Alpha
Consulting Engineers Pte Ltd

FEEDBACK REPORT FORM

Ref No: IXS - 080310 (S)

To: LCT From: LFY

Job No./Project: ELECTRICAL MASTER SPECS *(where applicable)*
Section 8 – Lighting, Power & Telephone Installation

Source of feedback: _____

Scope of Feedback: * ☐ Quality ☑ Environmental ☐ Administrative ☐ Contractual ☐
☑ Technical ☑ Specification ☐ Others

Section A : Problem & Cause
Specifications on lamps, ballasts (low loss & HF) are outdated. Specs for Electronic safety transformer, LED Drivers not available. Specs for Presence Detector outdated.

Section B : Mitigating Action Taken, if any

Section C : Suggested Corrective Action
Updated Spec for above added, Specs for Electronic Safety transformer and LED Driver added.

Section D : Approved Corrective Action

Document Affected * : ☑ Yes ☐ No Affected Document : E/8-1 to E8-19

Approved By : _____ Date : 3/3

Section E : Action

Action By : NA

Targeted Completion : March 2010

Actual Completion : 3/3/10 Verified By : _____

** Mark [X] where appropriate*

Distribution:							

SECTION 8 - LIGHTING, POWER & TELEPHONE INSTALLATION

8.1 General

This section of the specification specifies the requirements for lamps, luminaires, control gear, wiring accessories and telephone installation.

Select one of the clauses 8.2.1 or 8.2.2 or 8.2.3 only as appropriate.
25/09/09

8.2 Luminaires

Select 8.2.1 where some of the luminaires have been specified and some are under provisional sum.
03/03/10

8.2.1 General

The types of luminaires to be provided are shown on the Specification Drawings and as specified in the Schedule of Luminaires.

Luminaires which are to be supplied by others or under a Provisional Sum, are shown on the drawings as lighting points without designation. The Work shall include taking delivery of these luminaires on site, checking on the consignments for defective items, arrangement for replacements by suppliers, storage at site, fixing of lamps, installation and site testing and replacements of lamps/tubes and defective parts/fittings during the Maintenance Period. Further, all necessary fixing accessories, mounting brackets, supports, reinforced concrete stumps/bases, heat resistant flexible cords etc, as required for the installation of the luminaires supplied by others and/or supplied under the Provisional Sum shall be deemed to be included in the Work.

Provide luminaires manufactured to the relevant sections of BS 4533 and designed for 230V +/- 6%, single phase, 50 Hz a.c. supply.

Luminaires used as emergency luminaires including exit signs shall be constructed and installed in accordance with the current edition of Singapore Standard CP 19: Code of Practice for the Installation and Maintenance of Emergency Lighting and Power Supply Systems in Buildings.

Provide fittings and accessories for external use to IP54 rating and treated against corrosion for use in salt laden atmosphere. Provide sealing gaskets for totally enclosed luminaires and designed such that it is insect-proof.

Provide ventilation slots on the casing of luminaires, where required.

Provide cables that are used for internal wiring of the luminaires of not less than 0.5 sq. mm, cross-sectional area in compliance with IEC 60598. Provide cables whose insulation can withstand without deterioration, a maximum temperature of 105^{o}C, throughout the life of the luminaire.

Cables within the luminaires shall be neatly bundled by nylon self-locking cable ties. Wiring shall be properly routed and secured away from heat-generating accessories like control gear etc. wherever possible.

Shroud all cable terminations within the luminaires.

Provide an earthing terminal in every luminaire connection of the circuit protective conductor.

Select 8.2.2 where all the luminaires are to be specified.
03/03/10

8.2.2 General

Provide luminaires manufactured to the relevant Sections of BS 4533 and designed for 230V +/- 6%, single phase, 50 Hz a.c. supply.

Luminaires used as emergency luminaires including exit signs shall be constructed and installed in accordance with the current edition of Singapore Standard CP 19: Code of Practice for the Installation and Maintenance of Emergency Lighting and Power Supply Systems in Buildings.

Fittings and accessories for external use shall be of weatherproof construction specially treated against corrosion for use in salt laden atmosphere. Totally enclosed luminaires shall have sealing gaskets and shall be insect-proof.

Provide ventilation slots on the casing of luminaires, where required.

Ensure that cables used for internal wiring of the luminaires are not less than 0.5 sq. mm in compliance with IEC 60598. Provide cables whose insulation can withstand without deterioration, a maximum temperature of 105^{o}C, throughout the life of the luminaire.

Cables within the luminaires shall be neatly bundled by nylon self-locking cable ties to prevent loose lengths from touching hot surfaces.

Shroud all cable terminations within the luminaires.

Provide an earthing terminal in every luminaire, for connection of the circuit protective conductor.

*Select 8.23 where all the luminaires are to be **supplied by others**.*
01/10/09

8.2.3 General

All luminaires shall be supplied by others. The Work shall include taking delivery of luminaires on site, checking on the consignments for defective items including arrangement for replacements by suppliers, storage at site, fixing of lamps, installation and site testing of all these luminaires including replacements of lamps/tubes and defective parts/fittings during the Maintenance Period. Further, all necessary fixing accessories, mounting brackets, supports, rc stumps/bases, heat resistant flexible cords etc, as required for the installation of the luminaires supplied by others and/or supplied under the Provisional Sum shall be deemed to be included in the Work.

*Do **not** select clauses 8.2.4 to 8.2.9 if the luminaires were to be **supplied by others**.*
03/03/10

8.2.4 Metalwork of Luminaires

Fabricate housings for the luminaires using steel sheet of minimum thickness 0.8mm. Provide housings that are degreased, derusted, phosphate and sprayed painted with two coats of acrylic polyester or epoxy powders and then oven cured to the specified temperature of the paint manufacturer and for the recommended time. The total thickness of the two coasts of paints shall not be less than 50 microns. When the basic sheet steel is electro-zinc plated (zincron), the total thickness of the two coats of

paints can be 25 microns. The thickness of the paint will be measured in random samples during supply to check conformity when required by the Architect.

8.2.5 Diffusers and Reflectors

Provide plastic diffusers of non-deteriorating, and ultra-violet stabilised material, that will not change in shape with time or due to handling. Wash plastic diffusers with a detergent solution and dripped-dry immediately prior to installation to restrict electrostatic dust adhesion.

Provide louvred mirror reflectors made from high purity (99.9% minimum) die-formed semi-specular anodised aluminium in parabolic form to give good light distribution and efficacy. Design the metal louvres to give a 'bat-wing' light distribution with a downward light output ratio of at least 70%. The lamps will be screened from view along both directions of the lamp axis by metal louvres. Ensure that metal louvres or diffusers are hinged from one side of the luminaires for maintenance purposes and snap fit back into position.

8.2.6 High Intensity Discharge (HID) Lamps and Control Gears

High pressure sodium lamps where used shall be manufactured to IEC 60662.

Metal halide and mercury vapour lamps where called for shall be manufactured to IEC 61167 and EN 60188 respectively.

(a) HID Electromagnetic Ballast

Provide electromagnetic ballast that comply with the following standards:

Safety	EN 61347-2-9
Performance	EN 60923
RFI	EN 55015
Harmonic Current Emissions	EN 61000-3-2
EMC Immunity	EN 61547
Environmental Standard	ISO 14001

Ensure that these encapsulated electromagnetic ballasts of copper-iron construction are of compact dimensions, lowest hum-levels, light weight with minimal watt losses and equipped with protection against end of lamp life phenomena. Provide screw terminal blocks and a separate earth terminal to avoid wiring errors.

Lamp circuits using SON lamps rated at 35W, 50W, 70W, 100W, 150W, 250W, 400W or MB1 lamps rated at 70W, 150W, 250W, 400W, are to be provided with a timer to ensure that if the lamp fails to ignite, the circuit is isolated after a time delay.

Provide dry metallised polypropylene capacitors of appropriate value to improve the power factor of the lamp circuit to 0.9 lagging.

Provide auxiliary lamp with a lamp re-ignition monitor for switching the auxiliary lamp on when the discharge lamp has been extinguished and off after it has re-struck and run-up.

(b) HID Electronic Ballast

Provide electronic ballast that comply with the following standards:

Safety	EN 61347-2-1/2-3/2-9
Performance	EN 60927/EN 60929
RFI	EN 55015/EN 55022
Harmonic Current Emissions	EN 61000-3-2
EMC Immunity	EN 61547
Environmental Standard	ISO 14001

Provide electronic HID ballasts that are compatible with the HID lamps employed, with power factor of 0.95 lagging, earth leakage current less than 0.5mA per ballast, optimum end-of-lamp life protection including stopping circuitry and thermal cut-off.

8.2.7 Tubular Fluorescent Lamps and Control Gears

Provide TL8 or TL5 tubular fluorescent lamps where specified and manufactured to BS 1853, IEC 60081 and IEC 61195.

Provide lamps manufactured with highly efficient 3-band fluorescent coating in combination with precoating and lamp load and low mercury dose (3 mg for 75 and 5mg for T8).

Provide lamps with excellent lumen maintenance (85% lumen output after 2000 operating hours) and good colour rendering (RA>80).

Provide fluorescent lamps with the following colour temperature where specified by their light colour.

Light Colour	Colour Temperature
Daylight	6000 K
Cool white	5000 K
Neutral white	4000 K
“Crisp” warm white	3000 K
“Cosy” warm white	2500 K
Very warm white	2000 K

(a) Electromagnetic Ballast

Provide electromagnetic ballasts that comply with the following standards:

Safety	EN 61347-2-8
Performance	IEC 60921

Provide electromagnetic ballasts that are of the long life (average life time of 10 years of continuous operation) and low loss type, silent in operation, compact dimensions and suitable for switch-start operation.

Ensure that power factor correction capacitors are provided in lamp circuits to correct the power factor to 0.85 lagging.

Ensure that the ballast is approved by Spring Singapore prior to installation.

(b) High Frequency Ballast

Provide high frequency (HF) ballast that comply with the following standards:

RFI < 30 MHz	EN 55015
RFI > 30 MHz	EN 55022
Harmonics	EN 61000-3-2
Immunity	EN 61547
Safety	EN 61347-2-3
Performance	EN 60929
Vibration & Bump Tests	IEC 68-2-6 Fc IEC 68-2-29 Eb
Environmental Standard	ISO 14001
Temperature protected declared thermally	EN 61347-1

Provide slim and lightweight HF ballasts with warm start circuit for preheating the lamp electrodes up to a maximum time of 2.5 secs.

Ensure that the power factor of the ballast is 0.95 lagging or better and earth leakage current less than 0.5 mA per ballast.

Provide HF ballasts (with automatic stop circuit in case of lamp failure and are able to restart automatically after lamp replacement.

Ensure that the HF ballasts are designed to protect against excess mains voltage and incorrect connections.

Where dimmable HF ballasts are specified, ensure that the lamp power can be regulated from 100% to 1%. Ensure that the lamp life is unaffected by the dimming position and that lamp burning is stable in every dimming position.

Provide HF ballast with a service life of not less than 50,000 hours.

(c) Lampholders

Provide proprietary made lampholders of bi-pin, spring loaded, design to retain positively the lamp caps, independent of the contact springs and of

robust construction to BS 5042. Contact spring shall be of phosphor bronze material.

(d) Power Factor Correction Capacitors

Provide power factor correction capacitors that comply with IEC 61049.

Provide power factor correction capacitors that contain a low-loss film dielectric, metal polypropylene (MPP) enclosed in a metal case with two insulated connections and discharge resistor.

(e) Starters

Provide starters that comply with IEC 60155 and suitable for secure, safe and fast ignition of both inductive and capacitive lighting systems.

Provide starters that can preheat the lamp filaments and provide a sufficient pulse voltage to ignite the lamp for a minimum of 12,000 starts.

8.2.8 PL Lamps and Control Gears

PL lamps shall be of single-ended miniature fluorescent lamps each consisting of two narrow glass tubes welded together with a bi-pin cap and housing for starter and capacitor at one end. The correlated temperature of PL lamps shall be 2700 degree K and the colour rendering index shall be 81 or more. The lumen output of a PL 7 watts, PL 9 watts and PL 11 watts lamp shall be at least 410 lumens, 570 lumens and 890 lumens respectively. Each PL lamp shall be fitted with a radio interference suppression capacitor to suppress mains borne interference generated from the luminaires.

Lampholders for PL lamps shall be of type G23 suitable to receive the bi-pin cap of the PL lamps.

The ballasts for PL lamps shall be designed to operate any of the PL 7 watts, PL 9 watts or PL 11 watts lamp. The ballasts shall be rated for operation at 240V 50Hz single phase a.c. supply.

Power factor correction capacitors shall be provided for each PL lamp luminaire to correct the power factor to better than 0.85 lagging.

8.2.9 Low Voltage Tungsten Halogen Lamps and Control Gears

Provide tungsten halogen lamps rated at 12V, 35W or 50W as specified in the specification drawings.

Provide tungsten halogen lamps with dichoric reflector coating to reflect the heat generated back to the filament so that less energy is needed to operate the lamp.

Provide a front glass so that the lamp and reflector cannot be touched.

Provide halogen lamps with a colouring index Ra = 100 and lamp life of 5,000 hours.

(a) Electromagnetic Safety Transformer

Provide electromagnetic safety transformers that comply with EN 61558.

Provide transformers that are vacuum-impregnated with polyester resin and temperature switch with self-holding protection against overheating.

Provide transformers with primary and secondary terminals that are separated by an insulating divider.

(b) Electronic Safety Transformer

Provide electronic safety transformers that comply with the following standards:

RFI < 30 MHz	EN 55015
Harmonics	EN 61000-3-2
Immunity	EN 61547
Safety	EN 61046
Performance	EN 61047
Environmental Standard	ISO 14001

Provide transformers that are manufactured with inaudible hum, protection class 2 and internal protection against overload and short-circuit.

Provide transformers bearing the MM mark for mounting on surfaces of unknown flammability.

Ensure that the transformer is provided with temperature protection such that the surface of the casing must never exceed 110^{o}C.

Provide transformers that are compatible with phase-cutting leading-edge or trailing-edge dimmers.

(c) LED Driver

Provide constant voltage or constant current LED Drivers that comply with the following standards:

EMC (RFI)	FCC Class A/EN 55015
Harmonics	EN 61000-3-2
Electrostatic Discharge	IEC 61000-4-2
EMC Immunity	IEC 61000-4-3
Burst	IEC 61000-4-4
Surge	IEC 61000-4-5
Injected RF	IEC 61000-4-6
Mains Interruption	IEC 61000-4-11
Immunity	EN 61547/61047
Safety	EN 61347-2-13

Provide LED Drivers that are manufactured with resettable short circuit protection and overload regulation.

Provide LED Drivers bearing the MM mark for mounting on surfaces of unknown flammability.

8.3 Installation Requirements of Luminaires

The installation details for both the non-essential luminaires and essential luminaires shall be in accordance with the following respective clauses:

8.3.1 Non-Essential Luminaires

Each lighting point in areas having false ceilings shall be terminated with a BS ceiling rose in the soffit of the slab.

Each lighting point in areas without false ceilings shall be terminated at a BS circular conduit box having entries appropriate to the run of conduit. At each lighting point the wiring shall have an excess length of about 150mm before terminating to a connector. The circuit protective conductor shall also be wired to the connector.

Each surface mounted luminaire shall be terminated at a BS junction box having entries appropriate to the run of conduit and shall be complete with connectors and suitable for the size and number of connections to be made at the point and the wiring required to connect the specified luminaires. Wiring to luminaires within the false ceiling space shall be carried out by means of heat resistant (butyl or silicon rubber insulated to BS 6500) flexible cables with copper conductor of cross sectional area not less than 1.5 sq mm to be connected from a BS ceiling rose to the lighting fitting.

Recessed luminaires shall be suitable for housing in concealed or exposed (T bar) ceiling modules where appropriate. All recessed luminaires shall be supported from the r.c. ceiling slabs using appropriate fixing accessories such as steel rod, spring clips, ceiling brackets, suspension hooks, profile brackets, etc. to ensure proper installation of the luminaires on different types of ceiling panels. In areas where luminaires are installed directly below large ductworks etc., suitable brackets, channels, etc., shall be provided to facilitate suspension/support of the luminaires from the ceiling slabs. An adjustable resilient spring-clip shall be provided to enable the suspension length to be adjusted to fine tolerances. Suspension sets shall be proprietary make of adjustable type designed to carry the weight of the luminaires; the suspension sets shall be of adequate lengths for installation on the false ceiling panels concerned. Suspension rods shall be of at least 5mm diameter and shall be fixed at positions recommended by the luminaires manufacturers.

Suspension rods shall be provided so as to that the weight of the luminaire is equally distributed to all supporting rods with the luminaires remaining in level position. Suspension sets where exposed to sight shall be of adjustable rod type of minimum diameter 20mm with all necessary accessories.

8.3.2 Essential/Emergency Luminaires

For luminaires associated with essential/emergency supply circuits, wiring shall be terminated as follows:

(a) For surface/wall mounted luminaires, cables shall be terminated at a ceramic fuse-carrier mounted within the luminaires.

(b) For recessed luminaires (i.e. luminaires mounted on suspended ceiling), cables shall be terminated at a ceramic fuse-carrier mounted within a metal-clad terminal box securely fixed to the underside of the structural members within the ceiling space adjacent to the luminaires and the connection from the terminal box to the luminaires shall be by means of fire resistant cables, plug and socket with the socket incorporated in the terminal box enclosure in such a position as to facilitate withdrawal of the plug in the event of collapse of the ceiling.

The supply side of the aforesaid fuse carriers shall be sleeved with high temperature grade insulating material and the rating and characteristics of the fuse-element shall be properly selected to ensure proper protection of the circuit and discrimination with the upstream protection devices.

For luminaires with emergency power packs, an unswitched live wire shall be connected to each and every luminaire with emergency power pack so that the luminaires concerned can be switched off either from the associated lighting switches, timers, contactors etc.

8.4 External Lighting

Lighting poles for external lighting where called for shall be of tubular hot dipped galvanised steel column, the base compartment of which shall house the lamp fusegear consisting of a single fully shrouded single pole and neutral single entry type cut-out with 10 Amps Type B MCB complete with cable sealing box, armour clamps and compression gland, where required, suitable for reception of looping PVC/SWA/PVC cables or PVC cables of the sizes as required. The tubular columns shall be protected internally and externally against corrosion. For internal protection, a coating of black bituminous paint shall be applied. A priming coat of suitable paint shall be applied to the surface after it has been thoroughly cleaned and followed by at least two finishing coats to provide adequate protection against corrosion. The colour shall be to the Architect's review.

Wiring between lantern and cut-out shall be twin core 2.5 sq. mm tinned annealed circular copper conductor PVC insulated black PVC sheathed incorporating within the sheath a bare circuit protective conductor of the same cross sectional area.

An appropriate concrete base shall be provided for each outdoor luminaire for mounting onto the ground.

Each outdoor/external lighting point shall be terminated in a weatherproof polyester junction box of IP 65 similar to Legrand 95950 or equivalent.

8.5 Switches

Sub-circuit switches shall be single pole, quick make and slow-break, silent switch action type with solid silver alloy contacts and totally enclosed switch action for flush wall mounting or ceiling mounting as required and shall be suitable for indoor or outdoor service according to location, housed in standard purpose manufactured galvanised steel boxes complete with conduit knockouts made up into single or multi-gang units employing a grid switch system of fully interchangeable components.

Grids shall be adjustable for variation in depth of plaster and for squaring errors and of the same type for surface or flush mounting.

Switches in mechanical plantrooms and electrical sub-stations and switchrooms shall be of the metalclad type subject to review by the Architect, mounted in flush or surface conduit boxes as specified.

Switches for wall mounting in other locations shall be of 'Rocker' type similar to 'MK - Logic Slimline'. Switches mounted on aluminium door frames shall be similar to 'MK - Logic Architrave Plateswitches' from the 'MK - Logic Slimline' range. Switches located on brick or concrete walls shall be mounted in horizontal arrangement in galvanised steel boxes using box suspension straps. Counter-sunk screws shall be provided for fixing to the conduit box. Ceiling switches where used, shall be similar to MK Cat. No. 3190 complete with mounting bases and pull cords.

Switches for external use shall be of weatherproof construction and of standard similar to Walsall make or equivalent.

Samples of all switches, conduit boxes etc. and a schedule showing the type of switches to be installed at all locations shall be submitted to the Architect for review prior to placing orders.

Switches associated with essential supplies shall be provided with red toggles.

Switches shall be rated 10 Amps and suitable for use in a.c. inductive circuits or fluorescent lamp circuits complying with Singapore Standard SS 227, of the one way or two way type and fixed generally at a height of 1400mm from the floor level and where possible be located on the inside of the room on the handled side of the door as close to the door as practicable.

An earthing terminal shall be provided and connected to circuit protective conductor at every lighting switch position.

Single pole switches shall be connected to break the phase wire of the supply. The neutral wire shall not be routed through switch boxes.

Switches which are mounted in the same position adjacent to each other shall be of multi-gang type of the maximum number of gangs available. Where more than one phase of supply is brought into a multi-gang switch box, the switches and accessories and wiring connected to one phase shall be adequately separated from those connected to other phases by means of rigidly fixed screen or barriers. A suitable warning notice shall be displayed close at hand to warn of the presence of phase to phase voltage.

8.6 Switch Socket Outlets

Switch socket outlets shall be to Singapore Standard SS 145 single pole 13 Amp. 3 rectangular pin switch shuttered outlets, one or two gang suitable for indoor or outdoor service, surface or flush mounting according to locations where these socket outlets are to be installed.

Switches shall be of the quick make, slow break type with silent, totally enclosed switch action and solid silver alloy contacts. Switches socket outlets for indoor use shall be housed in suitable galvanised steel boxes to BS 4662 with conduit knockouts. Types and finishes of switch socket outlet plates for various areas shall be as specified for the lighting switches.

Switch socket outlets located in exposed situation shall be non shuttered, single-pole 3 round pin to BS 546, diecast zinc alloy weatherproof type with 25 mm E.T. screwed conduit entry,

rated at 13 Amp or 15 Amp as appropriate complete with protective captive screw-on cap to cover the socket orifice when not in use, similar to Legrand Cat. No. 081078 or 081031.

15 Amp switch socket outlets shall be 3 pin round type to BS 549 shuttered, of a finish similar to 13 Amp switch socket outlets and mounted in flush steel conduit boxes. 32 Amp, single phase switch socket outlets where used shall be 3 pin round type to BS 546 similar to MK 9369 BLU.

32 Amp, three phase switch socket outlet shall be 4 pole 5 wire 500V complete with equipment grounding and power interrupting locking devices. The receptacles shall be heavy duty moulded of polycarbonate, positive locking and cannot be pulled apart accidentally as similar to MK 9362 RED.

Generally switch socket outlets shall be positioned 300mm above floor level except in mechanical plantrooms, electrical switchrooms, etc. where they shall be positioned 1400mm above floor level or 150mm above counters or benches whichever is suitable. Switch socket outlets intended for mounting at high level shall be at such positions to suit the equipment served.

Switch socket outlets associated with essential supplies shall be provided with red toggles.

Samples of all switch socket outlets and a schedule showing the type of switch socket outlets to be installed at all locations shall be submitted to the Architect for review prior to placing orders.

8.7 Plugs

Each weatherproof switch socket outlet shall be provided with a weatherproof plug of the same manufacture. The plug shall be housed in an alloy case with clamping ring and screw down compressible gland capable of accommodating a flexible TRS 3 core cable of dimensions appropriate to the current rating of the plug.

8.8 Fused Connection Units

Fused connection units shall be of unswitched type each comprising a fuse carrier fitted with a 5 Amps cartridge fuse-link to SS 403 and BS 1363, an outlet for connection of flexible cord up to 2.5mm^2, 3 core, terminal block, etc. Each connection unit shall have a built-in safety shutter which closes over the live contacts immediately the fuse carrier is withdrawn. The carrier shall be secured firmly in position by a screw but automatically withdraws from the live socket as the screw is released. The connection units shall be of flush wall mounting type and housed in suitable galvanised steel boxes to BS 4662 with conduit knockouts. The finishes of fused connection units used at the various areas shall be as specified for the lighting switches.

8.9 Isolating Switches

Isolating switches (switch disconnectors) shall be manufactured to BS EN 60947-3 (Utilisation Category AC 23A) of either 2 pole or 4 pole type and shall be of the totally enclosed pattern, polycarbonate with positive quick-make and quick-break action.

Switch handles shall be interlocked to prevent opening the cover with the switch 'ON' and the covers shall be provided with gaskets, and rated for IP 66 similar to MK 4400 series.

Isolating switches shall generally be mounted at a height of 1400 mm.

Switch disconnectors for use in distribution boards shall be of the MCB styled similar to MK 5500 series or equivalent.

8.10 Cooker Control Units

Cooker Control Units shall be flush mounted conforming to BS 3676 having a double pole AC switch rated at 30 Amps complete with pilot indicating lamps and a self adhesive plastic identification label mounted on removable chassis contained within a steel box finished aluminium stove enamel provided with conduit knockouts and earthing terminals. The cover plates shall be of the same finish as those specified for the lighting switches, similar to MK Cat. No. G5105 WHI, or equivalent.

Associated connector units similar to MK Cat. No. 5045 WHI or equivalent shall be provided with the cooker control units.

8.11 Shaver Outlets

Shaver sockets shall comply with BS 3535 and shall comprise a 20 VA continuously rated double would isolating transformer to provide an earth-free a.c. supply at mains frequency, complete with self resetting thermal overload device filled in the primary circuit, an insulated voltage selector switch to provide either 115 or 230 volts output, one ON/OFF switch and one universal socket outlet suitable for British, American, Continental and Australian razor plugs, all contained in a recessed sheet steel box with insulated moulded front plate suitable for flush mounting and suitably inscribed to give a clear indication of the voltages available at the outlet and the service of the outlet.

8.12 Switch Panels

Switch panels shall be the wall mounted type fabricated from sheet steel of at least 18/20 swg as required by the Architect. The panels shall be of similar construction/finish as the distribution boards, each complete with hinged door, panel mounting switches (flush type) of appropriate current and voltage ratings, phase barriers, warning signs, neon indicators and label for each switch, circuit diagrams secured as per distribution boards and wiring to the items on the hinged panel shall be so arranged that the panel can be easily opened without straining the cables. Working drawings of the switch panels shall be submitted to the Architect for review before fabrication.

8.13 Radio Interference Suppression

Certain types of electrical equipment or systems involving sudden changes, or low frequency or of direct electric current such as contactors etc., supplied and installed under this Sub-Contract shall be fitted with radio and television interference suppression components suitable to meet the levels specified in BS 800.

8.14 Lighting Control Dimmers

Lighting control dimmer where called for shall be the solid state, variable load, thyristor controlled type suitable for controlling fluorescent or incandescent lighting circuits operating at 230V +/- 6%, 50 Hz, single phase a.c. supply. Each dimmer shall be fully rated to carry the circuit loads continuously at any intensity level. The lighting intensity shall be controlled by means of a knob or lever on the cover of the unit which shall provide smooth, even control of light from full brightness to moonlight glow. The units shall be suitable for surface mounting finished matt chrome with white circular or linear scale indicating the degree of brightness. Each dimmer shall be fitted with TV and radio interference suppressor. The dimmers shall be suitable for multi-phases connections and operation.

8.15 Ceiling and Wall Bracket Fans

Ceiling fans where called for shall be supplied with hook of the heavy duty type complete with rubber bush and suspension rod of adequate diameter and appropriate length. Safety pin shall be provided to prevent any loosening of bolt and nuts or screws due to vibration.

Bracing of the rods at certain height and at both directions (lengthwise and breadthwise) to prevent wobbling where it is deemed to be necessary.

Motors shall be suitable for 230 volt 50 Hz operation and of the multi-pole type with windings to Class E insulation. The casing shall be glass fibre reinforced polyester with flame retardant properties to local Authorities approval. Single or multiple regulators shall be provided as shown on the Specification Drawings.

Blades shall be appropriately trimmed and corrosion free of the highest quality aluminium with epoxy polyester-coated for durability, white finish and of heavy duty gauge.

Regulator for wall bracket fan shall be an integral part of the fan and with control for oscillating complete with three (3) speed and pull cord on/off switch.

8.16 OG Boxes

The weatherproof OG box shall be of hot moulded glass fibre reinforced polyester (GRP) of high impact strength of 80 kj/m sq with a rainhood top. The door shall be mounted on internal hinges with five points latching system to IP 55. The total insulation shall comply with BS EN 60439-1 and IEC 60439 to withstand an ambient of 150^{o}C. The OG box must be corrosion-proof, resistance against UV-light, chemicals, corrosive atmosphere, louvres with screen, etc.

The OG box shall be rigidly secured to its concrete base c/w PVC lead-in pipes, keys (3 sets), padlocking type of handle etc. colour and finish to be agreed by the Architect.

8.17 Automatic Sensing Switch

Automatic sensing switch shall comprise movement presence detector, timer controller, relay unit and other necessary items as required for automatically switch on or off the lighting and air conditioning system after the controlled area is left unoccupied for a preset length of time (adjustable).

(a) Presence Detectors

Presence Detectors shall employ a combination of 2 detectors using passive infrared and microwave detection technologies to provide wide coverage including a look-down zone.

Each detector operates independently and the alarm relay does not activate unless both sensors agree that there is an alarm. It should employ adaptive signal processing to adjust to background disturbances to reduce false alarms without sacrificing the ability to respond to the intruder. An externally visible alarm LED shall be provided to indicate the status of each detector independently.

The microwave circuit shall be fully supervised and should it fail, the infrared subsystem will provide single technology detection. The detector shall be able to distinguish between signals caused by humans and pets. Disturbances caused by drafts and insects should not cause the detector to operate. The detector should

also be able to adjust its sensitivity to identify human intruders at critical temperatures.

The detector should be easily mounted on a flat wall, at the junction of two perpendicular walls and on the ceiling with a ceiling mounting bracket. Where the detector has to be mounted in positions other than an upright position, proprietary mounting brackets should be used to rotate and swivel the detector.

(b) Timer Controller and Relay Unit

The timer controller and relay unit shall comprises time delay circuit and power relays suitable for switching 230V inductive circuit of current rating to suit the connected load. The time delay circuit shall be adjustable from 15 seconds to 15 minutes. An auxiliary NO/NC voltage free contact shall be provided for connection to the fan coil unit control circuit.

The Work shall include the proper selection of the most appropriate presence detector to enable detection of the complete controlled area. Where necessary, more than one single detector operating in parallel shall be provided in order to achieve detection of the complete area.

8.18 - 8.20 Not Used

8.21 Conduit Installation

Conduit installation for final circuits shall be in accordance with that specified for sub-mains distribution.

8.22 Wiring

The final circuit wiring for lighting and power within building shall be carried out using PVC circulated or FR cables as follows:

(a) wirings within the false ceiling spaces, riser ducts, electrical switchroom, substation, mechanical plant and the like shall be in surface G.I conduits/trunkings.

(b) wirings in staircases, apartment units (where applicable) and all common areas shall be in concealed PVC conduits, i.e. PVC conduits buried or cast in wall plasterings, columns concrete walls/slabs etc.

8.23 Photoelectric Switches

The rated voltage of the photoelectric switches shall be 230V and the rated current 20 Amp unless otherwise specified. Auxiliary contacts shall be provided for monitoring purpose.

The contact of the photoelectric switch shall be used to control environmental lighting and shall close at 30 lux general lighting level and open at 100 lux general lighting level. The triggering levels should be adjustable to a minimum of +30% of the nominal lighting level specified. A time delay circuity shall be incorporated to prevent switching on and off due to transient conditions.

The photoelectric switch shall be weatherproof and complete with mounting bracket.

8.24 Telephone Distribution System

The telephone distribution system shall comprise cable trays, cable ladders, and GI/UPVC conduits as shown on the Specification Drawings.

Telephone cable trays shall be similar to those specified elsewhere in this Specification for lighting and power system. The horizontal trays shall be supported from the floor slabs using proprietary framing system similar to 'UNISTRUT' to carry a minimum load of 200kg per linear metre run. The supporting hangers shall be spaced at intervals of not more than 1000mm apart and so designed that free access, unobstructed for the entire cable tray route, is possible from one side of tray, for any cable tray. Cable ladders in the telephone riser ducts and from the lead-in pipes to the MDF Room and to the telephone riser ducts shall be constructed to Infocomm Development Authority of Singapore (IDA)'s approval. Conduits shall be supplied and installed similar to those specified elsewhere for lighting and power system. Pull boxes be provided where necessary to facilitate wiring installation; further, nylon draw wires acceptable to Infocomm Development Authority of Singapore (IDA) shall be provided for all telephone conduits between every two pull boxes. Telephone cable trays and ladders shown on the Specification Drawings shall be used exclusively for the telephone service.

The telephone cable trays shall generally be installed at 300 mm below all other services but at 150 mm above the false ceiling panels to Infocomm Development Authority of Singapore (IDA)'s approval. Details of the telephone tray, ladder and conduit layouts shall be submitted to Infocomm Development Authority of Singapore (IDA) and the Architect for review before commencement of installation.

8.25 Telephone Distribution System (Pre-Wiring System)

8.25.1 General

The telephone distribution system shall comprise the following:

(a) Cable trays and or cable ladders from the incoming lead-in pipes to MDF room and Telephone Equipment Room (TER) and from MDF rooms and TER to the telephone risers; multi-cable transit (MCTs) where indicated will be provided by the builders.

(b) Vertical cable trays and ladders within the telephone risers.

(c) Distribution cabling from Intermediate Distribution Frames (IDFs) & Final Distribution Point (FDP) including terminations and connections.

(d) Final cabling from FDPs to the telephone outlets c/w telephone socket, including terminations and connections.

(e) Telephone cable trays, ladders, trunkings, conduits with draw wires, junction boxes, telephone outlet boxes, etc.

(f) IDFs, FDPs, distribution cases, block terminals.

(g) Telephone earthing system

The telephone distribution system shall be installed by installers and contractors who are licensed by Infocomm Development Authority of Singapore (IDA).

Telephone cable trays shall be the cable trays specified elsewhere in this Specification. The horizontal trays shall be supported from the floor slabs using proprietary framing system similar to 'UNISTRUT' to carry a minimum load of 200 kg

per linear metre run. The supporting hangers shall be spaced at intervals of not more than 1000mm apart and so designed that free access, unobstructed for the entire cable tray route, is possible from one side of tray, for any cable tray. Cable ladders in the telephone riser ducts and from the lead-in pipes to the IDF/Rooms and to the telephone riser ducts shall be constructed to Infocomm Development Authority of Singapore (IDA)'s approval. GI/UPVC conduits shall be supplied and installed similar to those specified elsewhere for lighting and power system. Pull boxes shall be provided for all telephone conduits between every two pull boxes. Telephone cable trays and ladders shown on the Specification Drawings shall be used exclusively for the telephone service. The telephone cable trays shall generally be installed at 300mm below all other services but at 150mm above the false ceiling panels to Infocomm Development Authority of Singapore (IDA)'s approval. Details of the telephone tray, ladder and conduit layouts shall be submitted to the Architect for review before commencement of installation.

All telephone riser floor openings shall be sealed effectively with suitable fire rated material to the requirements of the Local Authority.

8.25.2 Codes of Practice, Rules & Regulations

The complete telephone distribution system installation shall comply with the current editions of the following Codes of Practice, Standards, Rules and Regulations of the various Authorities:

(a) IDA's Code of Practice for Infocommunications Facilities in Building (COPIF)

(b) British Post Office Telecommunications Specifications:

(i) BPO CW 1293

(ii) BPO CW 1236

(c) Federal Communications Commission Specification Part 68 Subpart F.

8.25.3 Distribution Cases

Generally, IDFs take the form of distribution cases with larger capacities; while FDPs take the form of smaller distribution cases, boxes or block terminals and with smaller capacities.

Distribution cases shall be provided at the locations to Infocomm Development Authority of Singapore (IDA)'s requirements. Each distribution case shall have a capacity sufficient for the number of extensions connected thereto plus at least 30% spare unless otherwise stated.

The distribution cases shall be constructed of heavy gauge moulded PVC and shall be compact in arrangement/appearance. Labels shall be provided on the front cover of each distribution case. The terminal blocks shall be identified with coded ferrules.

Cables shall be bundled and secured. The distribution cases shall be constructed and labelled to the satisfaction of the Architect's and Infocomm Development Authority of Singapore (IDA)'s approval.

The IDFs and FDPs standard shall fully comply with BPO Standards and/or Infocomm Development Authority of Singapore (IDA)'s requirements.

8.25.4 Intermediate Distribution Frame (IDF)

The intermediate distribution frame (IDF) for terminating local cables as provided shall be of terminal capacity to suit the Infocomm Development Authority of Singapore (IDA)'s requirements.

The IDF shall be of the steel frame, floor mounted, free standing of not more than 2m high, constructed of galvanised mild steel to BPO Standards or Infocomm Development Authority of Singapore (IDA) Standards, whichever appropriate to Infocomm Development Authority of Singapore (IDA)'s approval.

The IDF shall be equipped with soldering tag-blocks and test jacks on the incoming side and soldering tag-blocks/screw terminal blocks/sleeve contact blocks and fused together with cartridge fuses on the outgoing line's side. There shall be sufficient quantities of these items to cater for the number pairs of IDF specified.

The incoming side and the line shall be incorporated with gas-discharge over voltage protectors of either twin-electrode or triple-electrode type.

A 25mm x 6mm tinned copper earth bar of 2m length shall be mounted on and along the full length of the IDF at 300mm above the finished floor level for earthing the telephone services. All earth connections in connection with the telephone services shall be extended from this earth bar.

All outgoing local cables shall be terminated and connected into the IDF including all necessary jumpering and labelling of the tagged or terminal blocks.

All the terminals, wires, etc. shall be fully marked, labelled and identified 'As built wires record' to the satisfaction of the Architect shall be submitted.

The IDF shall be earthed as specified hereunder.

All incoming local cables being installed underground in pipelines and manholes from the MDF shall be terminated and connected to this IDF by others.

8.25.5 Final Distribution Point (FDP)

The final distribution point (FDP) for terminating local cables on the incoming side and connecting internal wires on the outgoing side as provided shall be appropriate terminal capacity.

The FDP shall be constructed of heavy gauge moulded PVC with cover. The terminal blocks shall be provided with labels, markings, identifications, etc. The FDP shall be earthed as specified. All FDPs shall be of a type approved by Infocomm Development Authority of Singapore (IDA).

8.25.6 Telephone Cable Terminations

Cable terminations shall be carried out by Infocomm Development Authority of Singapore (IDA) Licensed Installators/Workers. Each cable pair at the IDF, telephone outlet and block terminal ends shall be appropriately labelled to enable identification of cable pairs.

Cable terminations to all distribution cases shall be securely fastened close to the box with cable sheaths butt close to the entry inside the box. Cables shall be left with at least 12mm loops neatly arranged just before the screw terminals. Where practicable, all cables shall enter the box from one direction and leave from another.

8.25.7 Telephone Distribution Cabling

Wiring of the entire system from the IDF up to telephone socket outlets shall be provided.

All the necessary cable trays, ladders, pipes, etc. to Infocomm Development Authority of Singapore (IDA)'s approval to facilitate running of the extensions and exchange lines to the IDF Room and the whole telephone distribution installation as specified herein shall be provided.

All distribution cables shall comply with BPO CW 1293 and to Infocomm Development Authority of Singapore (IDA)'s cable specifications as stipulated in the IDA's Code of Practice for Infocommunications Facilities in Building (COPIF)

8.25.8 Telephone Earthing System

An independent and complete earthing system consisting of copper conductors, conduits, electrodes, etc. and all accessories for the telephone system shall be provided as shown on the Specification Drawings. The earthing system and the resistance value to be attained must not exceed one(1) Ohms.

The minimum size of the earthing cable shall be 56 sq. mm and the cable insulation shall be green PVC. Earth terminations comprising electrodes, test clamps, inspection chambers and covers, etc. shall be provided.

All earth conductors from the main earth bar in the IDF to the telephone apparatus socket shall be 2.5 sq. mm PVC green copper cables run in G.I. conduit or clipped on edge of cable tray or rack at distances less than 300mm. One safety tag with the words "TELEPHONE EARTH - DO NOT REMOVE" shall be securely fixed to each point of the earth electrode. The label shall be of metal and letters shall be engraved and of a size of at least 6mm high. This label shall be clearly visible on opening the chamber cover.

8.25.9 IDF/FDP Cable Records

At least 4 copies of cable record cards shall be provided supplying the information in tabular form from the vertical and pair terminals from which the incoming cable is fed and to which the outgoing cables are distributed. Where pairs are jumpered between verticals, the vertical records shall give the appropriate cross-reference.

All entries on record cards shall be as specified for the extensions.

8.26 Telephone Outlets

Telephone outlets where called for shall be single or twin of the flush mounted type suitable to receive the plug-in telephone cable lead to the approval of Infocomm Development Authority of Singapore (IDA). The finishes of the telephone outlet plates at various areas shall be as specified for lighting switches.

The modular socket shall be in accordance to Federal Communications Commission Specification Part 68 Sub-part F.

Only approved types of telephone sockets of a recessed type, purchased from Infocomm Development Authority of Singapore (IDA) or Infocomm Development Authority of Singapore (IDA) Licensed Dealers or Suppliers shall be used for this installation.