CODE OF PRACTICE 101

FOR

DISTRIBUTION SUBSTATION DESIGN

Version 16

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APPENDIX

Note: COP 101 Version 16 is available on CLP Power web site.

1. INTRODUCTION

This Code of Practice provides the details of general principles to be applied to the design of distribution substations, including substations located at ground floor, basement, upper floor level (including at high level in high rise building) and outdoor areas. For substations situated in a special environment, special designs may be adopted subject to the approval by CLP Power.

2. OBJECTIVES

The objectives of this Code of Practice are to ensure all distribution substations provided by the customers or building owners are designed to the same standard, and fully comply with the statutory requirements of Fire Services Department (FSD), Buildings Department (BD) and those requirements of CLP Power.

Other than the above statutory requirements, this Code of Practice is to be read in conjunction with other relevant Ordinances, Regulations and Codes of Practice published by the Hong Kong SAR Government. In case there are discrepancies between the requirements stipulated herein and the other Ordinances, Regulations and Codes of Practice, the more stringent requirement shall prevail.

The requirements in this Code of Practice may be changed as new equipment becomes available, new technologies are developed or because of new requirements from FSD, BD or CLP Power.

3. PROJECT MANAGEMENT

3.1 Acquisition of Substation Site

Bearing in mind the difficulties likely to be encountered in acquiring a substation site once a development has been completed, careful consideration must be given at the initial design stage whether or not to request for a substation site.

3.2 Main Considerations

Considerations should be given to the following points when designing a substation:-

3.2.1 Distribution substations shall be planned having in mind the future loading and development of the area.

3.2.2 Many of the requirements are associated with the safety of the operational personnel, the public and the equipment. Priority shall be given to safety.

3.2.3 The maximum number and types of plant to be accommodated.

3.2.4 Personnel access and equipment access (including power cables).

3.3 Approval of Drawings

3.3.1 Substation layout plans prepared by the building owner / customer's agent (e.g. architects or consultants) shall be submitted for the approval of the Principal Manager - Planning and Design of the relevant Region of CLP Power. Regional boundary map in the Appendix A shows the geographical demarcation and contacts of the Regions in CLP Power supply area.

3.3.2 Standard (or typical) substation layout plans submitted by the Hong Kong Housing Authority shall be approved by the Head of Asset Strategy of the Asset Management Department, CLP Power.

3.3.3 The submitted drawings shall be in both hardcopy and softcopy format. The softcopy shall be in .dwg format and compatible to AutoCAD® 2007 version or later version accepted by CLP Power.

4. ELECTRICAL EQUIPMENT IN DISTRIBUTION SUBSTATION

4.1 General Arrangement

4.1.1 Distribution substation mainly consists of high voltage equipment including high voltage gas insulated switchgear (GIS) or air insulated switchgear (AIS), distribution transformer and associated auxillary equipment. Distribution substation can also be named as transformer room where transformer(s) are installed. High voltage switchgear room is for substation where only high voltage switchgear panels are installed.

4.1.2 Substations shall normally be equipped with non-flammable silicone fluid filled transformers or equivalent as a standard to avoid the need for a fixed fire fighting installation for the substation.

4.1.3 CLP Power will also consider to adopt other non-standard transformer (e.g. slim type transformer) by considering the site conditions and location of the substation where transportation issue is encountered subject to the approval by CLP Power.

4.1.4 For single development with only one transformer, the rating of transformer will be limited up to 1.5MVA.

4.2 Types of Electrical Equipment

4.2.1 A substation shall normally accommodate the following equipment.

HV switchgear	- This normally consists of the total number of panels required for the particular project plus one spare panel for future purpose.
Distribution transformer	- One to three transformers as required.
LV board	- One to two boards per substation with one transformer. - One to two boards per substation with two transformers. - Two to three boards per substation with three transformers.
LV capacitor bank	- One per transformer.
LV fuse cutout unit	- One per LV capacitor bank.
30V battery and charger	- One for 5 or less HV switchgear panels. Two for more than 5 panels.
Pilot marshalling box	- Two per substation.
Fibre optic marshalling box	- Two per substation.
Remote terminal unit	- Consists of Customer Remote Terminal Unit (CRTU) and Low Voltage Remote Terminal Unit (LRTU). One to two for each type per substation.
HV Meter Board	- One per substation for HV metering / summation metering facilities

4.2.2 The number of LV boards in a substation will normally be one to three units. The LV boards will be connected to other substations by LV cable interconnectors in order to improve the reliability of the LV supply to customers. Principal Manager - Planning and Design will determine the number of LV boards and LV cable interconnectors to be installed for the substation.

4.2.3 The battery/charger unit, pilot marshalling box, fibre optic marshalling box and remote terminal unit shall be wall-mounted.

4.3 Equipment Dimensions, Weights and Operation Space

Due to the variety and continuous improvement of equipment in feature and safety, the type of equipment and hence its dimensions and weight may vary from time to time. The substation layout is subject to the equipment being used.

In general, the minimum clearances and safe operating areas required around the electrical equipment shall be :

HV switchgear	- 1000mm at the back of the panels. - 1800mm in front of the panels. - 750mm on the other two sides of the switchboard.
Distribution transformer	- 900mm around the LV terminals. - 750mm on the other sides.
LV board	- 1000mm in front of the board. - 750mm on the sides where cables turn in and out. - The cable trench edge shall be 120mm from wall. - Two wall mounted eye bolts with safety loading of 1 ton shall be provided at 2.7m above floor level.
LV capacitor bank	- 750mm in front and 200mm on two or rear sides.
LV fuse cutout unit for LV capacitor bank	- 1000mm in front of cutout.
Remote terminal unit	- 1000mm in front of the unit. Maximum 20m wiring distance between LV board and CRTU / LRTU.

4.4 Foundations

4.4.1 The transformer foundation/plinth shall be capable of supporting a minimum load of 9000kg. The minimum loading of the passage for delivery of the transformer from the unloading point to the transformer plinth shall be sufficient to support the transformer weight. Normally, the transformer is supported by two metallic frames in form of channels or inverted U-channels or four steel wheels which stand on the transformer foundation/plinth. The plinth strength shall be adequate to stand for the pressure imposed by transformer base channels or wheels.

4.4.2 In case there is requirement to maintain a low noise environment for sensitive receivers under customer's duty, the building owner/ customer may adopt an option for constructing a transformer plinth with vibration isolation pads, according to typical design provided in drawing T-COP-10250-D-E33-0103-48.

4.4.3 The minimum dimensions of the transformer plinth should be 1.8m long x 1.35m wide and level with finished floor level. Actual plinth size is subject to the transformer rating and type.

4.4.4 The HV switchgear foundation shall be capable of supporting a maximum static plus dynamic load of 17kN per panel. The minimum cover between the finished floor level and the reinforcement bar of the foundation shall be 80mm. The floor surface shall be flat and within a tolerance of 1mm in 1000mm.

4.5 Earthing Design for Electrical Equipment

4.5.1 Earthing design for the electrical equipment shall be in compliance with CLP Power earthing standard. The designer or builder of the distribution substation should coordinate with the Principal Manager - Planning and Design of CLP Power for the provisions of earthing installation.

4.5.2 For the connection of CLP Power earthing network outside the distribution substation, the earthing bars which are provided and installed by the building owner for the distribution substation shall be extended to the first earthing draw-pit at the periphery of the premises area. Earthing draw-pits and related pipe ducts should be provided along the CLP Power supply cables within the private area managed by the building owner / property manager.

4.5.3 For ground floor substation directly accessible to open space, a layer of 150mm thick crushed rock shall be provided within a distance of 1500mm as sub-base material from the external wall of the substation. For other substations, floor finishes within a distance of 1500mm directly outside the substation entrance / exits shall follow the requirement as stated in clause 5.1.12.

4.6 Equipment for Metering at High Voltage Supply

When metering of high voltage supply is used, additional space and building provisions shall be required in the substation for accommodating the HV metering equipment. The building owner shall agree with CLP Power to provide enough space and provisions in the substation.

5. ARCHITECTURAL/CIVIL DESIGN

5.1 General Requirements

5.1.1 All substations shall comply with the Hong Kong Electricity Ordinance (Cap. 406), the Hong Kong Buildings Ordinance (Cap. 123) and the "Fire Services Requirements for Consumer Substations using Oil Filled Transformers and Switchgear in Buildings" (latest version of NP 101), Part X of FSD Circular Letter no. 4/96, Part X.2 of FSD Circular Letter no. 5/98 and the related Codes of Practice on Fire Services.

5.1.2 Substations shall be situated at the periphery of the building and be accessible at all times. For substations on ground level, the access route should be directly from open air (non-covered area). Such area should be vertically uncovered and unobstructed. In case the periphery is covered by the canopy of the building, the direct distance from the entry of the substation to the non-covered area should not exceed 2.5m. The permanent access to the substation shall be of adequate height, width and of sufficient strength to accommodate the size and weight of both the transformer and the conveying vehicle. The minimum width for plant delivery shall not be less than 3 meters taking into consideration the size of the major electrical plant such as transformers and switchgear being used, and the substations shall not be located more than 20m away from the nearest loading/unloading area.

5.1.3 For substation location exposing to the risk of flooding such as near an inclined road, slope and sea front, or locating at low principal datum (PD) level, less than 4.4mPD at Victoria Harbour or 5.5mPD at Tolo Harbour, the following anti-flooding measures shall be considered to prevent flooding of the substation:-

Description	Anti-Flooding Measures
New substation near inclined road, slope, sea front or located below the level of public street	Developer should change the location of substation from ground floor to upper floor or, retain the ground floor location with provision of one basement level below the substation, associate drainage system, sump pump facilities and flood gates subject to approval by CLP Power.
New substation outside pavement level reach **4.4mPD** at Victoria Harbour or **5.5mPD** at Tolo Harbour	Not required

Description	Anti-Flooding Measures
New substation outside pavement level reach between **3.8 ~ 4.4mPD** at Victoria Harbour or **4.9 ~ 5.5mPD** at Tolo Harbour	Install sump pump and a high water level detector facilities and flood gates. 600mm Flood gates should be installed in substation to prevent water ingress from door or low level louvre.
New substation outside pavement level below **3.8mPD** at Victoria Harbour or **4.9mPD** at Tolo Harbour	Developer should raise the substation floor level/change the location of substation from ground floor to upper floor

5.1.4 The layout shall be designed to be adequate for the lifetime of the substation and the ultimate quantities of electrical equipment to be installed such that any civil work in the substation can be avoided or will be minimal when additional electrical equipment is necessary to install.

5.1.5 The substation minimum clear headroom shall be:

- 3.3m above ground for substation without transformer.
- 3.6m above ground for substation with transformer and 630mm diameter exhaust fan.
- 3.8m above ground for substation with transformer and 800mm diameter exhaust fan.

The recommended maximum ceiling height is 4m but subject to the required clearance of lifting hoist on the ceiling if provided.

5.1.6 The substation ceiling and customer main switchroom ceiling shall be of suitable waterproof construction to prevent water leakage. No water pipe, drainage pipe or customer's installation shall be located in the substation or located in and passing through any part of and inside the ceiling slab of the substation. Decorative structure / add-on material applied on the ceiling surface of the substation will not be allowed.

5.1.7 To avoid water seepage / leakage into the substation from the floors above the substation, double slab ceiling with waterproofing construction and drainage system or equivalent design shall be constructed by the building owner / customer of the substation. The double slab ceiling or equivalent design shall first be agreed with CLP Power and shall be approved by the Authorized Person (AP) (as defined under the Buildings Ordinance) of the developer and/or the building owner of the substation.

5.1.7.1 The developer and / or the building owner of the substation is recommended to follow the standard requirement of double slab, which headroom of 1000mm under slab and 600mm underneath beam. However, in case the developer has encountered specific site difficulties and with substantiation provided such as:

1) site constraint;
2) height restriction;
3) tight construction programme.

The following alternative solutions will also be accepted by CLP:-

i) Transfer slab with minimum thickness of 1000mm;
ii) minimum 600mm under slab

5.1.7.2 There shall be no left in timber formwork inside the void after casting the concrete to avoid breeding of organisms.

5.1.7.3 Other alternative arrangements proposed such as light weight ceiling / non-structural double slab with water proofing are required to be substantiated by the developer with life time performance not worse than double slab design for CLP consideration.

5.1.8 No civil expansion joint shall be located in any part of the substation.

5.1.9 Not more than 3 transformers shall be accommodated within any one transformer room.

5.1.10 Ground level substations should be at least 150mm higher than the outside (pavement) level to reduce the risk of flooding.

5.1.11 Substation walls shall be made of reinforced concrete or concrete block of BS 6073 Part A with a compressive strength of not less than 20N/mm^2. The wall and the ceiling should be cement and sand plastered. Two coats of liquid applied waterproofing coating and two coats of light grey epoxy dustproof coating should be applied at bottom 1500mm high of the wall. Above 1500mm height, the wall and the ceiling should be finished with one coat of liquid prepolymer sealing and two finishing coats of white acrylic resin based coating in glossy finish.

5.1.12 The substation floor should be cement and sand rendered with trowelled smooth finish and painted with one coat of polyurethane sealer and two coats of grey epoxy dustproof coating, which dielectric strength property shall not be less than 20kV/mm. The total thickness of two coats of epoxy dustproof coating shall not be less than 1mm. For the floor finish outside substation, sub-base material shall be crushed rock with 150mm thickness.

5.1.13 When single core cables are used for the connection between the HV/LV transformer LV terminals and the customer's switchgear, the customer main switchroom should be immediately adjacent to, above or below the substation. Cable sealing to 2-hour fire resistance rating (FRR) by 'Multi-Cable Transit' (MCT) system shall be used.

5.1.14 The openings for cable inlet shall be properly sealed by CLP Power so as to prevent water ingress into the substation and be of 2-hour FRR construction. The method of sealing shall be referred to CLP Power's duct sealing standard.

5.1.15 For laying of temporary supply cables from the substation, a 150mm x150mm through wall opening at high level on the perimeter wall of the substation shall be provided. The opening shall be sealed by removable stainless steel cover with waterproof gasket. The cover shall be fitted on both inside and outside of the substation.

5.1.16 All external steelwork shall be stainless steel of the low carbon type, Grade 316L (Japanese SUS 316L or US AISI 316L). This specification applies to all doors, door frames, louvres, rat guards, etc. The stainless steel substation door should not be painted to avoid maintenance due to aging of the painting.

5.1.17 Internal steelwork (air trunking hangers, chequer plate, etc.) should be hot dip galvanised and finished with one coat of calcium plumbate or zinc phosphate primer and two finishing coats of grey synthetic paint.

5.1.18 Adequate ventilation to open air by means of permanent installation which is completely segregated from ventilation system of the main building should be provided.

5.1.19 A recess for sump pump in the deepest cable trench shall be constructed for placing the sump pump to extract water in the cable trench when necessary.

5.1.20 No storage of transformer insulant or switchgear insulant is allowed in the distribution substation or customer main switchroom.

5.1.21 The typical distribution substation layouts in this Code of Practice should be used whenever possible.

5.1.22 Black/Yellow colour stripes shall be painted on the edge/step where floor level change.

5.1.23 When stair is built for accessing the substation, handrailing shall be installed along the stair and the stair nosing (the front edge of the stair step) should use durable yellow colour tile or shall be painted by durable yellow colour reflective paint.

5.1.24 Adequate exit signage and emergency lights in compliance with the relevant BD, FSD regulations shall be provided along the emergency exit route of distribution substation.

5.1.25 For substation areas exposing to potential risk of falling, include but not limit to cable riser room, side wall opening or floor opening in upper floor substation, and ceiling opening in basement substation, precautionary measures in accordance with the following hierarchy shall be adopted in design stage :-

(i) Areas with falling hazard shall be protected by engineering control measure, such as permanent working platform, reinforced concrete cover, stainless steel fencing with proper guardrails, side wall opening with metallic gate/door/fencing etc.

(ii) For access to areas as mentioned above where provision of engineering control measure could not be maintained in working stage, fall restraint system shall be provided.

(iii) Fall restraint system consists of anchor point(s) which is capable of supporting at least 600kg (6kN) per person per anchor point to control or restrict the travel distance of person wearing a full body harness attached to anchor point from reaching the nearest edge of falling hazard. Fall restraint systems shall be positioned more than 2m from the falling hazard/edge. Typically worker shall connect a lanyard with fixed length of 1.8 metres to the anchor point(s) of the system.

(iv) When provision of fall restraint system is not reasonably practicable, fall arrest system shall be provided as the last resort.

5.2 Additional Requirements for Basement Substations

In general, basement substation would not be acceptable due to concerns of flooding risk. Basement substations would only be considered under the condition that there is no ground floor area available in the new development.

5.2.1 Basement substations shall be directly accessible from the open air at ground level by a separate and independent staircase.

5.2.2 Multiple substations on the same floor and are in close proximity may share one separate and independent staircase(s) leading to ground level in lieu of one staircase for each substation.

5.2.3 When the staircase or access route from the exit of the basement substation to ground floor is longer than 10m of travel, adequate natural or mechanical ventilation installation shall be provided. (For details, refer to the Section on Ventilation Design in this COP)

5.2.4 Basement substations should be located at maximum one level below the ground floor to reduce the risk of flooding, and at the same level

or above the customer main switchroom. Under the substation, there should be at least one accessible basement floor where adequate drainage system is installed to prevent flooding.

5.2.5 A protected lobby with self-closing doors fitted with panic bolt leading to the adjacent communal area of the building shall be provided.

5.2.6 A vehicular access leading from street level to the substation should be provided for equipment delivery.

5.2.7 Emergency exit route diagram shall be provided in the substation.

5.2.8 Subject to the configuration of the HV supply network, provision of a HV switch room(s) on ground level will be required as a switching substation for the HV cables supplying the building.

5.2.9 A fan room should be provided at ground level for accommodating the ventilation fans for the substation. Access and adequate working space shall be provided.

5.2.10 A suitable damp-proof course shall be provided on the outside of all external walls which are below ground level to separate the substation from unexcavated ground.

5.2.11 A sump pit with sump pump of minimum pumping capacity of 3 litres per second and sufficient head and removable covers shall be provided. A high water level detector shall be fitted in the sump pit to raise an alarm inside the substation and shall activate the substation monitoring alarm system. A drainage pipe with valve shall be provided to drain water in the sump pit to the building drainage system.

5.2.12 A change-over switch shall be provided for the sump pump so as to operate from the customer's supply when necessary.

5.2.13 Flooding alarm light shall be provided at each access point of the basement substation.

5.2.14 An automatic and manual control for the sump pump start/stop shall be provided. A normally open voltage free contact for the flooding alarm is required for substation monitoring alarm system by Distribution Automation. This alarm contact shall be provided in a weatherproof enclosure to IP55 located in the substation.

5.2.15 Alternative access by a lift in the public area inside the building shall be provided for operational and maintenance purpose.

5.3 Additional Requirements for Upper Floor Substations (maximum fifth floor or maximum 17m above ground level)

5.3.1 Upper floor substations should be located at the periphery of the building. Substations should be directly accessible by a separate and independent staircase.

5.3.2 The access and exit route of the upper floor substation shall always lead to the ground level of the building. Any lockable door, gate, barrier along the route shall be avoided.

5.3.3 A protected lobby with self-closing doors fitted with panic bolt leading to the adjacent communal area of the building shall be provided.

5.3.4 Clear, durable signage to indicate the location of the substation in the building shall be displayed at suitable places to guide personnel to access the substation. The layout of the signage shall be agreed by CLP Power. Emergency exit route diagram shall be provided in the substation.

5.3.5 Multiple substations on the same floor and are in close proximity may share one separate and independent staircase(s) leading to ground level in lieu of one staircase for each substation.

5.3.6 When the staircase or access route from the exit of the substation to ground level is longer than 10m of travel, adequate natural or mechanical ventilation installation shall be provided. (For details, refer to the Section on Ventilation Design in this COP)

5.3.7 Equipment access can be from a public area inside the building:
(i) through a slab opening, or
(ii) by a vehicular access

The loading and unloading area for the delivery of equipment in or out of the substation should be within the building area where it is owned or managed by the building owner. Using the public pavement or road outside the substation as loading and unloading area should be avoided. Access passage for equipment shall be at least 3m wide and 3m high.

5.3.8 In the case of equipment access through a floor opening, the opening shall be provided with three sides R.C. wall of 2-hour FRR construction. The wall opening shall be fitted with steel foldable door of appropriated fire resistance rating in accordance with the relevant statutory requirements. A protected lobby with double leaf door should be provided if higher FRR construction is required from relevant statutory requirements. Other facilities including foldable gate and fall restraint system shall be provided. An I-beam together with a wire type electrical hoist for lifting minimum 9000kg load in the substation shall be provided and maintained by the building owner. The building owner shall conduct point load test on the wire type

electric hoist to prove the minimum 9000kg lifting point load under normal operation. An emergency lowering device with handwheel shall also be provided and operated at ground level. A speed limit switch shall be equipped to control the movement of lifting object. The clear height of the hoisting equipment to the substation floor shall be minimum 3700mm under the hook.

5.3.9 A change-over switch shall be provided for the electric hoist to operate from either the customer's essential supply or the substation local supply.

5.3.10 In case of equipment access via external wall opening through retractable hoist beam within the building area, the vertical distance between floor level of substation and the floor level of lifting plant shall not be greater than 6m. The wall opening shall be fitted with steel foldable door of appropriated fire resistance rating in accordance with the relevant statutory requirements. Other facilities including foldable gate, I-beam, electrical hoist and change-over switch shall be provided. Fall restraint system shall be provided.

5.3.11 Subject to the configuration of the HV supply network, provision of a HV switch room(s) on ground level will be required as a switching substation for the HV cables supplying the building.

5.3.12 Independent cable riser rooms shall be provided solely for CLP Power's cables, constructed to 2-hour FRR and have access from a public area within the building. More than one stack of cable riser rooms shall be provided for multiple upper floor substations in the building to fulfill supply security requirement.

5.3.13 Cable riser room access doors shall be 2-hour FRR. Inside the cable riser room, opening on the floor and ceiling slabs shall be provided for installation of cables. The opening shall be sealed up with 2-hour FRR material by the building owner after installation of the cables.

5.3.14 Normally, the cable riser room height should not be greater than 4m. Otherwise, adequate space shall be reserved inside the cable riser room for the erection of working platform for working at high level inside the room.

5.3.15 A lifting beam and trolley shall be provided at the highest or intermediate cable riser room to facilitate cable installation. The requirement of lifting load shall refer to the drawing T-COP-10250-D-E33-0101-20.

5.3.16 Hooks for fastening of independent lifeline should also be provided at the ceiling of the highest cable riser room, and suitable locations when the access to the lifting beam/trolley is more than 2m above floor. This hook shall be with similar installation method as those haulage lug as shown in drawing T-COP-10250-D-E33-0101-20. The safety loading of each hook is 2 tons.

5.3.17 Alternative access by a lift in the public area inside the building shall be provided for operational and maintenance purpose.

5.4 Additional Requirements for High Level Substations (above fifth floor or 17m above ground level)

5.4.1 The substations shall be located on the mechanical services plant floor and at the periphery of the building.

5.4.2 When there is a refuge floor or another mechanical services plant floor is directly above or below the level where the substation is located, an independent staircase shall be provided in the substation to the refuge floor or another mechanical services plant floor as an additional route for emergency evacuation.

5.4.3 Multiple substations on the same floor and are in close proximity may share a separate and independent staircase(s) leading to the refuge floor or another mechanical services plant floor in lieu of one staircase for each substation.

5.4.4 Subject to the configuration of the HV supply network, provision of a HV switch room(s) on ground level will be required as a switching substation for the HV cables supplying the building.

5.4.5 The access and exit routes of the high level substation shall always lead to the ground level of the building. Any lockable door, gate, barrier along the route shall be avoided.

5.4.6 The exit door(s) shall be opened to a protected lobby with self-closing doors fitted with panic bolt leading to the adjacent communal area of the building.

5.4.7 Clear, durable signage to indicate the location of the substation in the building shall be displayed at suitable places to guide personnel to access the substation. The layout of the signage shall be agreed by CLP Power. Emergency exit route diagram shall be provided in the substation.

5.4.8 Equipment access shall be by a lift in the public area inside the building. The lift in the building shall be capable to carry the heaviest equipment in the substation such as transformer. This lift shall be able to change-over to the essential supply of the building when its normal supply fails. The building owner shall conduct point load test on the lift to prove the minimum 9000kg lifting point load under normal operation. The lift designer should coordinate with the Principal Manager - Planning and Design of CLP Power on the loading and layout out requirement of the lift.

Access passage for equipment shall be at least 3m wide and 3m high. Bigger access may be required in case of special applications.

5.4.9 Independent cable riser room shall be provided solely for CLP Power's cables, constructed to 2-hour FRR and have access from a public area within the building. More than one stack of cable riser rooms shall be provided for multiple high level substations in the building to fulfill supply security requirement.

5.4.10 Cable riser room access doors shall be 2-hour FRR. Inside the cable riser room, opening on the floor and ceiling slabs shall be provided for installation of cables. The opening shall be sealed up with 2-hour FRR material by the building owner after installation of the cables.

5.4.11 Normally, the cable riser room height should not be greater than 4m. Otherwise, permanent steel working platform with wire mesh floor of live load not less than 0.75kPa and proper access shall be provided for every 4m inside the cable riser room for cable laying work at high level.

5.4.12 A lifting beam and trolley shall be provided at the highest level and when required the intermediate floor level of the cable riser room to facilitate cable installation. The lifting load shall be determined by the weight of the heaviest cable at its full length. Detailed requirement is shown in drawing T-COP-10250-D-E33-0101-20.

5.4.13 If the total height of cable riser is more than 30 metres, haulage lug shall be installed on the ceiling of riser room(s) in the intermediate levels such that the maximum distance between each 2 haulage lugs is less than 30 metres. The safety loading of each haulage lug is 2 tons. Installation method of haulage lug is shown in drawing T-COP-10250-D-E33-0101-20.

5.4.14 Hooks for fastening of independent lifeline should also be provided at the ceiling of the highest cable riser room, and suitable locations when the access to the lifting beam/trolley/haulage lug is more than 2m above floor. This hook shall be with similar installation method as the haulage lug. The safety loading of each hook is 2 tons.

5.4.15 Cable jointing room, 3m by 3m, constructed to 2-hour FRR on each mechanical plant floor from the ground to the substation shall be provided to allow future cable repair/replacement.

5.4.16 A cable unloading area next to the cable riser room on ground level shall be provided for uncoiling the cable from the cable drum and laying to the cable riser room. The space for this unloading area varies for different cases, and shall be determined by CLP Power Planning Engineer.

5.5 Cable Trenches, Cable Ducts and Draw Pits

The cross-sectional areas of cable trenches shall not be reduced by ground beams or other civil structures. Power cables of different voltages should be segregated in different cable trenches. The invert level of cable trenches at the boundary of a substation should be 1050mm (if trench depth is 1200mm) below pavement level. If ground beams are present at the boundary of a substation, the clearance under the beams shall be 500mm minimum. A recess inside the cable trench should be constructed for placing the sump pump at the lowest level of the trench.
The cable trench steel chequer plates shall be marked with numbers (left to right and clockwise convention) to avoid being misplaced. Proper supports such as a removable angle iron should be provided at the bends and tee-points.

5.5.1 HV Cable Trenches

HV cable trenches shall be generally 1400mm deep.

5.5.1.1 1000mm wide for HV switchgear panels;

5.5.1.2 600mm wide for HV cables from HV switchgear to transformers; the final section which leads to the transformer HV terminal could be 300mm wide.

5.5.2 LV Cable Trenches

5.5.2.1 LV cable trenches should generally be 800mm wide x 1100mm deep.

5.5.2.2 Trench for LV single core cables from the transformers to customer main switchroom should be 1000mm wide x 1100mm deep for 4 MCT's. The maximum length of LV cables is limited to 20m.

5.5.3 Pilot Cable Trench

A short trench 400mm wide x 1100mm deep should be extended to where the pilot cable marshalling boxes are installed.

5.5.4 Trenches, Cable Ducts and Draw Pits Construction

5.5.4.1 Except cable trenches inside the substation, all cable trenches, cable ducts and draw pits outside the substation are required to fully fill up with sand, sifted soil or sand bags at all times after cabling by CLP Power is completed.

5.5.4.2 All trenches shall be covered with 5mm thick steel chequer plates. In case of a suspended trench, the trench walls shall be constructed to 2-hour FRR. All junctions of trenches shall be chamfered to 150mm x 150mm.

5.5.4.3 Both sides of the cable trench under the HV switchgear shall be of dense concrete construction to a minimum width of 200mm for switchgear support.

5.5.4.4 Design of cable trough for inclined surface shall be in compliance with CLP standard. Details refer to CLP Drawing 'Typical Cable Trough in Slope T-GEN-25500-D-E33-0226-01' when required.

5.5.4.5 Cable accommodations (e.g. cable ducts and draw pits, cable trough, or cable riser) between different substations shall be provided within development to fulfill supply security requirement.

5.5.5 Trench Outlet

5.5.5.1 All trench outlets should have the same or larger width as the trench and 150mm diameter G.I. sleeves / UPVC ducts shall be provided.

5.5.5.2 For basement and upper floor substations, adequate number of MCT holes should be provided for incoming power cables and pilot cables, taking into account the number of HV panels in the substation.

5.6 Doors

Substation doors shall be made of stainless steel. Substation which have doors open over a street, the doors shall be built such that when they are fully opened, which will not cause an obstruction to any person or vehicle using the street. For typical substation design, the door should be able to open outwards into an unobstructed space with a 180° swing.

(i) The following notice plate shall be installed by CLP Power:

- 'DANGER'
- Wear safety helmet
- Substation nameplate
- SF_6 gas-filled equipment warning plate for substations with SF_6 equipment installed

(ii) Fixed Fire Fighting Installation Notice plate shall be provided by the building owner / customer when required.

(iii) 25mm diameter galvanised steel eye bolts should be installed on internal wall on both sides of all doors at 1m above the floor for hanging a temporary caution

notice. A stainless steel box shall also be provided to store a 3m long red / white plastic chain (Box dimension : 125mm length x 125mm wide x 125mm high).

5.6.1 Type of Door

5.6.1.1 Double leaf door shall be normally 2600mm wide and 2800mm high for transformer access. Actual door size is subject to the transformer rating and type. In all case the 2600mm wide clearance should be maintained after the doors are opened. Otherwise the width of the door should be adjusted to maintain the minimum clearance for plant delivery through substation door.

A 700mm wide x 2100mm high wicket door with handles shall be provided in one leaf for personnel access. Drawings No. T-COP-10250-D-E33-0103-16 and T-COP-10250-D-E33-0103-17 show the details of this type of door.

5.6.1.2 Double leaf door 1500mm wide x 2800mm high shall be provided for HV switchgear and personnel access. Actual door size is subject to the switchgear rating and type. Drawing No. T-COP-10250-D-E33-0103-20 shows this type of door.

5.6.1.3 Single door 930mm wide x 2100mm high with handles shall be provided for personnel access and exit. Drawing No. T-COP-10250-D-E33-0103-14 shows this type of door.

5.6.1.4 Single leaf door for personnel access opening to a staircase or exit route shall be self-closing.

5.6.1.5 For doors which required fire resistance rating (FRR) such as 2-hour in terms of integrity (and insulation when necessary) shall comply with the relevant requirements of the Buildings and Fire Services Regulations such as the Code of Practice for Fire Safety in Building 2011 and latest corrigenda by Buildings Department and shall have relevant approval certificates / documents accepted by Building Department. Where FRR is required for external door by the government bodies or the building owner, the FRR external door should be designed to resist wind force. The design shall be agreed by CLP Power if it is deviated from our standard drawings. (Note: the drawings in this Code of Practice are only indicative in terms of door design, dimensions, wickets, etc.).

5.6.2 Lock

5.6.2.1 A substation shall have only one designated personnel access door and this door shall be fitted with an emergency exit deadlock set with panic bar and flush key hole.

5.6.2.2 A second, or emergency exit door should be provided for substations longer than 10m (possibly a wicket door in a double leaf door). Such an emergency exit will be provided with a panic bar which will operate top and bottom bolts of the door, without key.

5.6.2.3 In case of a double leaf switchgear access door an emergency exit deadlock set with panic bar will operate one leaf of the door if this is the only access.

5.6.2.4 Main double leaf transformer access doors will lock by top and bottom bolts inside the substation.

5.6.3 Controlled Access

The access need to be controlled to ensure that only authorized staff, contractors and visitors pass through by means of access control and intruder detection system. Metallic conduit system for access control should be provided from each access door to the pilot marshalling box. Detail refer to drawing T-COP-72000-D-E33-0103-23-A-A.

5.7 Substation Name

The following principles shall be followed when naming distribution substations :-

(i) Building name, or
(ii) Street and street number, or
(iii) Village name, or
(iv) The generally accepted location name.

The substation name shall not be more than 25 characters and the above shall be in both English and Chinese.

5.8 Vermin Proofing

5.8.1 Some distribution substations are located in buildings with a dusty, damp and vermin infested environment. Vermin are usually small animals such as rats, lizards and birds, etc. and insects are cockroaches and flies, etc. To avoid problems of hygiene, corrosion and risk of insulation breakdown inside the electrical equipment caused by the vermin, vermin proofing is normally achieved by a combination of means. The substation building itself will act as the first line of defense while the electrical equipment design will act as the second.

5.8.2 In case of indoor substations, the first line of defense shall be by means of :

- Substation walls

- Doors
- Rat guards at ventilation louvres and grills
- Sealing of cable trench openings

5.8.3 Electrical equipment in substations is designed to different degrees of protection according to IEC 60529. Typical HV switchgear is designed to IP4X while the LV boards are to IP2X. Therefore, the substation design shall provide an effective vermin proofing means as the first line of defense to protect the equipment.

5.8.4 In case of outdoor substations, vermin proofing mainly depends on the electrical equipment itself.

5.9 Stainless Steel for Substation External Steelwork

5.9.1 Material used shall be Grade 316L stainless steel. This is a nickel-chromium steel containing molybdenum and a small amount of carbon. This steel is well suited to external applications particularly coastal areas.

5.9.2 The Japanese standard for this steel is SUS 316L. The American equivalent is AISI 316L.

5.9.3 The following notes relate to all external steelwork and in particular the doors :-

(i) The hinges of each door leaf must be designed and constructed to withstand the weight of the door plus 50kg and be not less than four in number per leaf.

(ii) Welding treatment must be suitable for Grade 316L stainless steel and must not create weak spots at the weld. After welding, the weld surface must be brushed clean to remove all welding flux and surface dirt. The surface shall then be solvent cleaned to remove all residual dirt and grease.

(iii) The doors and other external steelwork shall be covered with plastic sheets at the time of installation and such plastic sheets shall not be removed until the building construction work is completed.

5.9.4 In order to measure the operational performance of a newly constructed substation door, metal foldable door and gate for substation, door pulling test with force measurement device shall be carried out to measure the manual operational force of the constructed foldable door and gate. The pulling force should not be larger than 120N or 12 kg.

5.10 Requirements of Substation External Decorative Louvre and Louvre Door

5.10.1 Generally, no external decorative louvre / louvre door should be installed, affixed or attached outside the distribution substation. For special circumstances, the building owner should obtain prior agreement of CLP Power if they wish to add such decoration.

5.10.2 Moreover, under such special circumstances, the external decorative louvre and louvre door shall meet all statutory requirements but not limited to:

(i) Decorative louvre / louvre door shall not obstruct the access of any person, operation and transport of equipment/facilities in and out of the substation, nor shall such decorative louvers/ louvre door(s) cause any undue delay. The decorative louvre / louvre door should be designed for easy operation by single person without the need of additional tool for assistance and the pulling force should not exceed 120N or 12 kg for real time access of any person. The building owner shall conduct load test on the decorative louvre / louvre door to prove the maximum 120N or 12 kg pulling force under normal operation. The design shall obtain prior agreement of CLP Power.

(ii) CLP substation exit doors with panic bar installed shall be always free from any possible obstruction to allow for emergency escape. Adequate space shall be allowed such that the exit door should be able to open outwards into an unobstructed space with 180 degree swing.

(iii) External decorative louvre / louvre door should not be fixed directly or indirectly onto substation stainless steel doors and ventilation louvres.

(iv) The weight and the fixing method of the external decorative louvre / louvre door shall be certified by the Authorized Person representing the building owner / customer to ensure that it will not impose hazard to our operation staff and the general public for safety and smooth operation of the door(s). The Authorized Person should also submit this design to the relevant authorities for approval according to relevant statutory regulation.

(v) The external decorative louvre / louvre door shall not affect the substation ventilation.

(vi) The decorative louvre / louvre door shall provide fitting provisions for installing the substation nameplate, danger warning notice etc. and shall not affect the display of the substation nameplate and notice plates.

(vii) The building owner/management company / customer shall be the owner of the external decorative louvre / louvre door and responsible for the maintenance of the decorative louvre / louvre door. Annual

inspection of the louver should be carried out by a competent person to confirm its safety.

(viii) The external decorative louvre / louvre door shall be fabricated with stainless steel or aluminium plate with minimum 3mm thick, or other fire retardant and corrosion resistant materials to the satisfaction of CLP Power. All coatings for the proposed decorative louvre / louvre door shall be fire retardant and fire resistant non-toxic paint.

5.11 Requirements for Vehicular Access

In general, the minimum requirements for vehicular access shall be :

Lorry dimension	11.5m (L) x 2.7m(W)
Lorry with rigger fully extended	11.5m (L) x 9m(W)
Turning radius of vehicular	10m
Headroom for loaded lorry movement	4.6m
Headroom for unloading area	6.2m
Weight for loaded lorry	38000 kg
Weight for fluid filled type transformer	9000 kg
Plant delivery access	3m (W) x 3m (H)

5.12 Plant Delivery

5.12.1 The maximum allowable gradient of ramp for plant delivery shall be in a ratio of 1:12. Level difference between floor inside substation and public pavement should not be greater than 400mm wherever practical. A landing area of 3m x 3m shall be provided if the horizontal length of the ramp exceeds 20m.

5.12.2 If there is a ramp at the plant delivery route, a structural steel haulage lug, 20mm diameter mild steel bar with minimum internal radius 80mm, fixing to the external wall structural element with 5000kg horizontal load capacity at the end of a delivery access ramp shall be provided and maintained by the building owner. Appropriate safe load test (horizontal load) certificate by an accredited testing laboratory, and shop drawing with structural calculation shall be submitted to confirm its safety.

6. VENTILATION DESIGN

6.1 Indoor substations housing transformers shall be adequately ventilated with a fixed ventilation system to cope with the total heat dissipated at full load, with a margin to provide for cyclic overloads.

6.2 The height of the ventilation outlet to free air should be 2.5m above footpath or street level. The hot air outlet stream should be directed away from personnel on the footpath nearby.

6.3 Effective inlet louvre area shall be a minimum of 1.12 sq.m for every 3000kVA of installed transformer capacity. Calculation shall be provided to verify the effective area of the proposed inlet louvre. The design shall obtain prior agreement of CLP Power.

6.4 For each transformer at or above ground level with heat dissipation of about 15kW, a 630mm diameter fan and 0.65 sq.m air trunking/duct (maximum 9m long) are required. If the transformer is in a basement, 800mm fan and 0.85 sq.m trunking should be provided. Typical dimensions of the air trunking/duct:

Fan Diameter (mm)	Air Duct Dimensions (mm)
800	1200 x 800 /1400 x 600 (minimum)
630	800 x 800 / 1200 x 600 (minimum)

6.5 The air duct should be painted in grey colour with exhaust air direction labels in black painted on the air duct.

6.6 The standard exhaust fans provided by CLP Power will be one of below types or with equivalent performance:-

Diameter (mm) / Impeller angle	RPM	Air Extraction Rate (Cu. m/hr.)	Static Pressure (N/m^2)	Maximum Noise Level at 1m
800 / 20°	700	7,000	100	63 dB(A)
630 / 20°	700	3,500	70	56 dB(A)
630 / 30°	700	4,500	70	58 dB(A)

6.7 Where weatherproof louvres are adopted, calculation shall be provided to verify that the exhaust fans to be adopted is suitable. The design shall obtain prior agreement of CLP Power.

6.8 Where a long air duct (e.g. 20m) is required, axial flow type fan with ventilation rate of 7000 cu.m/hour may be required in the middle of the air duct to compensate the air pressure drop. This axial fan and associated fan control panel, power supply switches shall be provided and maintained by the building owner. Source of electrical power supply shall be from building owner's / customer's essential power supply system. Detailed design of fan system depends on the number of bends and site conditions. Building owner / customer

shall add all necessary acoustic treatment to the axial flow type fan in case the noise level of the selected fan itself exceed the specified upper limit.

6.9 The exhaust fan should be controlled by a temperature sensing device to avoid unnecessary operation.

6.10 Exhaust fan in fan room, which is controlled by the fan control panel located in the substation, shall be fitted with emergency stop push button next to the exhaust fan.

6.11 The inlet and exhaust fans, if installed, shall be switched on simultaneously.

6.12 The ventilation air duct shall be constructed with the minimum number of bends and in such a way as to efficiently remove hot air from each transformer.

6.13 The inlet louvres and extraction trunking shall be so designed as to ensure the passage of air across the transformer, and eliminate any possible 'short circuit' of the air flow.

6.14 Markings should be provided on the air duct to identify the fresh air, exhaust air ducts and the direction of air flow.

6.15 When air exhausting from the air outlet louvre beneath a canopy may be accumulated under the canopy, an air duct not exceeding 2.5 m in straight length shall be provided to direct the exhausted air to open air. For longer air duct, the building owner / customer shall provide suitable ventilation fan to replace the standard fan which is provided by CLP Power and fire resistance air duct if applicable.

6.16 The building owner shall formally prove that the exhausted air will not be trapped underneath the canopy if an extension of air duct beneath the canopy connecting the exhaust air outlet louvre to direct the exhausted air to open air cannot be provided subject to the agreement of CLP Power.

6.17 Where possible the air duct intake associated with the transformer should be positioned such that the wire mesh at the intake mouth can be cleaned with the transformer energised, without endangering the person carrying out the work.

6.18 Indoor substations housing HV switchgear normally have ventilation louvres only, but a mechanical ventilation system should be provided for a large HV switchroom when more than five HV switchgear panels or the length of the switchroom is more than 7.5m from the peripheral wall. Normally, the substation layout should be designed to use the standard exhaust fans which are provided by CLP Power.

6.19 All linings for acoustic and thermal insulation purposes in ductings and concealed locations shall be of Class 1 or 2 Rate of Surface Spread of Flame as per British Standard 476: Part 7 or its international equivalent, or be brought up to that standard by use of an approved fire retardant product according to the requirement of Fire Services Department.

6.20 The air duct should not pass through public areas. If this cannot be avoided, the air duct shall be of 2-hour FRR and equipped with facility for maintenance.

6.21 Air duct passing through any floor, wall or ceiling shall be fitted with fire damper operated by fusible links, or fire damper can be omitted when fire resistance air duct is used e.g. Durasteel in accordance with the regulations.

6.22 The noise level measured from the substation, in condition that the ventilation system is in operation, shall comply with the requirement of the Noise Control Ordinance. The building owner / customer shall be responsible for further improvement on noise reduction when more stringent noise requirement for the site is raised by other parties like the residents.

6.23 A hoisting hook / eye bolt to withstand 100kg shall be provided at the ceiling next to the removable panel of the air trunking, or above the fan, to facilitate fan replacement. Safe Working Load (SWL) marking shall be displayed next to the hook.

6.24 For substation situated in the basement or upper floor and the access to the substation have to go through enclosed corridor or staircase, mechanical ventilation to supply fresh air and with manual control to the corridor or staircase shall be provided by the building owner / customer. The minimum ventilation rate shall not be less than 5 air changes per hour.

7. LIGHTING DESIGN

7.1 Illumination inside the substation should be average 160 lux measured on the floor for general areas and minimum average 400 lux on the vertical surface of the meters and switches.

7.2 The adjacent lighting fittings should be fed from different circuits of the distribution board such that illumination in part of the distribution substation will not be totally lost when one lighting circuit is tripped.

7.3 Twin light tube batten fittings of nominal length 1.2m fitting with T8 LED standard tube with G5 or G13 bi-pin cap base should be used. The fluorescent lighting fittings shall be fixed on the wall or suspended from the ceiling at 2.1m above floor level or suspended from the ceiling at 2.8m above floor along plant delivery route to provide adequate illumination in the working area.

7.4 Battery operated fixed fluorescent lighting shall be provided to enable a safe exit in the event of loss of power supply.

7.5 The emergency lighting should operate for not less than 2 hours. The batteries should be charged from the substation local supply.

7.6 Exit sign shall be provided inside the substation. Except ground floor substation with exit door opened directly to public area outside the building boundary.

7.7 Adequate exit signage and emergency lights in compliance with the relevant BD, FSD regulations shall be provided along the emergency exit route of HV distribution substation / transformer room.

8. ELECTRICAL SERVICES DESIGN

The distribution board, and the electrical wiring for substation lighting and power (power socket and ventilation fan) shall be provided and installed in accordance with the substation layout drawing. CLP Power will provide the supply source.

8.1 Distribution Board

The distribution board should be located near the main access door and shall house a 60A 4-pole main switch together with an adequate number of final circuits protected by MCB's as follows :-

8.1.1 At least two 6A final circuits for all lighting installations controlled by two single pole switches with pilot lamp located next to the main access door.

8.1.2 Some of the fluorescent lamps should incorporate an emergency lighting unit as shown on the layout drawings.

8.1.3 One 16A final circuit for each exhaust fan shall be connected to a 13A fused spur unit adjacent to the exhaust fan. The exhaust fan shall be controlled by a double pole switch and a temperature sensing device.

8.1.4 One 16A final circuit shall be provided for HV switchgear heaters. The rating of the heaters is typically 2 x 50W per switchgear panel.

8.1.5 An earthing terminal shall be provided adjacent to the distribution board for connecting all exposed metallic parts via appropriate conductors.

8.1.6 20A radial final circuit or 32A ring final circuit protected by miniature circuit breaker (MCB) with residual current protective device (RCD) for 13A socket outlets as required.

8.1.7 Lifting hoist when it is installed should use 3 phase supply for the distribution board.

8.2 Essential Supply

8.2.1 One independent single phase supply shall be provided for the 30V battery charger.

8.2.2 One independent single phase supply circuit shall be provided for the distribution automation equipment.

8.3 Supply Source

8.3.1 Source of supply shall be from the local transformer LV terminal. Where a substation houses switchgear only, the supply should be from the nearby CLP Power LV network as normal supply. The standby supply shall be obtained from the customer's LV main distribution board or from another CLP Power LV network, depending on the availability of nearby CLP Power LV network. There shall be warning notice on the customer's main distribution board – "Do not switch off this supply to CLP Power substation". Building owner /customer shall provide LV changeover facility for the two supply sources.

8.3.2 If no nearby CLP Power LV network, then the supply was solely from the customer's LV main distribution board. There shall be warning notice on the customer's main distribution board – "Do not switch off this supply to CLP Power substation".

8.4 Installation Requirement

8.4.1 The electrical wiring shall be run in surface mounted galvanised iron (G.I.) conduits. The conduits other than for fire services shall be painted with 400mm orange colour stripe at suitable interval for identification. For fire service conduits shall be painted with 400mm colour stripe that is 150mm orange at two ends and 100mm red in the middle.

8.4.2 Wiring installed by CLP Power shall be of minimum $4mm^2$ 2 core PVC/armoured.

8.4.3 Each circuit from the local transformer LV terminal shall be protected by high rupturing capacity (HRC) fuse, normally 32A for the distribution board and 10A for the 30V battery charger.

8.5 Earth Bonding

8.5.1 All metallic parts such as steel door frames, exhaust fan air duct, louvres, pipework for fixed fire fighting installation, etc., shall be connected to the earthing terminal at the distribution board by copper conductors not less than $6mm^2$. Flexible tinned earthing braid shall be used for connecting the door.

8.5.2 One earthing terminal for emergency use should be provided at a suitable position above ground level inside the substation.

8.6 Cable Tray System

In order to facilitate the installation of internal wiring and control wiring by CLP Power, a cable tray system shall be provided.

9. FIRE SERVICES DESIGN

9.1 Introduction

The fire services design criteria in this document summarize the Fire Services requirements in relation to electrical equipment of CLP Power installed in distribution substations and are based on the latest documents from the Fire Services Department, in particular the followings:

(i) NP101 latest revision "Fire Services Requirements for Consumer Substations Using Oil Filled Transformer and Switchgear in Buildings"

(ii) Circulation Letter no. 4/96 Part X "Miscellaneous Topics-Transformers"

(iii) Circulation Letter no. 5/98 Part X.2 "Miscellaneous Topics-Transformers"

These criteria highlight the type of fire fighting equipment which should be provided corresponding to the type, capacity and quantity of electrical equipment to be installed within the substation.

9.2 Fire Services Requirements

All distribution substations shall be incorporated in building plans formally approved by the Hong Kong SAR Government, and shall fully comply with the standard requirements of the Fire Services Department.

9.3 Passive Fire Protection – General Requirements

These requirements apply to all distribution substations.

9.3.1 Compartmentation

The substation shall be completely segregated from the remainder of the building. All walls, floors and ceilings shall be of a minimum of 2-hour fire resisting rating. The substation shall be situated at the periphery of the building.

9.3.2 Access

9.3.2.1 Ground Floor Substations shall be directly accessible from the open air and where possible be provided with an additional door fitted with panic bolt for emergency personnel egress. There shall be no access way from the substation to the interior of the building.

9.3.2.2 Basement Substations shall be directly accessible from the open air at ground level by a separate and independent staircase for personnel.

9.3.2.3 Plant access will be from a public area of the building through an opening or door of 2-hour fire resistance rating (FRR) construction. A protected lobby with self-closing door fitted with panic bolt leading to a public area of the building adjacent to the substation, shall be provided.

9.3.2.4 Upper Floor Substations shall be accessible from a public area of the building and where possible have vehicular access. A protected lobby with self-closing door fitted with panic bolt leading to a public area (separate from the public area of the main access) adjacent to the substation, shall be provided.

9.3.3 Openings

There shall be no unsealed openings left in any wall, ceiling or floor other than those which lead outside the building, e.g. door, exhaust fan outlet, ventilation louvres. Any service opening (e.g. cable trench outlet, trench or opening connecting to customer main switch room) shall be sealed to 2-hour FRR. This should also prevent passage of transformer insulant out of the substation as well as ingress of water into the substation.

9.3.4 Door Sill

All door openings shall be provided with imperforate fire resisting sill of sufficient height, generally 150mm, to contain the total capacity of transformer insulant within the substation. This sill will also prevent ingress of water into the substation.

9.3.5 Ventilation

9.3.5.1 Adequate and permanent ventilation to open air must be provided and shall be independent of any other ventilation system of the building.

9.3.5.2 In any areas protected by a Fixed Fire Fighting Installation (FFFI), the discharge sequence should include the automatic shutdown of the ventilation system and the closure of all ventilation openings.

9.4 Active Fire Protection – Fire Fighting Equipment

9.4.1 One 4.5kg CO_2 portable fire extinguisher shall be provided by CLP for the main access door of a substation using one or more SF_6, silicone fluid filled transformers or equivalent and switchgear with vacuum

circuit breakers (VCBs), or a substation having switchgear with VCBs only, or a substation having silicone fluid filled transformers only.

9.4.2 Automatic Fixed Fire Fighting Installation (FFFI)

For substation using the type of transformer and switchgear mentioned in clause 9.4.1, FFFI is not required. When FFFI is required for a substation, FM200 gas fire suppression system will be used because of the high safety risk of CO_2 system. The building owner shall design the system and seek comment from CLP Power. The final design for the FFFI shall be submitted to the Fire Services Department for approval.

9.4.3 Where FFFI has already been installed, the replacement of a transformer or transformers with SF_6, silicone fluid filled type or equivalent will not eliminate the necessity for FFFI. Unless all transformers are SF_6 or silicone fluid, the FFFI will be eliminated and portable CO_2 fire extinguisher(s) will be installed. Additional CO_2 fire extinguishers may be required subject to the actual layout of the substation.

9.5 Automatic and Manual Fire Alarm Installation

Distribution substation/transformer room, switchgear room and cable riser room consist of electrical equipment above 1kV. Automatic Fire Alarm installation (AFA) shall be provided as required by FSD. The design of the AFA shall be approved by the FSD.

9.5.1 Automatic fire alarm system shall be designed and installed to the latest FSD Rules for Fire Detection and Fire Alarm Systems for Building.

9.5.2 Heat Detection System shall be applied. Detectors must not be mounted directly above transformer or switchgear and must not be obstructed by ventilation air ducts inside the substation for ease of maintenance.

9.5.3 An independent fire detection zone shall be provided for each distribution substation/transformer room and switchgear room. Each detection zone must be provided with a remote fire indicator installed outside every entrance of distribution substation/ transformer room and switchgear room.

9.5.4 Visual and audible fire alarms such as bell and siren shall be installed inside substation. The sound alarm should be audible at every location inside the substation.

9.5.5 Manual fire call point(s) shall be installed adjacent to the exit door inside substation.

9.6 Equipment Provision and Maintenance

9.6.1 Portable Fire Extinguisher

All portable fire extinguishers are to be provided and maintained by CLP Power. The portable fire extinguisher is generally 4.5kg CO_2.

9.6.2 Automatic Fire Alarm System and Fixed Fire Fighting Installation

All AFA and FFFI systems are provided and maintained by the customer or the building owner and must be inspected and tested by a registered contractor according to regulatory requirements. At the time or any other time when an inspection or maintenance is carried out, the customer / building owner shall send a copy of the Certificate of Fire Service Installations (F.S. 251) to CLP Power.

10. CUSTOMER MAIN SWITCHROOM DESIGN

Customer switchroom shall comply to the latest edition of Electricity (Wiring) Regulations, Code of Practice for the Electricity (Wiring) Regulations, and all relevant statutory requirements (e.g. F&IU, BD & FSD regulations).

Customer Main Switchroom is where the customer main switch receives electricity supply from CLP Power electrical equipment and accommodate the main switch and distribution board for controlling and distributing electricity to all parts of the building. Therefore in designing the Customer Main Switchroom, the following requirements shall be noted.

10.1 Position of the Main Switchroom

Where the supply is taken from a transformer located within the building, the main switchroom should be located immediately adjacent to, above or below the distribution substation/transformer room so that the length and number of bendings of CLP Power cables connecting to the main switch are kept to minimum.

Where the supply is taken from a low voltage network, the main switchroom shall be as near to the building entrance as possible.

10.2 Access

The main switchroom must be readily accessible from a communal area at all times without the need to pass through any individual customer's premises. At least one exit of the main switchroom should open outwards and this emergency exit should be identified clearly.

10.3 Routing of Outgoing Circuits

The outgoing circuits from the main switchroom such as the rising mains and the landlord's services shall not pass through any individual customer's premises. Where this cannot be avoided, suitable concrete ducts must be provided so that the cables installed therein can be replaced without the need to enter any individual customer's premises at any time.

10.4 Dimensions

The main switchroom shall be big enough to accommodate all the associated switchgear, distribution board and CLP Power metering equipment, and also have adequate working space to facilitate installation, operation and maintenance of equipment.

The working space should meet the minimum requirement of Code of Practice for the Electricity (Wiring) Regulations – Clause 4E.

10.4.1 Supply from Local Transformers

10.4.1.1 The internal headroom shall be not less than 2.1m.

10.4.1.2 The minimum clearance behind the main switch board shall be 0.65m when the main switchroom is above the substation or adjacent to the substation provided that the customer's main switch such as air circuit breaker (ACB) in the main switchboard can be positioned in line with the MCT holes.

10.4.1.3 When the main switchroom is located below the substation, earthed metal cover shall be provided for covering CLP Power single core power cables. Additional 0.4m clearance shall be reserved for earthed metal cover.

10.4.1.4 When the main switchroom is adjacent to the substation, and the position of the air circuit breaker is not in line with the respective transformer, an access of 1000mm minimum shall be maintained behind the main switch board.

10.4.1.5 The main switchroom shall be wide enough to provide an unimpeded access of 650mm minimum on one side of the switchboard for gaining access to the rear of the switchboard.

10.4.2 Supply from LV Network

The minimum internal dimensions for accommodating electrical services only shall be as follows:-

Headroom	:	2.1m
Width	:	1.2m
Depth	:	1.2m

10.4.3 The access door(s) shall be not less than 0.8m wide and 2.1m high and the incoming terminals of the customer's main switch shall be at least 0.6m above the finished floor level.

10.4.4 If the main switchroom is also designed for the purpose of meter room accommodation, the additional requirements for meter room shall be noted :

10.4.4.1 To facilitate easy access for monthly meter reading and operation, the door of meter room shall be opened by conventional key without using any tools.

10.4.4.2 A dedicated key exclusively for the door of such meter room (i.e. sharing with other utility rooms including lift machine room / lift well is not permitted) shall be kept under the custody of relevant building management. The key shall be

available for CLP staff to facilitate meter reading and maintenance work. A label "Meter Room Key" shall be secured onto the key.

10.4.4.3 The locking device for the door of meter room / enclosure, including any front decoration panel, should be installed at height of not less than 1000mm and not more than 1500mm above finished floor level.

10.4.4.4 The minimum width of door and clearance path along the exit route in the meter room, for personnel evacuation during emergency, should not be less than 900mm.

10.4.4.5 Permanent label indicating both "電錶房" and "Meter Room" of letter dimension not less than 30mm in height should either be printed directly on the door or etched on nameplate to be fixed at a prominent position on the door.

10.5 Cable Containment for Metering Purposes

10.5.1 A metallic surface junction box of 100mm x 100mm at 2300mm above substation floor level shall be provided in both the customer's main switchroom and the CLP distribution substation to accommodate the communication cable for metering purposes. A 25mm diameter metallic conduit shall be installed for connection between the metallic junction boxes in the main switchroom and substation. The void made in the wall shall be sealed according to the appropriate degree of fire resistance of the wall.

10.5.2 Conduits and conduit fittings shall be type-tested for completed compliance with the following standards:

- Conduits shall have Class 4 protection in accordance with BS 4568: Part 1 or IEC 61386.
- Conduit fittings shall have Class 4 protection in accordance with BS EN 61386-1 or IEC 61386-1.
- Junction boxes shall have protection both inside and outside in accordance with BS 4662 or IEC 60670-1.

10.5.3 Regarding the metering detailed requirement for the communication infrastructure not within the substation, please refer to the meter installation guideline "Guide to Supply and Metering Arrangement on Customer's Internal Distribution System" issued by Customer Supplies and Services Branch.

10.6 Cable Trench

10.6.1 The width and depth of the cable trench for accommodating CLP Power single-core cables shall normally correspond to that in distribution substation/ transformer room.

10.6.2 Customer's outgoing cables and related supporting structures for customer's switchboard should not share a common cable trench with CLP Power cables. Where this cannot be achieved, customer's cables must be mounted permanently on the wall of the cable trench without interfering with CLP Power cables.

10.7 Other Services

No water pipe or drainage system is permitted within a customer main switchroom. Where the main switchroom is designed to accommodate other communication equipment such as telephone, communal aerial broadcasting distribution system or security system, such equipment and the associated wiring must be segregated from all electrical services.

10.8 Illumination and Ventilation

The illumination and ventilation should meet the minimum requirement of Code of Practice for the Electricity (Wiring) Regulations – Clause 4F (3).

10.9 Means to Prevent Ingress of Water

To prevent ingress of water, the main switchroom shall be suitably constructed and not be under an expansion joint. Where the internal floor level is less than 100mm above the external floor level, a kerb of not less than 100mm above the external floor level shall be provided.

10.10 Approval Procedure

On the distribution substation/transformer room detailed layout drawing, CLP Power will mark up the suggested trench layout and possible location for customer's main switch/ACB in the main switchboard for the owner/customer's consideration. The owner/customer or his agent must resubmit the detailed main switchroom layout incorporating the finalised cable trench and exact position of each main switch/ACB in the main switchboard for CLP Power approval prior to installation.

11. OUTDOOR SUBSTATION

The general requirements for outdoor substations are given below. Depending on the substation site and the surroundings, special design features may have to be incorporated as appropriate.

11.1 General

11.1.1 All outdoor substations shall be fenced off and a gate with 180° swing shall be provided for electrical equipment and personnel access. The fencing and gate(s) shall be not less than 2.5m in height to prevent any unauthorised entry to the substation.

11.1.2 A roof shall be constructed for outdoor substation located in a construction site.

11.1.3 Outdoor substation shall be naturally ventilated and no forced ventilation system shall be required.

11.2 Type of Fencing

Aluminium corrugated panel shall be used and fixed on steel posts which are connected to the substation earth. An oil retaining sill of 150mm x 150mm shall be provided at the perimeter.

11.3 Other Requirements

11.3.1 The substation ground level shall be 150mm above the outside ground (pavement) level.

11.3.2 Anti-climbing guard shall be provided at the top of the fencing, for example, outriggers made up of 4 strands of barbed wire.

11.3.3 'DANGER', 'Wear Safety Helmet', substation nameplate and SF_6 gas-filled equipment warning plate if applicable shall be installed on the gate and the fencing.

11.3.4 All cables inlet/outlet shall be sealed after cabling. All trenches shall be backfilled with fine soil, a layer of gravel and 150mm covering concrete paving.

11.3.5 The area inside the substation apart from trenches and plant foundations should be 200mm thick reinforced concrete slab.

11.3.6 A 50mm diameter drainage pipe with valve shall be provided adjacent to the gate. The valve shall normally be closed for oil containment and shall only be opened in order to drain any accumulated rain water.

12. PROVISION, INSTALLATION AND MAINTENANCE OF BUILDING WORKS AND ACCESSORIES IN DISTRIBUTION SUBSTATION

Provision, Installation and Maintenance of Distribution Substation Buildings and Accessories are detailed as follows :-

C - indicates items provided/maintained by CLP Power

B - indicates items provided/maintained by Building Owner / Customer

Item	Provision of Material	Installation	Maintenance
1. Substation Architectural/Civil Works			
1.1 Substation building, cable chase and cable riser room in accordance with substation drawings	B	B	B
1.2 Kerb (built after plant moved in)	B	B	C
1.3 Ladder/working platform	B	B	B
1.4 Re-painting of substation interior after commissioning	B	N.A.	B
1.5 Re-painting of substation external walls	B	N.A.	B
1.6 Fencing/Fence Wall for outdoor substation or package substation	B	B	B
1.7 Fine soil, gravel and concrete for filling and covering the cable trench in outdoor substation	B	B	C
1.8 Signage to indicate the substation location	B	B	B
1.9 Hoisting structure (beam/hook)	B	B	B
1.10 Hoisting machinery (trolley)	B	B	B
1.11 Louvre, decorative louvre and louvre door, including rat guard	B	B	B

Item	Provision of Material	Installation	Maintenance
1.12 Cable trench, duct, draw pit and similar provision for cable installation inside customer property boundaries	B	B	B
1.13 Anti-flooding provision as described in clause 5.1.3	B	B	B
1.14 Transformer plinth	B	B	B
2. Substation Access			
2.1 Substation door in accordance with typical drawings	B	B	B
2.2 Emergency exit deadlock set with panic bar	C	B	C
2.3 Lock for substation door	C	B	C
2.4 Panic bolt on exit door without lock	B	B	B
2.5 Conduit, junction box and accessories for door contact	B	B	C
2.6 Substation statutory notice plates	C	C	C
2.7 Notices for treatment of electric shock and for emergency action	C	C	C
2.8 Chain box for the storage of access control chain	B	B	B
2.9 Keybox for gate	B	B	B
3. Substation Building Works for Cables			
3.1 Chequer plate	B	B	B
3.2 Steel rack for holding cable cleats	B	B	B
3.3 Cable brackets and cleats in substation	B	B	B
3.4 Cable brackets in cable riser room for high rise building	B	B	B

Item	Provision of Material	Installation	Maintenance
3.5 Cable cleats in cable riser room for high rise building	B	B	B
3.6 Cable tray in accordance with typical drawing - note (a)	B	B	B
3.7 Sealing of cable entry opening except cable riser room for high rise building			
Before cable entry	B	B	B
After cable entry	C	C	C
3.8 Sealing of through floor/wall openings in high level substation and cable riser room for high rise building	B	B	B
3.9 Tinned copper bar bonding terminal for earthing	B	B	B
3.10 Earthing conductor in cable riser room / chamber	B	B	B
3.11 Earthing conductor through cable ducts and draw pits	B	B	B
4. <u>Substation Ventilation Installations</u>			
4.1 Exhaust fan and associated fan control panel:			
a) Propeller type (standard sizes 630/800mm diameter)	C	B	C
b) Axial type system	B	B	B
4.2 Fans and associated fan control panel for basement substation	B	B	B
4.3 Air duct, fire damper	B	B	B
4.4 Emergency stop pushbutton (for exhaust fan)	B	B	B
4.5 Drainage pipe with valve	B	B	B

Item	Provision of Material	Installation	Maintenance
5. Substation Electrical Installations			
5.1 Distribution board for substation supply in accordance with typical drawings – note (b)	B	B	C*
5.2 Electrical fittings in substation including cable conduit, light fitting, emergency lighting unit, socket and internal wiring	B	B	B
5.3 Sump pump (refer to clause 5.1.3 and 5.2.11)	B	B	B
5.4 Flooding alarm	B	B	B
6. Substation/Cable Riser Room Fire Services Installations			
6.1 Portable fire extinguisher (PFE)	C	C	C
6.2 Outdoor cabinet for PFE	B	B	B
6.3 Fire detection/alarm system	B	B	B
6.4 Fixed fire fighting installation	B	B	B
7. Substation Plant & Equipment for Provision of Supply			
7.1 Transformer	C	C	C
7.2 Switchgear	C	C	C
7.3 Battery charger	C	C	C
7.4 Fibre Optic/Pilot marshalling box	C	C	C
7.5 Remote terminal unit	C	C	C
7.6 Cables	C	C	C
7.7 Multi-cable transit plug-in (MCT)	C	C	C
7.8 Metering equipment	C	C	C

*Note :

(a) Actual installation location to be advised on site by CLP Power site engineer.

(b) Maintenance works by CLP Power only limited to the wiring and termination of cables into the distribution board after the first installation of the distribution board. Periodic inspection, testing according to the regulatory requirements such as WR2 and repair or replacement of defective components in the distribution board shall be responsible by the building owner / customer.

13. DRAWINGS

The layout drawings are typical design for the building owner / customer's agent (e.g. architects or consultants) as reference in designing the substation. The final design of the substation layout plans prepared by the building owner / customer's agent shall subject to the approval of the Principal Manager - Planning and Design of the relevant Region of CLP Power.

Layout Plans

T-COP-10250-D-E33-0101-02	Typical Ground Floor Substation Layout For One Transformer And HV Switchgear
T-COP-10250-D-E33-0101-03	Typical Ground Floor Substation Layout For Two Transformers And HV Switchgear
T-COP-10250-D-E33-0101-04	Typical Ground Floor Substation Layout For Three Transformers And HV Switchgear
T-COP-10250-D-E33-0101-05	Typical Basement Substation Sections
T-COP-10250-D-E33-0101-06	Typical Basement Substation Layout For One Transformer And HV Switchgear
T-COP-10250-D-E33-0101-07	Typical Basement Substation Layout For Two Transformers And HV Switchgear
T-COP-10250-D-E33-0101-08	Typical Basement Substation Layout For Three Transformers And HV Switchgear
T-COP-10250-D-E33-0101-09	Typical Upper Floor Substation Sections
T-COP-10250-D-E33-0101-10	Typical Upper Floor Substation Layout For One Transformer And HV Switchgear (Independent Staircase)
T-COP-10250-D-E33-0101-11	Typical Upper Floor Substation Layout For Two Transformers And HV Switchgear (Independent Staircase)
T-COP-10250-D-E33-0101-12	Typical Upper Floor Substation Layout For Three Transformers And HV Switchgear (Independent Staircase)
T-COP-10250-D-E33-0101-13	Typical Upper Floor Substation Layout For Housing One Transformer Without Vehicular Access (Independent Staircase)
T-COP-10250-D-E33-0101-14	Typical High Level Substation Layout For One/Two/Three Transformers And HV Switchgear In High Rise Building
T-COP-10250-D-E33-0101-15	Typical High Level Substation Layout For One Transformer And HV Switchgear In High Rise Building
T-COP-10250-D-E33-0101-16	Typical High Level Substation Layout For Two Transformers And HV Switchgear In High Rise Building
T-COP-10250-D-E33-0101-17	Typical High Level Substation Layout For Three Transformers And HV Switchgear In High Rise Building
T-COP-10250-D-E33-0101-18	Typical Plan Of Cable Riser Room On Ground Floor Or Floor Level Where Cable Entry (Sheet 1 of 4)

T-COP-10250-D-E33-0101-19	Typical Layout Of Cable Riser Room (Sheet 2 of 4)
T-COP-10250-D-E33-0101-20	Typical Sections Of Cable Riser Room (Sheet 3 of 4)
T-COP-10250-D-E33-0101-21	Typical Layout Of Cable Riser Room Cable Mounting Details (Sheet 4 of 4)
T-COP-10250-D-E33-0101-22	Typical Cable Cleats For HV Cables, Pilot Cables And Fibre Optic Cables
T-COP-10250-D-E33-0101-23	Typical Ground Floor Substation Layout For Two Transformers And HV Switchgear (With Two LV Boards)
T-COP-10250-D-E33-0101-24	Typical Ground Floor Substation Layout For Three Transformers And HV Switchgear (With Three LV Boards)
T-COP-10250-D-E33-0101-25	Typical Drawing For Standalone Substation (Sheet 1 of 3)
T-COP-10250-D-E33-0101-26	Typical Drawing For Standalone Substation (Sheet 2 of 3)
T-COP-10250-D-E33-0101-27	Typical Drawing For Standalone Substation (Sheet 3 of 3)
T-COP-10250-D-E33-0101-28	Typical Upper Floor Substation Layout for Housing One Transformer Without Vehicular Access (Indpendent Staircase & Protected Lobby)
T-COP-10250-D-E33-0101-29	Typical Layout for Ground Floor HV Switchgear Room
T-COP-10250-D-E33-0101-30	Typical Layout for First Floor Transformer Room with Two Transformers
T-COP-10250-D-E33-0101-31	Typical Ground Floor Substation Layout For Two Transformers And HV Switchgear (Split Board)
T-COP-10250-D-E33-0101-32	Typical Ground Floor Substation Layout For Customer With HV Supply (Sheet 1 Of 2)
T-COP-10250-D-E33-0101-33	Typical Ground Floor Substation Layout For Customer With HV Supply (Sheet 2 Of 2)

Section Plans

T-COP-10250-D-E33-0102-01	Minimum Requirements For Customer Main Switchroom Adjacent To Substation For Single Transformer Installation
T-COP-10250-D-E33-0102-02	Minimum Requirements For Customer Main Switchroom Adjacent To Substation For Multi-Transformer Installation
T-COP-10250-D-E33-0102-03	Minimum Requirements For Customer Main Switchroom Above Transformer Room
T-COP-10250-D-E33-0102-04	Minimum Requirements For Customer Main Switchroom Below Transformer Room
T-COP-10250-D-E33-0101-01	Typical Temporary Substation Layout For One Transformer And HV Switchgear
T-COP-10250-D-E33-0102-05	Cover For Temporary Substation Located Inside Construction Site

T-COP-10250-D-E33-0102-06	Withdrawn in version 12
T-COP-10250-D-E33-0102-07	Typical Sections Of Transformer Room At Exhaust Fan Position (Not Directly Above Substation Door) (Sheet 1 of 3)
T-COP-10250-D-E33-0102-08	Typical Sections Of Transformer Room At Exhaust Fan Position (Directly Above Substation Door) (Sheet 2 of 3)
T-COP-10250-D-E33-0102-09	Typical Section Of Fan Room (Sheet 3 of 3)
T-COP-10250-D-E33-0102-10	Double Slab Arrangement For Transformer Room
T-COP-10250-D-E33-0102-11	Minimum Requirements For Customer Main Switchroom Not Direct Below Transformer Room (Sheet 1 of 2)
T-COP-10250-D-E33-0102-12	Minimum Requirements For Customer Main Switchroom Not Direct Below Transformer Room (Sheet 2 of 2)

Indoor Substation Details

T-COP-10250-D-E33-0103-01	Installation Of Four "Multi-Cable Transit" Plug-In In Cable Trench In Two Layers (For Full Neutral Arrangement)
T-COP-10250-D-E33-0103-02	Installation Of Four "Multi-Cable Transit" Plug-In In Cable Trench In Line (For Full Neutral Arrangement)
T-COP-10250-D-E33-0103-03	Installation Of Two "Multi-Cable Transit" Plug-In In Cable Trench In Line (1000kVA Or Below Transformer)
T-COP-10250-D-E33-0103-04	Installation Of "Multi-Cable Transit" Plug-In Through Substation Ceiling
T-COP-10250-D-E33-0103-05	Installation Of "Multi-Cable Transit" Plug-In Through Substation Floor
T-COP-10250-D-E33-0103-06	Steel Former For 200mm Dia. "Multi-Cable Transit" Hole
T-COP-10250-D-E33-0103-07	Steel Former For 150mm Dia. "Multi-Cable Transit" Hole
T-COP-10250-D-E33-0103-08	Typical Details Of Number Marked On The Cable Trench Cover
T-COP-10250-D-E33-0103-09	Typical Details Of Cat Ladder
T-COP-10250-D-E33-0103-10	Typical Details Of Cable Trench (Sheet 1 of 3)
T-COP-10250-D-E33-0103-11	Typical Details Of Cable Trench (Sheet 2 of 3)
T-COP-10250-D-E33-0103-12	Typical Details Of Cable Trench (Sheet 3 of 3)
T-COP-10250-D-E33-0103-13	Cable Trench For Accommodating CLP Power Single-Core Cables In Customer Main Switchroom
T-COP-10250-D-E33-0103-50	Cable Trench For Accommodating CLP Power Single-Core Cables In Customer HV Main Switchroom
T-COP-10250-D-E33-0103-14	Typical Details Of Single Leaf Stainless Steel Door
T-COP-10250-D-E33-0103-15	Typical Details Of Single Leaf Stainless Steel Door Without Lock

T-COP-10250-D-E33-0103-16	Typical Details Of Double Leaf Stainless Steel Door With Wicket On The Right
T-COP-10250-D-E33-0103-17	Typical Details Of Double Leaf Stainless Steel Door With Wicket On The Left
T-COP-10250-D-E33-0103-18	Typical Details Of Double Leaf Stainless Steel Door With Wicket On The Right And Without Lock
T-COP-10250-D-E33-0103-19	Typical Details Of Double Leaf Stainless Steel Door With Wicket On The Left And Without Lock
T-COP-10250-D-E33-0103-20	Typical Details Of Double Leaf Stainless Steel Door (1500W x 2500H) For H.V. Switchgear Room
T-COP-10250-D-E33-0103-21	Typical Details Of Double Leaf Stainless Steel Door Without Lock
T-COP-10250-D-E33-0103-33	For Fire Rated Door With Insulation Typical Details Of Single Leaf Laminated Steel Door Without Lock
T-COP-10250-D-E33-0103-34	For Fire Rated Door With Insulation Typical Details Of Single Leaf Laminated Steel Door
T-COP-10250-D-E33-0103-35	For Fire Rated Door With Insulation Typical Details Of Double Leaf Laminated Steel Door and Without Lock
T-COP-10250-D-E33-0103-36	For Fire Rated Door With Insulation Typical Details Of Double Leaf Laminated Steel Door
T-COP-10250-D-E33-0103-41	For Fire Rated Door With Insulation Typical Details Of Double Leaf Laminated Steel Door With Lock Eye
T-COP-10250-D-E33-0103-42	For Fire Rated Door With Insulation Typical Details Of Single Leaf Laminated Steel Door With Lock Eye
T-COP-10250-D-E33-0103-46	For Fire Rated Door With Insulation Typical Details Of Double Leaf Laminated Steel Door With Wicket On The Right
T-COP-10250-D-E33-0103-47	For Fire Rated Door With Insulation Typical Details Of Double Leaf Laminated Steel Door With Wicket On The Left
T-COP-10250-D-E33-0103-22	Details Of Emergency Exit Deadlock Set With Panic Bar
T-COP-10250-D-E33-0103-23	Typical Arrangement Of Panic Bolt and Door Contact Installation For Transformer Room Doors
T-COP-10250-D-E33-0103-24	Typical Details Of Metal Trunking & Stainless Steel Louvre For 630mm Dia. Wall Mounted Exhaust Fan
T-COP-10250-D-E33-0103-25	Typical Details Of Metal Trunking & Stainless Steel Louvre For 800mm Dia. Wall Mounted Exhaust Fan
T-COP-10250-D-E33-0103-26	Typical Details Of Stainless Steel Louvre
T-COP-10250-D-E33-0103-27	Plastic Chain Storage Box

T-COP-10250-D-E33-0103-28	Cable Trench Cover For LV Cables Dropping From Transformer LV Terminals Into The Cable Trench
T-COP-10250-D-E33-0103-29	Details Of Outlet For Temporary Supply Cables
T-COP-10250-D-E33-0103-32	Typical Details For Upper Floor Substation With Retractable Hoist Beam And Trolley
T-COP-10250-D-E33-0103-43	Typical Details For Upper Floor Substation With Hoist Beam And Trolley
T-COP-10250-D-E33-0103-45	Typical Details For Upper Floor Substation With Hoist Beam And Trolley And Protected Lobby
T-COP-10250-D-E33-0103-37	Typical Details Of Hook for Independent Lifeline
T-COP-10250-D-E33-0103-38	Typical Design Of Fall Restraint System
T-COP-10250-D-E33-0103-39	Typical Design Of Ground Floor Entrance For Basement Substation
T-COP-10250-D-E33-0103-40	Typical Details Of Eyebolt Installation For L.V. Board
T-COP-10250-D-E33-0103-44	Steel Cabinet For Single Core Cable Brackets And Cleats In Customer Main Switch Room
T-COP-10250-D-E33-0103-48	Typical Details Of Transformer Floating Plinth
T-COP-10250-D-E33-0103-49	Typical Details Of Working Platform In Cable Riser Room
T-COP-10250-D-E33-0112-01	Details Of Stainless Steel Floodgate For Single/Double Leaf Door
T-COP-10250-D-E33-0112-02	Details Of Stainless Steel Floodgate For Ground Floor Louvre
T-COP-10250-D-E33-0112-03	Stainless Steel Floodgate Storage Frame Installation Details

Outdoor Substation Details

T-COP-10250-D-E33-0104-01	Details Of Metal Gate And Fence With Steel Post For Outdoor Substation
T-COP-10250-D-E33-0104-02	Withdrawn in version 11
T-COP-10250-D-E33-0104-03	Details Of Metal Gate And Brick Wall Surround For Outdoor Substation
T-COP-10250-D-E33-0104-04	Typical Details Of Cable Trench R.C. Cover
T-COP-10250-D-E33-0104-05	Typical Details Of Cable Draw-Pit (Straight Application)
T-COP-10250-D-E33-0104-06	Typical Details Of Cable Draw-Pit (Angle Application)
T-COP-10250-D-E33-0104-07	Typical Details Of Cable Draw-Pit (Tee Application)
T-COP-10250-D-E33-0104-08	Roofing With Insulation Parapet & Wall Details
T-COP-10250-D-E33-0104-17	Typical Details Of uPVC Pipe Connecting Socket
T-COP-10250-D-E33-0104-18	Earthing Draw Pit Arrangement For Substation

T-COP-10250-D-E33-0104-19	Typical Details Of Earthing Draw Pit
T-COP-10250-D-E33-0104-20	Typical Details Of Cover For Earthing Draw Pit
T-COP-10250-D-E33-0104-21	Typical Details Of Frame For Earthing Draw Pit
T-COP-10250-D-E33-0104-22	Typical On Grade Slab Detail Outside Substation

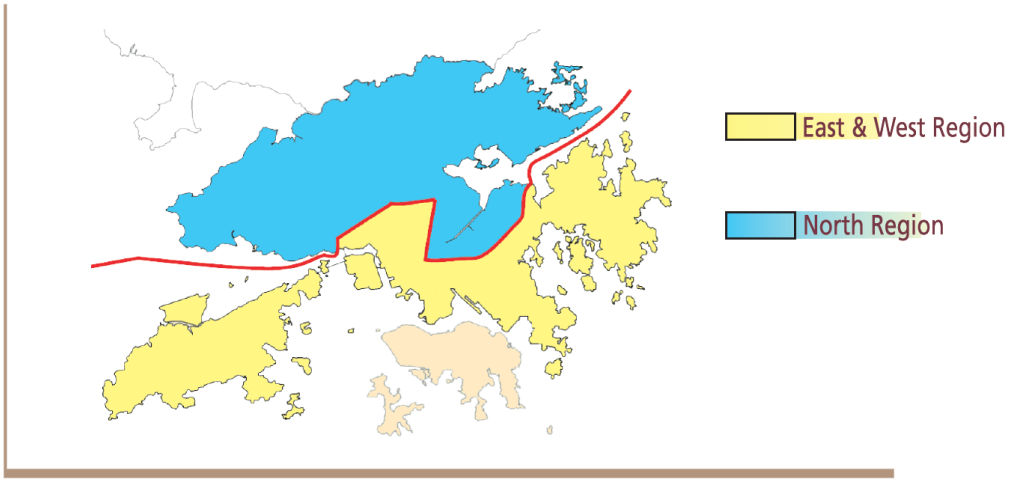
Accessories Details

T-COP-10250-D-E33-0105-01	Details Of Substation Statutory Notice Plate – Danger Warning
T-COP-10250-D-E33-0105-02	Details Of Substation Statutory Notice Plate – Danger & SF_6 Gas-Filled Equipment Warning
T-COP-10250-D-E33-0105-03	Details Of Substation Statutory Notice Plate – Substation Name
T-COP-10250-D-E33-0105-04	Disposition Of The Danger Plate And Substation Name Plate
T-COP-10250-D-E33-0105-05	Details Of Steel Wall Bracket And Wooden Cleat For Holding Single Core Cables
T-COP-10250-D-E33-0105-06	Details Of Steel Wall Bracket And Wooden Cleat For Holding HV Cables (240mm Sq. XLPE Cable, Pilot Cable And Fibre Optic Cable)
T-COP-10250-D-E33-0105-07	Withdrawn in version 12
T-COP-10250-D-E33-0105-08	Cable Lug For 960mm Sq. Single Core Stranded Aluminium Conductor L. V. Cable
T-COP-10250-D-E33-0105-09	Stainless Steel Cabinet For Outdoor 4.5kg CO_2 Fire Extinguisher

Schematic Diagrams

T-COP-10250-D-E33-0106-01	LV Schematic Diagram For Distribution Substation (With Transformer And HV Switchgear)
T-COP-10250-D-E33-0106-02	LV Schematic Diagram For HV Switchroom
T-COP-10250-D-E33-0106-03	Earthing Schematic Diagram
T-COP-10250-D-E33-0106-04	General Schematic Diagram Of Sump Pump And Pipe Connections For Basement Substation
T-COP-10250-D-E33-0106-05	Typical Arrangement Of Cable Tray
T-COP-10250-D-E33-0106-06	Colour Codes For Pipes And Conduits In Distribution Substation
T-COP-10250-D-E33-0106-07	Withdrawn in version 13
T-COP-10250-D-E33-0106-08	Fire Extinguisher Demarcation

Regional Boundary of CLP Power Hong Kong Limited



Contact Details of CLP Power Hong Kong Ltd.

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East & West Region	Yau Tong, Kwun Tong, Lam Tin, Sau Mau Ping, Kowloon Bay, Ngau Tau Kok, Choi Hung, San Po Kong, Wong Tai Sin, Diamond Hill, Tsz Wan Shan, Sai Kung, Tseung Kwan O, Clear Water Bay, Tsim Sha Tsui, Yau Ma Tei, Hung Hom, Tai Kok Tsui, Mong Kok, To Kwa Wan, Sham Shui Po, Shek Kip Mei, Cheung Sha Wan, Lai Chi Kok, Kwai Chung, Tsuen Wan, Tsing Yi, Lantau, Tung Chung, Peng Chau & Cheung Chau.	2678 3799	2678 3737	1 To Wah Road, Jordan, Kowloon
North Region	Sham Tseng, Siu Lam, Tuen Mun, Yuen Long, Kam Tin, Tin Shui Wai, Sheung Shui, Fanling, Tai Po, Shek Kong, Tai Mei Tuk, Sha Tau Kok, Lok Ma Chau, Tai Wai, Sha Tin & Ma On Shan	2678 2156	2678 2180	16 Ka Fu Close, Sheung Shui, N.T.