed actuators shall accept 24 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.

C Electronic Valve Actuators

1 Electronic valve actuators shall be manufactured by the valve manufacturer.

2 Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

3 Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

4 Modulating Actuators shall accept 24 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

5 Two-position or open/closed actuators shall accept 24 or 240 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

D Control Valves

1 All automatic control valves shall be fully proportioning and provide near linear heat

transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer (within the authority of 0.4 to 0.65), and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.

2 Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving variable flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving constant flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.

3 Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all hot and chilled water applications, except those described hereinafter. The valve discs shall be composition type. Valve stems shall be stainless steel.

4 All AHU and FAHU valves shall be energy saving electronic flow control valves with built in flow meter and flow controller to avoid disturbances due to pressure fluctuation over a wide range.

5 Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.

6 Butterfly Valve and Electrical Actuator shall be supplied by BMS supplier.

PART 6: TRAINING

6.1 The controls contractor shall provide the following training services:

A One day of on-site orientation by a field engineer who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the control system software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

B Training for two owner representatives in a factory-training lab. This training shall be performed by a factory-certified professional trainer and, at a minimum, shall consist of:

1 Two days training covering basic system operation.

2 One day training covering system reporting and alarm management.

3 One day training of scheduling and point trending.

6.2 General

A Provide training course schedule, syllabus, and training materials 45 days prior to the start of training. Furnish a qualified instructor to conduct training courses for designated personnel in the maintenance and operation of the HVAC and DDC system. Orient training to the specific system being installed under this contract. Use operation and maintenance manual as the primary instructional aid. Operational and maintenance manuals shall be provided for each trainee with four additional sets, two sets delivered for archiving at the project site, one set for the mechanical contractor, and one set for the design engineer. Training manuals shall include an agenda, defined objectives and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, assume the attendees will have a high school education and are familiar with HVAC systems. The minimum amount of training for this project shall be 24 hours.

1 Operator Training: Operator training shall include the detailed review of the control installation drawings, points list, and equipment list. The instructor shall then walk through the building identifying the location of the control devices installed. For each type of systems, the instructor shall demonstrate how the system accomplishes the sequence of operation.

2 From the workstation, the operator shall demonstrate the software features of the system. As a minimum, the operator demonstrate and explain logging on, setting passwords, setting up a schedule, trend, point history, alarm, and archiving the database.

3 Maintenance Training: The system maintenance course shall be taught at the project site within one month after the completion of the operators training. The course shall last for one 8 hour training day. The course shall include answering questions from the last training session, trouble shooting and diagnostics, repair instructions, preventive maintenance procedures and schedules, and calibration procedures.

a VAV/CAV box performance verification and documentation:

4 As part of the commissioning of the terminal unit control and air distribution system, the Contractor shall initiate an automated test where the dampers in one half of a group of boxes are stepped towards full open while the other half are stepped towards full closed. At each step, after a settling time, box airflows and damper positions will be sampled. Following the cycle, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation, or Maximum flow not achieved. The report shall be submitted as documentation of the installation.

5 The controls contractor shall issue a report based on a sampling of the VAV calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance. The sampling shall take place after completion of Test and Balance, when design cooling and heating media have been available and occupied conditions approximated for five consecutive days.

PART 7: INTEGRATION REQUIREMENTS SPECIFIC TO PROJECT

7.1 Systems Integration/BMS Specific Requirements

The purpose of integration is to ensure that all the low voltage systems work in co-ordination with each other as single system. The integration is not limited only to monitor/control of the 3rd party systems from BMS. The whole low voltage package shall work as a one complete system under the umbrella of BMS.

A Open Systems Integration

1 Chiller or central plant system(heat exchanger) Integrator Interface

a The BAS system shall include appropriate hardware equipment and software to allow two way data communications between the BAS system and the chiller manufacturer's chiller control panel via LON or Modbus communication protocol

b It shall be the joint responsibility of the BAS Contractor and chiller supplier to co-ordinate with each other to provide a functional data communications connection.

c All data supported by the chiller communication protocol shall be mapped into the supervisory DDC controller's database and shall be displayed on a chiller data screen at the Operator Workstation and shall be transparent to the operator.

d The BAS Contractor shall furnish either the Modbus or BacNet communications interface as required by the chiller manufacturer.

e The chiller manufacturer shall provide all hardware for connection of the manufacturer's processor to BMS.

2 VFD Integrator Interface

a The BAS system shall include appropriate hardware equipment and software to allow two way data communications between the BAS system and the VFD manufacturers control panel via LON or Modbus communication protocol

b It shall be the responsibility of the BAS Contractor and VFD supplier coordinate with each other to provide a functional data communications connection.

c All data supported by the VFD communication protocol shall be mapped into the supervisory DDC controller's database and shall be displayed on data screens at the Operator Workstation and shall be transparent to the operator.

d The BAS Contractor shall furnish Bacnet communications interface as required by the VFD manufacturer.

e The VFD manufacturer shall provide all hardware for connection of the manufacturer's processor to BMS.

3 Fire Alarm Integration

a The BAS system shall include appropriate hardware equipment and software to collect and display zone alarms into the BMS system.

b The BAS system shall be capable of actuating fire control equipment such as fire and smoke dampers

c It shall be the responsibility of the BAS Contractor to co-ordinate with the Fire Alarm vendor to provide a functional data communications connection.

d The BAS Contractor shall furnish the Bacnet communications interface as required by the Fire Alarm panel.

4 Car Parking Management System Integration

a The BMS shall be integrated with car park management system using the standard protocols referred in Section 2.2. The car park management vendor shall provide necessary hardware and software as required for integration to BMS.

5 Intelligent Lighting Control System Integration

a The BAS system shall include the supply, testing, commissioning and integration of Lighting system in his scope as per the specifications of Lighting system given in the tender document. It shall be a responsibility of the BMS supplier to provide appropriate hardware equipment and software to the communications between the BAS system and the Lighting system

b All data supported by the Lighting Control System shall be mapped into the Network Controller Database and shall be displayed on floor-wise at the BMS Operator Workstation and shall be transparent to the operator.

c The BAS Contractor shall furnish either the BACnet or LonMark communications interface as required by the Lighting Control System.

END OF SECTION

28.0 FIRE RESISTANCE CABLE

Cables to provide energy, data, communications and control are distributed throughout buildings in ducts, tunnels, on trays and in building cavities. These cables are able to propagate fires along their length, and can allow rapid spreading of fire throughout a building. The fire results in the generation of smoke, which may prevent escape of people from the building.

Gases are also liberated by the fire. These gases contain toxic and corrosive elements, causing possible harm to people and damage to equipment.

In fire situations the main priorities are: -

i. Safe evacuation of the building or area concerned (Life preservation).
ii. Minimizing the extent of damage to buildings and equipment (Property protection and business continuity).
iii. To achieve this, cables are required to have the following properties: -
iv. Prolonged circuit integrity for a defined period of time.
v. Low smoke and toxic gas emissions.
vi. Reduced flame propagation.
vii. Zero corrosive halogen gas emission.
viii. Fire resistant.
ix. Easy to install.
x. Cost effective.

Materials offering these properties are usually more expensive than conventional materials, and in some cases may not offer the same mechanical or electrical attributes. Therefore, a balance needs to be maintained between needed fire attributes and the required cables mechanical and electrical attributes.

28.1 CABLE DESIGN PARAMETER

Cables should design, manufactured and tested in accordance with BS 7846. They also comply with the test requirements specified in BS 6387. Fire Resistant cables are categorized by a letter symbol, or series of symbols, according to the fire-resistant characteristics they are required to meet, the test temperature selected and the duration of the test.

19.1.1 Requirement Symbol
Resistance to fire alone
6500C for 3 hours A
7500C for 3 hours B
9500C for 3 hours C
9500C for 20 minutes (short duration) S
Resistance to fire with water W
Resistance to fire with mechanical shock
6500C X
7500C Y
9500C Z

28.2 KEY PERFORMANCE UNDER FIRE CONDITIONS

i. Flame Retardant Test: Meets the requirement of Flame-retardant test as per BS EN 50266-2-4 and BS EN 60332-1-2 as well as IEC 60332-1-2, IEC 60332-3-22 (Category A) IEC 60332-3-23 (Category B), & IEC 60332-3-24 (Category C)
ii. Fire Resistance test: Meets the requirement of Fire resistance test as per BS 6387 (Category C, W, & Z), BS 7846 (Category F2), IEC 60331.
iii. Smoke emission test: Meets the requirement of smoke emission test as per BS EN 61034/ IEC 61034(min. light transmission shall be 70%, as per BS 7846)
iv. Acid gas emission test: Meets the requirement of acid gas emission test as per IEC 60754-1/ BS EN 50267-2-1(max. acid gas emission shall be 0.5% by weight)

28.3 CABLES QUALITY ASSURANCE

In order to ensure the best quality assurance system, it is extremely desirable to test and inspect the product at each stage of manufacturing including raw materials and finished product.

Cables should have the following Quality Assurance System: -

a. Raw Materials Inspection
b. In-process inspection
c. Finished product inspection

28.4 ELECTRICAL PARAMETERS

Conductor

i. DC resistance of conductor at 20 °C (Maximum) Ohm/Km 12.10 7.41 4.61 3.08 1.83 1.15 0.727 0.524 0.387 0.268
ii. AC resistance of conductor at 90 °C (Approximate) Ohm/Km 15.43 9.45 5.88 3.93 2.33 1.47 0.928 0.669 0.495 0.343
iii. Reactance at 50 Hz (Approximate) Ohm/Km 0.119 0.111 0.104 0.098 0.092 0.088 0.088 0.085 0.084 0.079
iv. Impedance at 50 Hz (Approximate) Ohm/Km 15.43 9.45 5.88 3.93 2.33 1.47 0.932 0.674 0.502 0.352
v. Voltage drop (Approximate for 3 phase system) V/A/Km 26.73 16.37 10.18 6.81 4.04 2.55 1.61 1.17 0.869 0.61
vi. Current rating on perforated cable trays / free air (Conductor operating temperature 90 °C & ambient air temperature 30 °C) A 21 28 38 49 65 87 113 140 169 212
vii. Short circuit current rating of conductor for 1 second KA 0.21 0.36 0.57 0.86 1.43 2.29 3.58 5.01 7.15 10.01

28.5 ARMOUR

i. Maximum DC resistance of steel wire Armour at 20 °C Ohm/Km 8.20 6.80 6.20 3.90 3.40 2.20 1.80 1.60 1.10 0.94
ii. AC resistance of Armour at 80 °C (Approximate) Ohm/Km 10.41 8.64 7.87 4.95 4.32 2.79 2.29 2.03 1.40 1.19
iii. Short circuit current rating of Armour for 1 second KA 1.03 1.12 1.71 1.94 2.45 3.55 4.20 4.66 6.71 7.73

28.6 RATING FACTORS

RATING FACTORS FOR GROUPS OF MORE THAN ONE MULTI CORE CABLE IN AIR PRESERVATION/STORING & HANDLING OF CABLE DRUMS

28.7 STORAGE

i. The site chosen for storage of cable drums should be well-drained and should preferably have a concrete surface which will not cause the drums to sink and so lead to flange rot and cause extreme difficulty in moving the drums.
ii. The drums should be stored in such a manner as to leave sufficient space between them for air circulation. It is desirable for the drums to stand on battens placed directly under the flanges.
iii. In no case shall the drums be stored “on the flat side” i.e. with flanges horizontal.
iv. For drums, overhead shade is not essential except in areas where the rainfall is heavy. The cables should however be protected from direct rays of Sun by leaving the battens on or by providing some form of sun shielding.

28.8 HANDLING

i. The drums should be rolled only in the direction of the arrow, indicated on them.
ii. No cable drums shall be slung except by a bar through the centre bore. Also, the cable drums shall be stored away from Boilers or Furnaces.
iii. When unloading the drums from truck, a crane should be used if available and the drums carefully lifted and deposited on the ground. If crane is not available then the drums should be carefully rolled down a suitable arranged ramp or rails. Under no circumstances should the drums be dropped to the ground, as the shock may cause serious damage to the inner layers of the cables.
iv. Transportation over long distance, from storage site to work spots - The drums should be mounted on cable drum wheels strong enough to carry the weight of the drums, which are pulled by means of rope, or alternatively they may be mounted on trailer or vehicle with low loading platform for transportation to the destination.

28.9 HEAT RESISTANT CABLE

CONDUCTOR
Plain annealed copper flexible stranded, Class 5 Circular conductor 10 BS EN 60228

28.10 INSULATION & STANDARDS

The insulation should be PVC Insulation complying with BS 50363-3, requirements of type T3 and standard code BS 6500.

END OF SECTION

29.0 ACCESS CONTROL SYSTEM

1. Stand Alone Access Control and Lock System

Stand-alone access control devices (hereinafter, stand-alone controllers or controllers) will be one-door stand-alone access control systems based on contact less Proximity keys. The keys may be realized in form of cards or key-tags that are more convenient for handling in a bunch of apartment or automobile keys. The key has a unique number (or code) applied in the course of manufacturing.

While introducing the code to controller Data Base (hereinafter DB) the key obtains certain rights within the system, e.g. it unlocks the door. If the key is not introduced into DB it initiates light and sound read indication while being presented, but never unlocks the door or changes controller performance. Moreover, multiple presentations of such keys should be indicated by controller as an attempt to fit a code and shall result in complete key read abortion for some time (Disable Mode.) It is the responsibility of the contractor to liaise with the Main Contractor to ensure compliance.

The lock should be electrically controlled and can be of any type: electric strike,

electromechanical or electromagnetic lock.

Door Contact (DC) is purposed for door condition control. It is recommended that DC should be installed if the lock has to be switched off after the door is unlocked or if a warning signal is necessary when the door is left open longer than the preset time.

Request to exit (RTE) button is necessary for opening the door from the inside on coming out. If an electromagnetic or another type of a lock without a handle purposed for manual door opening is used, this button should be installed as no other way to unlock the door is available.

The entire system should be powered from the external power supply unit with voltage 12-14 V DC. It is desirable to use the power supply unit with built-in battery for system independent performance within several hours in case of power failure.

2. Networked Access Control and Lock System

Each door installed with access control must be installed with an automatic door closer system. It is the responsibility of the contractor to liaise with the Main Contractor to ensure compliance.

Access Control Readers and Key Pad Requirements

The readers for IT Server Room etc. shall be minimum 04-digit keypad with proxy card readers. The rest of the access control points as listed in the paragraph above need only be reader. All readers will be linked to the access control software provided to run the system. All user information and transaction information shall be controlled and installed in the main PC control from the Security Control Room.

The system shall be connected to the LAN system of the store for the Security Manager to run the application of access control on his PC. The software shall be such that the PIN numbers entered in the system will not be visible and will be protected by “star” symbols to keep the numbers confidential.

Magnetic Locks and “Release” Rules Requirements

Magnetic locks shall be installed as the lock mechanism for access-controlled points. Each lock shall be low voltage with a minimum of 500, kilograms holding force. Each magnetic lock shall be installed with emergency break glass, release buttons where requested and battery back-up.

Electronic release buttons must be installed at each door at easily accessible locations as well as at the desks and counters where relevant for each area (a minimum of 2 Push-to-Exit (PTE)). Fail-safe systems must be installed.

Magnetic locks installed at the IT Server room etc. must only release on a combination of both proximity reading of a card and entering a pin number linked to the same user card only. Each card to have unique pin.

Access Control System Cards

Tender to include provision of 500 print grade proximity cards compatible with the client requirement – compatibility is the responsibility of the contractor normally 26-bit HID type cards.

GENERAL NOTE

1. Contractor has to submit the following:

    a. Method statement for installation

    b. Method statement for Testing & Commissioning c.

    c. Provide mock-up of installation

    d. Detailed Test Report for Systems Services, stamped by approved specialist.

    e. Submit valid calibration for all used instruments for T & C

    f. Provide detailed maintenance schedule covering full D.L.P Period; schedule has to be submitted during the (T & C) period for review/comments.

2. Contractor will consider (2) year warranty period for full system from handing over date.

3. Contractor has to provide the End-User/Client proper training operating all systems, training schedule/agenda has to be submitted for approval in (15) days prior handing over date.

4. Contractor is fully responsible to obtain related authorities approval prior to start site activities in accordance with project programmer of work.

END OF SECTION

30.0 TRANSFER SWITCHES

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Read this Section in conjunction Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section. The Contractor shall become familiar with other sections of the Specifications affecting work of this trade.

B. Conform to General Requirements for Electrical Services

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.

2. Bypass/isolation switches.

3. Remote annunciation systems.

4. Remote annunciation and control systems.

1.3 SCOPE OF WORKS

A. The Contractor shall furnish and install, transfer switches having ratings, features/accessories, enclosures, etc., as indicated on drawings or noted herein.

B. The Transfer switches shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity of power without de-rating, either open or enclosed.

C. The Transfer Switches shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity of power, without de-rating, either open or enclosed.

D. Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of Transfer Switches. The experience shall include applications of equipment and materials of the same detail and/or rating as the Transfer Switches specified.

E. Any request for substitution(s) must be submitted ten (10) business days before the scheduled bid date, and must include a technical proposal of adequate detail to fully define the system offered.

F. The technical proposal shall include the following:

1. A description of the configuration and operation of the proposed system.

2. A complete specification review indicating compliance with each subparagraph. By noting the term "comply," it is understood the manufacturer is in full compliance with the item specified and will provide exactly the same. Any requested deviation must be documented in sufficient detail to allow a complete understanding of the bidder’s intent. Detailed information to support the proposed substitute product, material or method shall

accompany any deviations.

3. Bill of Materials.

4. Catalog cut sheets and other descriptive material of all major components.

5. A list of like systems previously delivered.

6. Outline drawings of all proposed equipment in both plan and elevation view, including overall dimensions, weights and installation clearances required. Also include single-line drawings illustrating supplied equipment.

G. The listing of specific manufacturers in the list of approved manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.

H. The design drawings include details, equipment dimensions, and space requirements based on the first listed “acceptable product”. If the Contractor selects a different supplier, some redesign, including location of conduits and terminations may be required. Additional cost incurred for these changes shall be borne by the Contractor

1.4 RELATED SECTIONS

A. SWITCHGEAR.

B. DIESEL ENGINE GENERATOR.

1.5 REFERENCES

A. The Automatic Transfer Switch shall be engineered and constructed in according with the standard specified for the respective circuit breakers.

B. The Transfer Switches shall be UL 1008 listed.

1.6 POST CONTRACT SUBMITTALS

A. General: Comply with the requirements of Division 1, Submittal Procedures and submit the following.

B. Complete list of equipment and materials proposed, with an adequate description of each item, shall be submitted prior to approval.

C. Submit sufficient information to demonstrate compliance with drawings and specifications.

D. Include voltage rating, continuous current rating, number of phases, withstand and closing rating, dimensions, weights, mounting details, conduit entry provisions, front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, factory relay settings, and accessories.

E. For automatic transfer switches that are networked together to a common means of annunciation and/or control, submit interconnection diagrams as well as site and building plans, showing connections for normal and emergency sources of power, load, control and

annunciation components, and interconnecting communications paths. Equipment locations on the diagrams and plans shall match the site, building, and room designations on the drawings.

F. Complete nameplate data, including manufacturer's name and catalog number.

G. A copy of the markings that are to appear on the automatic transfer switches when installed.

H. The following information shall be submitted to the Engineer as a minimum:

1. Master drawing index

2. Front view elevation

3. Floor plan

4. Top view

5. Single line diagram

6. Controls One-Line diagram

7. Nameplate schedule

8. Component list

9. Conduit entry/exit locations

10. Assembly ratings including: a) Short-circuit rating b) Voltage c) Continuous current d) Basic impulse level for equipment over 600 volts

11. Major component ratings including:

a) Voltage

b) Continuous current

c) Interrupting ratings

12. Breaker Schedule a) Cable terminal sizes.

13. Product data sheets.

14. Sequence of operation description

15. Certified production test reports

16. Installation information

I. Where applicable the following additional information shall be submitted to the Engineer:

1. Busway connection

2. Connection details between close-coupled assemblies

3. Composite floor plan of close-coupled assemblies

4. Key interlock scheme drawing and sequence of operations

5. Descriptive bulletins

1.7 MATERIAL SUBMITTALS

1. Contractor shall submit three (3) copies of material submittal for the approval.

1.8 CLOSE OUT SUBMITTALS

A. General: Comply with the requirements of Division 1, Closeout Submittals and submit the following information shall be submitted for record purposes:

1. Final as-built drawings

2. As-built wiring diagrams

3. Installation information including equipment anchorage provisions

B. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

C. Warranties.

1. Warranty shall be 5 years from the date of provisional handover of all the works.

2. Warranty shall include all parts, labor, and the service technician’s travel and living expenses for the entire 5 years period.

3. Contractor shall warrant that the Work shall be free of defects in material and workmanship for a period of five years from the date of Taking-over. Contractor shall promptly and at its own cost and expense correct Work that is rejected by Engineer or Work that fails to conform to the requirements of the Specification.

4. Contractor shall assign to Engineer all manufacturers' warranties relating to any of the equipment and materials, specifically the respective manufacturers' extended warranties. Contractor shall deliver to Engineer copies of all such warranties.

5. Contractor shall warrant that it has obtained all applicable licenses for Employer to use the Materials and has paid all required royalties for use of the system for its expected useful life.

D. Operation and Maintenance Manuals: Equipment operation and maintenance manuals, test report and the point-to-point wiring diagram shall be provided with each Transfer switch shipped. It shall include results from factory functional testing on the identical the identical unit and shall show each Feature/Accessory as being tested satisfactorily in accordance with the requirements of this specification. The test report shall indicate the manufacturer's Shop Order Number and Serial Number of each Transfer Switch supplied.

1.9 QUALITY ASSURANCE

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Provide testing and inspections in accordance with Division 1, Quality Requirements.

1.10 CODES AND STANDARDS

A. The automatic transfer switches and controls shall conform to the requirements of:

1. UL 1008 -Standard for Transfer Switch Equipment

2. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment

3. NFPA 70 -National Electrical Code

4. NFPA 99 -Essential Electrical Systems for Health Care Facilities

5. NFPA 110 -Emergency and Standby Power Systems

6. IEEE Standard 446 -IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

7. NEMA Standard ICS10-1993 (formerly ICS2-447) -AC Automatic Transfer Switches

8. UL 508 Industrial Control Equipment

1.11 PROJECT CONDITIONS

A. The Switchboard shall be suitable for continuous operation in desert locations under high ambient temperatures and humidity. The atmosphere is to be considered saliferous, sulphurous, dusty, and with high concentrations of windburn sand as commonly encountered in the UAE. The possibility of condensation, as experienced during large temperature fluctuations in humid atmosphere, shall be considered

1. Unless specified otherwise the following site conditions shall apply:

a) Design temperature (Outdoor) + 50° C

b) Surface temperature due to solar radiation + 85° C

c) Maximum ambient air temperature -shaded + 55° C

d) Minimum ambient air temperature + 5° C

e) Altitude not exceeding 1000m AMSL

f) Maximum relative humidity at 46° C 100%

g) Ground temperature + 35° C

h) Soil thermal resistively 2.5° C m/ w

1.12 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to Site under provisions of Section 01600 Product Requirements.

B. Deliver, store, protect and handle products to Site with particular reference to Dubai, UAE climatic conditions.

C. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

D. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.

E. Switchgear shall be equipped to be handled by crane. Where cranes are not available, switchgear shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

F. Switchgear being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition. If stored outdoors, indoor gear shall be covered and heated, and outdoor gear shall be heated.

G. Each switchgear assembly shall be split into shipping groups for handling as determined during the shop drawing phase jointly with the installing contractor. Shipping groups shall be designed to be shipped by truck, rail or ship. Shipping groups shall be bolted to skids, and covered with tarps for protection from weather. Accessories shall be packaged separately.

PART 2 -PRODUCTS

2.1 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

D. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

F. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

G. Where neutral conductors must be switched as shown on the plans, the ATS shall be supplied with a full ampere/voltage rated 4th/neutral pole. The neutral pole shall have the same withstand and closing and operational ratings as the phase poles, and shall be arranged for break-last and make-first to minimize neutral switching transients. To ensure that the neutral pole operates reliably with the phase poles, the neutral pole shall be operated directly from the same mechanism and shaft as the phase poles. This construction shall provide complete disconnect of the Emergency and Normal source neutrals in the mid position, after the phase contacts are disconnected. Overlapping neutral and other neutral poles that do not have identical construction to the phase poles and/or do not operate directly from the main ATS transfer mechanism and shaft are not acceptable.

H. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

I. The automatic transfer switch must be equipped with self-diagnostic programmable solenoid protection. This protection shall remove power from the solenoid after a maximum of two (2) unsuccessful transfer attempts to prevent the solenoid from overheating This condition shall be latched and annunciated on the microprocessor controller screen, and capable of annunciation via a communication port, and configurable as an alarm status output signal. Reset shall require manual intervention by an operator.

2.2 BYPASS-ISOLATION SWITCH

A. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

B. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control inter-wiring shall be provided with disconnect plugs.

C. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.

D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing

are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.

E. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.

G. Designs requiring operation of key interlocks for bypass isolation or ATSs which cannot be completely withdrawn when isolated are not acceptable.

2.3 MICROPROCESSOR CONTROLLER

A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. Voltage sensing shall be true RMS type and shall be accurate to + 1% of nominal voltage. Frequency sensing shall be accurate to + 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of
the operator's manuals.

D. The contractor shall bundle factory wiring and shall label either by color-code or by numbered/lettered wire markers. Labels shall match those on the shop drawings.

E. Automatic Transfer Switches shall be capable of utilizing fiber optic connectors, or provide data to fiber converter at each ATS. Provide all required hardware for a functional system.

F. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

G. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

1. EN 55011:1991 Emission standard -Group 1, Class A
2. EN 50082-2:1995 Generic immunity standard, from which: EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity ENV 50140:1993 Radiated Electro-Magnetic field immunity EN 61000-4-4:1995 Electrical fast transient (EFT) immunity EN 61000-4-5:1995 Surge transient immunity EN 61000-4-6:1996 Conducted Radio-Frequency field immunity
3. IEEE472 (ANSI C37.90A) Ring Wave Test.

2.4 ENCLOSURE

A. The ATS/BPS shall be furnished in a NEMA1 enclosure unless otherwise shown on the plans.

B. All standard and optional door-mounted switches and pilot lights shall be 16-mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.

A.5 **CONTROLLER DISPLAY AND KEYPAD**

A. A four lines, 20-character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

1. Nominal line voltage and frequency
2. Single or three phase sensing
3. Operating parameter protection
4. Transfer operating mode configuration (Open transition, Closed transition or Delayed transition)

B. All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

2.6 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

B. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.

C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D.

Parameter	Source	Dropout / Trip	Pickup / Reset
Under voltage	N&E, 3-phase	75 to 98%	85 to 100%
Over voltage	N&E, 3-phase	105 to 110%	103 to 108%
Under frequency	N&E	45.0 to 59.9Hz	45.1 to 60Hz
Over frequency	N&E	50.1 to 63Hz	50.0 to 62.0Hz
Voltage unbalance	N&E	5 to 20%	4 to 19%

The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal & emergency to pro-vide digital readout of voltage on all 3 phases, frequency, and phase rotation.

2.7 TIME DELAYS

A. Controller shall include an adjustable time delay of 0 to 10 seconds to momentarily override a normal source failure and delay the operation of the transfer switch for a user-specified time period. Controller shall be capable of being programmed for an ex-tended time delay up to 259 minutes if an external power supply is provided to the ATS control. All ATS supplied shall have wiring and provisions for the connection of a customer supplied external 120VAC power supply source for extended time delay.

B. Controller shall include an adjustable time delay on transfer to emergency, adjustable from 0 to 259 minutes, for controlled timing of transfer of loads to emergency allowing emergency source to stabilize prior to transfer.

C. Controller shall include two independent time delays on retransfer to normal – one ad-justable 0 to 259 minutes for re-transfer from an outage of the normal source and one for re-transfer after a Fast Test operation. Time delays after a Fast Test operation shall correspond to minimum values to reduce testing time. The time delay on transfer to normal shall be automatically bypassed if the normal source is available and the emergency source

fails during the time delay period.

D. Controller shall include a time delay to override momentary emergency source outages or swells and delay all retransfer signals allowing initial loading of engine generator set. Time shall be adjustable from 0 to 30 seconds.

E. Controller shall include a time delay for cool down of the engine ahead of engine shutdown. Time shall be adjustable from 0 to 60 minutes.

F. Controller shall include fully user-configurable load control relays and contacts for control and signaling of loads before and after switch transfers. These Capabilities shall include:

1. The configuration of up to (6), programmable load control relays -each with a Form-C contact output pair wired to a terminal block for customer use, rated at 10A, 24VDC/120VAC.

2. Each load control relay shall be independently programmable as either an elevator pre-signal, or load control (connect/disconnect) signal.

3. Each relay shall have a customer-programmable time delay period, from 0 to 60 minutes.

4. Controller shall permit field adjustability of the type and time delay settings, without the need for field wiring or hardware changes.

G. All Closed Transition and Delayed (programmed) transition-type ATS shall also include the following time delays and capabilities:

1. Delayed (programmed) transition-type ATS shall include a time delay for the center-off/neutral position when transferring from source-to-source. Time shall be adjustable from 0 to 10 minutes.

2. Closed transition-type ATS shall include a Failure to Synchronize time delay, fixed at 1 minute, for failure to synchronize normal and emergency sources prior to closed transition transfer.

3. Closed transition-type ATS shall include a two-stage, backup time delay system for protection against unintended extended paralleling of both sources beyond 100ms. System shall operate independently as a redundant backup to the main controller. Should this time delay expire, a contact shall be provided to trip a remote source breaker to ensure extended parallel time does not exceed the local utility maximum parallel time, typically 100ms.

4. Closed transition-type ATS shall include a digital synchro scope for display of the phase difference, in electrical degrees, between the two sources. Display shall indicate fast/slow phase relationship of Genset source in relation to Utility source. Digital synchro scope shall indicate numbers of degrees sources are out of sync as real time values. Synchro scope data must be displayed and accessible from transfer switch main microprocessor controller.

H. All time delays shall be adjustable in 1second increments. All time delays shall be adjustable by using the graphical display, the front USB port, or manufacturer supplied free configuration software connected to the local USB, Serial, or Ethernet communication ports.

2.8 ANNUNCIATION, CONTROL AND PROGRAMMING INTERFACE COMPONENTS

A. Devices for communicating with remote programming devices, annunciators, or control panels and paralleling switchgear shall have open-protocol communication capability

matched with remote device.

B. Provide contacts for connection to elevator controllers, one closed when automatic transfer switch is connected to the normal source, and one closed when automatic transfer switch is connected to the emergency source.

C. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to the automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit in-rush and seal currents are rated for actual currents to be encountered.

2.9 ADDITIONAL FEATURES

A. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

B. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

C. Engine Shutdown Contacts: Time delay adjustable from zero to 15 minutes, and factory set for 5 minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

D. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

E. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

F. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

G. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

H. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.

I. An In phase monitor shall be provided in the controller. The monitor shall control transfer so

that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in phase monitor shall be specifically designed for and be the product of the ATS manufacturer.

J. Provide advanced transfer contacts to signal loads of transfer from normal to emergency and emergency back to normal.

K. Provide load dump relay capable of removing the ATS/BPS from generator service upon receiving a signal from the synchronizing switchgear.

L. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.

M. Engine Exerciser -The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

1. Enable or disable the routine.

2. Enable or disable transfer of the load during routine.

3. Set the start time,

 time of day day of week week of month (1st, 2nd, 3rd, 4th, alternate or every)

4. Set the duration of the run.

5. At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

N. System Status -The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example,

 Normal Failed

 Load on Normal

 TD Normal to Emerg

O. Self-Diagnostics -The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

P. Communications Interface – The controller shall be capable of interfacing, through a serial communication module or TCP/IP with a network of transfer switches, locally (up to 4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.

Q. Event Logger – The controller shall have the ability to log data and to maintain the last 256 events, even in the event of total power loss. Time and data stamping of events shall be

accurate to within 1ms. Controller shall be capable of synchronizing it's date/time setting with a main PC via Network Time Protocol (NTP) over an Ethernet TCP/IP network connection.

The following events shall be time and date stamped and maintained in a non-volatile memory:

Statistical Data

a. Last Primary Source Failure – Date & time

b. Last reason for transfer (source fail, test)

c. Last transfer to alternate source -Date & time

d. Last re-transfer to primary source -Date & time

e. Time load without power (last event) – Seconds

f. Time ATS powered up -days

g. Total (accumulated) time on Source 1 – Hours

h. Total (accumulated) time on Source 2 – Hours

i. Total # of Primary Source failures

j. Total # transfers [Primary□Alternate□Primary]

R. Communications Module –

1. Serial Communications: Controller shall support RS485 communications port to enable serial communications. Controller shall support communication baud rates up to an including 115.2Kbps. The baud rate shall be user configurable. The serial communications shall be capable of a direct connect or multi-drop configured network. All serial communications parameters shall be accessible from the front display without the use of additional programming tools. Controller shall support the addition of communications in the field without field wiring modifications.

2. Ethernet Communications: Controller shall support Ethernet TCP/IP communications via an internally mounted and self-powered communications card. Ethernet shall be 10/100 Mbit, auto-sensing and shall include an RJ45 network connector. All Ethernet communications parameters shall be accessible from the front display without the use of additional programming tools. Controller shall support the addition of communications in the field without field wiring modifications. Ethernet communication modules/cards requiring an external power supply source are not acceptable.

3. Open Protocol: Both Serial and Ethernet communications shall be Modbus protocol. Non-Open/Proprietary communication protocols shall not be acceptable.

2.10 WITHSTAND AND CLOSING RATINGS

A. The ATS/BPS shall be rated to close on and withstand the available RMS symmetrical short

circuit current at the ATS/BPS terminals with the type of overcurrent protection shown on the plans.

B. The ATS/BPS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1-1/2 and 3 cycle, long-time ratings. ATS/BPSs which are not tested and labeled with 1-1/2 and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

2.11 POWER QUALITY METERING

A. The ATS shall be able to provide metering for current, voltage, real power, reactive power, energy use, power factor, and frequency. Metering shall be true RMS type, 1% accuracy for voltage and 0.5% for currents with 5 A secondary current transformer (CT).

B. The following parameters shall be provided:

1. Phase and Neutral Current: Ia, Ib, Ic, In, and average Current (Iavg)

2. Voltage: Va, Vb, Vc, Vab, Vbc, Vca

3. Voltage and Current unbalance

4. Hz, PF, W, Var, VA

5. Wh, VARh

6. Voltage and Current Harmonics (%THD up to 8th order)

2.12 DATA LOGGER

A. In addition to logging system events, the ATS shall be capable of logging digital and analog measured parameters and storing the data in non-volatile memory.

1. Controller shall contain a 20-channel Data Logger. Each channel shall be capable of being configured to monitor a digital (on/off) or analog measured parameter.

2. The sampling rate of each channel shall be configurable from 1 cycle to 60 minutes per sample.

3. Data shall be stored in nonvolatile memory, in a FIFO (First In, First Out) sequence.

2.13 WAVEFORM CAPTURE/OSCILLOGRAPHY

A. The ATS shall be capable of monitoring and capturing waveform data in the event of utility power outages or other user-specified events.

1. Up to 10 active channels of waveform capture may be user-configured.

2. Each channel shall be capable of capturing up to 256 cycles of waveform information.

3. Analog channels may be configured for 4, 8, 16, or 32 samples/cycle.

4. Digital channels shall be configured for 1 sample/cycle.

5. Waveform triggers shall be user configurable.

6. Waveform data shall be stored in industry-standard COMTRADE format (IEEE C37.111) for broadest compatibility and ease of downloading to a PC.

2.14 Customers-Configurable Alarms

A. The ATS shall be capable of being configured to display customer-configured alarm events.

1. Controller shall be capable of being user-configured for up to ten (10) Digital and eleven (11) Analog alarms.
2. Each Digital Alarm shall be user-assignable to an available digital input (dry contact input), and shall include a user-configurable alarm name and time delay.
3. The following measured parameters shall be available for configuration as Analog Alarms, with user-specified pickup values and time delays:

   a. Low (load) PF Alarm

   b. Source 1 (or 2) Voltage Harmonics Alarm (%THD)

   c. Load Current Harmonics Alarm (%THD)

   d. KW Overload Alarm

   e. Overcurrent Alarms (A, B, C, or N)

   f. Source 1 (or 2) Voltage Unbalance Alarm

   g. Load Current Unbalance Alarm

4. All alarms shall also be capable of being reset via a remote dry contact input to the controller or a network-activated reset signal.

2.15 Flexible Feature Re-Assignment

A. The ATS shall be factory pre-configured in accordance with the project specifications.

B. The ATS shall utilize flexible controller inputs and outputs to permit re-configuration after installation, without the need for re-wiring, software upgrades, or factory service support.

C. Each ATS shall be configured with [SPECIFIER TO SELECT ONE] [4] [8] [12] field reconfigurable Digital Inputs and [4] [8] [12] field-reconfigurable Digital Outputs.

D. Configurable Digital Outputs: Each Digital Output may be assigned to one of the following features:

1. Common/Any Alarm Active

2. Self-Diagnostics Alarm

3. Switch Exercising

4. Control Disconnect Switch in Inhibit position

5. ATS Not in Auto Mode

6. Fail to Transfer to Source 1

7. Fail to Transfer to Source 2

8. Engine Start Active

9. Source 1 Failure

10. Source 2 Failure

11. Load Connected to Source 1

12. Load Connected to Source 2

13. ATS in Center/Neutral Position (delay type ATS only)

14. Bypass Switch connected to Source 1 (bypass type ATS only)

15. Bypass Switch connected to Source 2 (bypass type ATS only)

16. Auto Transfer Occurred – Source 1 to Source 2

17. Auto Transfer Occurred – Source 2 to Source 1

18. Programmable Load Control (up to 6 stages) – Each individually configurable for either Elevator Pre-signal or Load Disconnect/Connect signal. Each with independent timer adjustment.

E. Configurable Digital Inputs: Each Digital Input may be assigned to one of the following features:

1. Bypass Time Delay on Transfer to Source 2

2. Bypass Time Delay on Re-Transfer to Source 1

3. Engine Start

4. Test with or without Load

5. Inhibit Transfer to Source 1

6. Inhibit Transfer to Source 2

7. Selection of Preferred Source

8. Auto/Manual Re-Transfer to Source 1

9. Auto/Manual Re-Transfer to Source 1 and Source 2

10. Commit/No-Commit to Transfer to Source 2

2.16 FLEXIBLE LOGIC EDITOR

A. The ATS shall be capable of being configured to execute customized protection and control schemes.

B. The following logical operations shall be supported:

1. Gates: AND, NAND, OR, NOR, NOT, XOR, LATCH

2. Positive/Negative edge triggered One-Shot

3. Dual edge triggered One-Shot

C. Control logic shall be constructed using any of the measured parameters (analog) in the controller, the customer-configured Alarms, plus any of the controller's hardwired inputs or outputs (digital).

2.17 SURGE ARRESTORS

A. The switchgear meets the relevant IEC international standards with respect to system voltages and currents. When required, surge arresters can be mounted in the cable connection compartment.

2.18 NAMEPLATES AND IDENTIFICATION LABELS

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background and shall be provided by the same manufacturer as listed and as agreed with the Engineer

B. Furnish master nameplate for each switchgear and controls lineups. Circuit nameplates shall be provided with circuit designations as shown on purchaser's single-line diagrams.

C. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.19 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

2. Switch position.

3. Switch in test mode.

4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

1. Indicating Lights: Grouped for each transfer switch monitored.

2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.

3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.20 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Functional Description: Include the following functions for indicated transfer switches:

1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

2. Indication of switch position.

3. Indication of switch in test mode.

4. Indication of failure of digital communication link.

5. Key-switch or user-code access to control functions of panel.

6. Control of switch-test initiation.

7. Control of switch operation in either direction.

8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.

C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

1. Touchscreen type operator interface

2. Controls and indicating lights grouped together for each transfer switch.

3. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.

4. Digital Communication Capability: Matched to that of transfer switches supervised.

5. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

2.21 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.

1. Concrete Bases: 100 mm high, reinforced, with chamfered edges. Extend base no more than 100 mm in all directions beyond the maximum dimensions of switch, unless otherwise indicated.

B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

C. Identify components according to Division 26 Section "Electrical Identification."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Provide control and monitoring wiring and make all necessary connections at the transfer switches, synchronizing switchgear, and generator sets. Provide all wiring required. Coordinate requirements with synchronizing switchgear, ATS/BPS, and generator manufacturer.

F. The ATS/BPS and synchronizing switchgear manufacturer shall coordinate all requirements with the engine/generator manufacturer. Provide qualified field service technician to oversee installation and completely test the system.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 TESTS AND CERTIFICATION

A. The complete ATS/BPS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are following the specification requirements.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance

with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

C. The ATS/BPS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

3.4 SERVICE REPRESENTATION

A. The ATS/BPS manufacturer shall maintain a national service organization of company-employed personnel located throughout the UAE. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

END OF SECTION