Transmission & Distribution System
輸電與配電系統

HK Electric supplies electricity to Hong Kong Island and Lamma Island. Electricity is generated at Lamma Power Station (LPS) and transmitted at very high voltage – 275 kV and 132 kV – to various load centres via the transmission system. Electricity is then distributed to customers through the distribution system at a lower voltage.

The process of transmitting electricity from the power station to the load centres is termed 'transmission', while the process for distributing electricity from the load centres to customer buildings is termed 'distribution'.

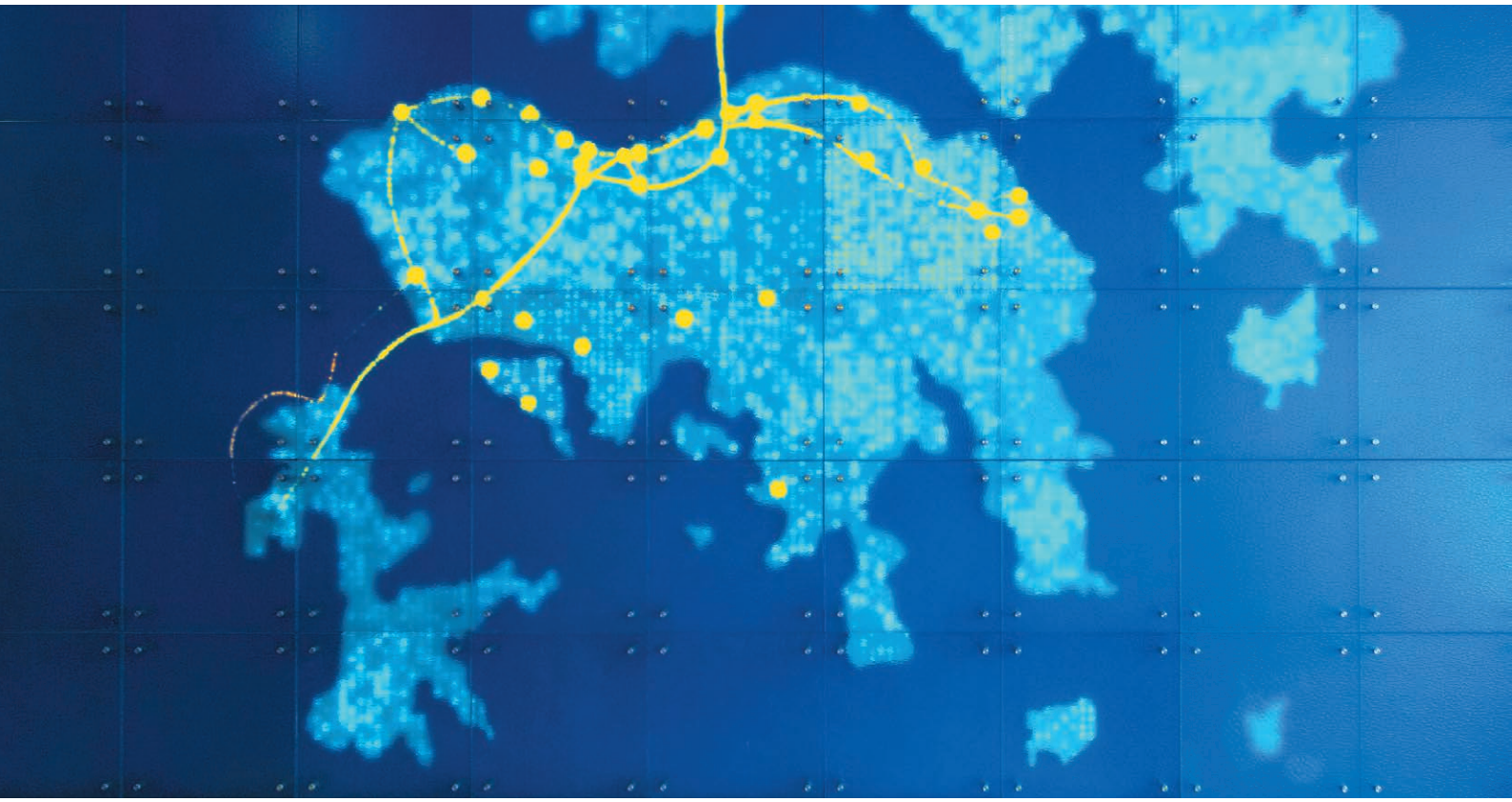
Causeway Bay Station Building
銅鑼灣電站

港燈為香港島及南丫島提供電力服務。由南丫發電廠生產的電力，以極高電壓 — 275千伏及132千伏 — 經輸電系統輸往不同的負荷中心，然後透過配電系統以較低的電壓分配至客戶。由發電廠輸送電力往各負荷中心的過程稱為「輸電」，而由負荷中心配電至客戶樓宇則稱為「配電」。

Transmission System

Power generated at LPS is transmitted to the major load centres on Hong Kong Island via the transmission system, which comprises mainly 275-kV and 132-kV underground and submarine cables. At present, there are only a few 132-kV overhead lines remaining in the system. In the major load centres where the transmission circuit ends, large capacity transformers are used to step down the voltage to 22 kV or 11 kV before distribution to customer substations.

The use of underground cables in the transmission system ensures supply reliability even in inclement weather such as typhoon and is ideal for a densely loaded area like Hong Kong. In addition to burying the cables directly underground, six dedicated cable tunnels have been built to house the transmission cables. Besides reducing the chances of cable damage under adverse weather, the use of underground cables and cable tunnels also eliminates visual intrusion and obstruction to land developments, thus helping to preserve the environment.



輸電系統

南丫發電廠生產的電力經由輸電系統輸往港島各主要負荷中心，並以275千伏及132千伏地底電纜及海底電纜輸送。目前只有少數132千伏架空電纜仍保留在系統中。在主要負荷中心的輸電線路末端，則會以大容量的變壓器把電力再降壓至22千伏或11千伏，然後才分配至客戶變電站。

輸電系統使用地底電纜，即使在惡劣天氣如颱風下，仍可確保電力供應穩定，而且非常適用於香港這類負載密度高的地區。港燈除將電纜埋藏於地底外，更特別建造6條電纜隧道用以敷設輸電纜。地底電纜及電纜隧道不但可減低因惡劣天氣對電纜可能造成的損毀，更不會影響視覺觀感，又能避免防礙日後土地發展，有助保護環境。

275-kV Cable Network

In HK Electric's transmission system, the 275-kV cable network consists of mainly fluid-filled cables while Cross-Linked Polyethylene (XLPE) insulated cables are mainly used inside substations. There are several 550-MVA circuits connecting LPS with Hong Kong Island. These circuits are partly on land and partly under the sea.

Single core 275-kV Polypropylene Laminated Paper (PPLP) insulated or Kraft paper insulated fluid-filled cables are used. In the land section, the cables are buried underground. In the submarine section, the cables, which take separate routes across the East Lamma Channel, have been installed by jet and cover method to achieve a burial depth of 3.5 to 5 metres in the seabed. There are over 60 275-kV cable circuits with a total circuit length of about 170 km.

Six dedicated cable tunnels have been built to accommodate some of the 275-kV fluid-filled cable circuits. One of the cable tunnels also accommodates a 5.7-km section of a 275-kV XLPE-insulated cable circuit.

HK Electric's Cable Tunnels
港燈的電纜隧道

Connecting the south-western area and the north-central area of Hong Kong Island
連接港島西南部至中北部
3.1 km公里
Commissioned in 1988
於1988年啟用

Connecting the southern part and the north-eastern part of Hong Kong Island
連接港島南部至東北部
5.7 km公里
Commissioned in 1993
於1993年啟用

Locates at the southern part of Hong Kong Island
位於港島南部
0.8 km公里
Commissioned in 1999
於1999年啟用

Locates at the southern part of Hong Kong Island
位於港島南部
0.8 km公里
Commissioned in 2002
於2002年啟用

Locates at Lamma Island
位於南丫島
0.2 km公里
Commissioned in 2006
於2006年啟用

Locates at Lamma Island
位於南丫島
0.1 km公里
Commissioned in 2006
於2006年啟用

Cable tunnels have made our electricity network less susceptible to extreme weather
電纜隧道有助減低極端天氣對港燈供電網絡可能構成的影響

275千伏電網

港燈輸電系統的最高輸電電壓為275千伏，電網大多採用充液式電纜，而275千伏交聯聚乙烯絕緣電纜則大多應用於變電站內。目前有多條550兆伏安電路連接南丫發電廠及香港島，均敷設於地底，而其中一段則埋於海底。

敷設的電纜為275千伏單芯聚丙烯薄膜夾心牛皮紙絕緣充液式電纜或牛皮紙絕緣充液式電纜。陸上敷設的電纜直接埋在地底，而海底電纜則以不同路線橫跨東博寮海峽，利用水力噴射覆蓋方法，將電纜埋藏於海床下3.5至5公尺。港燈目前超過60條275千伏電纜電路，總長度約170公里。

為方便敷設部份275千伏充液式電纜電路，公司特別建造6條電纜隧道，其中1條隧道也敷設了1段5.7公里長的275千伏交聯聚乙烯絕緣電纜。

132-kV Cable Network

Electricity transmitted at 275 kV is stepped down to 132 kV by supergrid transformers each rated at 365 MVA. The 132-kV cable network predominately comprises fluid-filled cables and the total circuit length including XLPE-insulated cables is about 270 km. There are over 100 132-kV Kraft paper fluid-filled cable circuits, which are of single core or three core design with conductor sizes from 194 to 2,000 mm^2. One important feature of the 132-kV cable network is the use of 132-kV Ring Main Units (RMU) in the zone substations to allow zone transformers to be teed off along the route of 132-kV cable interconnecting circuits.

For cable circuits inside substations, 132-kV XLPE-insulated single core cables are extensively used. There are also XLPE cable circuits installed with prefabricated joints at 132-kV level and 132-kV XLPE submarine cable circuits installed in the network.

The Company has not constructed any new transmission overhead line circuits since 1969. At present, only a few 132-kV overhead line circuits remain in the system with a total route length of about 7 km.

Routine inspection on 275-kV SF_6 gas-insulated switchgear
275千伏六氟化硫氣體絕緣開關裝置例行檢查

132千伏電網

以275千伏輸送的電力由365兆伏安超高壓變壓器降低至132千伏。港燈的132千伏電網主要採用充液式電纜，聯同交聯聚乙烯絕緣電纜線路的總長度約為270公里。網絡內超過100條132千伏牛皮紙充液式電纜電路，電纜均採用單芯或三芯設計，導體面積介乎194至2,000平方毫米。電網的其中一項主要特色為分區變電站採用132千伏環迴開關裝置，使分區變壓器與132千伏電網互相連接，以分流方式提供電力。

變電站內的電纜電路廣泛採用單芯交聯聚乙烯絕緣電纜。系統內更敷設使用預製式中間接頭的132千伏的交聯聚乙烯電纜電路和132千伏交聯聚乙烯海底電纜電路。

自1969年開始，公司已不再興建新的架空輸電纜。目前的輸電系統內只剩少數132千伏架空電纜，總長度約為7公里。

Zone Substations

Most of the electricity on Hong Kong Island is consumed in the narrow strip along the northern shore of the Island with electrical power density in excess of 260 MVA/km^2. To bridge between transmission and distribution system, zone transformers which step down the voltage from 275 kV or 132 kV to 22 kV or 11 kV are installed in zone substations. Zone substations with a total installed capacity of about 5,100 MVA are in service.

Before 1989, four zone transformers with maximum continuous rating of 40 MVA each were installed in one zone substation. Due to the extreme difficulty and long time span in acquiring new substation sites in the urban areas, a decision was made in 1987 to increase the zone substation capacity to 4 x 60 MVA.

Cyberport Station Building
數碼港電站

分區變電站

香港島主要用電地區位於北面沿海的狹長地帶。以每平方公里計算，耗電量密度逾260兆伏安。為連接輸電及配電系統，公司於分區變電站設置變壓器，將電壓由275千伏或132千伏降低至22千伏或11千伏。分區變電站的總安裝容量約為5,100兆伏安。

1989年前，公司於每個分區變電站裝設4台最高連續操作量每台為40兆伏安的分區變壓器。由於市區內極難尋找適當的地方興建新變電站，加上申請耗時甚久，公司於1987年決定將分區變電站的負荷量增至4 x 60兆伏安。

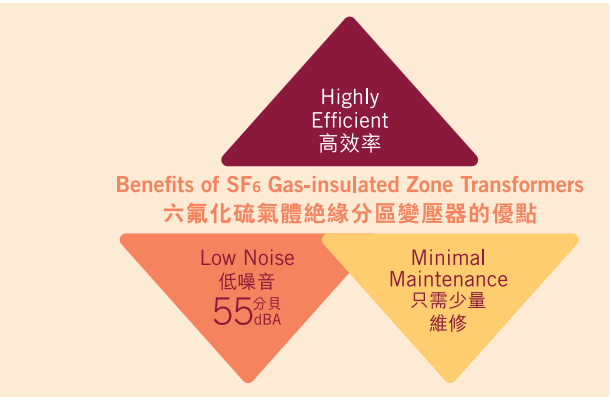
SF6 Gas-insulated Zone Transformers

The first 132/11-kV 60-MVA SF_6 gas-insulated zone transformer was commissioned in November 1991, 10 years after the first SF_6 gas-insulated distribution transformer was commissioned in the system. With the favourable performance of the earlier units, the Company has decided to switch over to gas-insulated zone transformer for new projects and for replacement. There are now over 75 gas-insulated zone transformers of rating 30, 40, 50 and 60 MVA in the system.

The gas zone transformers are filled with SF_6 gas at 1.4 kg/cm² G at 20°C. The HV cable box and on-load tap changer are also SF_6 gas-insulated. Polyphenylene Sulphide Film (PPS Film) is used as conductor insulation material of coil in these transformers. PPS Film has a better performance because of its higher thermal withstand capability of about 165-170°C.

Force circulation of SF_6 gas by gas blower is required when the transformer top gas temperature reaches above 55°C. Four gas blowers, each rated at 3.7 kW, are required for each 60-MVA gas transformer.

With the introduction of gas transformer, SF_6 and vacuum circuit breaker and XLPE-insulated cables, totally oil-free zone substation is possible and first realised in Shaukeiwan Zone Substation in 1992.




We make every effort to prevent faults in our network components
我們密切監察網絡組件，致力預防故障發生

六氟化硫氣體絕緣分區變壓器

港燈繼1981年採用首台六氟化硫氣體絕緣配電變壓器後，首台132／11千伏的60兆伏安六氟化硫氣體絕緣分區變壓器於1991年11月投入服務。由於此等變壓器表現理想，公司已決定在新的發展工程或更換舊有變壓器時，改用六氟化硫氣體絕緣變壓器。至今，超過75台分別為 30、40、50及60兆伏安氣體絕緣分區變壓器已先後投入服務。

分區變電站的氣體絕緣變壓器注有六氟化硫氣體，其壓力於溫度攝氏20度時為每平方公分1.4公斤，高壓電纜箱及調壓分接亦以六氟化硫氣體絕緣。

由於聚苯硫醚薄膜的耐熱能力可高達攝氏165度至170度，變壓器均以聚苯硫醚薄膜為導體絕緣物料。

當變壓器的頂部氣體溫度達攝氏55度以上，必須利用吹風機將變壓器內的六氟化硫氣體作循環運行。每台60兆伏安氣體絕緣變壓器都具有4個 3.7千瓦的吹風機。

公司更率先採用氣體絕緣變壓器、六氟化硫及真空斷路器和交聯聚乙烯絕緣電纜，於1992年在筲箕灣建成首個完全不含油的分區變電站。

Distribution System

Electricity is distributed at 22 kV and 11 kV to over 4,000 distribution substations on Hong Kong Island and Lamma Island. Voltage is further stepped down to 380 V 3-phase or 220 V single-phase and supplied via the low voltage underground cable system to customers. Distribution substations are equipped with remote control and monitoring facilities so that operation of switchgear and auxiliary equipment can be activated remotely from the System Control Centre. The condition of distribution substations is also continuously monitored at the control centre. For faults on the 22-kV/11-kV distribution cable network, restoration of supply is achieved remotely from the control centre and is normally carried out within a few minutes after a supply interruption.

For electricity supply which cannot be remotely restored at the control centre, emergency repair teams are despatched to the scene which is manned round-the-clock to respond to customers' calls on power interruptions. On average, the arrival time to scene in urban areas is less than 28 minutes.

System Control Centre monitors our power supply systems round the clock
港燈的系統控制中心日夜不停監察各供電系統

配電系統

電力是以22千伏及11千伏電壓配送至港島及南丫島合共超過4,000個配電變電站，並將電壓再降至380伏三相或220伏單相，經由地底電纜系統以低電壓供電予客戶。配電變電站內安裝遠動系統及監察設備，以便由系統控制中心靈活遙控變電站內開關及輔助設備。同時控制中心亦可持續監察配電變電站的情況。當22千伏／11千伏配電網出現故障時，可由控制中心遙控恢復供電，通常可在停電後數分鐘內完成。

若電力系統未能透過控制中心遙控恢復供電時，緊急搶修組人員便會到達現場搶修。他們24小時當值處理客戶因電力中斷的緊急召喚。市區內平均到達現場的時間少於28分鐘。

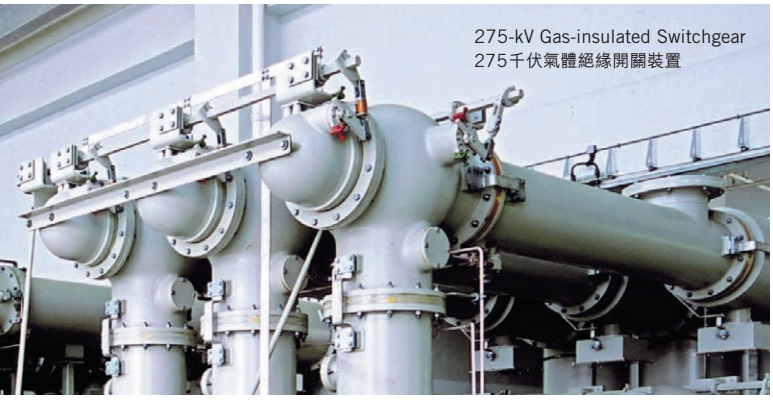
22-kV/11-kV Distribution Network

HK Electric's 22-kV/11-kV distribution cable network comprises cables buried directly underground. The total length of cables is over 4,200 km. The Company has adopted the use of XLPE insulation for all its cables since 1980. As a standard, all cables use 240 mm²/300 mm² copper conductor with corrugated aluminium metal sheath/steel wire armour and PVC/MDPE outer-jacket.

Electricity supply network at 22-kV/11-kV level is in the form of a closed or an open ring. A 22-kV/11-kV substation is normally fed from one or more supply sources. Alternative supply source is always available at the substation in case of fault or cable taken out of service.

The total length of 22-kV/11-kV underground cables in the distribution network is over
配電網內22千伏及11千伏地底電纜的總長度超過

4,200 km公里



275-kV Gas-insulated Switchgear
275千伏氣體絕緣開關裝置

Jointing underground cables
接駁地底電纜

22千伏／11千伏配電網

港燈22千伏／11千伏配電網的電纜均埋藏於地底。網內地底電纜的總長度超過4,200公里。自1980年開始，所有電纜均採用交聯聚乙烯為絕緣物料。電纜皆具有同一標準，採用240平方毫米／300平方毫米的銅導體，配以波紋形鋁金屬外殼／鋼絲護甲和聚氯乙烯／中密度聚乙烯護套。

22千伏／11千伏配電網以閉合或開放環形方式供電。正常情況下，1個22千伏／11千伏變電站的電力由1個或以上供電源供電，遇有電纜停用或其他故障，電力會隨即由另一個供電源供應。

Distribution Automation

HK Electric's distribution automation can be dated back to 1979 when the first 120 distribution substations were equipped with Remote Terminal Units (RTUs). Through RTUs, supervisory control and data acquisition of the distribution substation has been made possible from the centralised computer installed in the System Control Centre. All permanent substations in the 22-kV/11-kV distribution system are installed with RTUs and communication with the distribution computer is through dedicated in-house communication channels. Through the distribution computer, the operation of 22-kV and 11-kV switchgear can be initiated remotely. The RTU also monitors the loading, voltage and temperature of transformers inside the substation as well as the loading of all low voltage cables.

High voltage apparatus routine inspection
高壓設備例行檢查

配電自動化

港燈採用配電自動化操作可追溯至1979年，當時在首批120個配電變電站裝置遠動終端機。透過遠動終端機，系統控制中心的中央電腦可以監察控制及讀取配電變電站的資料。所有22千伏／11千伏配電系統內的永久性配電變電站均裝設有遠動終端機，利用特設的通訊線路連接負責配電的電腦系統。使用遠動終端機不單可以遙控啟動22千伏及11千伏變電站的高壓開關掣，更可以時刻監察變電站內變壓器的負荷、電壓和溫度，以至所有低壓電纜的負荷數據。

Oil-Free Distribution Substations

Completely oil-free distribution substations have been introduced since the early 1980s. By the end of 1995, all oil-insulated switchgear inside permanent substations have been replaced. At present, over 90% of our substations in the system are oil-free distribution substations. It was made possible by the large scale application of SF_6 gas-insulated distribution transformers, air and SF_6 gas-insulated ring main units and the use of XLPE-insulated cables.

Completely oil-free distribution substations greatly reduce potential fire hazards associated with electrical apparatus. As a result, substations can be installed on upper floors of a building. The highest distribution substation on Hong Kong Island is located at a height of 293 metres above ground.

不含油配電變電站

由於公司大規模採用六氟化硫氣體絕緣配電變壓器、空氣或六氟化硫氣體絕緣環迴開關裝置和交聯聚乙烯絕緣電纜，因此於1980年代初期已開始引進完全不含油的配電變電站。及至1995年年底，所有永久性配電變電站內的充油式絕緣開關已全被替換。目前超過90%為不含油的變電站。

完全不含油的配電變電站大大減低因電力裝置故障而可能引起火警的風險，令變電站可以設置於樓宇內的較高樓層，目前全港島最高的配電變電站離地面293米。

Monitoring the System

To ensure maximum security of power supply to customers, HK Electric's transmission and distribution system is monitored and maintained by a team of well-trained and experienced engineers who look after emergency repairs, maintenance and the developments of all networks.

The System Control Centre also maintains an on-line 24-hour surveillance and exercises remote control over the transmission and distribution system, ensuring a reliable and efficient supply of electricity to our customers.

Communication System

To maintain the effectiveness and efficiency of our transmission and distribution system, HK Electric has installed a comprehensive state-of-the-art communication system. The communication system includes a digital microwave radio and optical fibre/ pilot cable network for supervisory control and data acquisition system covering all the transmission and distribution substations, terrestrial trunked radio communication for site activities, digital PABX exchanges for internal and external communication. In addition, there is a computer telephone integration system for efficient handling of customer enquiries.

Green mobile electricity supply system
環保流動供電系統

Our professional and experienced engineers
港燈擁有具豐富經驗的工程師團隊

監察系統

為確保電力供應高度穩定，港燈的輸電及配電系統由1隊訓練有素、經驗豐富的工程師負責監察和保養工作，包括搶修、維修及網絡發展。同時，公司的系統控制中心亦透過在線系統電腦作24小時監察，以及遙控整個輸電及配電系統的操作，確保電力在高度穩定及高效率下輸送予客戶使用。

通訊系統

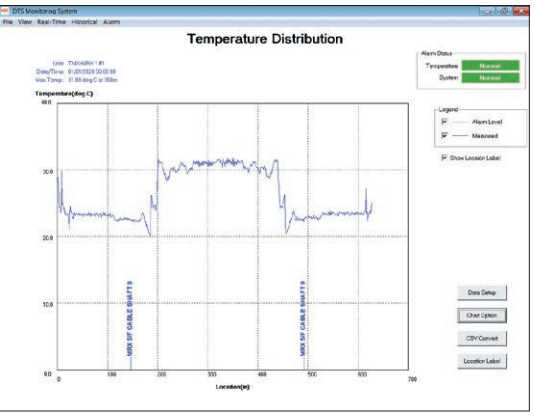
為維持有效率及高效能的輸配電系統運作，港燈設有1套先進周全的通訊系統。該系統包括數碼微波無線電及光導纖維／導線電纜網絡以供覆蓋所有輸配電變電站的監控和數據採集系統使用，在工地使用的數碼幹線無線電通訊系統和供對內及對外通訊用的數碼電話交換系統。此外，公司亦裝設電腦電話綜合系統，為客戶提供更快捷的查詢服務。

Innovative Technologies

HK Electric is keen to embrace innovation and new technologies in our transmission and distribution system. We continue to expand the use of advanced on-line systems, such as the On-line Partial Discharge Monitoring System and Distributed Temperature Sensing System, to monitor our transmission and distribution assets.

The On-line Cable Partial Discharge System mapping function has been introduced to supplement our off-line cable diagnosis for early detection of developing problems and abnormalities in our 11-kV cable network. In addition, we have developed an AI-based cable diagnostic tool that can analyse the cable testing data collected at site and help system operator to further evaluate the probability of cable failure and predict the cause of cable failure. This innovative approach will continue to be adopted in our transmission and distribution system to further enhance supply reliability.

On-line monitoring of temperature distribution of a transmission cable section
利用在線系統監察電纜溫度的分佈



The Solar Irradiance Monitoring Device monitors the efficiency of the solar panels at our Causeway Bay Station Building
利用「太陽輻照度監測系統」，監察銅鑼灣電站天台上太陽能板的效率

創新科技

港燈力求創新，並致力為輸配電系統引進新科技，包括更廣泛採用網上管理系統，例如「在線局部放電監察系統」及「電纜溫度分佈感應系統」，以監察有關輸配電資產的運作。

我們透過「在線電纜局部放電定位」功能，支援現有的11千伏配電電纜離線測試和診斷工作，及早找出異常情況和採取應對措施。此外，我們利用人工智慧開發的電纜診斷方法，可以用來分析電纜測試數據，幫助系統操作員進一步評估電纜故障的機率，並預測電纜故障的原因。我們將繼續善用創新科技，確保輸配電系統更穩定及進一步提升供電可靠性。

Green Features

HK Electric has implemented various environmental initiatives in our substations. A signature one is our Marsh Road Station Building designed with the concept of promoting sustainable development in mind. The building is fitted with a number of green features including a rooftop garden to lower indoor temperature of the building, thereby reducing the need for air-conditioning. One micro wind turbine and 30 solar photovoltaic panels also serve to generate green electricity for the premises. To conserve water resources, a rainwater collection tank was built for watering plants in the garden.

Noise level at our substations is also kept to the minimum through extensive use of low noise equipment such as transformers and substation ventilation fans. For all major projects, noise assessment studies are carried out to limit the noise levels during the construction and actual operation.

Rooftop garden at Marsh Road Station Building
馬師道變電站天台上的空中花園

環保設施

為保護環境，港燈在變電站內加入了不少環保設施，當中馬師道變電站最具代表性，是港燈首個以「全方位可持續發展」概念設計的變電站。站內加入了不少環保及節能設施，例如天台的空中花園有助降低大樓的室內溫度，節省空調的耗電量。另外，天台亦安裝了1台小型風力發電機組和30塊太陽能光伏板，為變電站提供零排放的綠色電力。而在節省用水方面，天台亦設有水缸收集雨水，用以灌溉站內的樹木和草地。

為確保輸配電系統內的音量水平減至最低，港燈變電站均廣泛使用低噪音的裝置如變壓器及變電站內的抽氣扇。而所有大型工程均會進行噪音評估，以限制工程在施工階段及實際投入運作時的音量水平。