CHAPTER 7

ELECTRIC VEHICLE CHARGING FACILITIES

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7.1 Introduction

1. Electric Vehicles ("EVs") have zero emission and help improve roadside air quality. Moreover, they are energy efficient at any speed and can even recover energy during braking. Such environmentally friendly vehicles well suit driving in urban environments like Hong Kong. Despite there are also charging stations installed by the Government and the private sectors, EV drivers still face charging challenges, especially in residential properties. To address this, HK Electric introduced the "Drive EV, Charge Easy" service for customers who wish to establish EV charging facilities at their buildings, covering technical advisory services, site meetings and visits to our charging facilities, with a series of "two working days" service pledges.

2. This Chapter introduces the general information of EV and the associated EV supply equipment, guidelines for erecting EV charging facilities and HK Electric EV charging support service.

7.2 Information of Electric Vehicle (EV) and Charging

1. Electric Vehicle

   In general, EVs are those vehicles using electric motors for propulsion instead of solely relying on conventional petrol or diesel internal combustion engines. Depending on how electricity is generated, EVs can be further divided into 4 types, namely battery EVs, hybrid EVs, plug-in hybrid EVs and fuel cell EVs.

   a. Battery EVs are driven solely by electric motors which are powered by batteries. The batteries require regular recharge by external power sources. Currently, lithium-ion (Li-ion) batteries are widely adopted in this category of EVs due to their higher energy density and longer service life as compared with other battery technologies like lead-acid and nickel-metal hydride batteries. Battery EVs are also known as zero-emission vehicles as they are powered purely by electricity.

b. Hybrid EVs (HEVs) are driven by combination of internal combustion engines and battery-powered electric motors. HEVs are primarily powered by internal combustion engines while electric motors are used as generators to recover the energy wasted during coasting and braking into electrical energy stored in the batteries. HEVs thus require no external recharging of the battery. The stored energy in the batteries will be released to drive the electric motors to provide extra power for acceleration, hill climbing or in low-speed driving applications. The internal combustion engines in HEVs can therefore be sized smaller to reduce fuel consumptions and roadside emissions.

c. Plug-in Hybrid EVs (PEVs) are HEVs with batteries that can be recharged by external power sources. PHEVs have higher energy efficiency than HEVs as batteries in PHEVs are sized to meet the modest power needed during normal daily driving, while the internal combustion engines are designed to cut in only when high driving power is required.

d. Fuel Cell EVs are driven by electric motors powered by electricity produced from an electrochemical process using hydrogen and oxygen. Water is the only by-product from the process. Emission from this type of system is much less than those from internal combustion engines. Fuel cell EVs are not yet commercialized. Researches over the world are being conducted to realise the application of fuel cell technology in the automobile industry.

2. EV charging

a. Standard Charging is simple and convenient. It consists of a British standard BS 1363 13-A socket outlet with dedicated circuit and independent protective device. However, it takes a longer charging time comparing with other charging methods. For example, it requires 6 ~ 7 hours for charging an EV with battery capacity of 18 kWh from 0 to 100%.

b. Medium Charging can provide up to 20-kW rated power. It is a much faster charging method comparing with standard charging. For charging an EV with battery capacity of 18 kWh from 0 to 100%, it requires 2 ~ 3 hours by using 1-phase 32-A charging. IEC standard and SAE standard are commonly adopted in most of the medium charging facilities. With a suitable vehicle coupler (charging cable), different brands of EV can be charged by these medium charging facilities.

c. Quick Charging uses specialized EV quick charger to provide high power for charging EV and hence the charging time can be greatly shortened. CHAdeMO is one of the standards for DC quick charging. Typically, it can provide 50-kW DC output and could normally charge up an EV with 18-kWh battery capacity to 80% in just 30 minutes. However, the cost of EV quick charging equipment is much higher than that of standard and medium charging equipment. Combined Charging System (CCS) is another standard for DC quick charging. It integrates single-phase AC charging, three-phase AC charging and DC charging into a single vehicle inlet. There are two variants of the CCS. One is based on SAE J1772 socket interface (equivalent to IEC Type 1 socket) and the other based on IEC Type 2 socket interface. They are called Combo 1 and Combo 2 respectively.

3. There are four different EV conductive charging modes specified in IEC 61851 standard.

a. Mode 1 charging makes use of a standard socket outlet, such as BS 1363 13-A socket outlet, to deliver AC charging current without communication to the on-board charger of the EV. The presence of a residual current device (RCD) is a must on the supply side of the fixed electrical installation.

b. Mode 2 charging makes use of a charging cable incorporated with an in-cable control box. The provision of fixed electrical installation for Mode 2 charging facilities is similar to that for Mode 1 except that the final circuit, protective device and socket outlet shall be of a suitable rating to cater for the higher level of charging current not exceeding 32 A.

c. Mode 3 charging makes use of dedicated EV supply equipment (EVSE) and a charging cable. The control pilot cable of the charging cable allows communication between the EVSE and the on-board charger of an EV to perform functions including verification of connection with the EV, continuous checking of protective earth conductor integrity, energization and de-energization of the supply, and selection of charging rate. Mode 3 charging can deliver a higher charging current (e.g. 220 V/32 A, 380 V/32 A, 380 V/63 A) and hence shorten the charging time. However, the power rating of the on-board charger of the EV may be a limitation of the charging current.

d. Mode 4 charging makes use of an off-board charger to deliver DC charging current directly to the battery bypassing the on-board charger of the EV. DC quick charging can greatly shorten the charging time by using a higher electrical power ranging from 20 kW to 120 kW. The EV supply equipment for Mode 4 charging is relatively more expensive than other modes of charging.

7.3 Requirements for Electric Vehicle (EV) Charging Facilities

1. General Arrangement

a. EV charging facilities are fixed electrical installations and shall comply with the relevant requirements of the Electricity Ordinance (Cap. 406) and its subsidiary regulations.

b. Electrical work on EV charging facilities including design, installation, commissioning, inspection, testing, maintenance, modification and repairing shall be carried out by registered electrical contractors and registered electrical workers of the appropriate grade.

c. All EV charging facilities which are connected to, or intended to be connected to HK Electric's supply of electricity must comply with HK Electric's Supply Rules, the Electricity (Wiring) Regulations and other relevant Government ordinances and regulations.

d. The electrical installations shall comply with the << Technical Guidelines on Charging Facilities for Electric Vehicles >> and << Technical Guidelines for Electric Vehicle (EV) Charging-enabling for Car Parks of New Building Developments >> published by the Electrical and Mechanical Services Department and Environment Bureau / Electrical and Mechanical Services Department respectively.

e. EV charging facilities shall be supplied and metered appropriately as per HK Electric's requirements.

f. Electrical loads of EV charging facilities should be evenly distributed among the three phases as reasonably practicable.

g. An earth leakage protective device shall be provided for each final circuit. Residual current device (RCD) with characteristics of type A and residual operating current not exceeding 30 mA is acceptable.

h. Electric cable of each final circuit shall be selected based on the design current of the EV charging facilities and taking into account the constraint of voltage drop in the circuit in accordance with the relevant requirements of the latest Code of Practice for the Electricity (Wiring) Regulations. A larger size electric cable may be used to facilitate future upgrade. In connection with this, a conductor size suitable for carrying a minimum rated current of 32 A is recommended.

i. Means of preventing unauthorized usage of EV charging facilities such as housing the socket outlet in a padlocked box or using an access card for energizing charging facilities may be provided as necessary.

2. Metering Arrangement

a. Tariff metering equipment is important to HK Electric and customers in the determination of electricity consumption. Tariff meters shall be installed in a clean and dry indoor location which is not exposed to weather, mechanical damage, vibrations, extremes of temperature or dampness etc. They shall be under conditions which are suitable for meter installation, reading and maintenance. The meter position shall be readily accessible from communal area at all times in accordance with Chapter 5 – Metering Requirements.

b. Supply to EV charging facilities shall normally be derived from the electric supply equipment installed on the same floor level. HK Electric's meters for individual parking spaces shall be installed inside a communal meter room at each car park level.

c. HK Electric's meter shall be electrically connected at a position immediately after the customer's main switch and the metering point of an installation shall be at a position as close to the origin of the supply source as practicable.

d. Meter position shall satisfy the requirements for meter reading, meter fixing and meter maintenance. For details, please refer to Drg. No. GCS/5/14, GCS/5/17 and GCS/5/18.

e. A meter may be applied for each parking space with EV charging facilities (Refer to Drg. No. GCS/7/01).

f. A single meter may also be applied for several parking spaces with EV charging facilities (Refer to Drg. No. GCS/7/02).

g. HK Electric may allow customers to install their check meters / timers for recovering electricity consumption charges for EV charging via metered communal installations (Refer to Drg. No. GCS/7/03). This is restricted for EV charging installations only and customers are required to obtain prior approval of HK Electric by submitting a standard form (Form EV1). The recovery of electricity consumption charges for non-EV charging installations is not allowed.

7.4 Electric Vehicle Charging Support Service

To facilitate our customers in setting up EV chargers in existing private residential and commercial buildings, we provide a comprehensive range of EV charging support services:

1. Technical Advisory Services

   a. Provide technical information on EV charging facilities
      i. Charging standards
      ii. Typical rating and charging time

   b. Supply arrangements for customer installations

   c. Capacity to meet demand for EV charging
      i. Review building electricity consumption trend and pattern
      ii. Confirm availability of capacity at HK Electric supply point

2. Site Meetings

   a. Support erection of EV charging facilities
      i. Provide a dedicated contact point for further assistance
      ii. Introduce EV charging equipment available in the market, such as EV charger, charging cable, etc.

   b. Assist in identifying suitable locations in buildings for erecting EV charging facilities including
      i. Metering arrangements
      ii. Supply arrangements

3. Visit our Charging Facilities

   a. EV charging facilities:
      i. Standard chargers
      ii. Medium chargers
      iii. Quick chargers
      iv. Charging poles with Radio-frequency identification and Octopus payment system

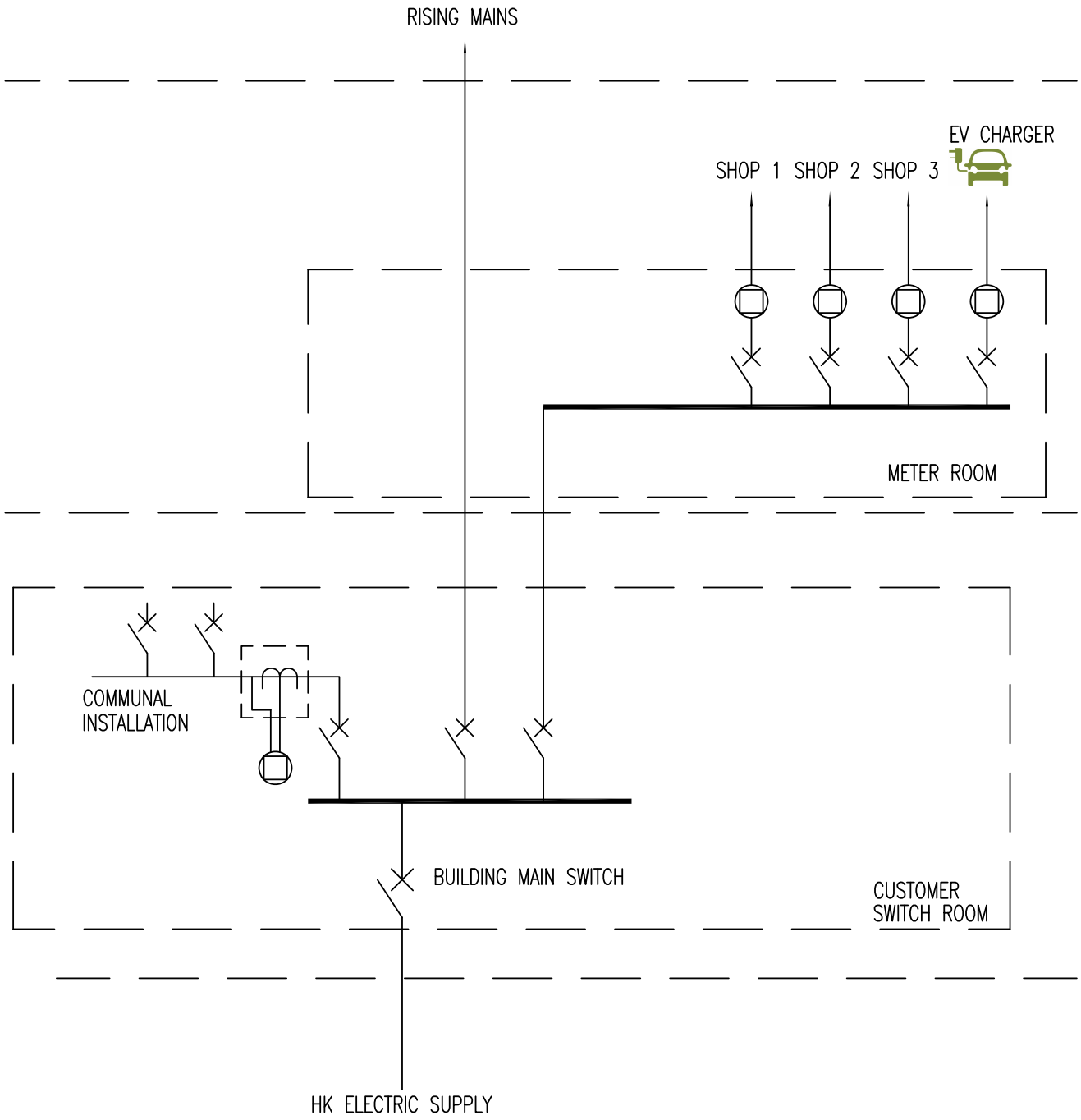
   b. Charging management system

For any further assistance and information on Electric Vehicle (EV) Charging Facilities, please contact our dedicated team for EV Charging Facilities Support and Development:

Hotline: (852) 2510 2701
Email: ev@hkelectric.com
Website: http://www.hkelectric.com/EV

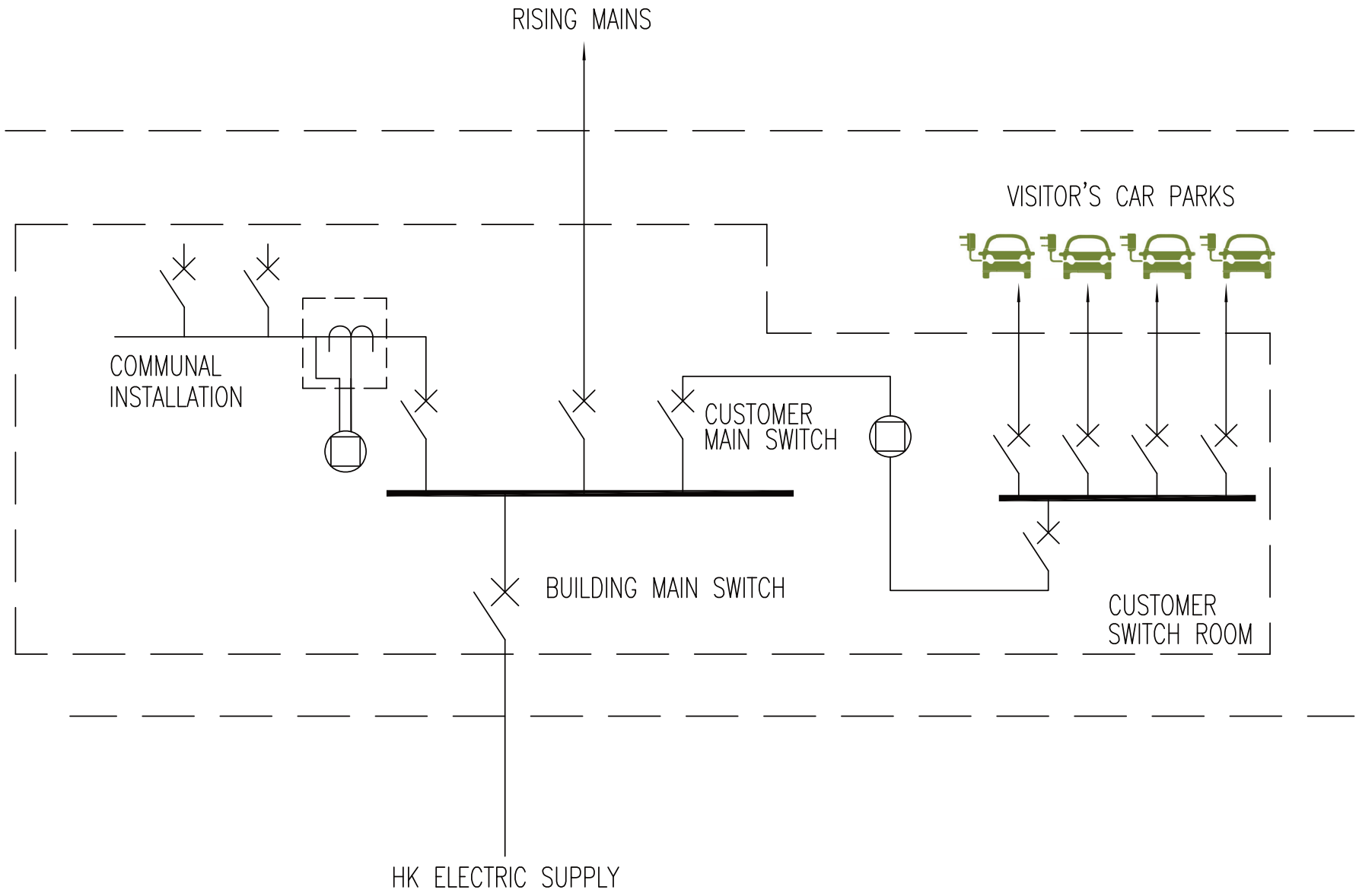
7.5 Schedule of Drawings - Metering Arrangements for EV Charging Facilities

Drawing No.	Drawing Title
GCS/7/01	Metering Arrangement of a Meter for Each Parking Space with EV Charging Facilities
GCS/7/02	Metering Arrangement of a Single Meter for Several Parking Spaces with EV Charging Facilities
GCS/7/03	Arrangement of Installing Check Meters / Timers by Customers for Recovering Electricity Consumption Charges for EV Charging via Metered Communal Installations



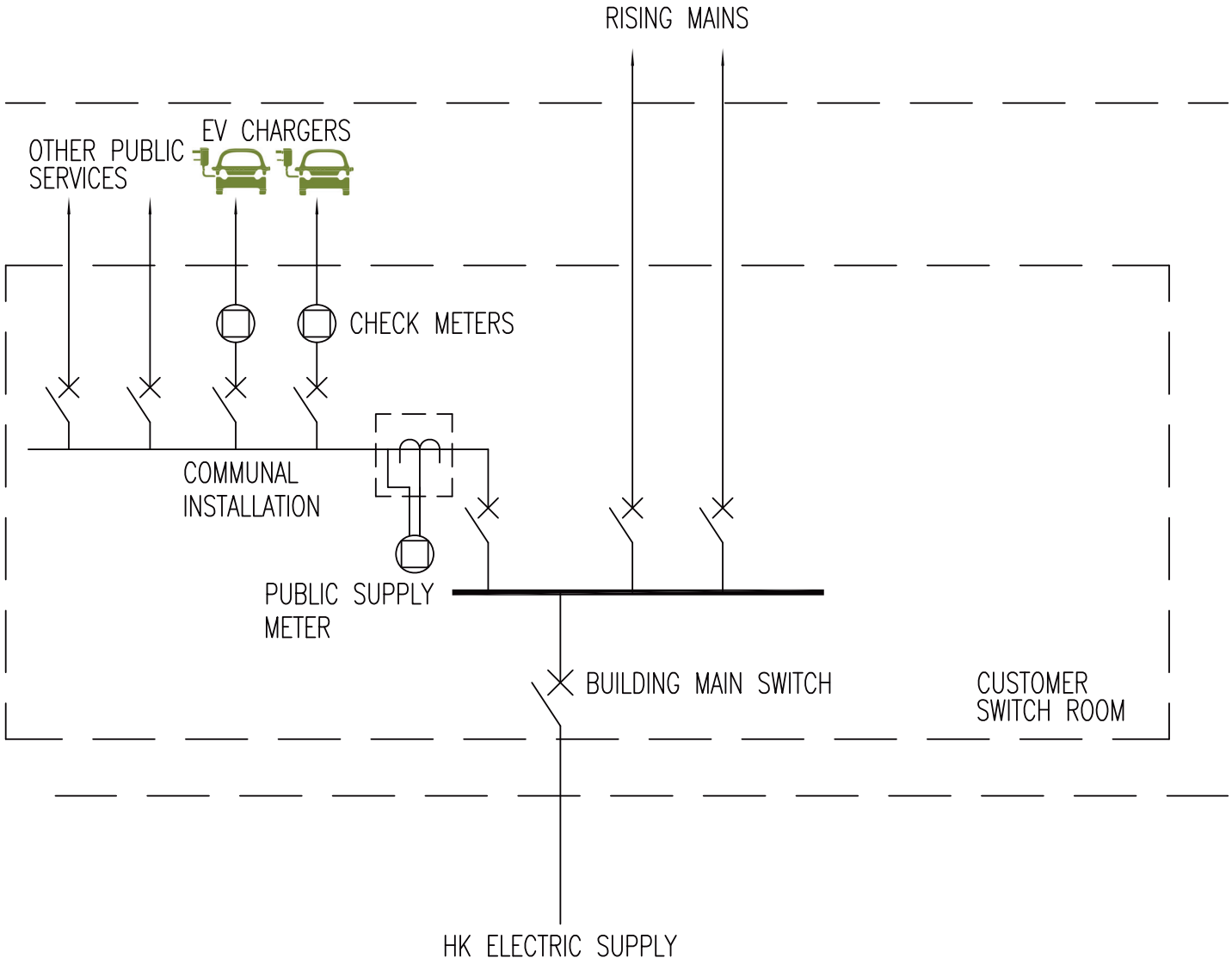
Drg. No. GCS/7/01

METERING ARRANGEMENT OF A METER FOR EACH PARKING SPACE WITH EV CHARGING FACILITIES



Drg. No. GCS/7/02

METERING ARRANGEMENT OF A SINGLE METER FOR SEVERAL PARKING SPACES WITH EV CHARGING FACILITIES



Drg. No. GCS/7/03

ARRANGEMENT OF INSTALLING CHECK METERS / TIMERS BY CUSTOMERS FOR RECOVERING ELECTRICITY CONSUMPTION CHARGES FOR EV CHARGING VIA METERED COMMUNAL INSTALLATIONS