



中華電力

CLP Power



**CODE OF PRACTICE
FOR
DISTRIBUTION SUBSTATION DESIGN
Version 9.0**

2005



CODE OF PRACTICE 101

FOR

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Version 9.0

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CONTENTS	Page
1. INTRODUCTION	1
2. OBJECTIVES	1
3. PROJECT MANAGEMENT	1
4. ELECTRICAL EQUIPMENT IN DISTRIBUTION SUBSTATION	3
5. ARCHITECTURAL/CIVIL DESIGN CRITERIA	5
6. VENTILATION DESIGN CRITERIA	15
7. LIGHTING DESIGN CRITERIA	17
8. ELECTRICAL SERVICES DESIGN CRITERIA	18
9. FIRE SERVICES DESIGN CRITERIA	20
10. CUSTOMER MAIN SWITCHROOM DESIGN CRITERIA	26
11. OUTDOOR SUBSTATION	29
12. PROVISION, INSTALLATION AND MAINTENANCE OF BUILDING WORKS AND ACCESSORIES IN CUSTOMER SUBSTATION	30
13. DRAWINGS	34
 APPENDIX	
A. Regional Boundary of CLP Power Hong Kong Limited	A1

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1. **INTRODUCTION**

This Code of Practice details the 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 for the substation may be adopted that is subjected to the approval by CLP Power.

2. **OBJECTIVES**

The objectives of this Code of Practice are to ensure that all distribution substations provided by the customers or building owners are designed to the same standard, and fully comply with the requirements of Fire Services Department (FSD), Buildings Department (BD) and those 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 Code of Practices published by HKSAR. In case, there are discrepancies between the requirements stipulated herein and the other Ordinances, Regulations and Code of Practices, the more stringent requirement should prevail.

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

3. **PROJECT MANAGEMENT**

3.1 Acquisition of a 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 the 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 should be given to safety.

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

3.3 Approval of Drawings

3.3.1 Substation layout plans prepared by the customer's agent (e.g. architects or consultants) shall be submitted for the approval of the Planning and Design Manager of the relevant Region of CLP Power. Regional boundary map in the Appendix A shows the 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 Asset Development Manager of the Asset Management Department, CLP Power.

3.3.3 The submitted drawings shall be in hardcopy and softcopy format. The softcopy shall be in .dwg format and compatible to AutoCAD Release 14 up to 2002 version.

4. **ELECTRICAL EQUIPMENT IN DISTRIBUTION SUBSTATION**

4.1 General Arrangement

High voltage Gas Insulated Switchgear (GIS) or Air Insulated Switchgear (AIS) is to be installed in the distribution substation.

Substations located on ground floor shall be equipped with silicone oil filled transformers or equivalent to avoid the need for a fixed fire fighting installation. Substations sited other than on ground floor such as basement and upper floor of a building shall be equipped with non-flammable transformers such as SF6 gas insulated or dry type transformers. Non-flammable type transformer is at a higher standard in terms of fire safety. Under normal circumstance, this practice should be followed for new installations.

In certain situations, due to the external factors such as site conditions, the use of non-flammable type transformer may not be practical. The customer or the building owner of the distribution substation and CLP Power shall agree on using other type of transformer for example silicone oil filled transformer. All regulatory requirements shall also be complied in all cases.

4.2 Types of Electrical Equipment

A substation shall normally accommodate the following equipment.

- | | |
|-----------------------------|---|
| 11kV switchgear | - This normally consists of the total number of panels required for the particular project plus one spare panel for any future purpose. |
| Power Transformer | - One to three transformers as required. |
| LV board | - Normally one per substation. |
| LV capacitor bank | - One per transformer. |
| 30V battery and charger | - One for 5 units or less 11kV switchgear panels. Two for more than 5 units. |
| Pilot marshalling boxes | - Two per substation. |
| Fibre optic marshalling box | - Two per substation. |
| Remote terminal unit | - One to two per substation. |
| Meter summation panel | - One per substation. |

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 the equipment and hence its dimensions and weight may vary from time to time. The substation layout is subjected to the equipment being used.

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

- | | |
|-------------------|---|
| 11kV switchgear | <ul style="list-style-type: none">- 1000mm at the back of the panels.- 1500mm in front of 11kV circuit breakers. Where metering circuit breaker panels are installed, 2000mm for the operation of the VT lifting trolley may be required.- 750mm on the other two sides of the switchboard. |
| Transformer | <ul style="list-style-type: none">- 900mm around the LV terminals.- 750mm on the other sides. |
| LV board | <ul style="list-style-type: none">- 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. |
| LV capacitor bank | <ul style="list-style-type: none">- 750mm in front and 200mm on two or rear sides. |

4.4 Foundations

- 4.4.1 The transformer foundation shall be capable of supporting a minimum load of 9000kg.
- 4.4.2 The minimum dimensions of the transformer plinth should be 1.8m long x 1.3m wide and level with finished floor level. Actual plinth size is subjected to the transformer rating and type installed.
- 4.4.3 The 11kV 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 for Electrical Equipment

CLP Power Technical Guidelines on “Earthing Design for Distribution Substations” shall be applied.

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 accomodating 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 CRITERIA

5.1 General Requirements

5.1.1 All substations shall comply with the Hong Kong Electricity Ordinance 1990 (Cap. 406), the Hong Kong Building 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 (4/96) and the related Codes of Practice on Fire Services.

5.1.2 Substations shall be situated at the periphery of the building. For the substations on ground level, they shall be directly accessible from open air (non-covered area) at all times. The permanent access to the substation shall be of adequate height, width and of sufficient strength to withstand the combined weight of the transformer and the conveying vehicle.

5.1.3 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 avoid or minimal when additional electrical equipment is necessary to install.

5.1.4 The substation minimum clear headroom should be:

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

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

- 5.1.5 The substation ceiling and customer's 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 or passing through any part of and inside the ceiling slab of the substation.
- 5.1.6 Adjacent and adjoining occupancies and hazards must be taken into account, particularly in respect of avoiding, as far as possible, "wet" environments above the substation, e.g. water tanks, toilets and the like. If these cannot be avoided, waterproofing double ceiling slab and drainage shall be provided.
- 5.1.7 No civil expansion joint shall be located in any part of the substation.
- 5.1.8 Not more than 3 transformers shall be accommodated within any one transformer room.
- 5.1.9 Ground level substations should be at least 150mm higher than the outside (pavement) level to reduce the risk of flooding.
- 5.1.10 Substation walls are to be tiled up to a height of 1500mm above floor level with 150mm x 150mm white ceramic tiles. Above the tiles, the wall and the ceiling should be cement and sand plastered and finished with one coat of liquid prepolymer sealing and two finishing coats of white acrylic resin based coating in glossy finish.

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.

- 5.1.11 When single core cables are used for the connection between the 11kV/LV transformer LV terminals and the customer's switchgear, the customer's switchroom should be immediately adjacent to, above or below the substation. Cable sealing to 2-hour fire resistance period (FRP) by 'Multi Cable Transit' (MCT) system shall be used.
- 5.1.12 The openings for cable inlet shall be properly sealed by CLP Power so as to prevent water ingress into the substation and be of two hour FRP construction. For exceptional arrangement, the section on Provision, Installation and Maintenance of Building Works and Accessories in Customer Substation shall be referred to.
- 5.1.13 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.

- 5.1.14 All external steelwork shall be stainless steel of the low carbon type AISI 316L. This specification applies to all doors, door frames, louvres, rat guards, etc.

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

- 5.1.15 Adequate ventilation to open air by means of permanent installation which is completely segregated from ventilation system of the main building shall be provided.
- 5.1.16 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.
- 5.1.17 No storage of transformer or switchgear insulant is allowed in the transformer room or customer switchroom.
- 5.1.18 Typical distribution substation layouts in this Code of Practice should be used whenever possible.
- 5.1.19 Black/Yellow colour strips shall be painted on the edge/step where floor level change.

5.2 Additional Requirements for Basement Substations

- 5.2.1 Basement substations shall be directly accessible from the open air at ground floor by a separate and independent staircase with ventilation. A vehicular access leading from street level to the substation should be provided for equipment delivery. A protected lobby with self-closing doors fitted with panic bolt leading to the adjacent communal area of the building shall be provided. Emergency exit route diagram should be provided in the substation.
- 5.2.2 Basement substations should not be located at the lowest basement level to reduce the risk of flooding. Under the substation, there should be at least one accessible basement floor where drainage system is installed to prevent flooding.
- 5.2.3 A ground floor 11kV switch room is required for basement substation(s) located at 7m or more below ground level.
- 5.2.4 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.

5.2.5 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.

5.2.6 A sump pit with 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.

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

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

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

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

Access passage for equipment shall be at least 3m wide and 2.8m high.

In the case of equipment access through a floor opening, the opening shall be provided with removable R.C. covers of two hour FRP construction. An I-beam together with an electrical hoist for lifting 9000kg load in the substation shall be provided and maintained by the building owner. An emergency lowering device with handwheel shall also be provided. The clear height of the hoisting equipment to the substation floor shall be minimum 3700mm under the hook.

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

5.3.6 A ground floor 11kV switch room is required for substations located at 7m or more above ground level.

5.3.7 Independent cable riser rooms shall be provided solely for CLP Power's cables, constructed to 2-hour FRP and have access from a public area within the building. More than one stack of cable riser rooms may be required that will be determined by the power load of and location in the building.

Cable riser room access doors shall be 2-hour FRP. In 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 FRP material by the building owner after installation of cables.

A lifting beam and trolley shall be provided at the highest cable riser room to facilitate cable installation. The lifting load shall be 500kg. Hooks for fastening of safety belt shall be provided at suitable locations when the access to the lifting beam/trolley is more than 2m above floor.

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 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 A ground floor 11kV switch room is required.
- 5.4.4 The access and exit route 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.
- 5.4.5 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.
- 5.4.6 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.
- 5.4.7 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. This lift shall be able to change-over to the essential power of the building when its normal supply fails.

Access passage for equipment shall be at least 3m wide and 2.8m high. Bigger access may be required in case of special applications.

- 5.4.8 Independent cable riser room shall be provided solely for CLP Power's cables, constructed to 2-hour FRP and have access from a public area within the building. More than one stack of cable riser rooms may be required that will be determined by the power load of and location in the building.

Cable riser rooms access doors shall be 2-hour FRP. In 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 FRP material by the building owner after installation of cables.

A lifting beam and trolley shall be provided at the highest 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. Hooks for fastening of safety belt shall be provided at suitable locations when the access to the lifting beam/trolley is more than 2m above floor.

- 5.4.9 Cable jointing room, 3m by 3m, on each mechanical plant floor from the ground to the substation shall be provided to allow future cable repair/replacement.
- 5.4.10 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

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 850mm (if trench depth is 1000mm) 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 1000mm deep minimum except under the switchgear where the trench shall be 1200mm deep.

5.5.1.1 800mm wide for 11kV switchgear panels;

5.5.1.2 600mm wide for 11kV cables from 11kV 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 1000mm deep.

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

5.5.3 Pilot Cable Trench

A short trench 400mm wide x 1000mm deep should be extended to where the pilot cable marshalling boxes are installed.

5.5.4 Trench Construction

All trenches shall be covered with 6mm thick steel chequer plates. In the case of a suspended trench, the trench walls shall be constructed

to have a 2 hour FRP. All junctions of trenches shall be chamfered to 150mm x 150mm.

Both sides of the cable trench under the 11kV switchgear shall be of dense concrete construction to a minimum width of 200mm for switchgear support.

5.5.5 Trench Outlet

5.5.5.1 All trench outlets should have the same width as the trench and 150mm diameter G.I. sleeves 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 11kV panels in the substation.

5.6 Doors

All substation doors shall open outwards into an unobstructed space with a 180° swing and shall be of stainless steel.

The following notice plate shall be installed by CLP Power:

- 'DANGER'
- Wear safety helmet
- Substation nameplate
- SF6 gas-filled equipment warning plate for substations with SF6 equipment installed.

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

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 plastic chain (Box dimension : 400mm length x 200mm wide x 800mm high).

5.6.1 Type of Door

5.6.1.1 Double leaf door shall be normally 2400mm wide and 2800mm high for transformer access. Actual door size is subjected to the transformer rating and type installed.

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 2500mm high shall be provided for 11kV switchgear and personnel access. Actual door size is subjected to the switchgear rating and type installed. 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. Drawing No. T-COP-10250-D-E33-0103-14 shows this type of door.

Doors shall be of 2 hours FRP or shall comply with the relevant requirements of the Buildings and Fire Services Regulation and shall have relevant approval certificates/documents accepted by FSD (drawings in this Code of Practice are only indicative in terms of door design, dimensions, wickets, etc.).

5.6.2 Lock

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.

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.

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.

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

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.

5.8 Vermin Proofing

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 defence while the electrical equipment design will act as the second.

In case of indoor substations, the first line of defence shall be by means of ;

- Substation walls
- Doors
- Rat guards at ventilation louvres and grills
- Sealing of cable trenches.

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

Electrical plant in substations is designed to different degrees of protection according to IEC 60529. 11kV switchgear is designed to IP4X while the LV boards are to IP2X.

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 SU 316L. The American equivalent is TP 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.

5.10 Requirements of Substation External Decorative Louvre

- 5.10.1 The weight and the fixing method of the external decorative louvre shall be certified by the authorized person representing the building owner/customer, and to be submitted to CLP Power for agreement.
- 5.10.2 External decorative louvre should not be fixed directly or indirectly onto substation stainless steel doors and ventilation louvres.
- 5.10.3 With the decorative louvre, all substation doors should be able to open outwards with 180 degree swing.
- 5.10.4 The external decorative louvre shall not affect the substation ventilation.
- 5.10.5 The building owner/customer shall be the owner and responsible for the maintenance of the decorative louvre.

6. VENTILATION DESIGN CRITERIA

- 6.1 Indoor substations housing transformers shall be adequately well 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.
- 6.3 Effective inlet louvre area shall be a minimum of 1.12 sq.m for every 3000kVA of installed transformer capacity.
- 6.4 For each 1500kVA transformer at or above ground level with heat dissipation of about 11kW, a 630mm diameter fan and 0.65 sq.m air trunking (maximum 9m long) are required. If the transformer is in a basement, 800mm fan and 0.85 sq.m trunking should be provided.
- 6.5 The standard exhaust fans provided by CLP Power will be the WOODS or other approved equivalent 800mm, or 630mm, 700 RPM type or one of equivalent performance as follows:-

Diameter (mm)	RPM	Air Extraction Rate (Cu. m/hr.)	Static Pressure (N/m ²)	Maximum Noise Level
800	700	7,000	100	63 dB(A)
630	700	3,500	70	56 dB(A)

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. Detailed design depends on the number of bends and site conditions.

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

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

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

- 6.7 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.

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.

The air duct should not pass through public areas. If this cannot be avoided, the trunkings shall be equipped with facility for maintenance and be of 2 hour F.R.P.

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.

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

- 6.8 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.

- 6.9 Indoor substations housing 11kV switchgear normally have ventilation louvres only, but a mechanical ventilation system should be provided for a large 11kV switchroom when more than five 11kV switchgear panels or the switchroom is deeper than 7.5m. Normally, the substation layout should be designed to use CLPP's standard exhaust fans.

- 6.10 The noise level generated by the ventilation system shall comply with the requirement of the Noise Control Ordinance.
- 6.11 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 (S.W.L.) marking shall be displayed next to the hook.

7. **LIGHTING DESIGN CRITERIA**

- 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 equipment.
- 7.2 The adjacent lighting fittings should be fed from different circuits of the distribution board such that illumination in part of the transformer room will not be totally loss when one lighting circuit is tripped.
- 7.3 Twin fluorescent batten fittings for 1.2m fluorescent tube at 40W or more energy efficient fluorescent tube should be used and fixed on the wall at 2.1m above floor level or suspended from the ceiling at 2.8m above floor to provide adequate illumination in the working area.
- 7.4 Battery operated fixed fluorescent lighting, portable lighting unit (if provide), and exit sign shall be provided to enable a safe exit to be made from the substation in the event of loss of power supply.

The emergency lighting should operate for not less than 1 hour. The batteries should be charged from the substation local supply.

8. ELECTRICAL SERVICES DESIGN CRITERIA

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 32A 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 11kV 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 One 20A final circuit for 13A socket outlets protected by an RCCB with overload protection.
- 8.1.7 Lifting hoist when it is installed should use 3 phase supply for the distribution board.

8.2 Essential Supply

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

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

8.3 Supply Source

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. If not available, the supply shall be obtained 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

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 strip at suitable interval for identification. For fire service conduits shall be painted with 400mm colour strip that is 150mm orange at two ends and 100mm red in the middle.

Wiring installed by CLP Power shall be of minimum 4mm² 2 core PVC/armoured.

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

8.5 Earth Bonding

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 6mm². Flexible tinned earthing braid shall be used for connecting the door.

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

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

9. **FIRE SERVICES DESIGN CRITERIA**

9.1 Introduction

This fire services design criteria summarise the Fire Services requirements in relation to CLP Power plant located in distribution substations and is based on the latest documents from the Fire Services Department, in particular the following FSD's documents:

- (a) NP101 latest revision "Fire Services Requirements for Consumer Substations Using Oil Filled Transformer and Switchgear in Buildings"
- (b) Circulation letter no. 4/96 part X "Miscellaneous Topics-Transformers"
- (c) 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 plant 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 comply fully 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 Compartmentalisation

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

9.3.2 Access

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.

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

Plant access will be from public areas inside the building through an opening or door of two hours fire resistance period (FRP) construction. A protected lobby with self-closing door fitted with panic bolt leading to a public area of the building adjacent the substation, shall be provided.

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's main switch room) shall be sealed to two hours fire resistance; 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

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

In any areas protected by a FFFI, the discharge sequence should include the automatic shutdown of the ventilation system and the closure of all ventilation openings, (see paragraph on Requirements for FFFI).

9.4 Active Fire Protection – Fire Fighting Equipment

Requirements for fire fighting equipment correspond to the type, capacity and quantity of equipment (i.e. circuit breakers, transformers) to be installed inside that particular substation. The following table shows the requirements.

Fire Fighting Equipment Requirements for Distribution Substations

Substation Location	Equipment Installed	
Ground Floor	1 or 2 x 1,500kVA SF6 Tx. or Sil Tx. or 1 x 2,000kVA Sil Tx. + VCB's	3 x 1,500kVA SF6 Tx. or Sil Tx. + VCB's
Basement	1 x 4.5kg CO ₂ PFE	2 x 4.5kg CO ₂ PFE
Upper Floors	1 x 4.5kg CO ₂ PFE	2 x 4.5kg CO ₂ PFE

- Abb :
- SF6 Tx = Sulphur Hexafluoride Filled Transformer
 - Sil Tx = Silicone-fluid Filled Transformer
 - VCB = Vacuum Circuit Breakers
 - RMU = Ring Main Unit
 - PFE = Portable Fire Extinguisher
 - FFFI = Automatic Fixed Fire Fighting Installation
 - FSD = Hong Kong Fire Services Department

* Where FFFI is installed, the replacement of a transformer or transformers with SF6 or Silicone-fluid type will not eliminate the necessity for FFFI, unless all transformers are SF6 or Silicone-fluid.

- Note :
- 1) Where FFFI is installed, portable CO₂ fire extinguisher(s) will also be installed.
 - 2) Additional CO₂ fire extinguishers may be required subject to the actual layout of the substation.

9.4.1 Automatic Fixed Fire Fighting Installation (FFFI)

The normally approved type of FFFI for distribution substation uses CO₂ as the extinguishing media. It consists of a gas reservoir which is in the form of gas cylinders and connected by pipes and discharge nozzles. Design for all FFFI shall be submitted to the Fire Services Department for approval.

Requirements for FFFI:

- 9.4.1.1 All gas cylinders shall be housed in a separate room having access independent of substation access.
- 9.4.1.2 Minimum design concentration of CO₂ for fire suppression required for the FFFI shall be not less than 50% maintained for a period of not less than 20 minutes.

- 9.4.1.3 FFFI shall be provided with means of both automatic and manual operation coupled to an audible and visual alarm device installed both outside and inside the substation.
- 9.4.1.4 Lock-off unit, manual release, visual and audible devices, if located externally, shall be of weather-proof type or housed in weather-proof box to I.P. rating not less than IP54.
- 9.4.1.5 Key box for lock-off key and the key for the weather-proof box should be provided and installed at the main personnel access inside the substation.
- 9.4.1.6 A name plate must be posted adjacent to the lock-off unit with wording in English and Chinese to show the names of the fire services contractor, owner or management staff with telephone number to be contacted in emergency.
- 9.4.1.7 A plate must be mounted adjacent to the lock-off unit with wording in English and Chinese stating the operation instructions for the system. This notice might be combined with the plate as per Clause 9.4.1.6, above.
- 9.4.1.8 Detection system installed for the FFFI shall comprise smoke (ionisation) and heat (rate of rise and fixed temperature) detectors arranged in a 'Dual Zone' manner as follows :-
- (i) Zone 1 detection circuit is of smoke detector type and Zone 2 is of heat detector or vice versa.
 - (ii) Upon actuation of either Zone 1 or Zone 2 circuit, local alarms and warning signs are generated without gas discharge.
 - (iii) Only the actuation of both the detection circuits will cause the discharge of the CO₂ flooding system.
- 9.4.1.9 Detectors and discharge nozzles should not be located at positions where the ventilation ducts and other services would have an adverse effect on the proper functioning of the detectors and nozzles.
- 9.4.1.10 Detectors and discharge nozzles must not be mounted directly above transformer tanks or switch panels.
- 9.4.1.11 The ventilation system (exhaust fans or air conditioners) must be shut off automatically prior to discharge of the system.

- 9.4.1.12 Means to seal up exhaust fan wall openings and trunking and ventilation louvres shall be provided and arranged to close automatically prior to discharge of the system.
- 9.4.1.13 Penetrations and openings in the substation shall be properly sealed with BD approved material offering a fire resistance not less than FRP (Fire Resistance Period) of the element being penetrated to achieve the integrity of the room.
- 9.4.1.14 A.C. supply from the Power Company is the primary power supply for the FFFI and shall auto-changeover to a 24V d.c. standby supply in case of the a.c. supply failure. The capacity of the 24V d.c. supply shall be adequate for operating the alarm sounders in all zones for at least one hour or capable of maintaining the FFFI in operation for at least 24 hours.
- 9.4.1.15 The gas cylinders storage room must be indicated both in English and Chinese as “CO₂ Cylinder Room for CLP Power Substation”.
- 9.4.1.16 FSD approved CO₂ sign must be provided on the door of the substation.
- 9.4.1.17 The CO₂ total gas flooding system shall be designed and installed to NFPA 12 (latest edition).

9.5 Automatic Fire Alarm Installation (AFA)

Transformer and switchgear rooms having electrical equipment of above 1 Kilovolt but without Fixed Fire Fighting Installation (FFFI) shall be provided with an automatic fire alarm installation (AFA) as required by the Fire Services Department (FSD). Design of the AFA must be approved by the FSD.

- 9.5.1 Point type automatic heat detectors of combined fixed temperature and rate of rise type to BS 5443 : Part 5 shall be used.
- 9.5.2 An independent fire detection zone should be provided for each transformer room, and CLP Power’s switchgear room.
- 9.5.3 Each detection zone must be provided with a remote fire indicator installed outside every entrance of the designated transformer room and/or CLP Power’s switchgear room.
- 9.5.4 Detectors must not be mounted directly above transformer tank and/or CLP Power’s switchgear.

- 9.5.5 Automatic fire alarm system shall be designed and installed to FSD's requirements and reference to the latest edition of the "Loss Prevention Council (LPC)/FOC Rules for Automatic Fire Alarm Installations for the Protection of Property" and "BS 5839 : Part 1 Fire Detection and Alarm Systems for Buildings, Part 1 – Code of Practice for System Design, Installation and Servicing". In order to alert people working inside the transformer room, attention shall be paid to the audibility of fire alarms as stated in the above standards.
- 9.5.6 AFA will not be provided for the concrete stand-alone substations where the spread of fire is not likely to happen.

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, generally 4.5kg CO₂.

9.6.2 Fixed Fire Fighting Installation/AFA

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

10. CUSTOMER MAIN SWITCHROOM DESIGN CRITERIA

Customer Switchroom shall comply to the Electricity (Wiring) Regulations, Code of Practice for the Electricity (Wiring) Regulations, latest edition and all relevant statutory requirements.

The purpose of establishing a customer switchroom in a building is to receive electricity supply from CLP Power service equipment and accommodate the main switch and distribution board for controlling and distributing electricity to all parts of the building. Therefore in designing a customer switchroom, the following requirements shall be noted.

10.1. Position of Switchroom

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

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

10.2. Access

The 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 a switchroom should open outwards and this emergency exit should be identified clearly.

10.3. Routing of Outgoing Circuits

The outgoing circuits from the 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 switchroom shall not only be big enough to accommodate all the associated switchgear, distribution board and CLP Power metering equipment but also have adequate working space to facilitate installation, operation and maintenance.

The working space should meet the minimum requirement of COP for the Electricity (Wiring) Regulations – clause 4E.

10.4.1 Supply from Local Transformers

The internal headroom shall be not less than 2.1m.

The minimum depth shall be 2.75m when the switchroom is above the substation or adjacent to the substation provided that the customer's main ACB can be positioned in line with the MCT holes.

When the switchroom is below the substation or adjacent to the substation but designed to take the supply from more than one transformer, the minimum depth shall be 3.15m.

In addition, the 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

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

10.5. Cable Trench

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

Customer's outgoing cables 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.

10.6. Other Services

No water pipe or drainage system is permitted within a customer switchroom. Where the 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.

10.7 Illumination and Ventilation

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

10.8. Means to Prevent Ingress of Water

To prevent ingress of water, the 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.

10.9 Approval Procedure

On the transformer substation detailed layout drawing, CLP Power will mark up the suggested trench layout and possible location for customer's main ACBs for the owner/customer's consideration. The owner/customer or his agent must resubmit the detailed switchroom layout incorporating the finalised cable trench and exact position of each main ACB 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 surrounding, 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 plant/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 No forced ventilation system shall be required.

11.2 Type of Fencing

Galvanised wire mesh of gauge No. 10 and 50mm mesh shall be used and fixed on concrete post or 75mm x 75mm x 9mm steel angle posts connected to 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 Helment', substation nameplate and SF6 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.

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 CUSTOMER SUBSTATION

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

C - indicates items provided/maintained by CLP Power

D - indicates items provided/maintained by Owner/Customer

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

Item	Provision of Material	Installation	Maintenance
<p>2. <u>Substation Access</u></p> <p>2.1 Substation door in accordance with typical drawings</p> <p>2.2 Emergency exit deadlock set with panic bar</p> <p>2.3 Lock for substation door</p> <p>2.4 Panic bolt on exit door without lock</p> <p>2.5 Substation statutory notice plates</p> <p>2.6 Notices for treatment of electric shock and for emergency action</p> <p>2.7 Chain box for the storage of access control chain</p>	<p>D</p> <p>C</p> <p>C</p> <p>D</p> <p>C</p> <p>C</p> <p>D</p>	<p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>C</p> <p>C</p> <p>D</p>	<p>D</p> <p>C</p> <p>C</p> <p>D</p> <p>C</p> <p>C</p> <p>D</p>
<p>3. <u>Substation Building Works for Cables</u></p> <p>3.1 Chequer plate</p> <p>3.2 Steel rack for holding cable cleats</p> <p>3.3 Cable brackets and cleats in substation.</p> <p>3.4 Cable brackets in cable riser room for high rise building.</p> <p>3.5 Cable cleats in cable riser room for high rise building.</p> <p>3.6 Cable tray in accordance with typical drawing *</p> <p>3.7 Sealing of cable entry opening except cable riser room for high rise building</p> <p style="padding-left: 40px;">Before cable entry</p> <p style="padding-left: 40px;">After cable entry</p>	<p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>C</p>	<p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>C</p>	<p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>C</p>

Item	Provision of Material	Installation	Maintenance
3.8 Sealing of through floor/wall openings in high level substation and cable riser room for high rise building	D	D	D
3.9 Tinned copper bar bonding terminal for earthing	D	D	D
<p>4. <u>Substation Ventilation Installations</u></p> <p>4.1 Exhaust fan: Propeller type (standard sizes 630/800mm diameter) Axial type (for long air duct)</p> <p>4.2 Air duct, fire damper</p> <p>4.3 Emergency stop pushbutton (for exhaust fan)</p> <p>4.4 Drainage pipe with valve</p>	<p>C</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p>	<p>D</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p>	<p>C</p> <p>D</p> <p>D</p> <p>D</p> <p>D</p>
<p>5. <u>Substation Electrical Installations</u></p> <p>5.1 Distribution board for substation supply in accordance with typical drawings</p> <p>5.2 Electrical fittings in substation including cable conduit, light fitting, emergency lighting unit, socket and internal wiring</p> <p>5.3 Sump pump (for basement substation)</p> <p>5.4 Flooding alarm</p>	<p>D</p> <p>D</p> <p>D</p> <p>D</p>	<p>D</p> <p>D</p> <p>D</p> <p>D</p>	<p>C</p> <p>D</p> <p>D</p> <p>D</p>

Item	Provision of Material	Installation	Maintenance
6. <u>Substation/Cable Riser Room Fire Services Installations</u>			
6.1 Portable fire extinguisher (PFE)	C	C	C
6.2 Outdoor cabinet for PFE	D	D	D
6.3 Fire detection/alarm system	D	D	D
6.4 Fixed fire fighting installation	D	D	D
7. <u>Substation Plant & Equipment for Provision of Supply</u>			
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 : Actual installation location to be advised on site by CLP Power Site Engineer.

13. DRAWINGS

Layout Plans

TCOP10250DE33-0101-01-A	TYPICAL TEMPORARY OUTDOOR SUBSTATION LAYOUT FOR ONE TRANSFORMER AND 11kV RING MAIN UNIT
TCOP10250DE33-0101-02-B	TYPICAL GROUND FLOOR SUBSTATION LAYOUT FOR ONE TRANSFORMER AND 11kV SWITCHGEAR
TCOP10250DE33-0101-03-B	TYPICAL GROUND FLOOR SUBSTATION LAYOUT FOR TWO TRANSFORMERS AND 11kV SWITCHGEAR
TCOP10250DE33-0101-04-B	TYPICAL GROUND FLOOR SUBSTATION LAYOUT FOR THREE TRANSFORMERS AND 11kV SWITCHGEAR
TCOP10250DE33-0101-05-A	TYPICAL BASEMENT SUBSTATION SECTIONS
TCOP10250DE33-0101-06-B	TYPICAL BASEMENT SUBSTATION FOR ONE TRANSFORMER AND 11kV SWITCHGEAR
TCOP10250DE33-0101-07-B	TYPICAL BASEMENT SUBSTATION LAYOUT FOR TWO TRANSFORMERS AND 11kV SWITCHGEAR
TCOP10250DE33-0101-08-B	TYPICAL BASEMENT SUBSTATION LAYOUT FOR THREE TRANSFORMERS AND 11kV SWITCHGEAR
TCOP10250DE33-0101-09	TYPICAL UPPER FLOOR SUBSTATION SECTIONS
TCOP10250DE33-0101-10-B	TYPICAL UPPER FLOOR SUBSTATION LAYOUT FOR ONE TRANSFORMER AND 11kV SWITCHGEAR (INDEPENDENT STAIRCASE)
TCOP10250DE33-0101-11-B	TYPICAL UPPER FLOOR SUBSTATION LAYOUT TWO TRANSFORMERS AND 11kV SWITCHGEAR (INDEPENDENT STAIRCASE)
TCOP10250DE33-0101-12-B	TYPICAL UPPER FLOOR SUBSTATION LAYOUT FOR THREE TRANSFORMERS AND 11kV SWITCHGEAR (INDEPENDENT STAIRCASE)
TCOP10250DE33-0101-13-B	TYPICAL UPPER FLOOR SUBSTATION LAYOUT FOR HOUSING ONE TRANSFORMERS WITHOUT VEHICULAR ACCESS (INDEPENDENT STAIRCASE)
TCOP10250DE33-0101-14	TYPICAL HIGH LEVEL SUBSTATION LAYOUT FOR ONE/TWO/THREE TRANSFORMER AND 11kV SWITCHGEAR IN HIGH RISE BUILDING
TCOP10250DE33-0101-15-B	TYPICAL HIGH LEVEL SUBSTATION LAYOUT FOR ONE TRANSFORMER AND 11kV SWITCHGEAR IN HIGH RISE BUILDING
TCOP10250DE33-0101-16-B	TYPICAL HIGH LEVEL SUBSTATION LAYOUT FOR TWO TRANSFORMERS AND 11kV SWITCHGEAR IN HIGH RISE BUILDING

TCOP10250DE33-0101-17-B	TYPICAL HIGH LEVEL SUBSTATION LAYOUT FOR THREE TRANSFORMERS AND 11kV SWITCHGEAR IN HIGH RISE BUILDING
TCOP10250DE33-0101-18-A	TYPICAL PLAN OF CABLE RISER ROOM ON GROUND FLOOR OR FLOOR LEVEL WHERE CABLE ENTRY (SHEET 1 OF 4)
TCOP10250DE33-0101-19	TYPICAL LAYOUT OF CABLE RISER ROOM (SHEET 2 OF 4)
TCOP10250DE33-0101-20-A	TYPICAL SECTIONS OF CABLE RISER ROOM (SHEET 3 OF 4)
TCOP10250DE33-0101-21-A	TYPICAL LAYOUT OF CABLE RISER ROOM CABLE MOUNTING DETAILS (SHEET 4 OF 4)
TCOP10250DE33-0101-22	TYPICAL CABLE CLEATS FOR HV CABLES, PILOT CABLES AND FIBRE OPTIC CABLES

Section Plans

TCOP10250DE33-0102-01	MINIMUM REQUIREMENTS FOR CUSTOMER'S SWITCHROOM ADJACENT TO SUBSTATION FOR SINGLE TRANSFORMER INSTALLATION
TCOP10250DE33-0102-02	MINIMUM REQUIREMENTS FOR CUSTOMER'S SWITCHROOM ADJACENT TO SUBSTATION FOR MULTI-TRANSFORMER INSTALLATION
TCOP10250DE33-0102-03	MINIMUM REQUIREMENTS FOR CUSTOMER'S SWITCHROOM ABOVE TRANSFORMER ROOM
TCOP10250DE33-0102-04	MINIMUM REQUIREMENTS FOR CUSTOMER'S SWITCHROOM BELOW TRANSFORMER ROOM
TCOP10250DE33-0102-05	COVER FOR OUTDOOR SUBSTATION LOCATED INSIDE CONSTRUCTION SITE
TCOP10250DE33-0102-06-A	TYPICAL ARRANGEMENT OF WET ENVIRONMENT ABOVE DISTRIBUTION SUBSTATION
TCOP10250DE33-0102-07	TYPICAL SECTION OF TRANSFORMER ROOM AT EXHAUST FAN POSITION (NOT DIRECTLY ABOVE SUBSTATION DOOR) (SHEET 1 OF 3)
TCOP10250DE33-0102-08	TYPICAL SECTION OF FAN ROOM (DIRECTLY ABOVE SUBSTATION DOOR) (SHEET 2 OF 3)
TCOP10250DE33-0102-09-A	TYPICAL SECTION OF FAN ROOM (SHEET 3 OF 3)

Indoor Substation Details

TCOP10250DE33-0103-01	INSTALLATION OF FOUR "MULTI-CABLE TRANSIT" PLUG-IN IN CABLE TRENCH IN TWO LAYERS (FOR FULL NEUTRAL ARRANGEMENT)
TCOP10250DE33-0103-02	INSTALLATION OF FOUR "MULTI-CABLE TRANSIT" PLUG-IN IN CABLE TRENCH IN LINE (FOR FULL NEUTRAL ARRANGEMENT)
TCOP10250DE33-0103-03	INSTALLATION OF TWO "MULTI-CABLE TRANSIT" PLUG-IN IN CABLE TRENCH IN LINE
TCOP10250DE33-0103-04	INSTALLATION OF "MULTI-CABLE TRANSIT" PLUG-IN THROUGH SUBSTATION CEILING
TCOP10250DE33-0103-05	INSTALLATION OF "MULTI-CABLE TRANSIT" PLUG-IN THROUGH SUBSTATION FLOOR
TCOP10250DE33-0103-06	STEEL FORMER FOR 200mm DIA. "MCT" HOLE
TCOP10250DE33-0103-07	STEEL FORMER FOR 150mm DIA. "MCT" HOLE
TCOP10250DE33-0103-08	TYPICAL DETAILS OF NUMBER MARKED ON THE CABLE TRENCH COVER
TCOP10250DE33-0103-09-A	TYPICAL DETAILS OF CAT LADDER
TCOP10250DE33-0103-10	TYPICAL DETAIL OF CABLE TRENCH (SHEET 1 OF 3)
TCOP10250DE33-0103-11-A	TYPICAL DETAIL OF CABLE TRENCH (SHEET 2 OF 3)
TCOP10250DE33-0103-12-A	TYPICAL DETAIL OF CABLE TRENCH (SHEET 3 OF 3)
TCOP10250DE33-0103-13	CABLE TRENCH FOR ACCOMMODATING CLP POWER SINGLE-CORE CABLES IN CUSTOMER'S SWITCHROOM
TCOP10250DE33-0103-14-A	TYPICAL DETAILS OF SINGLE STAINLESS STEEL DOOR
TCOP10250DE33-0103-15-A	TYPICAL DETAILS OF SINGLE STAINLESS STEEL DOOR WITHOUT LOCK
TCOP10250DE33-0103-16-A	TYPICAL DETAILS OF DOUBLE LEAF STAINLESS STEEL DOOR WITH WICKET ON THE RIGHT
TCOP10250DE33-0103-17-A	TYPICAL DETAILS OF DOUBLE LEAF STAINLESS STEEL DOOR WITH WICKET ON THE LEFT
TCOP10250DE33-0103-18-A	TYPICAL DETAILS OF DOUBLE LEAF STAINLESS STEEL DOOR WITH WICKET ON THE RIGHT AND WITHOUT LOCK

TCOP10250DE33-0103-19-A	TYPICAL DETAILS OF DOUBLE LEAF STAINLESS STEEL DOOR WITH WICKET ON THE LEFT AND WITHOUT LOCK
TCOP10250DE33-0103-20-A	TYPICAL DETAILS OF DOUBLE LEAF STAINLESS STEEL DOOR (1500Wx2500H) FOR H. V. SWITCHGEAR ROOM
TCOP10250DE33-0103-21-A	TYPICAL DETAILS OF DOUBLE LEAF STAINLESS STEEL DOOR WITHOUT LOCK (1500Wx2500H)
TCOP10250DE33-0103-22	DETAIL OF EMERGENCY EXIT DEADLOCK SET WITH PANIC BAR
TCOP10250DE33-0103-23	TYPICAL ARRANGEMENT OF PANIC BOLT FOR TRANSFORMER ROOM DOORS
TCOP10250DE33-0103-24	TYPICAL DETAILS OF METAL TRUNKING & STAINLESS STEEL LOUVRE FOR 630mm DIA. WALL MOUNTED EXHAUST FAN
TCOP10250DE33-0103-25	TYPICAL DETAILS OF METAL TRUNKING & STAINLESS STEEL LOUVRE FOR 800mm DIA. WALL MOUNTED EXHAUST FAN
TCOP10250DE33-0103-26	TYPICAL DETAIL OF STAINLESS STEEL LOUVRE

Outdoor Substation Details

TCOP10250DE33-0104-01	DETAIL OF METAL GATE AND CHAIN LINK FENCE WITH STEEL ANGLE POST FOR OUTDOOR SUBSTATION
TCOP10250DE33-0104-02	DETAIL OF METAL GATE AND CHAIN LINK FENCE WITH PRECAST CONCRETE POST FOR OUTDOOR SUBSTATION
TCOP10250DE33-0104-03	DETAIL OF METAL GATE AND BRICK WALL SURROUND FOR OUTDOOR SUBSTATION
TCOP10250DE33-0104-04	TYPICAL DETAIL OF CABLE TRENCH R.C. COVER
TCOP10250DE33-0104-05	TYPICAL DETAILS OF CABLE DRAW-PIT (STRAIGHT APPLICATION)
TCOP10250DE33-0104-06	TYPICAL DETAILS OF CABLE DRAW-PIT (ANGLE APPLICATION)
TCOP10250DE33-0104-07-A	TYPICAL DETAILS OF CABLE DRAW-PIT (TEE APPLICATION)

Accessories Details

TCOP10250DE33-0105-01-A	DETAIL OF SUBSTATION STATUTORY NOTICE PLATE – DANGER WARNING
TCOP10250DE33-0105-02-A	DETAIL OF SUBSTATION STATUTORY NOTICE PLATE – DANGER & SF6 GAS-FILLED EQUIPMENT WARNING
TCOP10250DE33-0105-03-A	DETAIL OF SUBSTATION STATUTORY NOTICE PLATE – SUBSTATION NAME
TCOP10250DE33-0105-04-A	DISPOSITION OF THE DANGER PLATE AND SUBSTATION NAME PLATE
TCOP10250DE33-0105-05-A	DETAILS OF STEEL WALL BRACKET AND WOODEN CLEAT FOR HOLDING SINGLE CORE CABLES
TCOP10250DE33-0105-06-A	DETAILS OF STEEL WALL BRACKET AND WOODEN CLEAT FOR HOLDING 11kV CABLES (240mm SQ. XLPE CABLE, PILOT CABLE AND FIBRE OPTIC CABLE)
TCOP10250DE33-0105-07	DETAILS OF WALL MOUNTED STEEL BRACKET FOR SUPPORTING PORTABLE EMERGENCY LIGHTING UNIT
TCOP10250DE33-0105-08	CABLE LUG FOR 960mm SQ. SINGLE CORE STRANDED ALUMINIUM CONDUCTOR L. V. CABLE
TCOP10250DE33-0105-09	STAINLESS STEEL CABINET FOR OUTDOOR 4.5kg CO2 FIRE EXTINGUISHER

Schematic Diagrams

TCOP10250DE33-0106-01-A	LV SCHEMATIC DIAGRAM FOR CUSTOMER SUBSTATION (WITH TRANSFORMER AND 11kV SWITCHGEAR)
TCOP10250DE33-0106-02-A	LV SCHEMATIC DIAGRAM FOR 11kV SWITCHROOM
TCOP10250DE33-0106-03-B	EARTHING SCHEMATIC DIAGRAM
TCOP10250DE33-0106-04	GENERAL SCHEMATIC DIAGRAM OF SUMP PUMP AND PIPE CONNECTIONS FOR BASEMENT SUBSTATION
TCOP10250DE33-0106-05-A	TYPICAL ARRANGEMENT OF CABLE TRAY
TCOP10250DE33-0106-06	COLOR CODES FOR PIPES AND CONDUITS IN DISTRIBUTION SUBSTATION
TCOP10250DE33-0106-07	NOMENCLATURE OF 11KV SWITCH PANEL AND SWITCHBOARD FOR CUSTOMER SUBSTATION

Regional Boundary of CLP Power Hong Kong Limited



Contact Details of CLP Power Hong Kong Ltd. General enquiries for distribution substation design

Regional Office	Responsible Areas	Telephone No.	Fax No.	Address
West Region	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	26783838	26783737	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	26782186	26782180	16 Ka Fu Close, Sheung Shui, N.T.
East 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, Tai Wai, Sha Tin, Ma On Shan, Sai Kung, Tseung Kwan O & Clear Water Bay	26781511	26781468	171 Shatin Pass, Tze Wan Shan, Kowloon

