Technical Guidelines

for

Connection to District Cooling System

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EMSD

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1 Interpretation

The terms used in this set of Technical Guidelines for Connection to District Cooling System (Guidelines) have the same meanings attributed to them by the District Cooling Services Ordinance, Cap. 624 (the Ordinance). Applicant and approved consumer of district cooling services (DCServ) are advised to refer to the Ordinance for details where necessary. In particular, it should be noted that:

"agreed starting date", in relation to a building for which a person is an approved consumer, means the intended starting date for the provision of district cooling services to the building as agreed by the Director when approving the person as the consumer under the Ordinance;

"***approved consumer***", in relation to a building, means a person who is approved under the Ordinance as the consumer of DCServ for the building;

"***contract cooling capacity***", in relation to a building, means the estimated maximum cooling capacity required for providing DCServ to a building as proposed by the consumer for a building and agreed by the Director of Electrical and Mechanical Services (DEMS) on the approval of the consumer of DCServ for a building or revised by the approved consumer for a building and agreed by the DEMS;

"***consumer installation***", in relation to a building, means an installation of chilled water system of the central air conditioning system of the building, which connects to the district cooling system through the interfacing pipes of the secondary side of the heat exchanger(s) of the district cooling system, inside the substation by the approved consumer;

"***district cooling services (DCServ)***" means the supply of chilled water for air conditioning purposes by a district cooling system owned by the Government, and other related services;

"***DCServ equipment***" means equipment such as chillers, pumps, heat exchangers, valves, fittings, metering and monitoring and control devices for the provision of district cooling services;

"***district cooling system (DCS)***" means a system in which chilled water is supplied from one or more central chiller plants to user buildings within the area served by the system through a network of pipes for air conditioning in the buildings;

"meter", in relation to a building to which DCServ are provided by a DCS, means a device owned by the Government and maintained by the Electrical and Mechanical Services Department (EMSD) or the operator in the building for the purpose of measuring the actual cooling capacity demanded and the actual cooling energy used by the building;

"***nominal flow rate***" in respect of a heat exchanger of the DCS means the flow rate of chilled water at the secondary side of the heat exchanger corresponding to the contract cooling capacity at the supply temperature of 6°C and return temperature of 14°C;

"*normal operating conditions*" at any time means all of the following conditions: (i) the approved consumer's cooling capacity demanded from DCServ does not exceed the contract cooling capacity (Cc in kWr); (ii) the chilled water flow rate at the secondary side of every heat exchanger is not less than 20%, but not more than 100%, of its nominal flow rate (Q = Cc / 33,600, in m3/s); and (iii) the chilled water return temperature at the secondary side of every heat exchanger is maintained at 14°C;

"*operator*" means a person who has entered into an agreement with the Government for the management, operation and maintenance of a DCS;

"*substation*" means the site within the building in which the heat exchangers, the chilled water pipes, meter and other associated equipment are installed to receive DCServ as specified by EMSD.

2 Introduction

2.1 Scope

This Guidelines addresses the general principles and requirements to be applied to the design and installation works required for connection to DCS, including the provision of substation(s) located at ground floor or basement level of the building concerned.

2.2 Purpose

This Guidelines aims, by providing guidelines and minimum requirements, to ensure that the installations to be connected to DCS or the facilities required for the building to receive DCServ such as the substations, provided by the approved consumers are designed and built to the acceptable standard; and by providing recommendations on the design of consumer's air conditioning installation for the approved consumer, to ensure such system is compatible with DCS.

Other than the statutory requirements, this Guidelines is to be read in conjunction with other relevant ordinances, regulations and codes of practice published by HKSAR Government. In case there are discrepancies between the requirements stipulated herein and the other ordinances, regulations and codes of practice, the more stringent requirement should prevail.

3 Application for District Cooling Services

3.1 Application Procedure

Any person who is eligible under the Ordinance and wishes to apply for the DCServ shall follow the procedures as detailed in the District Cooling Services Supply Conditions (Supply Conditions) issued by EMSD and the following technical requirements.

- EMSD or the operator, upon receipt of an application or an enquiry on the provision of DCServ, may require the applicant/ approved consumer to submit additional information for reference and consideration.
- All drawings submitted by the applicant/ approved consumer should be in both hardcopy and softcopy formats. The softcopy should be in ".dwg" format and compatible with either one of the latest three AutoCAD® versions.
- The applicant/ approved consumer must submit the detailed layout drawings incorporating the pipe trench and exact position of interfacing services together with the works programme for agreement by EMSD or the operator prior to installation.
- After joint inspection with satisfaction, the substation will be taken over by EMSD or the operator for the installation of heat exchangers and related facilities in the substation. Before testing and commissioning of the heat exchangers and related facilities, the approved consumer shall submit pressure test report and water treatment report to EMSD.

  The approved consumer shall issue handover completion report to EMSD or the operator after testing and commissioning. On acceptance of such report, EMSD or the operator will commence the operation and maintenance of DCServ equipment in the substation.

3.2 Handover date for EMSD's installation

EMSD or the operator shall agree with the approved consumer on a handover date of trench and substation. The handover date should normally be at least five (5) months before the agreed starting date. After taking possession of the trench and substation, EMSD or the operator will install the DCServ equipment including heat exchangers, chilled water pipes and accessories inside the substation and within the approved consumer's site boundary. Subject to the approved consumer's completion of all the required testing and commissioning works of their air conditioning installation and submission of the required testing and commissioning reports to the satisfaction of EMSD or the operator, EMSD or the operator will coordinate with the approved consumer for testing and commissioning of the heat exchangers and the related facilities and such testing and commissioning should generally start to take place at least one month before the agreed starting date. In case the approved consumer fails to comply with the above requirements, the provision of DCServ to the building may only be able to start on a later date instead of the agreed starting date. Once the provision of DCServ to the building commences, the approved consumer of the building is required to pay to the Government the DCServ charges in accordance with the Ordinance.

4 District Cooling Services Specification

4.1 Supply Temperature

4.1.1 EMSD or the operator shall normally operate the DCS to supply chilled water at primary side of heat exchanger, measured at 30-minute interval, at Design Primary Supply Temperature of 5°C ± 1°C (DPST) under normal operating conditions. The return temperature on consumer side shall be maintained at 14°C by the approved consumer. If the return temperature on the consumer side is continuously maintained well below the required 14°C for a prolonged period, EMSD or the operator may adopt necessary measures such as increasing the DPST so as to provide DCServ in an energy efficient manner to the consumer concerned.

4.2 Supply Quality

4.2.1 EMSD or the operator shall exercise reasonable care and skill to provide the approved consumer with an uninterrupted supply within the DPST under normal operating conditions on a 24 hour-a-day basis.

4.2.2 EMSD or the operator shall use their best efforts to prevent any interruption in the provision of DCServ and to minimize the duration of any such interruption. EMSD or the operator shall notify the approved consumer as soon as practicable if there is unexpected significant change in the operating status of DCServ or if any interruption is expected to occur.

4.2.3 DCServ may be interrupted or may deviate from the DPST due to, but not limited to, the following circumstances:-

a) When in the DEMS's opinion, work is required to be carried out for the installation, inspection, testing, operation, maintenance, regulating, alteration, repair, replacement or removal of any part of the DCS;

b) When in the DEMS's opinion, work is required to be carried out in the event of an operational emergency arising from a fault in the DCS;

c) When in the DEMS's opinion, it is necessary to do so to protect life or property;

d) When in the DEMS's opinion, the behaviour of, or an installation of the building by, the approved consumer for the building is jeopardizing or will jeopardize the operation or reliability of the DCServ;

e) When the operation of the approved consumer's air conditioning system of the building does not comply with the normal operating conditions.

4.3 Supply Capacity

4.3.1 EMSD or the operator shall use their best efforts to provide the approved consumer the required contract cooling capacity at all times, provided that the approved consumer shall always maintain the chilled water return temperature at 14°C.

5 General DCS Connection Design Guidelines

5.1 General

5.1.1 The minimum requirements and general design criteria for the facilities to be provided by the approved consumer for interfacing with DCS are detailed in this section.

5.1.2 The approved consumer shall at their own cost design, provide, construct and install the substation in accordance with the plans and specifications, on the approved consumer's submission, agreed by EMSD. Such plans and specifications shall not be altered without the approval in writing by EMSD or the operator. The approved consumer shall ensure that the substation shall only be used for plant and equipment in relation to the provision of DCServ within the approved consumer's site boundary.

5.1.3 The approved consumer shall at their own cost design, provide, construct, install and maintain the trench and cover for pipe work installation and substation within the consumer's site boundary inclusive of building structure, infrastructure, building services and general cleanliness within the substation.

5.2 Connection between the DCS Network and the Substation

5.2.1 Valve Chamber

5.2.1.1 A valve chamber, in which isolation valves are installed, will be assigned to each approved consumer to serve as a main gate to separate the supply for individual building from the DCS piping network. It will be designed, built, operated and maintained by EMSD or the operator.

5.2.1.2 Location of the valve chamber is to be decided by EMSD or the operator, subject to coordination with other relevant government departments. The valve chamber will normally be located outside the approved consumer's site boundary at a location where is easily accessible so as to facilitate daily operation and emergency isolation of the pipe work

5.2.2 Pipes & Trenches from the Valve Chamber to the Substation

5.2.2.1 For avoidance of doubt, only DCServ equipment including pipes, valves and control wirings are to be designed, built, operated and maintained by EMSD or the operator. Other facilities and infrastructure for connection from the valve chamber to the substation including, but not limited to, pipe trenches, thrust blocks (if any), backfilling, protection and covers are designed, built, operated and maintained by the approved consumer. The routing and size are to be mutually agreed by the approved consumer and EMSD or the operator, whilst a minimum clearance of 1.5m from DCServ pipeline shall be reserved from the ground level and other utilities.

5.2.2.2 The cross-sectional areas of pipe trenches should not be reduced by ground beams or other civil/building structures. The invert level of pipe trenches at the boundary of the substation should be coordinated with EMSD or the operator. If ground beams are present at the boundary of the substation, adequate clearance under the beams should be allowed as mentioned above. Trench should be built with bedding of compacted sand with a minimum thickness of 100mm. The required thickness of bedding in trench should also take into account the gradient requirement of the pipes to be laid. The size of pipe trench should be sufficient for laying 3 nos. chilled water pipes in parallel at the same level and 2 nos. cable ducts at each side of the trench (total 4 nos.). Bends should always be avoided. Unless agreed by EMSD, the number of bends should not exceed 4 in each pipe run with a view to limiting the friction loss in pipe. Vertical bend (e.g. "U" & "Λ" bend) shall be avoided to prevent accumulation of dirt and air lock in pipe. If pipe bends are used, drain valves and air vents at suitable locations completed with pits with adequate maintenance space should be provided.

5.2.2.3 Bell holes with dimensions of not less than 2000mm in width and 800mm in depth shall be provided at the welding joints of DCServ pipe. The bell holes shall be backfilled with sand by the approved consumer.

5.2.2.4 Draw pit(s) of a minimum size of 1100mm(W)x1100mm(L)x1500mm(H) for 4 nos. uPVC cable ducts for control cables shall be provided by the approved consumer. Details shall be submitted by the approved consumer and agreed by EMSD or the operator.

5.2.2.5 The DCServ pipes shall be direct buried. The approved consumer shall be responsible for backfilling after pipe work installation and testing and commissioning. All backfills shall be properly deposited and compacted to standards not less than the following:

(a) The backfills shall be of suitable materials i.e. sand for bedding up to 300mm above DCServ pipes and general fill from 300mm above DCServ pipes to formation in compacted layers. The backfilling materials shall not contain any broken concrete, bricks, clay, bituminous material, materials susceptible to spontaneous combustion, perishable materials or debris. Sharp stones or objects shall not be used as backfilling material to prevent damaging the cladding of DCServ pipes;

(b) Sand shall be used as the bedding material of DCS pipes with a minimum thickness of 100mm;

(c) The backfilling shall be carried out in accordance with the requirements and procedures specified in the latest edition of the General Specification for Civil Engineering Works or General Specification for Building, whichever is appropriate, published by the HKSAR Government.

5.2.2.6 The minimum width and depth of the trenches under different cooling capacities are shown in Table D1 in Appendix D.

5.3 Substation Details

5.3.1 General

5.3.1.1 Substation should comply with all applicable statutory requirements.

5.3.1.2 Unless otherwise approved by EMSD, each approved consumer shall only have one substation connecting to the DCS in relation to the provision of DCServ to the building.

5.3.1.3 For the substation on ground level, it should be directly accessible from open space (non-covered area) at all times. The permanent access to the substation should be of adequate height and width; and of sufficient strength to withstand the combined weight of the equipment and the delivery vehicle during installation and subsequent operation and maintenance.

5.3.1.4 For the substation situated at a location where exposes to the risk of flooding such as near an inclined road, slope and sea front, anti-flooding measures and facilities should be provided to prevent flooding of the substation such as minimum 150mm(H) kerbs at doors should be constructed after EMSD's or the operator's delivery of heat exchangers. The floor level of the substation on ground floor should be at least 150mm higher than the outside (pavement) level to reduce the risk of flooding.

5.3.1.5 Adequate loading should be allowed at ceiling and walls of the substation for DCServ equipment installation.

5.3.1.6 Level access with sufficient space should be allowed for equipment delivery.

5.3.1.7 The minimum clear headroom requirements (excluding any lifting hook), in consideration of the headroom required for heat exchanger installation, for substations with different cooling capacities are shown in Table D1 in Appendix D.

5.3.1.8 Permanent hoisting facilities should be provided for each heat exchanger within the substation for delivery, installation, maintenance and replacement.

5.3.1.9 The substation shall be solely for the DCServ equipment, building services serving only the substation and the consumer's air conditioning installation in relation to the provision of DCServ to the building. Other utilities, equipment, control panel and system not intended for DCServ shall not be installed within the substation.

5.3.1.10 General arrangement for the substation is shown on Fig. C1 in Appendix C.

5.3.2 Location

5.3.2.1 The substation shall be located within the approved consumer's site boundary at a location which shall be proposed by the approved consumer and agreed by EMSD or the operator.

5.3.2.2 The substation shall be close to the site boundary of the approved consumer and the valve chamber as mentioned in section 5.2.1. The substation shall preferably be located at the periphery of the building to ensure ease of installation, operation and maintenance.

5.3.2.3 To facilitate the delivery of heavy equipment, the substation shall be located on ground floor (road level) or at basement 1 (one level below road level). In any cases, the substation ceiling level as well as the top level of pipe work should not exceed +10mPD. Suitable protections shall be provided by the approved consumer for the aboveground DCServ pipes, and details of which shall be submitted by the approved consumer and subject to approval by EMSD or the operator before installation.

5.3.3 Layout

5.3.3.1 Typical substation layouts and dimensions for two heat exchangers and three heat exchangers are indicated in Fig. C3 and Fig. C4 in Appendix C and Table. D1 in Appendix D. The layouts and the table showing the minimum dimensions. The approved consumer shall submit proposed layout for agreement by EMSD.

5.3.4 Substation Dimensions

5.3.4.1 The substation should be planned in accordance with the estimated maximum cooling capacity which will become the contract cooling capacity on EMSD's approval. The cooling load calculation, water-side schematic of the consumer's air conditioning installation and assumptions used in the cooling load calculation shall be submitted to EMSD in the application form for review and approval. This can ensure that adequate cooling capacity is reserved for the consumer.

5.3.4.2 The dimensions of the substation will be subject to the cooling capacity. The indicative dimensions and provisions are listed in Table D1 in Appendix D. The table shows the required minimum dimensions which is subject to change due to site conditions and/or comment from EMSD or the operator. The substation layout and provisions shall be discussed and agreed between the approved consumer and EMSD or the operator before installation.

5.3.5 Additional Requirements for Substation at Location other than Ground level

5.3.5.1 The substation should be directly accessible from open space at ground level by at least one staircase.

5.3.5.2 Emergency exit route diagram should be provided and exhibited at the substation.

5.3.5.3 Enough access leading from street level to the substation should be provided for equipment delivery.

5.3.5.4 Curb should be provided if necessary, provision (i.e. height of curb) is subject to specific site condition / location.

5.3.6 Equipment Dimensions, Weights and Operational Space

5.3.6.1 The clearances and operating areas required around the equipment should be adequately allowed with due consideration for future operation, maintenance and upgrade.

5.3.6.2 In general, the minimum clearance required around the heat exchangers are:-

a) 1000mm on the back side

b) 1500mm between side wall and heat exchanger

c) 1500mm between each heat exchanger

The above dimensions given are measured from plinth to plinth and subject to final approval by EMSD or the operator.

5.3.7 Foundation/ Plinth

5.3.7.1 The heat exchanger foundations/ plinths to be provided by the approved consumer should be capable of supporting equipment loads. The indicative dimensions are listed in Table D1 in Appendix D.

5.3.7.2 The foundation should be capable of supporting a maximum static plus dynamic load per equipment. The floor surface should be flat and within a proper tolerance. The structural floor loading should be designed of at least 20kPa.

5.3.8 Doors

5.3.8.1 Doors with secured key lock should be provided to EMSD or the operator for the substation and should be available during the handover of the substation to EMSD or the operator. Only EMSD or the operator will have the key to the substation once the substation is handed over to EMSD or the operator for installation. The door width and height should be enough for equipment delivery. The door fire resisting period (FRP) should be at least the same as the fire compartment as required in the Code of Practice for Fire Resisting Construction issued by the Buildings Department.

5.3.9 Internal Finishing

5.3.9.1 The walls and ceiling of the substation shall be cement and sand plastered and finished with suitable paint. The floor of the substation shall be oil resistant non-slip finished.

5.3.10 Access to Substation

5.3.10.1 Chilled water lead-in pipes

a) The substation shall provide aperture(s) sufficient for the chilled water pipes and control cable ducts lead-in's. The locations, sizes and levels of the required apertures will depend on the tee-off locations, entry levels and chilled water lead-in pipe diameters. Details of these requirements shall be provided by EMSD or the operator for agreement.

b) EMSD or the operator shall provide pipe sleeves with puddle flanges for the approved consumer to install at penetrations through the building. The water stop for uPVC control cable duct shall be provided and installed by the approved consumer. To avoid doubt, the approved consumer shall be responsible for water tightness of the substation and such seals at pipes and cable ducts shall be maintained by the approved consumer.

c) Builder's works drawings for the slab opening(s), aperture(s) and other associated details for the DCServ pipes and control cable ducts penetrations shall be submitted by the approved consumer and agreed by EMSD or the operator prior to commencement of the works.

5.3.10.2 Delivery

a) Loading of the route for delivery of the equipment should be sufficient to support the equipment weight as well as other loading associated with the delivery.

b) The approved consumer shall provide all necessary support and facilities for EMSD or the operator's delivery of equipment at installation and operation phases and also for the subsequent replacement due to maintenance issue.

c) Hoisting equipment shall be provided for the installation work and future operation and maintenance. Size of such hoisting equipment shall be adequate to lift all the DCServ equipment including heat exchangers and valves inside the substation. The approved consumer shall coordinate and agree with EMSD or the operator on the details.

5.4 Equipment in the Substation

5.4.1 General

5.4.1.1 In general, all DCServ equipment installed within a substation is to be supplied, installed, operated and maintained by EMSD or the operator. Details are shown on Fig. C1 and Fig. C2 in Appendix C.

5.4.2 Heat Exchanger

5.4.2.1 Adequate number of heat exchangers will be installed inside the substation according to the estimated maximum cooling capacity/ contract cooling capacity (see Table 5.1 below). The table below is for design reference only, the exact number of heat exchangers to be provided shall be subject to agree with EMSD or the operator.

Cooling Capacity (kW)	Heat Exchangers (no. x kW)
100	2 x 60
200	2 x 120
300	2 x 180
400	2 x 240
500	2 x 300
1000	2 x 600
2500	2 x 1500
5000	2 x 3000
7500	2 x 4500
10000	3 x 4000
12500	3 x 5000
15000	3 x 6000
20000	3 x 8000
24000	4 x 7200

Table – 5.1 Reference Schedule of Number of Heat Exchangers vs Cooling Capacity of the Building

5.4.2.2 The number of heat exchangers and necessary components to be provided by EMSD or the operator in the substation will be determined by EMSD.

5.4.2.3 The following general design criteria of heat exchanger are specified for the approved consumer's design of their air conditioning system to be connected to DCS.

a) The supply water temperature on the primary chilled water side is 5 ± 1°C;

b) The secondary return chilled water temperature should be at 14°C;

c) The close temperature approach is within 1°C;

d) The maximum working pressure is 16 bar;

e) The pressure drop across heat exchanger at rated flow rate is 50kPa;

f) The minimum flow rate at secondary side of each heat exchanger is 20% of its nominal flow rate; and

g) The heat transfer plates are single wall type; comply with BS 7766; and are manufactured from stainless steel AISI 316 with a minimum thickness of 0.5mm.

5.4.2.4 If the approved consumer estimates that the actual cooling demand of the building is often very low comparing to the contract cooling capacity, additional smaller heat exchanger(s) may be requested to cater for such low load conditions. The approved consumer shall provide relevant information for EMSD's consideration and approval. The approved consumer shall provide extra floor space of the substation for installation of such additional heat exchanger(s).

5.4.3 Interfacing for the Meter

5.4.3.1 EMSD or the operator will only provide one set of meter in the substation as the standard provision. The meter, which will be installed at the DCS supply side, is to measure and record the actual cooling capacity and the actual cooling energy consumption of the building. The meter will be supplied, installed, operated and maintained by EMSD or the operator. Adequate straight pipe run shall be reserved for the metering devices to allow accurate measurements.

5.5 Building Services Requirements for the Substation

5.5.1 General

5.5.1.1 The building services provisions inside the substation should include, mechanical ventilation (and/or air conditioning), fire services, plumbing & drainage, electrical services and telecommunication. All the building services provisions should be designed, provided, constructed, installed, operated and maintained by the approved consumer, including all the subsequent utilities costs such as electricity cost, water cost, telecom cost, etc. Detailed requirements for the building services provisions are specified below.

5.5.2 Indoor Environment

5.5.2.1 The indoor environment of the substation shall be maintained in good conditions to the satisfaction of EMSD or the operator at all times by the approved consumer.

5.5.2.2 The substation should be adequately ventilated with a fixed mechanical ventilation system and/or air conditioning system with fresh air supply to maintain the indoor temperature and dry air moisture content not exceeding 35 °C dry bulb and 0.021 kg/kg dry air respectively.

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

5.5.2.4 Effective inlet louvre area should be considered and determined. Filter shall be provided and maintained by the approved consumer at the supply inlet.

5.5.2.5 The air duct should be painted in white colour with air flow direction labels in black painted on the air duct.

5.5.2.6 The mechanical ventilation fan(s) or air conditioning unit(s) should be controlled by temperature sensing devices completed with local manual on/off and timer to avoid unnecessary operation.

5.5.2.7 The supply and exhaust fans, if installed, should be switched on simultaneously.

5.5.2.8 The noise level generated by the ventilation system and/or air conditioning system should comply with requirements of the Noise Control Ordinance.

5.5.3 Plumbing and Drainage Services

5.5.3.1 The plumbing and drainage services at the substation should comply with the requirements of the Water Supplies Department and the Buildings Department.

5.5.3.2 Floor drains with a minimum size of 100 mm in diameter discharging to the building's drainage system for proper floor wash down and drainage should be provided. Discharge point should be available prior to testing and commissioning of the DCServ equipment.

5.5.3.3 One cleansing trough with faucet of 32mm water inlet point fed from the building's water supply system should be provided and should be available for EMSD's or the operator's use prior to testing and commissioning of the DCServ equipment.

5.5.3.4 The substation floor should be laid to fall of minimum 1 in 100 to the drain points in order to ensure proper water drainage.

5.5.3.5 A flood alarm system comprises at least a high water level sensor with control panel inside the substation and a flashing light at the door of substation shall be provided. The flooding signal shall be transmitted to the management system or control room of the building. The approved consumer shall also provide the repeated signal in the form of a pair of dry contacts in the substation near the EMSD's DDC panel for EMSD's or the operator's connection..

5.5.3.6 150mm wide surface channel with suitable cast iron grating and minimum 2 nos. 100mm diameter drain outlets with dome gratings and connecting to the drainage system of the building surrounding each concrete plinth for heat exchanger should be provided.

5.5.4 Fire Service

5.5.4.1 The fire service provisions should comply with the requirements of Fire Services Department (FSD) and any other statutory requirements. In general, smoke/heat detectors and fire extinguishers should be provided in the substation. The exact fire service provisions should be subject to FSD's approval.

5.5.5 Lighting System

5.5.5.1 Illumination inside the substation should be average 200 lux measured on the floor level inside the substation.

5.5.5.2 The adjacent lighting fittings should be fed from different circuits of the distribution board such that illumination inside the substation will not be totally loss when one lighting circuit is tripped.

5.5.5.3 Twin fluorescent batten fittings for 1.2m energy efficient T5 fluorescent tube or other more energy efficient lighting fittings should be used. The lighting fitting shall have IP rating of IP54.

5.5.5.4 Battery operated fixed lighting and exit sign should be provided to enable a safe exit to be made from the substation in the event of loss of power supply. The battery shall be maintained for at least 2 hours operation.

5.5.5.5 Emergency lighting providing illumination of minimum 2 lux measured at floor level should be provided in accordance with the Fire Services Department's and the Buildings Department's requirements.

5.5.6 Power Supply System

5.5.6.1 Power supply to the substation should be provided by the approved consumer for the building services of the substation and the DCServ equipment. The distribution board should be located near the main access door and should house a 32A SPN

main switch together with an adequate number of final circuits protected by miniature circuit breaker (MCB) for lighting installation, small power, ventilation and metering/control equipment. The distribution board shall have IP rating of IP 54 and be supplied with preferably back-up power supply. Sufficient number of 13A single phase socket outlets should be provided for general maintenance.

5.5.6.2 The power supply for EMSD's instrumentation & control and other accessories shall be provided in each substation near EMSD's PLC panel by the approved consumer.

5.5.7 Telecom Facilities

5.5.7.1 One fixed telephone line with outlet and telephone set should be provided inside the substation. Mobile phone signal coverage should also be provided at the substation.

5.5.8 Earthing

5.5.8.1 Earthing terminal connecting points to the main earthing terminal of the building should be provided inside the substation.

5.5.8.2 Earthing should be provided to the electrical equipment including, but not limited to, lighting fixtures as per the Code of Practice for Electricity (Wiring) Regulations issued by EMSD.

5.6 Temporary Facilities and Building Services during Installation

5.6.1 The following temporary facilities and building services shall be provided by the approved consumer for EMSD's or the operator's installation and T&C works at the substation. The approved consumer should seek EMSD's or the operator's further agreement on the details of such provisions before handover of the substation and commencement of the works.

a) Temporary power of one no. 60A TPN and one no. 20A SPN;

b) Temporary dewatering pumps, pipes and associated controls (The approved consumer shall be responsible for maintaining the substation and trenches in dry condition for installation);

c) Fire services provisions for construction site when the permanent ones are not ready;

d) Security for the substation;

e) Storage area for DCServ pipe, equipment and tools; and

f) Refuse collection point at a location close to the substation (The approved consumer shall be responsible for disposal of refuse collected thereat).

6 Compatibility of Design of the Primary and Secondary Sides

6.1 DCServ Equipment to be Installed at Secondary Side Inside Substation

6.1.1 EMSD or the operator shall design, provide, install, operate and maintain the following DCServ equipment at the secondary side inside the substation.

a) Temperature and pressure sensors and gauges at the supply and return pipe lines;

b) Strainers, pressure relief valves, dismantling joints (or flexible bellows), drain pipes and air vents for operational, safety and maintenance purposes;

c) Temporary flushing by-pass connection for flushing the secondary circuit inside the substation without passing water through heat exchangers;

d) An ON/OFF motorized valve at the return pipe of each heat exchanger to control the on/off operation of heat exchanger.

6.2 Equipment to be Installed at the Consumer's Air-conditioning System

6.2.1 The approved consumer shall design, provide, install, operate and maintain the following equipment at their air conditioning system.

a) Industrial grade automatic air vents at all the high points of the consumer's internal chilled water system.

b) Chilled water treatment system including manual feed chemicals, dosing pot with necessary rust inhibitors and biocides with sufficient quantity necessary for testing, commissioning and operation. The approved consumer shall employ a specialized water treatment company to handle the water treatment system.

c) A common signal of the approved consumer's chilled water pumps on/off status in the form of a pair of dry contacts at the nearest interfacing point of the PLC panel of DCServ inside the substation

6.3 Recommendations to Ensure Compatibility

Some recommendations on the design of the consumer's air conditioning installation are stated below and detailed in Appendix A and B to ensure such installation is compatible with DCS.

6.3.1 All terminal equipment such as air handling units, fan coil units etc. shall be designed to

a) Supply Temperature = 6°C ± 1°C

b) Return Temperature = 14°C

6.3.2 Variable speed chilled water pumps shall be provided for distribution of the consumer's chilled water system or other mean which the consumer considers it can efficiently control the chilled water flow rate.

6.3.3 A bypass pipe completed with a modulating valve connecting the chilled water supply and return mains shall be installed. When the chilled water return temperature becomes below 14 °C, the modulating valve will open to allow the chilled water re-circulating from the return pipe through the bypass pipe to the supply pipe. Such re-circulation will stop when the chilled return temperature rises to 14 °C. The purpose of the above is to maintain the chilled water return at the design temperature before entering the heat exchanger of DCS.

6.4 Consequences

The consumer's chilled water return temperature of lower than 14°C will adversely affect the efficiency of the DCS chillers and pumping plants and consequently, the reliability and service level of DCServ may not be guaranteed.

7 Testing and Commissioning and Handover of Substation

7.1 Hydraulic Testing for Chilled Water Pipe Work

7.1.1 The approved consumer shall be responsible for initial filling of water for their chilled water system and any make-up water requirement thereafter.

7.1.2 The approved consumer shall carry out hydraulic pressure test for their chilled water pipe work at a pressure of minimum 1.5 times of the total working pressure and such pressure shall be maintained for a period of not less than 24 hours without loss of pressure to ensure that the pipes are free from leak. Report of the results of hydraulic pressure test shall be submitted by the approved consumer to EMSD or the operator for approval.

7.2 Flushing and Cleaning

7.2.1 The approved consumer shall perform a complete and thorough flushing of the chilled water pipe work using cleaning chemicals and potable water as recommended by the water treatment specialist of the approved consumer to ensure that at the time of supply of DCServ, the approved consumer's piping system is clean and suitable for connection with DCS. Before connecting to DCS, the approved consumer shall install a temporary bypass pipe at consumer installation for the purpose of allowing the flushing water to recirculate in the consumer's chilled water pipe work so as to reduce the water demand and wastewater discharge. The consumer side cleaning method including flushing and chemical treatment details shall be submitted by the approved consumer to EMSD or the operator for comment and approval, prior to commencement of each activity.

7.2.2 The approved consumer shall submit flushing, cleaning and water treatment reports to EMSD or the operator for comment and approval before supply of DCServ with a view to ensure that the quality of chilled water of the consumer's air conditioning installation will not adversely affect the DCServ equipment and the operation of DCS. However, EMSD's or the operator's comment and approval shall not relieve the approved consumer of the responsibility of ensuring industry standard procedures for flushing, cleaning and water treatment.

8 Interfaces during Operation and Maintenance

8.1 Access for O&M and Data Reading

8.1.1 Adequate space accessible without any obstruction shall be allowed by the approved consumer for data taking, maintenance and replacement in the substation. The substation should be locked to keep out unauthorized personnel.

8.1.2 The personnel access shall be freely accessible by EMSD or the operator 24 hours a day to conduct operation and maintenance and inspection so as to ensure continuous and reliable supply of chilled water.

8.1.3 For avoidance of doubt, the approved consumer shall be responsible for any civil and/or builder's work required for DCS within their site boundary at no cost to EMSD or the operator.

8.2 Water Treatment

8.2.1 In a closed water loop with minimal make-up water requirements, chemical water treatment is normally used for neutralization of corrosive properties and control of scaling in heat exchangers. The consumer is responsible to provide adequate water treatment in the secondary circuit of the heat exchanger.

8.2.2 The approved consumer shall submit water treatment report for the consumer side air conditioning installation to EMSD or the operator on a monthly basis. Unless otherwise recommended by the approved consumer's water treatment specialist and accepted by EMSD or the operator, the following minimum standard shall be maintained.

pH value:	8.0 – 10.0
Turbidity (FTU scale):	Below 10
Total dissolved solid:	Below 1,000 ppm
Conductivity:	Below 1,500 μS/cm
Total hardness (as $CaCO_3$):	Below 50 ppm
Total iron:	Below 1.0 ppm
Total copper:	Below 0.2 ppm
Nitrate:	250 – 600 ppm
Total bacterial count:	Below 10,000 npml

8.3 Meter

8.3.1 EMSD will provide one set of meter as mentioned in Section 5.4.3 in the substation as the standard provision. As power supply to the meter shall be fed from the approved consumer's system, the approved consumer shall maintain the power supply system in good order from time to time so as to achieve continuous and accurate measurements.

8.3.2 If there is an interruption of consumer side's power supply to the meter or due to any other reasons which lead to the meter fails to measure properly for a period, EMSD or the operator will estimate the actual cooling capacity and actual cooling energy consumption for that period in a suitable manner. The estimated amounts will be detailed in the monthly consumption record to be issued to the approved consumer.

8.3.3 In order to maintain the accuracy in metering, regular validation tests for the meters will be conducted by EMSD or the operator. During the test, measurement by the meter will be suspended for about one hour and accordingly EMSD or the operator will estimate the measurements in accordance with section 8.3.2 above.

Appendix A – Fundamentals of DCS

1) Principle

District cooling system is a large scale centralized air conditioning system which consolidates the chillers required in each individual building into a central plant serving the consumer building's centralized air conditioning installation in a district. The chilled water produced at the DCS plant will be distributed to consumer buildings through a closed loop network of underground pipes. Cooling energy required by each consumer building will be transferred via heat exchangers installed at the substation connected to the distribution network of DCS. Fig. A1 below illustrates a typical configuration of DCS.

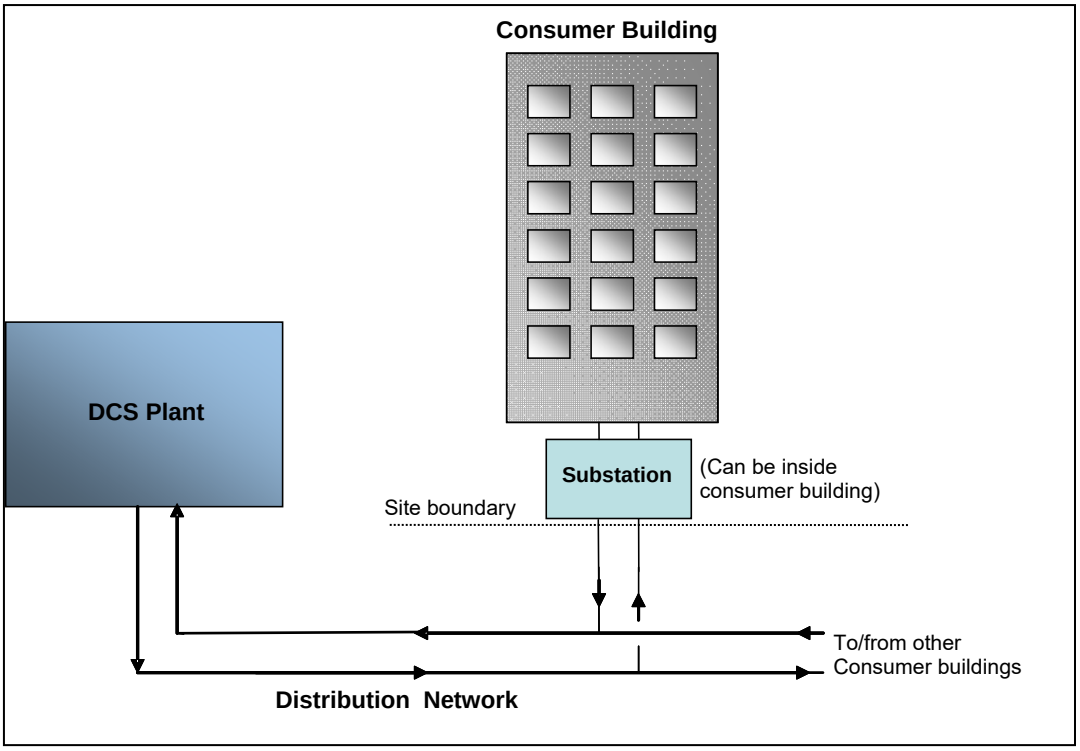


Fig. A1 – Typical Configuration of District Cooling System

2) Kai Tak District Cooling System (KTDCS)

(i) System Configuration

The KTDCS comprises two plants, namely the North Plant and the South Plant cum seawater pump house in which there are chillers, chilled water pumps, controls, power supply installations and supporting facilities.

Variable speed pumping system is adopted with a view to optimizing the energy consumption. Chilled water will be distributed by the variable speed pumps through the distribution network to substations where cooling energy is transferred for the consumer buildings' use. The DCS chilled water supply flow rate to each substation will be adjusted according to the cooling demand of the consumer building.

Chilled water pipes from the DCS distribution network are connected to the plate type heat exchangers installed inside the substation. The heat exchanger and the associated pipe work inside the substation will be provided by EMSD or the operator.

(ii) Design Conditions

The design chilled water supply and return temperatures at the primary chilled water side (DCS supply side) at the substation for KTDCS under normal operating conditions are,

- Supply Temperature = 5°C ± 1°C
- Return Temperature = 13°C

The design chilled water supply and return temperatures at the secondary chilled water side (consumer's air conditioning installation) under normal operating conditions are,

- Supply Temperature = 6°C ± 1°C
- Return Temperature = 14°C

(1°C temperature rise through heat exchanger as recommended by manufacturer)

Both EMSD or the operator and the approved consumer have the obligations to fulfil the design conditions to ensure energy efficiency and the approved consumers are supplied with stable chilled water.

Appendix B - Recommendations on the Design of the Consumer's Air Conditioning Installation

1) Design Chilled Water Temperature

All terminal equipment such as air handling units, fan coil units etc. shall be designed to

a) Supply Temperature = 6°C ± 1°C

b) Return Temperature = 14°C

2) Air Handling and Terminal Units

The approved consumer is recommended to:

a) Use variable flow chilled water system and two way equal percentage control valves for all air handling units and fan coil units and the control valve shall be capable of controlling flow through full range of expected turn-down and through full range of expected differential pressure across the valve. The chilled water modulating valve shall be closed when AHU fan's status is off. Such control shall be added in the PLC/DDC programme logic as an interlock to operate the PID loop of modulating valve. The chilled water valve shall modulate based on the set point when the status of machine is "ON" and follow the PID logic;

b) Fit all air handling units, fan coils units and main branches with double regulating balancing valves with self-sealing test point used for chilled water flow measurement as required during balancing and commissioning;

c) Install strainers on all air handling unit supply chilled water pipe;

d) Test, adjust and balance the hydraulic system to make sure that the chilled water requirement of each fan coil unit and air handling unit is met. Preferably the testing and balancing shall be carried out by a specialized third party commissioning firm; and

e) Operate the AHU/FCU chilled water valve based on the return air temperature (RAT) of the AHU/FCU. As the RAT reflects the actual condition of the space, controlling the chilled water valve to maintain the RAT at design set point instead of either the supply air temperature or off-coil temperature can achieve comparatively higher energy efficiency and maintain the return chilled water at the design temperature.

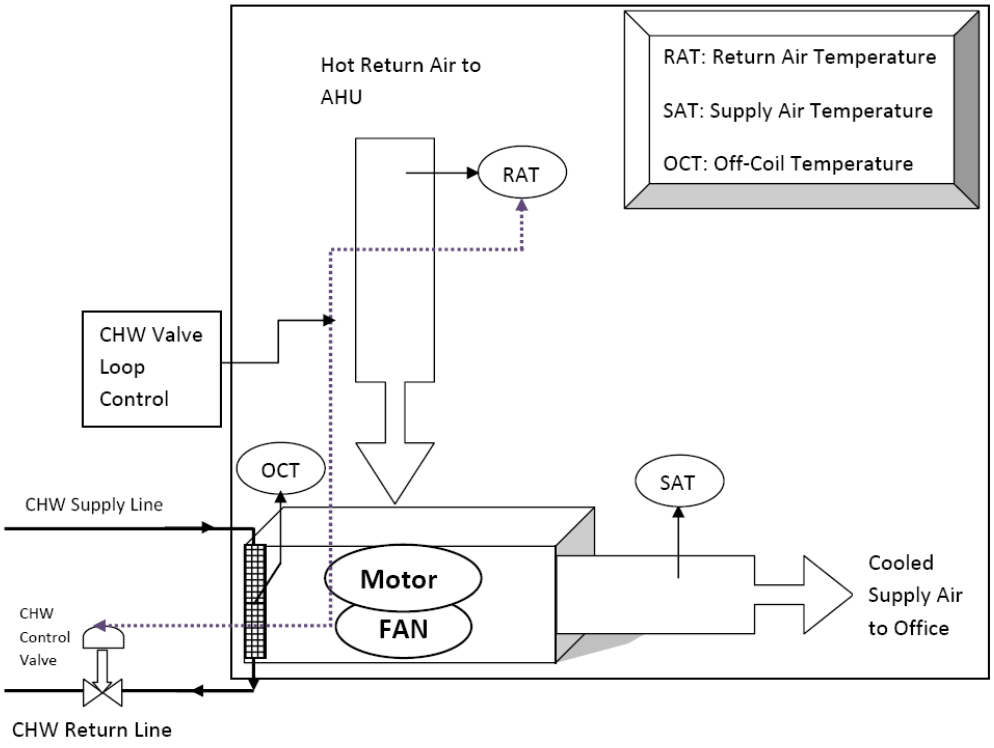


Fig. B1 – Air Handling and Terminal Units

3) Mixing Valve at the Consumer's Air conditioning Installation

The approved consumer is recommended to:

a) Install a modulating control valve between the chilled water supply and return lines of the consumer's chilled water pipe circuit. Modulating control valve shall operate in response to the chilled water return temperature at the consumer's side to maintain the return temperature at 14 °C;

b) Install two way control valves to ensure that the variable chilled water flow operates properly at the consumer side throughout the year, especially in achieving the expected chilled water return temperature; and

c) Install a modulating bypass valve such that when the consumer side chilled water return temperature is below 14 °C, the modulating bypass valve shall open to re-circulate the returned chilled water back to the system. The purpose of such provision is to maintain the chilled water return temperature at the heat exchanger(s) in the substation to the design set point, ie. 14 °C. Such modulating bypass valve shall be capable of re-circulating up to 2/3 of the full consumer side design flow

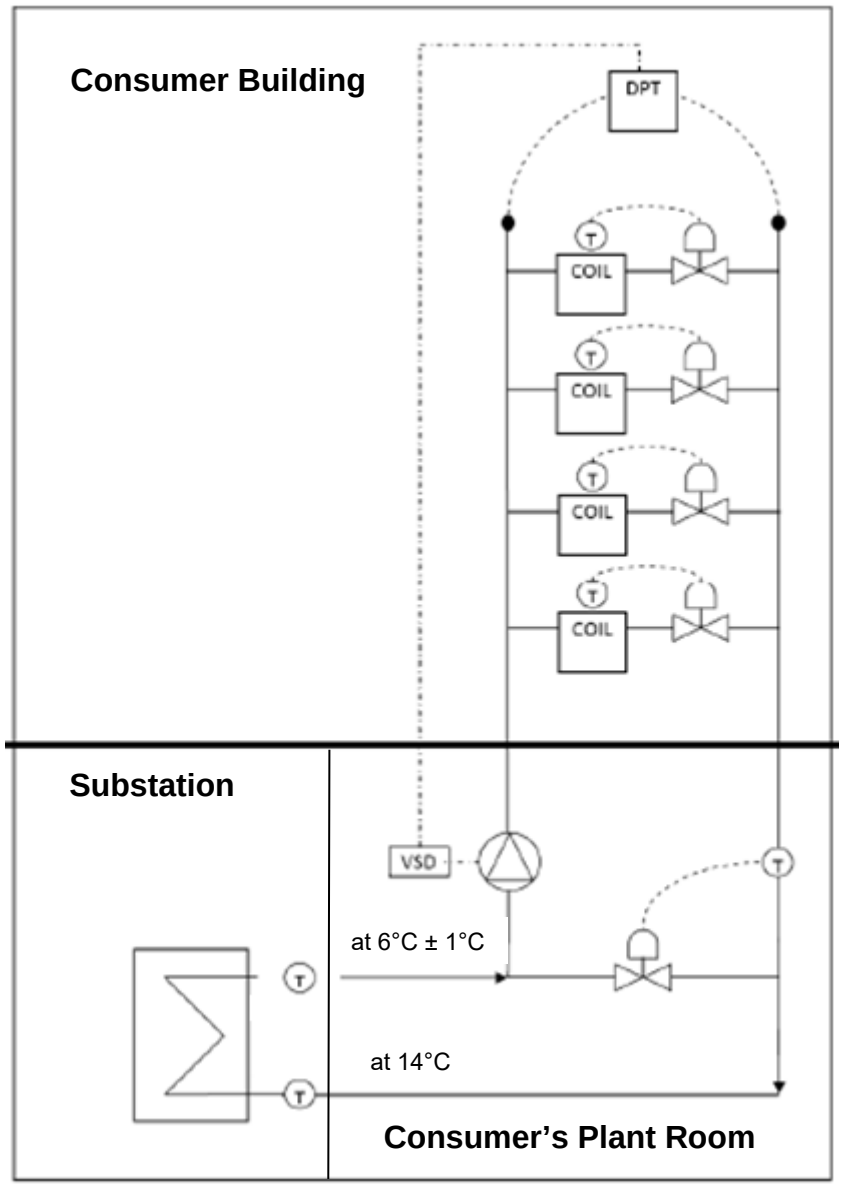


Fig. B2 – Mixing Valve at the Consumer's Air conditioning Installation

4) Consumer Side Chilled Water Pump Control

- Consumer side chilled water pumps shall be controlled based on the differential pressure transmitters (DPT) installed at the consumer's side of the chilled water system. The works on the consumer's side of the heat exchangers outside the substation are the responsibility of the approved consumer.
- An industrial grade DPT located across the hydraulically far end of the consumer's chilled water system for each building shall be used if the consumer side circuit serving more than one building. The consumer side chilled water pumps shall be of variable flow and shall be controlled based on the input from DPT(s) sensor.

5) Operation of Heat Exchanger

- The modulating valve on DCS side of heat exchanger shall be commanded to fully close if the modulating valve on consumer side is in fully closed position.
- To have better control and to enhance energy efficiency of the DCS, an ON/OFF motorized valve shall be installed on the consumer side chilled water return pipe of each heat exchanger by EMSD or the operator to control the on/off operation of the heat exchanger. The number of heat exchanger to be operated will depend on the instantaneous cooling demand and flow rate at the consumer side of the heat exchanger. The consumer should note that such ON/OFF motorized valve at consumer side of the heat exchanger might be fully closed according to DCS operational need. The consumer is recommended to install his own bypass at the consumer side chilled water system for the purpose to maintain consumer side chilled water circulation, if the consumer decides to, in case the ON/OFF motorized valve at the consumer side of the heat exchanger is completely closed.

Appendix C

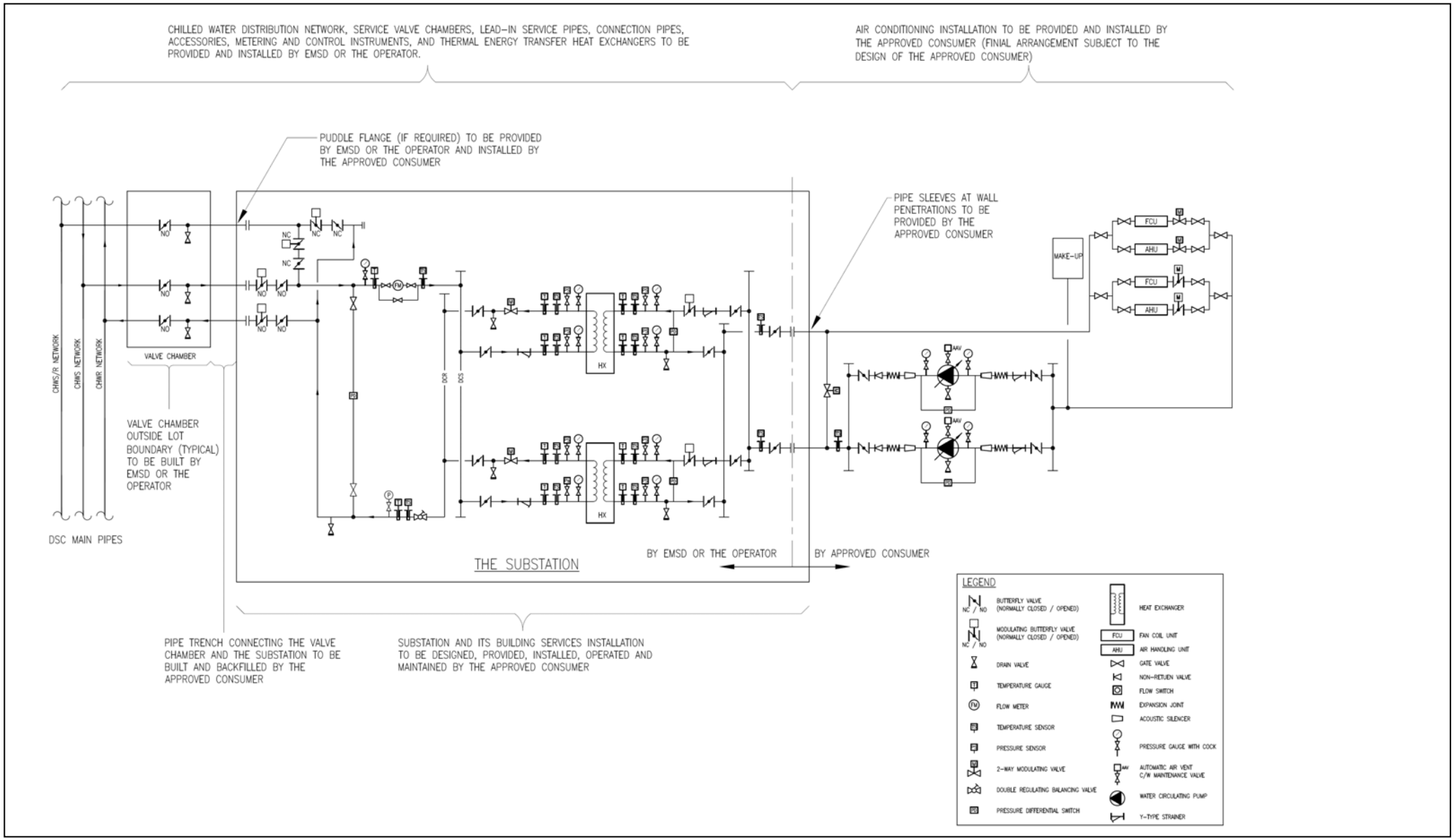


Fig. C1 – General Arragement on Construction of Substation

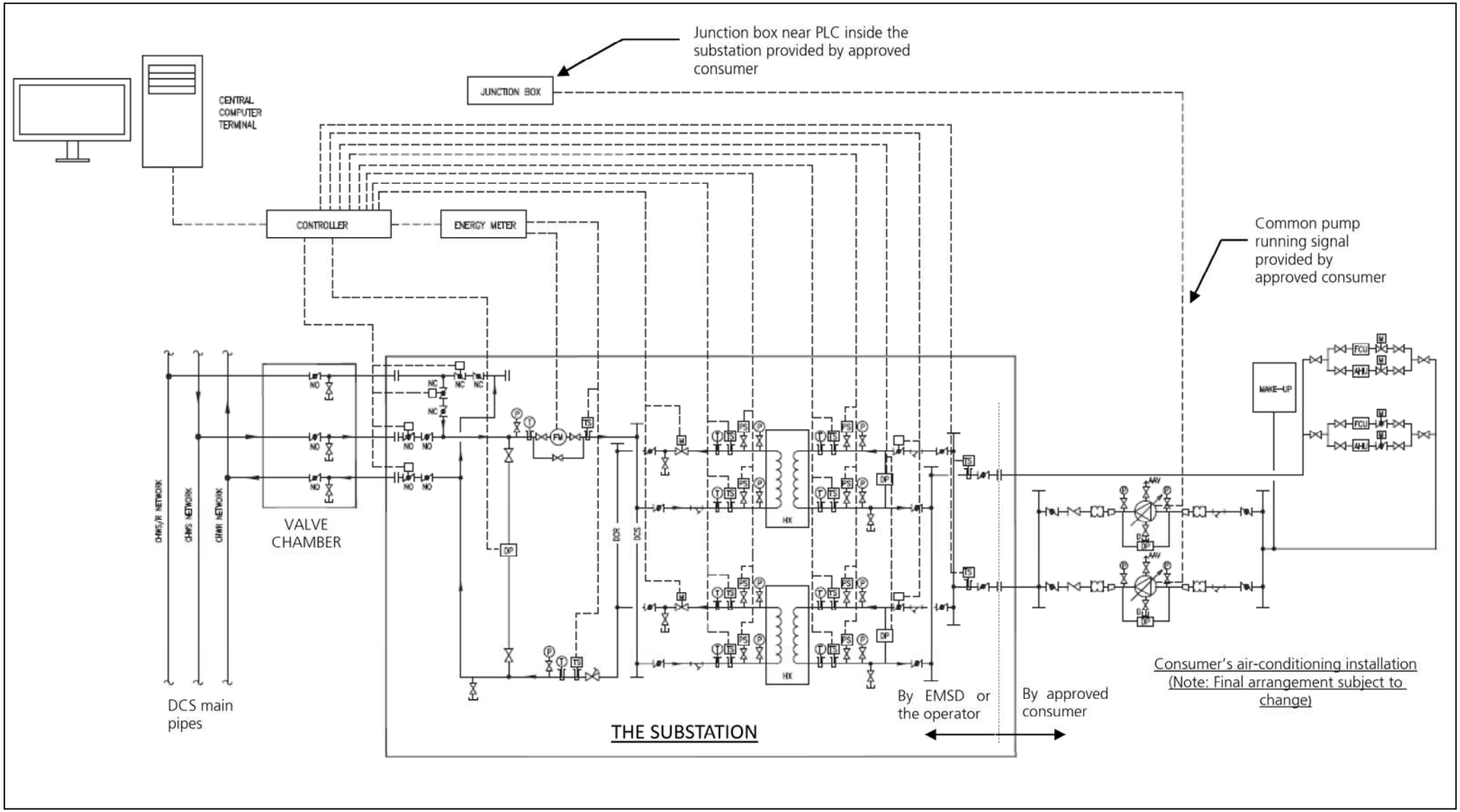
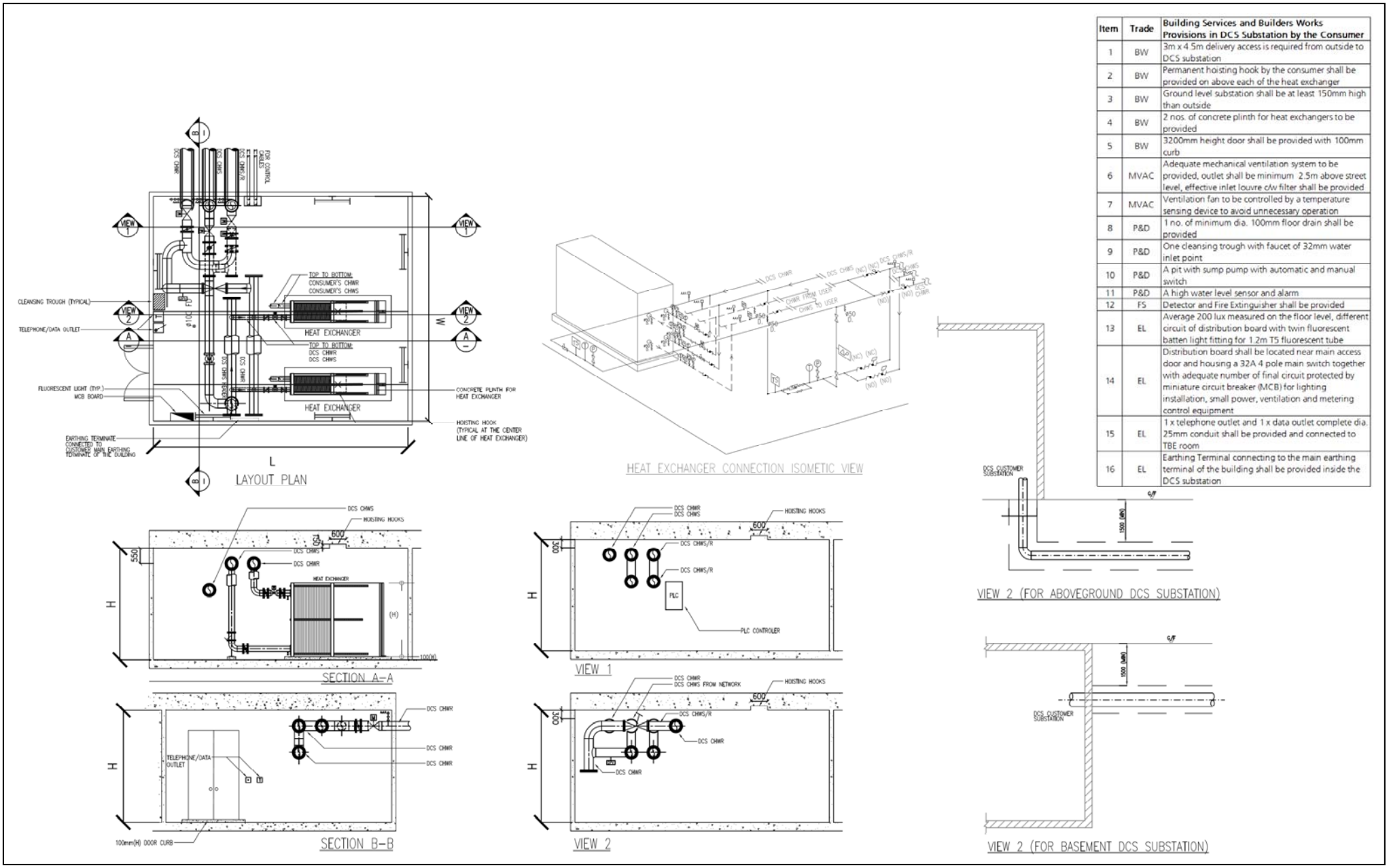
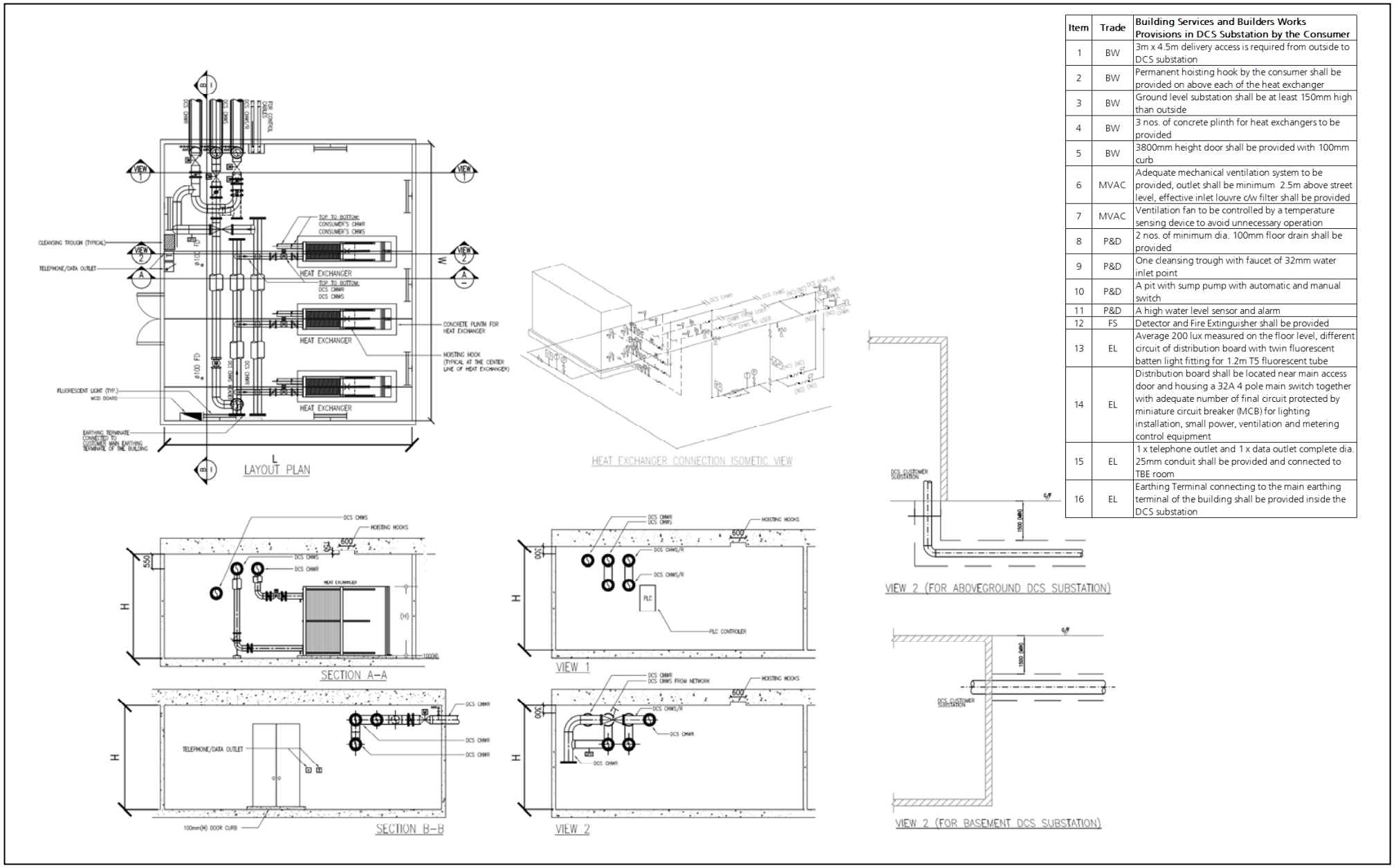


Fig. C2 – Control Schematic Diagram in Substation



Item	Trade	Building Services and Builders Works Provisions in DCS Substation by the Consumer
1	BW	3m x 4.5m delivery access is required from outside to DCS substation
2	BW	Permanent hoisting hook by the consumer shall be provided on above each of the heat exchanger
3	BW	Ground level substation shall be at least 150mm high than outside
4	BW	2 nos. of concrete plinth for heat exchangers to be provided
5	BW	3200mm height door shall be provided with 100mm curb
6	MVAC	Adequate mechanical ventilation system to be provided, outlet shall be minimum 2.5m above street level, effective inlet louvre c/w filter shall be provided
7	MVAC	Ventilation fan to be controlled by a temperature sensing device to avoid unnecessary operation
8	P&D	1 no. of minimum dia. 100mm floor drain shall be provided
9	P&D	One cleansing trough with faucet of 32mm water inlet point
10	P&D	A pit with sump pump with automatic and manual switch
11	P&D	A high water level sensor and alarm
12	FS	Detector and Fire Extinguisher shall be provided
13	EL	Average 200 lux measured on the floor level, different circuit of distribution board with twin fluorescent batten light fitting for 1.2m T5 fluorescent tube
14	EL	Distribution board shall be located near main access door and housing a 32A 4 pole main switch together with adequate number of final circuit protected by miniature circuit breaker (MCB) for lighting installation, small power, ventilation and metering control equipment
15	EL	1 x telephone outlet and 1 x data outlet complete dia. 25mm conduit shall be provided and connected to TBE room
16	EL	Earthing Terminal connecting to the main earthing terminal of the building shall be provided inside the DCS substation

Fig. C3 – Typical Layout of Substation of Two Heat Exchangers



Item	Trade	Building Services and Builders Works Provisions in DCS Substation by the Consumer
1	BW	3m x 4.5m delivery access is required from outside to DCS substation
2	BW	Permanent hoisting hook by the consumer shall be provided on above each of the heat exchanger
3	BW	Ground level substation shall be at least 150mm high than outside
4	BW	3 nos. of concrete plinth for heat exchangers to be provided
5	BW	3800mm height door shall be provided with 100mm curb
6	MVAC	Adequate mechanical ventilation system to be provided, outlet shall be minimum 2.5m above street level, effective inlet louvre c/w filter shall be provided
7	MVAC	Ventilation fan to be controlled by a temperature sensing device to avoid unnecessary operation
8	P&D	2 nos. of minimum dia. 100mm floor drain shall be provided
9	P&D	One cleansing trough with faucet of 32mm water inlet point
10	P&D	A pit with sump pump with automatic and manual switch
11	P&D	A high water level sensor and alarm
12	FS	Detector and Fire Extinguisher shall be provided
13	EL	Average 200 lux measured on the floor level, different circuit of distribution board with twin fluorescent batten light fitting for 1.2m T5 fluorescent tube
14	EL	Distribution board shall be located near main access door and housing a 32A 4 pole main switch together with adequate number of final circuit protected by miniature circuit breaker (MCB) for lighting installation, small power, ventilation and metering control equipment
15	EL	1 x telephone outlet and 1 x data outlet complete dia. 25mm conduit shall be provided and connected to TBE room
16	EL	Earthing Terminal connecting to the main earthing terminal of the building shall be provided inside the DCS substation

Fig. C4 – Typical Layout of Substation of Three Heat Exchangers

Appendix D

Substation	Cooling	Heat Exchanger	Operating Weight	PHE size	Clear Room Size	Floor Drain	FS Provision	Ventilation Flow	Cleasing trough with fauet	Hoisting Hook	Lead-in service pipes	Min. Trench Dimensions	Lighting	Lighting Fixture
Type	Capacity (kW)	(no x kW)	(each PHE)(kg)	(L x W x H)(mm)	(L x W x H)(mm)	(no. & size)		Rate (ACH/hr)		(kg)		(WxH)mm	(Lux)	IP
1	100	2x60	1000	800x400x1300	7000x4500x3500	1 x Φ100	Heat Detector & FE	6	1 x Φ32	1000	Φ80	2600x950	200	IP 54
2	200	2x120	1100	700x480x2400	7000x4500x3500	1 x Φ100	Heat Detector & FE	6	1 x Φ32	1500	Φ80	2600x950	200	IP 54
3	300	2x180	1250	1100x480x2400	7000x4500x3500	1 x Φ100	Heat Detector & FE	6	1 x Φ32	1500	Φ100	2800x950	200	IP 54
4	400	2x240	1350	1100x480x2400	7000x4500x3500	1 x Φ100	Heat Detector & FE	6	1 x Φ32	1500	Φ100	2800x950	200	IP 54
5	500	2x300	1450	1200x610x2400	7000x5000x4400	1 x Φ100	Heat Detector & FE	6	1 x Φ32	1500	Φ125	2900x950	200	IP 54
6	1000	2x600	2200	1410x610x2400	7000x5000x4400	1 x Φ100	Heat Detector & FE	6	1 x Φ32	2500	Φ150	3000x1050	200	IP 54
7	2500	2x1500	3750	2600x610x2400	8000x7000x4400	1 x Φ100	Heat Detector & FE	6	1 x Φ32	4000	Φ200	3200x1100	200	IP 54
8	5000	2x3000	7500	3300x770x2700	8500x8500x4700	1 x Φ100	Heat Detector & FE	6	1 x Φ32	8000	Φ300	3500x1200	200	IP 54
9	7500	2x4500	10250	5300x770x2700	10000x10000x4700	1 x Φ100	Heat Detector & FE	6	1 x Φ32	10500	Φ400	3800x1400	200	IP 54
10	10000	3x4000	9500	4800x770x2700	10000x12000x4700	2 x Φ100	Heat Detector & FE	6	1 x Φ32	10000	Φ400	3800x1400	200	IP 54
11	12500	3x5000	13400	5300x770x3300	10000x12500x5300	2 x Φ100	Heat Detector & FE	6	1 x Φ32	14000	Φ500	4200x1500	200	IP 54
12	15000	3x6000	16300	5300x970x3300	10000x13500x5300	2 x Φ100	Heat Detector & FE	6	1 x Φ32	17000	Φ500	4200x1500	200	IP 54
13	20000	3x8000	19900	6250x970x3300	11500x14500x5300	2 x Φ100	Heat Detector & FE	6	1 x Φ32	20000	Φ600	4500x1500	200	IP 54
14	24000	4x7200	19000	6000x970x3300	13000x16500x5300	2 x Φ100	Heat Detector & FE	6	1 x Φ32	19500	Φ700	4800x1600	200	IP 54

Table D1 – Building and Building Services Provisions for Substations with Different Cooling Capacities