



PART 1 GENERAL PROVISIONS FOR ELECTRICAL INSTALLATION

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GENERAL PROVISIONS FOR ELECTRICAL INSTALLATION

1 Scope of Work

- 1 The Contractor shall design, supply, install, test and commission and handover the complete electrical services installations in accordance with the Contract preliminaries and conditions and as described within this specification, general technical preliminaries specification, and applicable sections of the standard specification for electrical engineering services as outlined on the Tender drawings (If applicable).
- 2 The Contractor shall include for specialist equipment and systems to be detailed designed and commissioned by relevant specialist vendors and suppliers. This shall include but not be limited to:
 1. Fire Alarm Systems
- 3 The contractor shall provide complete installations for the project and other associated works such as supporting structures, ancillary works etc. A brief description of electrical works will be as follows:
 1. **Distribution Boards:** Provide the lighting & power Distribution Boards as described within this specification (as required based on the demand load & 20% future load). , inclusive of the final circuit cables and connections to the associated lighting & power loads.
 2. **HVAC Plant:** Provide the power & controls wiring to all the items of HVAC plant as described within this specification (as required based on the demand load & 20% future load).
 3. **Lighting:** Provide the lighting installations as described within this specification and Service space requirements as per standards.



4. **Wiring Containment:** Provide the Wiring Containment for all the electrical systems as described within this specification and as per standards.
5. **Emergency Lighting System:** Provide the Battery Emergency Escape Lighting installations as described within this specification and as per standards.
6. **Fire Detection & Alarm:** Provide the Fire Detection & Alarm Systems as described within this specification.
7. **Testing & Commissioning:** The contractor shall include for the testing and commissioning of the above mentioned systems by employing the engineer of the specialist manufacturer's representative of the respective systems.
8. Demonstration and handover to the CLIENT
9. Provision of handover documentation including Operating and Maintenance manuals, provision of warranties, service agreements and Planned Preventative Maintenance schedules.
10. Training of CLIENT's staff
11. Coordinating and obtaining drawings and/or document approvals from local authorities having jurisdiction such as CDD.

2 Regulations

- 1 All supplies and services offered in response to this specification shall conform to the latest standards.
- 2 The design, equipment and installation requirements shall comply with the standards and recommendations laid down by the following:
 - (a) Regulations for Electrical Installations as issued by the Jordan National Building Council
 - (b) Standards relating to Electrical Installations and equipment as issued by International Electrotechnical Commission (I.E.C.) and British Standards Institute (BSI)
 - (c) National Electrical Code issued by National Fire Protection Association (NFPA), Boston, U.S.A
- 3 Where two or more applicable standards and/or the Specifications are in conflict, the most stringent shall apply.



3 Existing Services

- 1 The Contractor is deemed to have visited and inspected the site to familiarize himself with the existing site conditions and services at tender stage.
- 2 Co-ordination between shop drawings, work on site and existing services shall be carried out by the Contractor.
- 3 The Contractor shall be fully responsible for any damages to the existing services including repairs, and penalties imposed by the concerned parties etc, and for removing any site obstacles such as underground cables, pipes, civil works etc, which is obstructing his work on site.

4 Electricity Supply

- 1 The Supply Authority will make available, at the incoming terminals of each Main Switchboard (Medium Voltage Panel) a 3 phase + Neutral, 4 wire, 400 V, 50 Hz supply of adequate capacity and having the following tolerances:
 - (a) voltage $400 \pm 4\%$
 - (b) frequency $50\text{Hz} \pm 0.1\text{ Hz}$ (short term $\pm 0.15\text{ Hz}$ for a duration of only a few seconds)
- 2 Phase rotation of supply to BS 158.
- 3 Earthing system: TT



DISTRIBUTION BOARDS

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DISTRIBUTION BOARDS

1 GENERAL

1.1 Scope

- 1 This Part shall include all labour, materials and accessories for the complete performance of all MCCB panel boards, distribution boards in accordance with the Specifications and Drawings.
- 2 The work of this Part is integral with the whole of the Project Documentation and is not intended to be interpreted outside that context.
- 3 Co-ordinate the work with all other services affecting the work of this Part.

1.3 References

- 1 The following standards or updated/amended/revised versions are referred to in this Section:
BS 89, IEC 51Direct acting indicating electrical measuring instruments
BS 6231PVC insulated cables for switchgear
BS 159, IEC 61439.....Busbar and connection
BS EN 60947-4 IEC-1 & 1A Contactors

BS EN 60529, IEC 529 Degree of protection of enclosures
BS EN 60947-3, IEC 408 Air break switches
BS 7354, IEC 61439, .BS EN 6094 Electrical power switchgear

1.4 Submissions

- 1 Product Data:
 - (a) full specifications of the enclosures and the components of the switchgear, switchboards with relevant sheets of manufacturer's catalogues

2 PRODUCTS

2.1 Final Distribution Boards

- 1 Distribution boards shall be provided to serve lighting, fans, socket outlets, and other appliances. Board shall be arranged in banks of ways as indicated on the schedule of points.
- 2 Distribution Boards shall be flush mounted type, or surface mounted type and shall be mounted separately from motor control centers or switchboards. The boards shall be totally enclosed, dust protected, vermin proof type. Distribution boards installed in all plant rooms and other process areas shall be corrosion resistant.
- 3 Enclosure shall be fabricated from robust galvanized sheet steel fully rust- proofed, stove enamelled, of minimum thickness of 1.5mm and shall be protected to IP 32 for internal use with neoprene gaskets for the doors.
- 4 The distribution boards shall be provided with fixed cover and a hinged door with padlock which can be opened without any obstruction about 120 degrees and conduit knockouts from the top and bottom. The hinged door with a lock and key shall be integral part of the fixed cover.
- 5 All distribution boards shall be controlled by an adequately rated on-load main isolator or circuit breaker to interrupt the supply to the entire distribution board. This main isolator or circuit breaker shall be double pole for single phase DBs and triple pole for three phase DBs. Moreover, it shall be connected to the busbar directly without links whatsoever.
- 6 A circuit label shall be provided to indicate the area served by each MCB.
- 7 Busbars shall:
 - (a) be of appropriate current carrying capacity at least 125% equal to the rating of the main incoming isolator or circuit breaker.
 - (b) be of high electrical conductivity copper.
 - (c) Where the main isolator or circuit breaker is connected to bus bars then these bus bars shall be shrouded.



- 8 Each DB shall have separate earth and neutral bars having the same number of connection as there are for phase connections. A cable connection shall be made from earth bar to the incoming cable gland earth tag. All phase and neutral bars shall be sized to carry the full load current of the controlling breaker which shall be of flat tinned copper rigidly mounted, supported on shock-resisting, non-hygroscopic, high grade insulators with high resistance to tracking, not subject to mould growth or termite attack with adequate spacing and clearance.
- 9 Connection from the bus bars to the breakers shall be made by using solid circular insulated conductors or insulated and tinned copper strip neatly set and formed. Each connection to or from a phase or neutral bar shall have its own brass fixing screws, washers, butts and locknuts.
- 10 Each distribution board shall be fitted with an identification label on its front cover. The label shall be suitably inscribed stating the distribution boards reference number/letter, rating in volts & amperes and the number of ways in English and Arabic. In addition to the above a reference card shall be fitted inside the distribution board giving details of each circuit, MCB size, cable size and location. The reference card shall be affixed to the inside of the distribution board's door via a transparent envelope.
- 11 Distribution Boards (DB) located remote from the main switch boards shall be mounted at a height of not less than 1200mm from finished floor level to bottom of the DB and maximum height of this DB shall be 2200mm from finished floor level to top of DB.
- 12 All live terminals of parts and bus bars shall shrouded with insulating materials to ensure that it is impossible for any live metal to be touched while withdrawing or replacing MCBs.
- 13 All breakers and DBs shall be of one make throughout the whole of the works.

3 EXECUTION

3.1 Examination

- 1 Receive, inspect, handle, and store switchboards according to relevant BS and local authority regulation.
- 2 Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- 3 Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other
- 4 conditions affecting performance of the Work.
- 5 Proceed with installation only after unsatisfactory conditions have been corrected.



3.2 Connection

- 1 Comply with requirements for terminating feeder bus as specified. Drawings indicate general arrangement of bus, fittings, and specialties.
- 2 Comply with requirements for terminating cable trays as specified. Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.3 Identification

- 1 Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification as specified.
- 2 Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification as .
- 3 Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification as specified.

3.4 Earth Bonding

- 1 Each panel section shall be cross bonded to adjacent panel section earthing terminal.



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PROTECTIVE DEVICES

1 GENERAL

1.1 Scope

1. This Part shall specify the requirements for protective devices.

1.2 General Reference

1. The work of this Part is integral with the whole of the Project Documentation and is not intended to be interpreted outside that context.
2. Co-ordinate the work with all other services affecting the work of this Section.

1.3 Ratings

1. The ratings of the various overcurrent protective devices shall be, in general, as indicated on the Project Drawings. However, the protective device ratings shall be confirmed based on the equipment and items being provided by the Contractor. Contractor shall provide calculation and justification for proposing any change in the rating.



1.4 Standards

1. The following standards shall be followed:
 - i. BS EN 60898, IEC 157-1A Miniature and Moulded Case Circuit Breakers
 - ii. BS EN 60947, IEC 947-2 Low Voltage circuit breakers

1.5 Compatibility

1. Preference will be given to one manufacturer of MCCB and MCB to ensure proper co-ordination study.

2 PRODUCTS

2.1 Moulded Case Circuit Breakers

1. Shall have a combination of thermal and magnetic tripping giving an inverse time delay protection against sustained overloads and instantaneous tripping under heavy overloads and short circuits. Unless otherwise stated in the particular specification or drawings, MCCB shall have a minimum short circuit rating of 15 kA.
2. Breakers shall have a quick make, quick break over-center switching mechanism that is mechanically trip free from the handle so that contacts cannot be held closed against short circuits and abnormal current.
3. Tripping due to overload or short circuits shall be clearly indicated by the handle assuming a position mid-way between the manual ON and OFF position.
4. Latch surfaces shall be polished.
5. Poles shall be constructed to open, close and trip simultaneously.
6. Ampere ratings shall be clearly visible.
7. Breakers shall be completely enclosed in a moulded case to IEC No. 157 - 1A, suitable for installation inside switchboards.
8. Non-interchangeable trip breakers shall have the trip unit sealed.
9. Breakers with earth leakage relay protection shall be provided with shunt trips.
10. Frame sizes shall be as per manufacturer's standard size and as approved by the Engineer.
11. The magnetic trip shall be adjustable type for rating 200 Amp. and above, with 8 settings from 1.5 to 10 times the rated current of the circuit breaker.



12. Each MCCB shall be housed in a separate Compartment with the operating handle door interlocked when used as an Incomer, feeder or motor starter isolator, so that access can only be gained to the Compartment with the MCCB in the OFF position. Padlocking shall be provided in the OFF position only. When the MCCB is used for control transformers, distribution or ICA compartments the handle shall be internally mounted with appropriate shrouding and warning labels.
13. Each MCCB shall be complete with 2 N/O and 2 N/C spare auxiliary contacts (10A, 230v rating) in addition to those required for the Contract.
14. Mechanical interlock.
15. All incoming circuit breakers shall be provided with electrical & mechanical interlocking scheme to ensure that only one incoming supply can be energized at any one time where more than one supply is available.

2.2 Miniature Circuit Breakers

1. These shall be type C for general purpose uses, suitable for the load they feed, and shall have short circuit rating of 5 kA, unless specified otherwise in the Project Documentation.
2. They shall be fault rated so that fuse backup protection is not required.
3. They shall be rated in accordance with BS EN 60898, IEC 898.
4. They shall include the following minimum features:
 - a. magnetic and thermal trip elements
 - b. trip-free mechanisms
 - c. Locking of facilities with detachable proprietary brackets and clearly marked ratings.
5. RCBO shall comply with BS EN 61008-1 & BS EN 61009-1

2.3 Isolating Switches

1. The switch when used alone as explained above as an Isolator shall confirm to the utilization category AC23 and shall fully comply with the requirement specified for isolating functions specially the isolating distance in accordance with the applicable standard.
2. An Isolator shall be capable of opening and closing the circuit ON-LOAD with full voltage applied across the terminals.
3. The Isolator shall be capable of carrying currents under normal circuit conditions and carrying for specified time currents under abnormal conditions such as those of short-circuit.
4. All other features of the Isolator shall be same as specified above for combination fuse switch unit.



3 EXECUTION

3.1 Field Quality Control

1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
3. Perform tests and inspections:
 - Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
4. Test and Inspection:
 - Inspect the breakers, wiring, components, connections, and equipment installation.
 - Test continuity of each circuit.
 - Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - Prepare test and inspection reports including a certified report that identifies the devices. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.2 Adjusting

1. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
2. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
3. Adjust the trip settings of breakers and thermal-magnetic circuit breakers with adjustable instantaneous trip elements.
4. Set field-adjustable circuit-breaker trip ranges.



CABLES AND SMALL WIRING

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CABLES AND SMALL WIRING

1 GENERAL

1.1 Scope

- 1 This Part specifies the general requirements for power cables and small wiring systems. It shall be read in conjunction with other parts of the Project Documentation.
- 2 This particular requirement is to be read in conjunction with Specification for Underground Cables in PVC-u Ducts, plus Section 21 Part 30 Duct Bank and Manholes refers (but not limited to).

1.2 References

- 1 Cables and wires shall comply with the following standards or updated/revised amended versions as appropriate:
 - BS 5308.....Instrumentation cables.
 - BS 5467.....(IEC 502) Cables with thermosetting Insulation for electricity supply for voltages of up to and including 600/1000 V and 19000/30000 V
 - BS 6346.....PVC insulated cables for electrical supply.

BS 6360.....(IEC 228) Copper conductors for
cables.
BS 6746.....PVC Insulation and sheath of electric
cables
IEC 60364 Low voltage electrical installations

1.3 Quality Assurance

- 1 The Contractor shall determine the correct size of cables to be used for the equipment selected, based on current rating and voltage drop, as relevant, after taking into consideration:
 - (a) type of cable and wire
 - (b) ambient conditions
 - (c) method of installation
 - (d) the disposition of each cable relative to other cables
 - (e) fault power level
 - (f) protective device ratings
 - (g) motor circuit voltage drop during starting.
- 2 Voltage drop and current ratings shall be calculated according to **BS 7671** , **IEC 60364** and IEE regulation, whichever is more stringent.
- 3 All cables and wires shall be suitable for installation and continuous service in the ambient conditions described in Part 1, and shall be manufactured to ISO 9000 or equivalent.
- 4 Approximate cable route lengths and equipment power ratings indicated on the Project Drawings shall be for calculating cable sizes for tendering purposes. The Contractor shall determine exact cable lengths from site measurements and calculate cable size from the power ratings of the actual equipment being proposed. The Contractor shall be responsible for any increase in costs or design work associated with proposed equipment which has different electrical characteristics than the equipment on which the design was based.

2 PRODUCTS

2.1 Cables

- 1 Unless otherwise specified, cables and wires of the following specified voltage ratings shall be used as indicated.
 - (a) 6350/11000 V rated cables : MV ring and radial circuit

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Electrical Specifications



- (b) 600/1000 V rated cables : Main and sub-main distribution panels, motor control centers, circuit serving process equipment
- (c) 450/750 V rated cables : Final sub-circuit supplies for lighting, socket outlets, etc.
- (d) 300/500 V rated cables : Instrumentation
- (e) 250 V rated cables : Extra low voltage wiring, communication where the maximum voltage is 50 V.
- (f) Special screened and : Music/paging systems, Cable and TV system cable twisted pair conductors

2 General:

- (a) conductors shall be high conductivity copper, to BS 6360 (IEC 228) unless otherwise indicated.
- (b) copper conductors shall be stranded.
- (c) signal control cables shall have solid conductors.
- (d) flexible cords shall have fine stranded conductors.
- (e) conductor sizes shall be metric. Conductors with cross sectional areas smaller than those specified will not be accepted.
- (f) insulation for each conductor shall be colour coded or otherwise identified as required by the Regulations. Colour coding shall be maintained throughout the installation.
- (g) the current carrying capacity of conductors has been determined in accordance with the specified Regulations, the specified type of insulation and the expected conditions of installation.
- (h) all cables shall be as far as practicable, of one manufacturer only. All cables shall comply with the relevant IEC/BS.

3 PVC Insulated PVC Sheathed (PVC/PVC) Cable.

- (a) to BS 6346, 600/1000V Grade, or to BS 6004, 300/500 V Grade
- (b) flat twin and three core cable shall be to BS 6004 and incorporate an earth conductor placed between the red and black cores for two core cable and between the yellow and blue cores for three core cable.
- (c) conductor: annealed high conductivity copper, stranded, shaped and laid in an approved manner.
- (d) insulation: Colour coded to BS 6746C.
- (e) PVC for sheath and insulation : to BS 6746.

4 Single core PVC Insulated Wires:

- (a) cable shall be to BS6004, rated 450/750V, with high conductivity copper conductors and PVC compound insulation. Colour coding shall be in accordance with table 51 A of BS 7671 .



- (b) wires shall be continuous from outlet to outlet and no splice shall be made except within outlet and junction boxes. A separate neutral wire shall be provided for each circuit. Wires shall be left sufficiently long enough (minimum 150mm) to permit making final connections.

5 Mineral Insulated Cable:

- (a) to BS EN 60702 : Part 1, rated 600/1000V
- (b) cable shall comprise of a pressure packed magnesium oxide insulation contained within a continuous soft ductile copper sheath and copper conductors embedded in the dielectric in standard formation
- (c) cable termination kit shall comprise of conductor insulation of neoprene sleeving retained by cone shaped beads beneath a fibre sealing disc. Each conductor shall be identified with regard to phase etc., by means of sleeving placed over the neoprene insulation
- (d) cable seals shall comprise of screw-in-pot type seals, with brass ring glands designed to accommodate the pot seal.

6 Terminals:

- (a) for cable up to 6 mm²: two screw pinching type
- (b) for cable over 6 mm²: grip lug type cable sockets
- (c) brass saddles: purpose made, two fixing screw type.

7 Fire resistant cables:

- (a) Moisture resistant extruded silicon rubber, colour coded, stranded plain annealed copper conductor fire resistant cable shall conform to BS 6387 (Cat. C, W & Z).
- (b) The cable shall have tinned copper circuit protective conductor.
- (c) Fire resistant cables shall meet flame test requirement of IEC 331 and flame retardant requirement of IEC: Part I and BS 4066 Part 1.
- (d) Silicon rubber insulation shall conform to BS 6889.
- (e) Voltage class of the cables shall be 0.6 / 1kV.
- (f) Multicore cables shall be armored SWA.
- (g) Outer jacket shall be LSF/LSZH.
- (h) The cable shall be installed either on surface directly or recessed in adequately sized conduits trunking with wide bend turnings. The bending radius shall be maintained minimum 8 times outer diameter.
- (i) Ferrules supplied by the manufacturer shall be fitted immediately after removal of sheath so as to prevent any damage to core insulation.

8 Flexible Cable:

- (a) to BS 6007, or BS 6500, rated in accordance with manufacturer's tables



- (b) flexible cables subject to excessive heat shall be insulated as (8) above, (a) or (b) as per the Project Documentation requirement.

9 600/1000V rated XLPE Insulated Cable

- (a) to BS 5467, 600/1000V grade, designated XLPE/SWA/PVC for armored multicore cable, and XPPE/PVC for unarmored cable
- (b) conductors : plain annealed copper to BS 6360
- (c) cable shall comprise of plain copper, stranded circular conductors insulated with an adequate thickness of extruded cross linked polyethylene (XLPE)
- (d) conductors shall be laid up together and warmed circular with suitable performed fillers and warnings, bound with polythene terephthalate (PTP) tape and covered with an extruded PVC sheath, minimum 1.4 mm thick for multicore cable
- (e) armoured multicore cable shall have steel wire armouring and extruded sheath of black PVC
- (f) armoured single core cable shall have aluminium wire armouring and extruded sheath of black PVC
- (g) outer sheath of single core cables shall be at least 2.5mm thick
- (h) conductor screen : non-metallic comprising either semi-conducting tape or a layer of extruded semi-conducting material
- (i) prevent void formation in insulation by careful control of its passage through temperature graded water baths
- (j) cable shall be terminated with compression glands as specified below, giving adequate mechanical support by locking on the armour and ensuring high earth continuity.

2.3 Sundries

- 1 Cable Jointing and Termination:
 - (a) joints in wires and cable shall be avoided wherever possible. Joints in flexible cables and cords are not permitted.
 - (b) joints and terminations of all power cables shall be made by skilled cable jointers approved by the Engineer .
 - (c) no reduction in the number of strands of a cable core shall be allowed at a cable joint or termination.
 - (d) ferrules, compression connectors and bare portions of cable core resulting from a jointing or terminating process shall be insulated with an approved type of insulating tape or heat shrinkable tubing after completion of process. Such insulating tape or heat shrinkable tubing shall have equal or better electrical and mechanical properties than those of the original insulation removed, and shall be adhered to the cores etc. securely and permanently. The final thickness shall be in smooth contour throughout the whole length .
 - (e) every compression joint shall be of a type which has been the subject of a test certificate as described in BS 4579. When a compression



joint is made, the appropriate tools specified by the manufacturer of the joint connectors shall be used.

- (f) a circuit protective conductor having adequate cross sectional area and of same material as the phase conductors shall be installed and connected to maintain the effectiveness of the earth continuity across every cable joint
- (g) all cable jointing and termination shall be witnessed by the Engineer
- (h) sufficient spare cable shall be allowed to remake the joint or termination .
- (i) above ground cable joints and terminations shall be accessible
- (j) cable cores shall pass through glands or termination boxes directly to equipment terminals, without crosses if practicable.

2 Joints:

- (a) straight through joints for copper conductors: Where permitted by the Engineer, conductors shall be joined by approved type compression connectors using the appropriate tools and connectors
- (b) joints shall be made core-to-core.

3 Joints Boxes and Termination Boxes :

- (a) malleable cast iron boxes for joints in all power cables shall be compound filled and of adequate size. The boxes shall be fitted with suitable armouring clamps and glands. The armouring of the cables shall be terminated at the armouring clamps and the inner sheath shall pass through the gland. Self amalgamating tapes shall be applied to give fully screening insulation reinstatement where the insulation is screened
- (b) the box and compound shall be at the correct temperature before the compound is poured to allow total adhesion between the compound and the box. The compound shall then be allowed to cool and
- (c) with the consent of the Engineer, plastic shells fitted with suitably sized armour bond and filled with an approved type of cold pouring encapsulating compound to BS 6910 may be used as an alternative to the compound filled cast iron joint boxes for jointing PVC-insulated power cables. In such cases, the complete jointing kit, including plastic shell, compound, insulating tape etc. shall be from the same proprietary manufacturer who is specialised in manufacturing products for this purpose. The jointing methods and procedures, as laid down by the manufacturer, shall be followed in strict accordance

4 Cable Glands

- (a) cable glands shall be used for terminating cables to switch gear, switch boards, motor control centers, motors and other equipment
- (b) they shall be brass compression glands and comply with the relevant part of BS 6121, except for MICC cables, which shall comply with BS 6207 Part 2.
- (c) glands for armoured or screened cables shall have suitable clamps
- (d) external compression glands shall have close fitting PVC shrouds

- (e) earthing for armouring and metallic sheaths: suitable brass or copper clamps, and copper strip conductor and not less than 2.5 sq.mm
- (f) cables forming part of a LAN or structured cable system shall be terminated to floor plates or wall sockets compatible with the media interface connector specified for the particular network being used.

3 EXECUTION

3.1 General

- 1 Installing cables:
 - (a) pull cable into position by hand, where possible using an adequate number of operative roller guides suitably positioned along cable length .
 - (b) obtain approval of pulling cables by winch or similar appliance .
 - (c) when pulling by winch or the like, fit a suitable tension gauge into the haulage line between winch and cable. Pulling tension shall not exceed the limit recommended by the cable manufacturer .
 - (d) do not allow cable to twist or rotate about its longitudinal axis .
 - (e) lay 3 phase groups of single core cables in trefoil formation. If this is not possible obtain instructions .
 - (f) install cables to allow any one cable to be subsequently removed without disturbing the remainder .
 - (g) underground cable horizontal separation shall be a minimum of 150mm .
 - (h) damaged cables shall be removed, unless the Engineer agrees to a repair.
 - (i) all cables shall be neatly run in all situations. Where two or more cables are to be installed, cable tray must be provided.
 - (j) where power cables are surface run on the external faces of structures or above ground level they shall be installed on cable tray. They shall be protected from radiation of the sun by means of purpose made sunshades, which shall be of an approved design, securely fixed and fully ventilated.
 - (k) mechanical protection by cable tray covers shall be provided for all cable trays above ground/floor level to a height of 1000mm.
 - (l) when more than one cable is to be terminated at particular items of equipment special care should be taken to ensure that all cables to that equipment are routed from a common direction and each is terminated in an orderly and symmetrical fashion. Each and every cable shall be permanently identified at each end by its cable number as noted within the schedules. The identification label shall be of adequate size and style to a pattern approved by the Engineer and shall be securely fixed to its relative cable.
 - (m) identification labels shall also be fixed on cables at each and every entry and exit point of buried ducts, exits and entry to any structure and in such other positions as are necessary to identify and trace the route of any site cable. The use of punch type adhesive labels (Dymo-tape) will not be permitted.



- (n) where cables enter or leave structures or panel plinths, the ducts including spare ducts shall be sealed at the points of entry or exit. Caulking shall be carried out with an approved asbestos compound and followed by not less than 40mm of epoxy resin two-mix cold waterproof compound or a weak sand/cement mixture as directed by the Engineer. The Contractor shall be responsible for temporarily sealing all cable ducts into structures during the installation stage to prevent accidental flooding of structures.
- (o) during caulking care should be taken to ensure that the serving and/or armouring of any cable is not damaged. Any damaged cables shall be replaced entirely.
- (p) all cables entering or leaving hazardous areas (e.g. wet well), air conditioned areas or areas protected by a fixed fire fighting installation shall do so via approved proprietary manufactured cable transits. Cables entering or leaving structures or passing between rooms of the same classification may be sealed by alternative means subject to the agreement of the Engineer.
- (q) cables shall be free from kinks and the whole installation shall present a neat appearance.
- (r) ties of PVC, nylon, plastic or similar material will not be permitted under any circumstances.
- (s) protection of cables against possible mechanical damage shall be provided wherever seen to be necessary by the Engineer. All cables are to be run with particular regard to neatness. Multiple runs are to be arranged so that cables entering or leaving the run do so in a logical order.
- (t) all power cables shall be terminated with palm type compression terminals of the correct type and size.
- (u) special terminals shall be provided where necessary. Standard terminals which have palms/holes which are oversized for the application will not be acceptable. Standard terminals which are drilled out to a larger size, reducing the area of the palm will not be acceptable.
- (v) removal of strands or shaving of conductors to enable them to be terminated at terminals which are not designed for the size of cable necessary will not be permitted at any point.
- (w) pneumatic crimping machines shall be employed with correctly sized dies. Hand crimping shall not be used.
- (x) Power cables should be installed in cable tray and arranged aesthetically with proper clearance to minimize derating factor on cables ampacity.
- (y) Only the small wiring is permitted to run in cable trunking with 45% space factor and not exceeded in accordance with Kahramaa.



CONDUITS AND CONDUIT BOXES

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CONDUITS AND CONDUIT BOXES

1 GENERAL

1.1 General Reference

- 1. The work of this section is integral with the whole of the Project Documentation and is not intended to be interpreted outside that context.
- 2. Co-ordinate the work with all other services affecting the work of this section.

1.2 References

- 1. The following references are referred to in this Part:
 - BS 2782 Method of testing plastics
 - BS 4607 Non-metallic conduits and fittings for electrical installations rigid PVC conduits and conduit fittings, metric units
 - BS EN 60423 IEC 423-A, Conduit diameters and threads for conduit and fittings.



1.3 Description

1. This Section to include the supply, installation and commissioning of all conduit works in accordance with the Project Documentation.
2. General:
 - a. light and power circuits, fire alarm, telephone, signal and other low current system wiring shall be drawn in conduits unless otherwise indicated
 - b. conduit system shall generally be concealed and installed as indicated, unless otherwise indicated.
 - c. light and power circuits, fire alarm wiring, telephone wiring, signal wiring and low current system wiring shall each be run in separate conduit and wire way
 - d. cable insulated for two different categories of circuit shall be segregated
 - e. irrespective of service, conduit and fitting used shall be:
 - i. where embedded: heavy gauge rigid PVC complying to BS 4607, BS 6053 and BS 6099 Part 2, section 2.2
 - ii. where surface mounted, EMT
 - iii. where installed in flame proof and hazardous areas: galvanized steel
 - iv. from terminal box to machine: flexible steel conduit as per BS BS EN 50086-1:1994.

1.4 Submissions

1. Samples:
 - a. cut-away samples of all sizes of conduits, conduit boxes and fittings of each type shall be fixed to a board and submitted to the Engineer.
2. Product Data:
 - a. at the time of submitting samples submit manufacturer's details, catalogues and copies of test certificates confirming that offered types comply with the Specification.

2 PRODUCTS

2.1 Rigid PVC Conduit and Fittings

1. Standards:
 - a. Conduit and fittings shall comply with BS 4607: Part 1 and CEE Publication 26 or revised/amended/updated standards. In addition, conduit and fittings shall comply with this specification where requirements are more stringent
2. Physical Properties:



a. conduit and fittings shall be:

- i. resistant to high temperatures
- ii. non-hygroscopic
- iii. self-extinguishing
- iv. of adequate insulation resistance and electric strength
- v. inert to all liquid normally discharged from residential, commercial and industrial premises
- vi. suitable for installation, storage and transportation at temperature not normally below -5°C . or above 85°C . and at these temperatures shall not:
 - soften or suffer any structural degradation
 - show signs of cracking, or deform so that cables cannot be easily drawn in or are likely to be damaged when drawing in, when bent, compressed or exposed to extreme temperature
- vii. of adequate mechanical strength and thermal stability
- viii. suitably and indelibly marked and identified. Markings shall include nominal size and be easily legible
- ix. Smooth inside and outside and free from burrs and sharp edges. Surfaces and corners over which cables may be drawn shall be smooth and well rounded.

3. Sizes of Conduit:

- a. minimum 20 mm, internal diameter unless otherwise indicated
- b. Where size is not indicated: select in accordance with the regulations and as proper to the number and size of conductors.

4. Fittings:

- a. conduit entries shall be designed to ensure a watertight joint.

5. Expansion fittings:

- a. type to be approved.

6. PVC Conduit Boxes:

- a. PVC Conduit Boxes can be used through PVC Conduit raceway system and shall comply with BS 4607
- b. metallic conduit boxes as specified elsewhere in this section can be used alternatively if required for PVC conduit raceway system
- c. all boxes shall be provided with tapped brass inserts for fixing the screws
- d. all boxes for switches, sockets, outlets, etc., shall be rigid PVC or metallic type and their dimensions shall be suitable for fixing the switches, sockets and other accessories.



2.3 Rigid Steel Conduit and Fittings

1. Rigid Steel Conduit

- a. all metallic conduits shall comply with BS 4568 and of Class 4 rigid steel screwed type having an interior and exterior zinc coating of uniform quality and appearance throughout all surfaces
- b. conduits shall not be less than 20 mm diameter size, and shall be complete with all necessary threaded fittings, couplings and connecting devices having galvanized equivalent finish
- c. Conduits and fittings shall be manufactured specially for electric wiring purposes. When manufactured by a continuous weld process, weld heads both inside and outside the tube shall be completely removed prior to galvanizing
- d. all conduits and fittings shall be free from rust or other defects on delivery to the site and shall be properly stored in covered racking so that it is protected from mechanical damage and damage by weather and water whilst stored on the site
- e. all conduits shall be coupled to boxes and trunking wires using brass male bushes. All such bushes shall be hexagon headed, heavy duty long threaded type
- f. all conduit expansion couplings used shall be fabricated from material equal or equivalent to that of the conduit with which the coupling is to be used, having factory installed packing ring and pressure ring to prevent entrance of moisture. All coupling shall be equipped with earthing ring or earthing conductor
- g. all conduit runs shall be fixed using spacer bar pattern saddles giving not less than 3 mm clearance between the conduit and the surface to which it is fixed. Saddles shall have finish to match the conduit and saddle clips shall be secured to the bar by means of brass screws.

2. Metallic Conduit Boxes:

- a. metallic conduit boxes shall be used throughout metallic conduit raceway systems, and shall comply with, or be of demonstrated equivalent quality and performance to BS 4568 requirements. All boxes and covers shall be galvanized, zinc plated or rust-proof finish equivalent to conduit finish
- b. circular and/or rectangular boxes shall be used for pull boxes and terminating boxes, according to size and number of conduits connected to box. Boxes shall be either malleable iron or heavy duty steel construction with welded joints and tapped holes to

receive metal threaded cover retaining screws. Self tapping screws will not be permitted

- c. all boxes, other than those to which a fitting or accessory is to be directly mounted shall be fitted with covers screwed to the box by brass screws. Malleable iron covers shall be used with malleable iron boxes and heavy gauge steel covers shall be used with sheet steel boxes
- d. all cover and accessory fixing provisions shall be so positioned that the fixing screws lie completely clear of cable entering the box. All fixing screws shall be of brass all boxes installed in exterior locations, plant rooms, ducts, etc., shall be fitted with approved type gaskets to provide a waterproof seal between box and cover or other items fitted to the box
- e. all boxes provided as junction boxes where cable joints are specified or permitted, shall be provided with fixed terminal blocks. Such boxes shall be of suitable size to contain the terminal block and sufficient cable to allow neat connections to be made. The terminal blocks shall be fixed to the box by brass screws and shall comprise brass conductor connectors, with brass clamping screws enclosed in porcelain or other heat resisting insulation material which will not distort or otherwise have its properties damaged by temperatures below the highest temperature at which the insulation of any cable connected to it is destroyed.

2.4 Flexible Conduit and Connections

1. Flexible Conduit:

- a. to BS EN 50086-1:1994 or updated standard, watertight, PVC sheathed, spiralled stainless steel metal type and UV resistant plastic covered. The conduit shall be terminated at boxes and equipment by means of approved stainless steel or brass/bronze compression glands
- b. to be of the unpacked type for normal atmospheric conditions and non-asbestos packaged for damp situations. Adapters shall be of the solid type rust resistant (Stainless steel/Brass/bronze).
- c. flexible conduit shall be used for the final connection of rigid conduit to the terminal boxes of machines fitted with a means of drive adjustment and/or where vibrations is likely to occur.
- d. flexible conduit for use outdoors shall be weatherproof and certified to be resistant to UV radiation.

2. Flexible Connections:

- a. Where connections to electrical machines are to be by multicore glands, the final termination shall be by ring type universal glands and locknuts, and adequate slack cable in the form of a loop or spiral being left to allow for the movement of motors necessitated by belt retensioning, vibration, etc.



3 EXECUTION

3.1 Preparation

1. Sets and Bends:

- a. conduits up to 32 mm diameter; form on site with an approved bending machine using proper formers, guides, springs, etc., taking care not to deform conduit
- b. conduits over 32 mm diameter : use coupling fittings.

3.2 Cleaning

1. The conduit outlets when installed and before wiring shall be temporarily closed by means of well-fitting wooden plugs, and immediately before cables are drawn in, conduit systems shall be thoroughly swabbed out until they are dry and clean.



WIRING ACCESSORIES AND GENERAL POWER

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WIRING ACCESSORIES AND GENERAL POWER

1 GENERAL

1.1 General Reference

- 1 The work of this Section is integral with the whole of the Project Documentation and is not intended to be interpreted outside that context.
- 2 Co-ordinate the work with all other services affecting the work of this Section.

1.2 References

- 1 The following standards are referred to in this Part:
 - BS 1363.....13A Plugs, Switched and Un-switched Socket Outlets and connection units
 - BS 4343.....Industrial Plugs, Socket Outlets and Couplers
 - BS 4662.....Boxes for enclosure of electrical Accessories
 - BS 5419.....Fuse Switches and Switch Fuses
 - BS 5733.....General requirements for electrical accessories
 - BS 6972.....General requirements for luminaire supporting couplers



1.3 Description of Work

- 1 This Section shall include all labour, materials, equipment, appliances and accessories necessary for the complete performance of all switches, socket outlets, connection of mechanical equipment etc. In accordance with the Specifications and Drawings.

2 PRODUCTS

2.1 General

- 1 All individual items of materials shall be of the same make throughout the Project unless specifically approved by the Engineer.
- 2 Unless otherwise indicated in the sections to follow, the faceplate of all devices shall be polycarbonate.
- 3 Wiring devices are to be always flush mounted except for electrical/plant rooms area unless otherwise specified in construction drawings.
- 4 Provide brass earthing terminal in each mounting box.
- 5 For flush insulated accessories, provide galvanized steel mounting boxes to BS 4662 with Knock outs and adjustable lugs. For external insulation only stainless steel screws to be used.
- 6 All wiring accessories shall be earthed properly.

2.2 Switches

- 1 Lighting Switches
 - (a) to BS 3676
 - (b) to be rated 10, 15 or 20 amps depending on connected load
 - (c) 230V, 50 Hz.
 - (d) recessed with concealed conduit, surface pattern elsewhere
 - (e) quick make and break type
 - (f) single pole, double pole, one way, two way or intermediate as indicated
 - (g) surface mounted switches to be either poly-carbonate, or metallic and as indicated in the Project Documentation
 - (h) flush mounted switches to be of the grid fixing type with finish as noted in the Project document.
 - (i) switches shall be certified for AC-23A duty
- 2 Waterproof Switches:
 - (a) to be watertight IP 56 or as indicated in the Project Documentation
 - (b) to be rated 10, 15 or 20 amps depending on connected load
 - (c) 230V, 50 Hz.
 - (d) to be made of poly-carbonate for indoor application in damp and wet



areas.

- (e) to be metallic suitable for AC-23A duty and have sunshades fitted where exposed to direct sunlight.
- (f) to be provided with rear entry for outdoor use to avoid the exposure of conduit/cables to the harmful effects of the sun.

3 Double Pole Switches:

- (a) the double pole switches shall be with neon indication lamps and shall be rated 20, 30 or 45 Amps. as indicated on the drawings
- (b) switches shall be certified for AC-23A duty.

2.4 Ceiling Roses

- 1 Ceiling roses shall be of the all insulated type conforming to BS76 with a white finish.
- 2 Ceiling roses shall be provided with insulated terminals for the switched live, neutral and protective conductors; loop-in facilities shall be provided.
- 3 Plug-in ceiling roses shall be used in large buildings, with extensive false ceiling systems, as detailed in the particular specification.

2.5 Socket Outlets

- 1 General purpose Socket Outlets:
 - (a) to BS 1363
 - (b) 3 rectangular pin (2P+E) shuttered, with combined switch, rated 13A, 230 V
 - (c) to be supplied with plug complete with fuse
- 2 16A Socket Outlet:
 - (a) to BS 546
 - (b) 3 round pin (2 P + E) shuttered switched pattern complete with plugs.
 - (c) Neon indicator lamp, unless specified otherwise in the Project Documentation.
- 3 Weather proof Sockets:
 - (a) 13A Sockets: to BS 1363
 - (b) 3 rectangular pins, Un-switched type to be complete with weather proof plugs
 - (c) plugs: 13 Amps
 - (d) sockets: fused type with single pole cartridge fuse link of same rating as plug



- (e) sockets and plugs:
 - (i) to have minimum IP 55 grade protection
 - (ii) housing parts: brass or pressure die-cast finished in grey hammered stove
 - (iii) plugs:
 - cable grips shall have rubber compression rings
 - there shall be rubber gasket between plug and socket to ensure weather tightness.
- (f) sockets shall have screw on caps that close tight on socket when plugs are not inserted.

2.7 Disconnect Switches and Switch Fuses

1 Generally

- (a) to be metal clad with front operated handles interlocked with switch fuse case to prevent opening switch in the “ON” position
- (b) switch shall have “ON/OFF” indication and provision for locking in “OFF” position
- (c) Protection class IP65 with salt (corrosion) resistance finish paint as manufacture recommendation for outdoor and IP54 for indoor locations.
- (d) Load break switch and switch fuses should be ‘ARC TESTED’ complete system (along with enclosure) should be type tested from reputed testing laboratory recognized under ‘LOVAG’ for degree of protection as well as ARC Testing.
- (e) Enclosure should have reliable position indicator. If the contacts are welded together, the handle (front operated) should deviate from ON-Position less than 45°.
- (a) utilization category AC 23A

2 Fuse switch and switch fuses

- (a) to BS 5419
- (b) fuses: to BS 88 bolted type, class Q1, certified for 400V and AC 80 Duty, rated as indicated
- (c) fused switch carriages: withdrawable type
- (d) fuse switches: ASTA certified to 50 KA.
- (e) Protection class IP65 for outdoor and IP54 for indoor wet locations.

3 Disconnect switches

- (a) same design as switch-fuses, with solid copper links in place of fuses
- (b) single pole and neutral, or triple pole and neutral
- (c) ratings, as indicated.



- (d) rated fused short-circuit current 44kA RMS.
- (e) Protection class IP65 for outdoor and IP54 for indoor wet locations.

3 EXECUTION

3.1 Installation of Outlet Boxes

- 1 Location of Boxes:
 - (a) determine exact location of boxes on site and obtain the Engineer's approval before commencing installation
 - (b) make allowance for overhead pipes, ducts, variations in arrangement, thickness of finish, window trim, panelling and other construction when locating boxes.
- 2 Fixing:
 - (a) fix outlet boxes securely
 - (b) fix exposed outlet boxes to permanent inserts or lead anchors with machine screws.

3.2 Installation of Switches

- 1 Lighting Switches:
 - (a) located at the strike side of the door, approximately 150 mm from the edge of door frame
 - (b) plates shall be installed with all four edges in continuous contact with finished wall
 - (c) plates shall be installed with an alignment tolerance of 1.5 mm
 - (d) all switch assembly louvered plates shall have their earthing terminal connected to the earth terminal attached to the switch box by an insulated 2.5 mm² protective conductor.

3.3 Installation of Junction, Pull and Terminal Boxes

- 1 Generally:
 - (a) fix junction, pull and terminal boxes where indicated and where required to facilities pulling of wires and cables and connection of future appliances
 - (b) locate boxes as inconspicuously as possible, but accessible after work is completed.
- 2 Pull Boxes:
 - (a) fix at maximum 15m spacing and to limit the number of bends in conduit to not more than two 90° bends.



LIGHT FITTINGS

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LIGHT FITTINGS

1 GENERAL

1.1 General

- 1 This section includes the supply and installation of lighting fittings as shown on the drawings, and as specified.

1.2 Quality Assurance

- 1 Design Criteria:
- (a) lighting fittings shall be of first class quality, made by approved manufacturers and shall be suitable for trouble free operation on the system voltage at the site
 - (b) lighting fittings shall be complete with internal wiring between lamp holder and termination point. Wiring shall be in silicone rubber insulated heat resistant flexible cables
 - (c) the Contractor shall be responsible for co-ordinating the light fitting installation with any other components of the ceiling systems



- (d) all lighting fittings shall be complete with accessories and fixing hardware necessary for installation whether so detailed under fixture description or not
- (e) outdoor lighting fittings shall be installed at mounting heights as specified or instructed on site by the Engineer
- (f) all outdoor lighting fittings shall be suitably constructed and protected to withstand the corrosive atmosphere and high ambient temperatures of the site, whether indicated under the fittings description or not
- (g) lighting fittings shall have power factor not less than 0.9.

1.3 References

- 1 The following standards are referred to in this Part:
 - BS 800..... Limits and methods of measurement of radio interference characteristics of household electrical appliances, portable tools and similar electrical apparatus
 - BS4533.....Luminaires
 - BS EN 60529Degrees of protection provided by enclosures

2 PRODUCTS

2.1 Lamps

- 1 General:
 - (a) lamps shall be furnished and installed in all luminaires covered under the Contract
 - (b) lamps used for temporary lighting services shall not be utilised in the final use in fixture units
 - (c) lamps for permanent installation shall not be placed in the fixtures until so directed by the Engineer, and this shall be accomplished directly before the building areas are ready for occupancy by the Employer
 - (d) lumen output of lamps shall be in accordance with BS EN 5225
 - (e) generally, high output, low consumption, tri-phosphorus lamps shall be used, unless otherwise indicated.
 - (f) For lamp lumens, lamp power, fixtures' specifications refer to the selected lighting fixtures as per project documentations.



- 2 LED Lighting
LED lamp and fixture shall be used where indicated on drawings, specification and ID Package.
The incandescent lamp LED replacement shall be integrated with LED driver built in and shall have the same base (screw) as the incandescent lamp.
LED shall be dimmable using same incandescent dimmers.
The LED shall have the following minimum specification:
 - (a) 5 year guarantee
 - (b) Lifetime expectancy of 50,000 working hours (minimum)
 - (c) LED shall have same color temperature like incandescent (tungsten) lamp. Samples for each type shall be submitted for approval.
- 3 Lamp Holders:
 - (a) SBC, BC GES, Bi-pin, etc. as necessitated by the lamp cap
 - (b) Edison screw lamp holders, to BS EN 60238, to be designed so that the lamp cap only makes electrical contact when fully screwed home, and to have means to prevent the unscrewing of the lamp due to vibration or similar cause
 - (c) Lamp holders for fluorescent lamps, shall be the spring loaded rotary type, to BS 6702.

2.2 Luminaires

- 1 Luminaires shall be manufactured to BS 4533 with an appropriate IP classification to BS EN 60529.
- 2 All lighting fittings shall be supplied complete with appropriate control gear where necessary, lamps, mounting and fixing accessories etc. whether explicitly mentioned in the description of each light fitting or not. All the fittings shall have the same appearance, material, technical details and approximate dimensions.
- 3 Luminaires shall be connected to the main circuit wiring with heat resistant flexible cables of a minimum conductor size of 2.5 mm² insulated with silicon rubber.
- 4 Break joint rings shall be used in conjunction with batten holders, ceiling roses or back plates mounted onto a flush installation.
- 5 Standard fluorescent luminaires shall have two suspension or fixing points. The thickness of the luminaries body shall not be less than 0.6 mm.
- 6 All lamp-holders for flexible pendants shall be of the all insulated skirted pattern with code grips and for batten or wall mounting shall be of similar pattern. All lamp holders shall be of the bayonet cap pattern.



- 7 The point box suspensions and other parts of the lighting fittings shall be provided to be erected at festival time to suit the building program for decoration as per the requirements of the Project Documentation.
- 8 The glassware diffusers, shades and lamps shall not be fitted until all building work is complete.
- 9 All fittings shall be easy to clean inside and outside, when mounted.
- 10 All fluorescent fittings shall be suitable for instant start irrespective of any catalogue or list numbers quoted.
- 11 Diffusers on fluorescent luminaires shall be poly-carbonate unless otherwise specified in the Project Documentation.
- 12 All fittings that are mounted in areas accessible to the public shall be provided with vandal proof high strength diffusers and shall be additionally provided with a galvanized steel mesh security guard.
- 13 All luminaires shall be certified by the manufacturer for use in an ambient temperature of 50°C.
- 14 All luminaires intended for use in hazardous areas shall be certified to be zone 1 or 2 as required at 50°C ambient temperature.
- 15 Wet well luminaries, fixtures and cabling shall conform to ingress protection IP67, shall be PTFE coated and shall be provided with tungsten halogen lamps i.e. no run up or re-strike time for safety reasons.
- 16 All wet well luminaries, fixtures and cabling shall conform to ingress protection IP67.

2.3 Termination/Earthing

- 1 Fused terminal blocks shall be fitted and be of sufficient capacity for the wiring involved. Each terminal shall be capable of accommodating two 2.5 mm² conductors.
- 2 Connector strip terminals shall have a current rating not less than the rating of the circuit protective device and shall be encapsulated in self-extinguishing grade polyethylene.
- 3 Where connector strips are provided in boxes behind heat producing appliances, porcelain connectors shall be used where temperatures in excess of 70 °C are likely.
- 4 Conductors shall be clamped between metal surfaces such that no screws make direct contact with the conductor. The metal used in

construction of the connector shall be at least 85 °C copper alloy such that good conductivity and electrolytic compatibility are maintained at all times.

- 5 All light fittings shall be provided with an earthing terminal which shall be connected to the earth continuity lead of the final sub-circuit.
- 6 The earthing of all pendant or semi-pendant fittings shall be by a separate core in the connecting flex or cable securely bonding the earth terminal on the fitting to the glanded joint of interconnecting cables. In no case shall pendant chains or conduit support tubes be used as a means of earthing.

2.4 Ceiling System

- 1 In false ceilings, luminaires whether surface or recessed mounted shall not be supported by the false ceiling construction. Separate independent supporting systems shall be provided for each luminaire, comprising drop rods, chains or similar.
- 2 Luminaires installed in false ceilings shall be connected to the lighting circuit using mechanically coupled plug-in ceiling roses.
- 3 Luminaires shall be positioned to provide ease of access for maintenance, cleaning etc., while not impairing the distribution of light.
- 4 The Contractor shall ensure that the luminaire manufacturer has the correct details of the ceiling system, including suspension, tiles, etc. He shall ensure that the luminaires are supplied with the correct trim, suspension system and are fully compatible with the ceiling system.

3 EXECUTION

3.1 Lighting Installation

- 1 Terminations:
 - (a) general fluorescent fittings mounted direct to conduit outlet boxes shall have the circuit wiring run direct to the fittings terminal position. Flexible conduit pigtail shall be provided for all fixtures to J-boxes
 - (b) terminations for recessed, or semi-recessed pattern fittings fitted in false ceilings, shall have the circuit wiring terminal above the ceiling in a ceiling rose. Outlets shall be mounted adjacent to the fitting.

3.2 Installation of Lamps

JUST Incineration Facility
Electrical Specifications



- 1 Generally install new lamps in all luminaires at substantial completion of work.

3.3 Cleaning and Adjusting

- 1 Clean fixtures internally and externally after installation. Use method and materials recommended by manufacturer.
- 2 Adjust aimable fixtures to provide required light intensities.



EMERGENCY LIGHTING AND CENTRAL BATTERY

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EMERGENCY LIGHTING AND CENTRAL BATTERY

1 GENERAL

1.1 Scope

- 1 This Part specifies the general requirements for emergency lighting and accessories both maintained and non-maintained. It shall be read in conjunction with other parts of the Specifications and the Project Drawings.

1.2 General

- 1 Emergency lighting shall fulfill the following functions:
 - i. Illuminate the escape routes.
 - ii. Indicate the escape route direction clearly
 - iii. Provide EXIT signs on escape doors and routes to such doors.
 - iv. Ensure fire alarm call points, firefighting equipment and other life saving equipment on the premises are illuminated.



1.3 Reference Standards

- 1 The following standards and documents of other organisations are referred to in this Part, and shall be complied with:

BS 4533General requirements and tests

BS 4533.....Luminaires for emergency lighting

1.4 Warranty

- 1 Battery units, luminaires and accessories shall be warranted for a minimum of 5 years by the manufacturer. The battery shall have minimum 10 years useful life.

2 PRODUCTS

2.1 General

- 1 Emergency lighting installations shall be complete with emergency batteries, chargers, luminaires and wiring, all as described in Specifications and as indicated on the Project Drawings, complying with BS 5266 Part 1 and NFPA 101 for emergency lighting levels. All emergency lighting shall be Non-maintained type except for the EXIT lights where it shall be maintained unless otherwise explicitly specified in the project documentation.

2.2 Self Contained Emergency Battery Packs

- 1 Where a central emergency battery unit is not installed, individual emergency luminaries shall consist of individual power packs installed within or remote to the luminaries.
- 2 Battery pack units shall consist of converter/inverter devices, with nickel-cadmium batteries to provide 3 hours operation under mains failure, unless the main supply is restored prior to this.
- 3 Luminaries with self contained battery packs shall be connected to the 'live side' of the local lighting circuit and lamps shall operate automatically under mains failure conditions.
- 4 Units shall have the capability of sustaining high temperature so that they can be accommodated in fittings with high internal temperatures. However, if the internal temperature of the fittings exceeds 50 °C, the battery unit shall be mounted remote to the luminaries. In the case of remote mounting, a purpose made remote mounting box shall be provided.
- 5 Key operated switches shall be provided, at the locations indicated on the Project Drawings, for all self contained emergency pack unit luminaries,

to control the operation of the luminaries manually for testing purposes.
Test key switches shall be clearly labelled "Emergency Lighting".

3 EXECUTION

3.1 Wiring

- 1 Where the emergency lighting system installation is via a central battery unit, the wiring to emergency luminaries shall be carried out in LSF fire rated cables, unless specified otherwise.
- 2 Where the emergency lighting scheme is self-contained emergency packs, the wiring system shall either be or in PVC insulated single core wires in conduits.
- 3 Generally, cables shall be 2.5 mm² cross-sectional area unless specified otherwise.

3.2 Adjusting and Cleaning

- 1 Aim and adjust lamp fixtures as indicated on Drawings.
- 2 Position exit sign directional arrows as indicated on Drawings.



FIRE ALARM SYSTEM

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PART-3 FIRE ALARM SYSTEM

1 GENERAL

1.1 General Description

1. The contractor shall install, test and commission the fire alarm system as per the specifications detailed herein. The work under this part shall include for the complete performance of Fire Alarm and Detection system in accordance with the specification, drawings, Civil Defense Department requirements and relevant NFPA Standards. The system shall be composed of an Conventional system with latest technology in the field to achieve maximum facilities in identifying the spot of fire outbreak and with minimum annunciation of false fire phenomena.
2. All the systems components such as control panel, sensors, manual call points, sounders, etc. shall be produced by the same manufacturer who has

at least five (5) years' experience in design, manufacturing, installation, commissioning and maintenance of Fire Alarm System in Jordan

1.2 Related Work

1. Conduit Part
2. Wiring Part
3. Equipment identification Part

1.3 Reference Standards:

1. Fire alarm system is to be in accordance with the local fire prevention regulations, and in compliance with American National Fire Protection Association NFPA 72, National Fire Alarm Code.
2. The system and components are to be listed by Underwriters Laboratories Inc., UL listing, and/or Factory Mutual approval, FM approved, for use in fire protective signaling system, this is subject to CDD approvals.

2 PRODUCTS

2.1 Equipment Supplier

1. Equipment and materials shall be provided by Authorized Engineered Systems Distributor.
2. The Engineered Systems Distributor of the Fire Alarm/Life Safety Equipment specified herein shall provide a copy of their certificate of successful completion of an authorized Training Course given by the Manufacturer of the Fire Alarm/Life Safety Equipment.

2.2 Power Supplies

1. The power supply shall provide a central processor with a watchdog circuit. It shall provide 2 initiating circuits, 2 notification appliance circuits rated at 24 Vdc at 2.5A, form 'C' alarm and trouble contacts, and auxiliary power at 24Vdc at 500 mA.
2. The power supply shall be a high efficiency switch mode type providing 4A totals to the notification appliance circuit (NACs), 500 mA of auxiliary power at 24Vdc, and an automatic battery charger.



2.4 Intelligent Detectors

2.4.1 Optical Smoke Detector

1. Optical smoke detectors shall be provided in the pressurized air conditioned storage areas, offices and electric room to the following specification:
 - a. Optical smoke detectors shall be capable of detecting visible combustion gases emanating from fires.
 - b. Optical smoke detectors shall have sensitivity sufficient to be classified as 'B' in BS 5445.
 - c. Optical smoke detectors shall work on forward scatter principle, using optical components operating at a wavelength of 4.35nm.
 - d. Optical smoke detectors shall operate at 24V DC.
 - e. Optical smoke detectors shall operate satisfactorily at an ambient temperature range of 5oC - 55oC and maximum relative humidity of 95%.
 - f. Optical smoke detectors shall be protected to a minimum of IP44.
 - g. Optical smoke detectors shall incorporate screens designed to prevent insects from entering the sensing chamber.
 - h. Optical smoke detectors shall have an internal alarm indicator.
 - i. Optical detectors shall be installed as per the guidelines set in BS 5839 Pt.1

2.4.2 Fixed Temperature/Rate of Rise Heat Detector

1. Provide intelligent combination fixed temperature/rate-of-rise heat detectors. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135°F (57°C) and a rate-of-rise alarm point of 15°F (9°C) per minute.

2.4.3 Standard Detector Mounting Bases

1. The base shall, contain no electronics, support all Signature Series detector types and have the following minimum requirements:
 - a. Removal of the respective detector shall not affect communications with other detectors.
 - b. Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.
 - c. The base shall be capable of supporting one (1) Remote Alarm LED Indicator. Provide Remote LED alarm indicators where shown on the plans.



2.4.4 Isolator Detector Mounting Bases

1. The operation of the isolator base shall be controlled by its respective detector processor. Isolators which are not controlled by a detector processor shall not be accepted. Following a short circuit condition, each isolator/detector shall be capable of performing an internal self-test procedure to re-establish normal operation. Isolator/detectors that are not capable of performing independent self tests shall not be acceptable. The isolator base shall support all Detector types and have the following minimum requirements:
 - a. The isolator shall operate within a minimum of 23 msec. of a short circuit condition on the communication line.
 - b. When connected in Class A configuration the Loop Controller shall identify an isolated circuit condition and provide communications to all non isolated analog devices.
 - c. Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.

2.5 Analogue Conventional Monitor Module

1. Provide intelligent single input modules. The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The single input module shall support the following circuit types:
 - a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
 - b. Normally-Open Alarm Delayed Latching (Water flow Switches)
 - c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
 - d. Normally-Open Active Latching (Supervisory, Tamper Switches)

2.6 Analogue Conventional Control Relay Module

1. Provide intelligent control relay modules. The Control Relay Module shall provide one form "C" dry relay contact rated at 2 Amps @ 24V DC to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware.

2.7 Intelligent Manual Pull Stations

1. Double Action (lift cover and pull alarm lever), non-coded type manual station, of cast metal construction, with normally open, Single-Pole, Single-Throw general alarm contacts. The manual station shall include an Conventional module which shall consist of printed circuit board with discrete circuitry for monitoring the station alarm contacts. When operated, the alarm lever shall remain in its "down" position to indicate its



operation, with alarm contacts closed until the station is reset. The station shall be reset by opening the front, resetting the lever and closing the station front.

2. The station shall be tested by opening the station front and then returning same to normal. It shall be necessary to open the station to replace the break rod. A spare break rod shall be furnished with each station.
3. Provide intelligent single action, single stage fire alarm stations. The fire alarm station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver "PULL IN CASE OF FIRE" English lettering.

2.8 Control Panel

2.8.1 General

1. A diagram shall be provided adjacent to the control panel showing the general layout of the building and the fire zones. The diagram shall be engraved with black paint filling on a white ebonite sheet of thickness not less than 2 mm. The letter height shall be 5 mm. The diagram shall be colored to show the extent of the area covered by each fire zone. A different color shall be used for each zone.
2. Upon receipt of an alarm, the control units shall perform the following actions:
 - a. illuminate fire zone detector
 - b. activate alarm warning devices within the building
 - c. operate internal fire sounder
 - d. operate ancillary devices as appropriate
3. Alarm warning devices shall be de-activated by operation of the "Silence Alarms" switch. The internal sounder will continue to operate and the fire indicators remain lit until the key switch controlled push switch is operated. This should only be achieved if the alarm initiating device is no longer in alarm.
4. Reset of the controller, after the fire incident has been investigated, will be achieved by operation of the "Reset" switch.
5. The fire alarm panel shall comply with BS 5839 Part 4 and requirements herein and be suitable for installation of fire detection and alarm systems to BS 5839 Part 1.

2.8.2 Fabrication

1. The panel shall be of the multi-zone, modular type and capable of extension. The number of zones shall be related to the requirements of the individual buildings and shall be agreed with the Engineer.



2. A lockable smoked glass door shall protect the face of the panel from access by unauthorized personnel.
3. The enclosures of panels shall be fabricated from sheet steel, minimum thickness 1.5 mm and shall be provided with a hinged lockable door. Protection to at least IP54 shall be provided.
4. Control panels shall as a minimum requirement be equipped with the following:
 - a. mains supply on indicator
 - b. DC supply faulty indicator
 - c. alarm indicator for each zone
 - d. alarm accept push-button to acknowledge fire alarm signals, silence external audible alarms and energizes an internal bleeper unit or sounder
 - e. reset push-button to restore monitoring systems to the inactive condition
 - f. integral sealed battery and trickle battery charger where appropriate
 - g. alarm transmission facilities via the telephone alarm system (this facility shall be provided for future use if not utilized under this Contract)
 - h. termination for incoming and outgoing wiring systems
 - i. voltage free normally closed circuits which shall open in the event of an alarm to shutdown ventilation and air conditioning equipment in the immediate vicinity of the alarm
 - j. suitable fault indication (both visual and audible)
 - k. interfacing facility to connect to Civil Defense Department system
 - l. interfacing facility to control elevator system
 - m. interfacing facility to control air handling units (AHU) of the HVAC systems
 - n. interfacing facility to control fire doors/dampers.
5. Alarm indicators shall be of the light emitting diode type. Indicators shall be provided in pairs for each function.
6. Control panels shall continuously monitor all alarm circuits, including wiring and control devices. When a fault monitoring circuit has been energized it shall not rest until the fault condition is cleared.
7. The control panel shall include the following:
 - a. power supply normal light (green LED)
 - b. power supply fault light (amber LED)
 - c. battery charger fault light (amber LED)
 - d. general evacuate push button
 - e. silence alarm push button
 - f. reset push button
 - g. common fire light (twin red LED)



8. Repeat facilities shall be available for common fire and fault conditions. In addition, two normally open/normally closed (NO/NC) volt free auxiliary contacts each rated at 2.5 amps (inductive) for 24 V DC and 230 V AC shall be available
9. Cable entries are to be made from knock-outs located on top and bottom of the fire alarm panel.
10. The removal of any detector(s) shall not affect the performance of other detectors in the system.
11. The sensitivity of any of the sensors shall be adjustable from the control panel.

2.9 Batteries and Charging Equipment

2.9.1 General

1. The system shall be of the 24 V DC, monitored, open circuit type utilizing transformed and rectified mains voltage supply under all normal circumstances but with stand-by provision in the form of rechargeable sealed lead-acid batteries.

2.9.2 Batteries

1. Batteries shall have a capacity capable of maintaining the system in normal working condition for at least 24 hours and in the alarm state for at least 30 minutes without recharging unless otherwise stated in the Project Documentation.
2. Batteries to include 25% spare over the specified time.

2.9.3 Battery Chargers

1. Battery chargers are to be of sufficient capacity to power the system whilst recharging a fully discharged battery. The battery shall be fully charged within 8 hours.

3 EXECUTION

3.1 Installation

1. Equipments shall be installed in accordance with the manufacturer's instructions. And in accordance with the drawings.



2. Special care shall be taken with the installation of cables to avoid damage due to rough hangings and short radius bends.
3. Conduits are to be run concealed in underground, above suspended ceilings, in walls or under floors in a manner to protect them from physical damage and excessive heat, and to permit ease of accessibility for servicing and modifications. Fixing accessories are to include two-piece plastic clamps, galvanized screws, wall base- holders and fibber-plastic inserts or raw-bolts, subject to the approval of the Engineer.
4. Use only proper tools for all installation work particularly in making connections.
5. The installations shall be carried out under the direct supervision of a qualified technician, licensed by and trained at the factory.
6. Galvanized conduits shall be used to accommodate the fire alarm cables at are with exposed conduits installation, as per the engineer approval.
7. The contractor to have the responsibility to obtain the CDD approval.

3.2 Testing and commissioning

1. The analogue Conventional fire alarm System should be test and commission According to the manufacturer's regulations and standards.

3.3 Operator and Maintenance Instructions

1. Three complete bound manuals of operation and maintenance instructions shall be provided.
2. The manuals shall include complete data on every component of the system.
3. The Contractor shall include in his price the cost of training of at least 2 Technicians to operate and maintain the equipment.