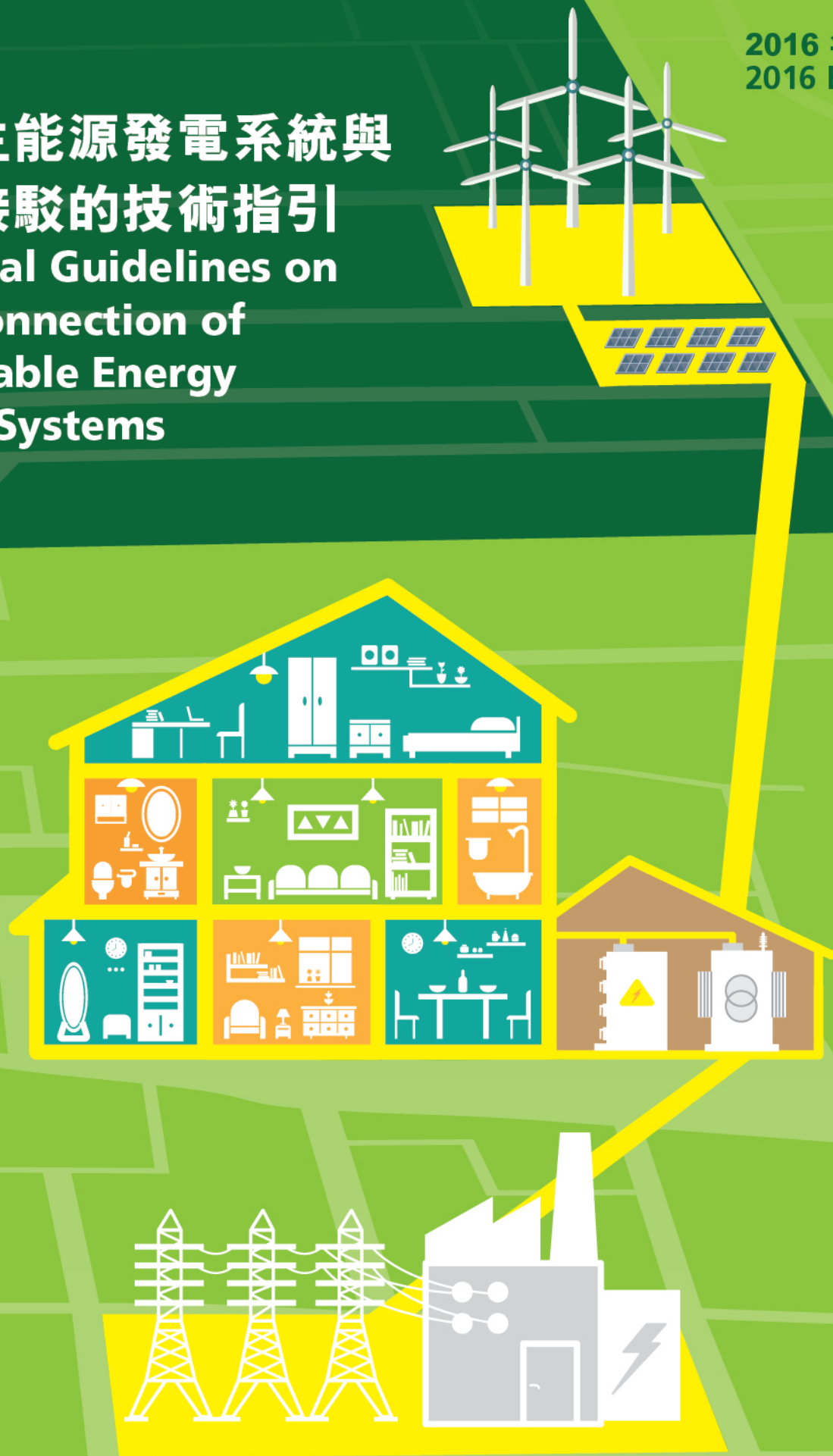


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可再生能源發電系統與 電網接駁的技術指引

Technical Guidelines on Grid Connection of Renewable Energy Power Systems



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前言 Foreword



為了讓公眾更了解有關小型可再生能源裝置與電網接駁的技術事宜和申請程序，機電工程署於2005年成立一個由電力公司、政府、業界組織、地產發展商和專業學會代表組成的工作小組，負責編製《小型可再生能源發電系統與電網接駁的技術指引》。

機電工程署於2007年12月出版技術指引修訂版，把適用功率上限由200千瓦提高至一兆瓦。

其後，本港兩間電力公司的接駁電網安排，以及有關接駁電網、光伏系統和供電質量的本地守則和規則及國際標準都有所修訂。本版本的《小型可再生能源發電系統與電網接駁的技術指引》是上一個版本的修訂版，加入了2007年至今曾作出的修改。

To assist the public to better understand the technical issues and the application procedures relating to grid connection of small-scale renewable energy installations, a Working Group with members from power companies, the Government, trade associations, property developers and professional institutions was formed in 2005 to develop the Technical Guidelines on Grid Connection of Small-scale Renewable Energy Power Systems.

In December 2007, a revised edition extending the applicable capacity limit from 200kW to 1 000kW was made available to the public.

Since then, the grid connection arrangement of the two power companies in Hong Kong, local codes and rules, international standards on grid connection, PV systems and power quality have been amended. This edition of the Technical Guidelines on Grid Connection of Small-scale Renewable Energy Power Systems is a revision of the previous edition and incorporates changes since 2007.

辭彙及縮略語

Glossary of Terms and Abbreviations

1



總額定功率
Aggregated Power Rating

安裝在每個地點或每幢建築物內，所有可再生能源發電系統的各個發電設備的額定功率總和，不論有關設備是由業主抑或租戶安裝。

The arithmetic sum of the power rating of each item of power generating equipment of all the Renewable Energy Power Systems (REPSs) installed in each location or in each building, irrespective of whether they are installed by the landlord or tenants.

附設於建築物的光伏系統 (BIPV)
Building Integrated Photovoltaic (BIPV) system

有光伏板安裝於或完全裝嵌於建築物天台及外牆的發電系統。

An electricity generation system consisting of photovoltaic panels mounted on or fully integrated into the roofs, facades and walls of buildings.

工作守則
COP

機電工程署出版的《電力（線路）規例工作守則》最新修訂版。

The current revised edition of the Code of Practice for the Electricity (Wiring) Regulations issued by the Electrical and Mechanical Services Department.

配電系統
Distribution System

由場地擁有人或管理小組操作並安裝於現場的220/380伏特低壓供電網絡。

The on-site 220/380V low-voltage electricity supply network operated by the site owner or the site management team.

EEO

機電工程署能源效益事務處

Energy Efficiency Office of the Electrical and Mechanical Services Department

《電力條例》
Electricity Ordinance

香港法例第406章，由機電工程署負責執行，用以規管供電安全及家用電氣產品安全。

Chapter 406 of the Laws of Hong Kong, which is enforced by the Electrical and Mechanical Services Department regulating the safe supply of electricity and the safety of household electrical products.

EMSD

香港特別行政區政府機電工程署

Electrical and Mechanical Services Department of the Government of the Hong Kong Special Administrative Region

電網
Grid

由電力公司營運的220/380伏特低壓供電網絡。

The 220/380V low-voltage electricity supply network operated by the Utility.

辭彙及縮略語

Glossary of Terms and Abbreviations



千瓦小時 (kWh)
Kilowatt-hour (kWh)

供應一千瓦功率達一小時所需電力的量度單位。
A measure of electricity required to provide power at one kilowatt for one hour.

擁有人
Owner

擁有與電網接駁的可再生能源發電系統的人士或機構。
The owner of the grid-connected REPS.

註冊電業工程人員
Registered Electrical Worker

根據《電力條例》（第406章）註冊的電業工程人員。
An electrical worker registered under Electricity Ordinance, (Cap. 406).

可再生能源
Renewable Energy (RE)

指由取之不盡及用之不竭的來源產生的能源，即沒有儲備耗盡問題的能源，例如太陽能、風能等。
Energy generated from sources that are secure and inexhaustible, in the sense that there is no problem of reserves being depleted. Examples of RE sources are solar, wind, etc.

可再生能源發電系統
Renewable Energy
Power System (REPS)

電力公司客戶擁有的發電設施，該設施主要利用可再生能源發電，以滿足客戶電力裝置在安裝現場的部分用電需求。
Electricity generation facilities owned by a customer of the Utility, with RE sources as the primary feedstock to meet part of the on-site electricity demand of the customer's electrical installations.

《供電則例》
Supply Rules

電力公司供電予客戶的一般及技術條款和條件。
The general and technical terms and conditions under which the Utility supplies electricity to its customers.

電力公司
Utility

供電予客戶的電力公司。本港目前有兩間電力公司，分別是中華電力有限公司及香港電燈有限公司。
A power company that supplies electricity to its customers. Currently the two power companies in Hong Kong are CLP Power Hong Kong Limited and The Hongkong Electric Company Limited.

簡介 Introduction

2

概論

General

- 2.1** 一如其他已發展的經濟體系，香港的社會及經濟發展有賴可靠穩定的能源供應，而電力正是我們日常生活中最常使用的能源。電力一向是透過燃燒煤、石油及天然氣等化石燃料產生。燃燒這些化石燃料會向大氣層釋放溫室氣體及空氣污染物，導致全球暖化及造成空氣污染。

Like all other developed economies, Hong Kong requires reliable and secure supply of energy to support its social and economic development, and electricity is the most common form of energy in our daily lives. Electricity is conventionally generated by burning fossil fuels, such as coal, oil and natural gas. The burning of these fuels releases greenhouse gases and air pollutants into atmosphere causing global warming as well as air pollution.

- 2.2** 使化石燃料發電帶來的另一個問題，就是化石燃料的蘊藏量不斷減少，而減少的速度相當可能會令化石燃料日後的供應更形緊絀，價格更加高昂。

Another problem associated with the use of fossil fuels for electricity generation is that fossil fuel reserves are diminishing in a rate that it is very likely fossil fuels would become more scarce and expensive in future.

- 2.3** 由可持續的天然資源產生的可再生能源（例如風能及太陽能），可紓解使用化石燃料帶來的問題。

RE produced from sustainable natural sources, such as wind and solar can make a contribution in mitigating the problems associated with the use of fossil fuels.

- 2.4** 機電工程署能源效益事務處推行的其中一項能源效益及節能措施，是推廣使用可再生能源。能源效益事務處曾委託顧問公司進行研究，評估各類可再生能源技術適合在本港使用的潛力。研究確認，太陽能及風能都是有潛力可於本港廣泛應用的可再生能源技術。

The promotion of the use of RE is one of the initiatives on energy efficiency and conservation implemented by the Energy Efficiency Office (EEO) of the Electrical and Mechanical Services Department (EMSD). The EEO had commissioned a consultancy study to evaluate the potential of various RE technologies appropriate for local use. The study has identified solar power and wind power as promising RE technologies for wide-scale application in Hong Kong.

- 2.5** 可再生能源發電系統是其中一種可再生能源應用技術，它利用可再生能源資源產生電力，以滿足安裝現場的部分電力負載需求。典型的可再生能源發電系統包括附設於建築物的光伏系統、附設於建築物的風力發電系統，以及其他並非附設於建築物的可再生能源發電系統等。

Renewable Energy Power System (REPS) is one kind of RE application that generates electricity with RE resources to meet part of the load demand on the site. Typical REPSs include BIPV System, Building Integrated Wind Power System and other non-building-integrated REPSs etc..



技術指引的目的

Objective of Technical Guidelines

- 2.6** 本技術指引的目的，是概述經由有關建築物的配電系統把可再生能源發電系統與電網接駁的各種技術事宜。

The objective of this Technical Guidelines is to give an outline of various technical issues relating to the connection of REPSs to the Grid through the Distribution System of the building concerned.

- 2.7** 本技術指引並非旨在作為設計手冊。然而，當推展任何把可再生能源發電系統與電網接駁的建議時，為確立相關的技術要求，本文件可提供便捷的參考。此外，本文件亦提供一份清單，列明向電力公司申請把可再生能源發電系統與電網接駁時所須提交的一般資料。

This Technical Guidelines does not purpose to be a design manual. However, it serves as a quick reference to establish the technical requirements for developing any prospective grid-connected REPS proposals. It also provides the list of information in general to be submitted to the Utility to support applications for connecting REPSs to the Grid.

- 2.8** 擁有人應確保其可再生能源發電系統符合所有現行的法定規定，以及關乎電力裝置安全、可靠性及供電質量的實務指引的要求，當中包括《電力條例》及其附屬規例、《供電則例》、電力公司就個別個案所釐定的詳細技術要求等。如適用，發電系統也應符合《電力（線路）規例工作守則》（工作守則）的相關要求。凡本地規例或實務指引沒有涵蓋的可再生能源發電系統安裝細則，可參考附錄III 所列的相關國際標準或海外國家標準。發電系統的最終設計細則，應獲得擁有人及電力公司雙方同意。

The Owner should ensure that the REPS complies with all prevailing statutory requirements and best practices on safety, reliability and power quality of electrical installations, such as the Electricity Ordinance and its subsidiary regulations, the Supply Rules, and details of case-specific technical requirements of the Utility. The requirements in the Code of Practice for the Electricity (Wiring) Regulations (COP) should be complied with when relevant. For installation details of REPS not covered in any of the local regulations or best practices, reference may be made to relevant international standards or overseas national standards as given in Appendix III. The final design details should be agreed by both the Owner and the Utility.

- 2.9** 為了確保可再生能源發電系統能妥善操作，擁有人應注意，除了須聘用熟練的工程人員在裝置上施工外，還須使用優質的設備，這兩者均十分重要。

To ensure the proper operation of the REPS, the Owner should note the importance of using high quality equipment in addition to employing skilled workers to work on the installation.

- 2.10** 可再生能源發電系統屬於發電設施。擁有人應注意《電力條例》及其附屬規例下有關維修保養發電設施的要求。

The REPS is classified as a generating facility. The Owner should note the maintenance requirement of generating facility under the Electricity Ordinance and its subsidiary regulations.

可再生能源發電系統與電網接駁

Connection of the REPS to the Grid

3

3.1 可再生能源的來源大都不是供應穩定的能量源。為了確保可再生能源發電系統的指定電力負載能有可靠的電力供應，發電系統須配置蓄電池系統以儲存系統產生的電能，或利用另一個電源作為系統的備用電力。不過，由於棄置蓄電池或會引致其他環境問題，因此使用蓄電池系統通常並非首選方案。

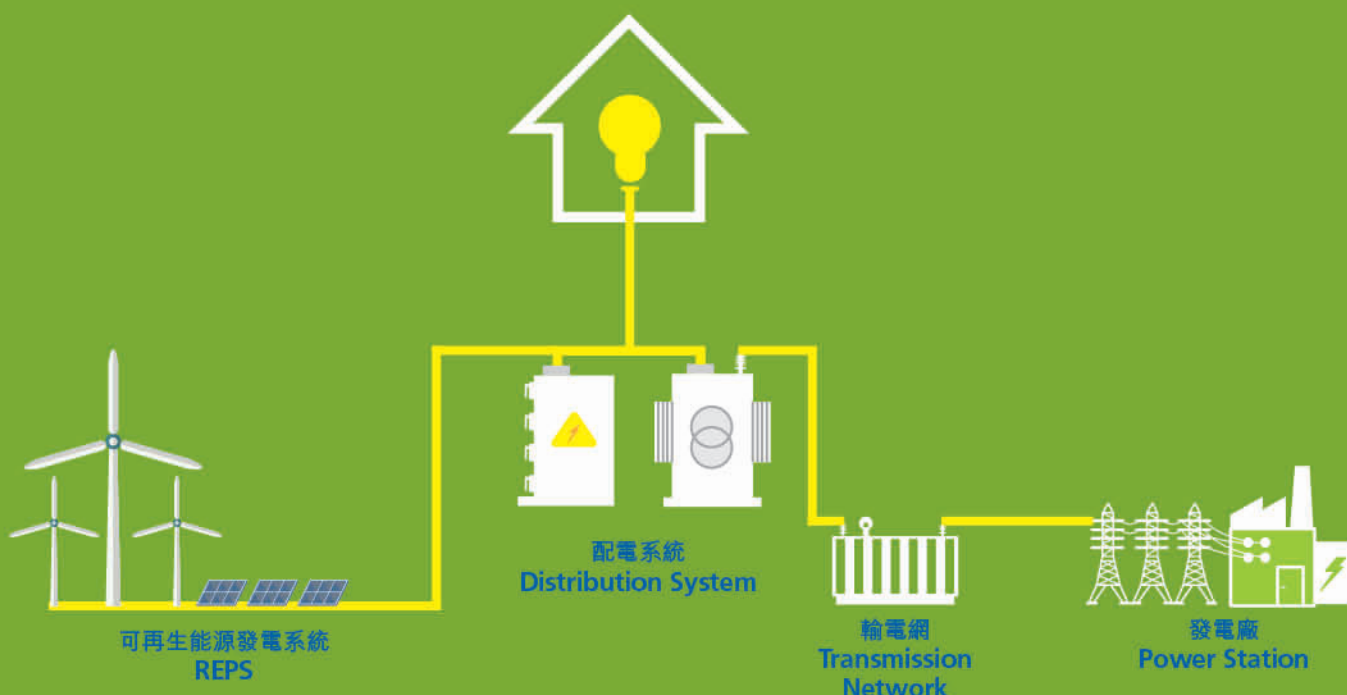
RE sources are mostly intermittent in nature. To ensure a reliable electricity supply to the designated loads of a REPS, it is necessary to provide either a battery system to store electricity generated from the REPS or a backup power to the REPS from another power source. However, the use of battery system is normally not considered as a first priority option since the disposal of batteries may also cause other environmental problems.

3.2 把可再生能源發電系統與電網接駁十分普遍。在一些海外國家，電網的作用是補足及支援由可再生能源發電系統所提供電力的需求缺額。常見的做法是在配電系統的某一端把可再生能源發電系統的與電網接駁，而該接駁點通常是發電系統的安裝位置。

Connection of a REPS to the Grid is very common. In some overseas countries, the Grid serves to complement and back up the electricity demand supplied by a REPS. The common practice is to connect the REPS to the Grid at a certain point of the Distribution System, usually at the location where the REPS was installed.

3.3 與電網接駁後，可再生能源發電系統便成為配電系統的一部分。因此，確保發電系統能安全可靠地操作，是擁有人、電力公司和政府的共同責任。

After connected to the Grid, the REPS becomes part of the Distribution System and it is to the common responsibility of the Owner, the Utility and the Government to ensure that the REPS will operate in a safe and reliable manner.





4.1 本技術指引大致適用於總額定功率最高達一兆瓦並與電網接駁的可再生能源發電系統。隨後各章闡述把可再生能源發電系統與電網接駁的各種技術要求。下文第4.3節所述的附加要求，適用於總額定功率為200千瓦以上至最高達一兆瓦的可再生能源發電系統。

This Technical Guidelines is generally applicable to grid-connected REPSs of Aggregated Power Rating up to 1 000 kW, and the following chapters address the technical requirements for grid connection of REPSs. For REPSs of Aggregated Power Rating greater than 200 kW and up to 1 000 kW, additional requirements as described in 4.3 below will apply.

4.2 本技術指引只涵蓋把可再生能源發電系統與電網接駁的技術要求。然而，在加設與電網接駁的可再生能源發電系統時，電力公司或須作出特別的配合，提供額外的電力設備及/或服務，以確保在任何時刻，可再生能源發電系統的指定電力負載都有安全、足夠及可靠的電力供應，即使可再生能源發電系統無法供電時亦然。因此，除了可再生能源發電系統的安裝費用外，擁有人或須承擔額外費用。擁有人及電力公司因而應商討和議定本文件未有涵蓋但關於把可再生能源發電系統與電網接駁的其他相關非技術事宜。

This Technical Guidelines covers only the technical requirements for connection of REPS to the Grid. However, the addition of a grid-connected REPS may require the Utility to pay special efforts and provide additional electrical equipment and/or services for ensuring a safe, adequate and reliable power supply to the designated loads of the REPS at any moment even when the REPS is out of service. The Owner may therefore be required to bear extra costs in addition to the installation cost of the REPS. It is therefore important that both parties should also discuss and agree on other related non-technical issues which are not covered in this document for connecting REPS to the Grid.

4.3 由於可能須要電力公司作出更多技術方面的考慮，例如配電網絡因加入可再生能源發電系統而致使故障水平提高，因此總額定功率高於200千瓦的可再生能源發電系統應按個別情況轉交電力公司處理。一般來說，如某一場地或建築物由超過一台1 500千伏安配電變壓器供電，則連接至每台變壓器的可再生能源發電系統的總額定功率便以200千瓦為電力負載上限。此外，在某些情況下，如可再生能源發電系統的設備有故障電流限定功能，則連接至每台變壓器的可再生能源發電系統的總額定功率上限或可提高，但須按個別情況處理。

REPSs with Aggregated Power Rating greater than 200 kW should be referred to the Utility on a case-by-case basis as more technical considerations on the Utility's side such as the increase in fault level of distribution network due to REPSs may possibly be required. As a general rule, for a location or building supplied from more than one 1 500 kVA distribution transformers, an Aggregated Power Rating loading limit of 200kW of installed REPSs per distribution transformer can be applied. Furthermore, under certain circumstances it may be permissible to exceed the per-transformer REPSs Aggregated Power Rating limit when there is fault-current limiting function on the REPSs equipment, and this shall be handled on a case-by-case basis.

安全考慮

Safety Considerations

5



- 5.1** 如可再生能源發電系統經由配電系統與電網接駁，當出現電網停止供電等異常情況時，可再生能源發電系統仍有可能會向電網繼續供電。因此，擁有人應確保無論在正常或緊急情況下，與電網接駁並不會對在相關電力裝置上施工的電業工程人員的安全構成危險。電力公司也應採取適當的安全預防措施，防止因逆向通電而危及電業工程人員的安全。

If a REPS is connected to the Grid through the Distribution System, it is possible that the REPS may still supply electricity to the Grid under abnormal conditions such as supply power outage. The Owner should ensure such a connection would not create any safety problem to electrical workers carrying out works on related electrical installations both under normal and emergency situations. Appropriate safety precaution should also be taken by the Utility to prevent danger to its electrical workers due to back energisation.

- 5.2** 建議採取以下措施：
The following provisions are recommended:

- (a) 在可再生能源發電系統的設計中加入「防孤島」功能，其作用是當電網不論基於何種原因而停止供電時，能自動使任何與電網接駁的可再生能源發電系統與配電系統脫離。「防孤島」功能旨在確保電力中斷時，可再生能源發電系統不會繼續向配電系統供電，從而保障在電網或配電系統上施工的電業工程人員的安全，同時亦可配合電網裏斷路器的重合操作。

Incorporate an "anti-islanding" function in the design of the REPSs. This function can automatically disconnect any grid-connected REPS from the Distribution System in the event that the Grid is de-energised for whatever reasons. The purpose of an "anti-islanding" function is to ensure that REPS would not continue to supply power to the Distribution System so as to allow electrical workers to work safely on the Grid or the Distribution System during the power interruption, and to cater for circuit breaker reclosing operation in the Grid.

- (b) 在便於到達的位置安裝可上鎖開關，讓獲授權的電業工程人員在有需要時，能以手動方式把可再生能源發電系統和電網隔離。

Install a lockable switch at a readily accessible position to allow authorised electrical workers to manually isolate the REPS from the Grid whenever necessary.

- (c) 在所有設有雙重供電電源的電力設備上展示警告牌（見圖1及圖2範例），以提醒維修人員。

Display warning labels at all electrical equipment with dual power supply sources (see examples in Figure 1 and Figure 2) so as to alert the maintenance personnel.

- (d) 定期更新電路圖，並把電路圖展示於適當地點，以助維修人員在正常及緊急操作的情況下，均能正確地切斷可再生能源發電系統與電網的接駁。

Update circuit diagrams regularly and display them at appropriate locations to facilitate maintenance personnel to properly shut down the grid connection arrangement under normal and emergency operations.

- (e) 擁有人與電力公司必須建立直接溝通的渠道，以確保可再生能源發電系統和電網能安全操作。擁有人應指派一名合資格人士，負責在正常及緊急操作的情況下，與電力公司直接聯絡。

Establishing a direct communication channel between the Owner and the Utility is essential to ensure the safe operation of the REPS and the Grid. Designate a suitably qualified person to communicate directly with the Utility under normal and emergency operations.

5

安全考慮 Safety Considerations



警告牌 Warning Label



圖1 • 雙重供電警告牌1
Figure 1 • Dual Power Supply Warning Label 1



圖2 • 雙重供電警告牌2
Figure 2 • Dual Power Supply Warning Label 2



6.1 由於設備損壞或會引致其他安全問題，因此為設備設置保護裝置極為重要。本節載述的建議措施，可為相互連接的可再生能源發電系統、配電系統及電網提供保護。

Providing protection facilities for equipment is important as damage to equipment may lead to other safety issues. This section describes the provisions recommended for the protection of the REPS, the Distribution System and the Grid when they are connected together.

- (a) 評估可再生能源發電系統與電網接駁後新的故障水平，從而確保配電系統及電網內的所有設備都能在新的故障水平下安全操作。
Carry out assessment on the new fault level due to the connection of the REPS to the Grid such that all equipment in the Distribution System and the Grid can operate safely under the new fault level.
- (b) 在有需要時，為指定與配電系統作電力性連接的斷路器或接觸器安裝具備同步檢測功能的裝置。可再生能源發電系統與配電系統的只會在兩者同步操作時才會接上，即該兩個電源的電壓強度、相角及頻率差異，均控制在可接受限值以內。
Install facilities with synchronisation check function, whenever necessary, to circuit breakers or contactors designated for making electrical connection to the Distribution System. The connection of the REPS to the Distribution System would only take place when they are operating in synchronisation, i.e. the differences in voltage magnitude, phase angle, and frequency of these two power sources are controlled within acceptable limits.
- (c) 為可再生能源發電系統配置保護功能，以避免出現非同步接駁的情況。為了確保發生電力故障後能迅速恢復電力供應，電力公司或會在電網中設置發生電力故障後會即時運作的自動開關及/或自動重合裝置。如配電系統仍得到可再生能源發電系統供電，非同步接駁可能造成的損壞雙方的設備。
Incorporate protection function in the REPS to avoid unsynchronised connection. To enable fast restoration of supply after power failure, the Utility may be equipped with auto-switching and/ or auto-reclosing facilities that would operate soon after power failures. If the Distribution System is still energised by the REPS, unsynchronised connection may damage equipment of both parties.
- (d) 配置有關裝置，當可再生能源發電系統出現故障時，自動把發電系統和配電系統隔離。
Incorporate facilities to isolate the REPS from the Distribution System automatically when fault occurs in the REPS.
- (e) 在每一個可再生能源發電系統隔離點採用四極的斷路器或隔離開關，讓可再生能源發電系統在停止運作期間能與配電系統完全隔離。此安排可確保配電系統在可再生能源發電系統停止運作期間不受到後者的影響。
Use 4-pole type circuit breakers or isolators on all isolation points of the REPSs to allow complete isolation from the Distribution System when the REPSs is not in service. This arrangement is to ensure that the Distribution System would remain intact and not be affected by the REPSs.



- (f) 為可再生能源發電系統配置適當的保護裝置，以避免發電系統因配電系統及電網出現瞬態異常情況（例如供電中斷、電壓及頻率出現波動、電壓驟降等）而損壞。
Incorporate appropriate protection facilities in the REPS to avoid damage to the REPS caused by transient abnormalities that would occur in the Distribution System and the Grid, such as supply interruption, voltage and frequency fluctuation, and voltage dip.
- (g) 配置穩定和反應迅速的電壓及頻率調節器，以確保可再生能源發電系統能應付配電系統出現的正常電壓與及頻率波動情況。
Incorporate a stable and fast responding voltage and frequency regulator to ensure that the REPS can handle the normal voltage and frequency fluctuations in the Distribution System.
- (h) 為可再生能源發電系統配置有關裝置，當察覺到配電系統的電壓及頻率持續出現波動時，能自動使可再生能源發電系統與配電系統脫離。在設定延遲自動脫離的時間時，可參考附錄 III 所列國際標準提供的建議，而該時間亦應獲得擁有人及電力公司雙方同意。
Incorporate facilities in the REPS which can automatically disconnect the REPS from the Distribution System when sustained voltage and frequency fluctuations are detected in the Distribution System. The time delay for automatic disconnection can be set with reference to the recommendations of international standards as given in Appendix III and should be agreed by both the Owner and the Utility.
- (i) 為可再生能源發電系統配置有關裝置，當配電系統出現電壓及頻率波動情況消失後，能自動把可再生能源發電系統和配電系統重新接上。在設定延遲重新接上的時間時，可參考附錄 III 所列的國際標準提供的建議，而該時間亦應獲得擁有人及電力公司雙方同意。延時功能有助避免因過早作電力性連接而導致斷路器重複斷路。
Incorporate facilities in the REPS which can automatically reconnect the REPS back to the Distribution System after fluctuations in voltage and frequency in the Distribution System have been cleared. The time delay for re-connection can be set with reference to the recommendations of international standards as given in Appendix III and should be agreed by both the Owner and the Utility. The time delay is to avoid repeated operation of the circuit breakers due to premature electrical connection.



7.1 確保現時與配電系統接駁的電力裝置的電力供應不會因引入與電網接駁的可再生能源發電系統而受到影響極為重要。在設計與電網接駁的可再生能源發電系統時如考慮下述建議措施，就可避免因可再生能源發電系統出現故障而導致配電系統及電網中斷供電的情況。

It is important that the electricity supply to existing electrical installations connected to the Distribution System would not be affected by the introduction of a grid-connected REPS. Any fault developed in the REPS that causes power interruption of the Distribution System and the Grid can be avoided if the following recommended provisions are considered in the design of the grid-connected REPS.

- (a) 選用高可靠性（例如平均故障間隔時間較長）的逆變器是十分重要的，因為逆變器是可再生能源發電系統內把系統和配電系統直接接上的主要組件。

Select an inverter with high reliability, such as having a high "mean-time-between-failure" index. This is essential since the inverter is the principle component in the REPS that directly connects the REPS to the Distribution System.

- (b) 設定配電系統內所有保護裝置的操作水平，以配合新的故障水平，此項安排是為了避免在發生故障時，保護裝置出現錯誤操作的情況。

Set the operating levels of all the protective devices in the Distribution System to suit the new fault level. This arrangement is to avoid improper operation of protective devices during fault conditions.

- (c) 配置反應迅速的電壓及頻率調節器，用以調校可再生能源發電系統的輸出，從而配合配電系統的電壓及頻率變化，盡量減少發電系統出現故障的機會。

Incorporate a fast responding voltage and frequency regulator that can adjust the output of the REPS to match the voltage and frequency of the Distribution System. This would help to minimise failure of the REPS.

- (d) 在可再生能源發電系統內加設自動截斷功能，當配電系統的電壓及頻率在既定時限內持續偏離可容許限值時，能自動使可再生能源發電系統與配電系統脫離。有關時限以附錄 III 所列國際標準提供的建議為依據，並應獲得擁有人及電力公司雙方同意。

Provide an automatic disconnection function in the REPS that can operate when the voltage and frequency of the Distribution System deviate outside the allowable limits persistently for a pre-determined period recommended by international standards as given in Appendix (III) and agreed by both the Owner and the Utility.



8.1 一般而言，電力供應的供電質量良好，對電子及電力設備的正常及有效率地操作十分重要。因此，一個供電質量良好的配電系統，不但為擁有人帶來好處，其他由同一配電系統供電的客戶亦同樣受惠。供電質量的問題應在設計階段予以仔細考慮，以避免須在安裝後採取善後措施。
In general, good power quality in the electricity supply is essential for the normal and efficient operation of all electronic and electrical equipment. A Distribution System with good power quality would therefore benefit both the Owner and other consumers receiving power supply from the same Distribution System. The power quality issue should be well considered in the design stage to avoid post-installation mitigation action.

8.2 可再生能源發電系統內一般都設有逆變器，而該逆變器或會影響配電系統的供電質量。以下的建議措施有助盡量減低與電網接駁的可再生能源發電系統對配電系統供電質量所造成的影響：

An inverter is normally included as part of a REPS and it may impair the power quality of the Distribution System. The following provisions are recommended to minimise the effect on the power quality of the Distribution System caused by the grid-connected REPS:

(a) 安裝具備功率調節功能的逆變器，用作把可再生能源發電系統的諧波電流及輸出功率因數保持在可接受的範圍內，令可再生能源發電系統能有效率地操作，並且不會影響其他設備。
Install an inverter with power conditioning function to control the harmonic currents and the output power factor of the REPS within an acceptable range such that the REPS can operate efficiently and not affect others.

(b) 在功率逆變器的輸出部分裝設隔離變壓器，以排除直流電可能從可再生能源發電系統注入配電系統的情況。注入配電系統的直流電如過多，會令配電系統的電壓波形變形，並對與系統連接的其他設備的帶來問題。

Install an isolation transformer on the output side of the power inverter to eliminate the possibility of injecting direct current (DC) from the REPS into the Distribution System. Excess direct current injected into the Distribution System would distort its voltage and cause problems to other connected equipment.

(c) 安裝反應迅速的電壓及頻率調節器，以盡量減少配電系統出現電壓閃變的情況而影響與系統連接的其他電力設備的操作。

Install a fast responding voltage and frequency regulator to minimise voltage flickering in the Distribution System which affects the operation of other connected electrical equipment.

(d) 在設計初期，可參考附錄 III 所列國際標準評估電磁兼容性要求，以便妥善控制可再生能源發電系統產生的傳導或輻射電磁，從而避免對配電系統內的其他電力設備造成干擾。

Evaluate the electromagnetic compatibility requirements specified in international standards as given in Appendix III at the design inception stage. Conducted or radiated electromagnetic emission from the REPS would then be properly controlled so as not to create interference to other electrical equipment in the Distribution System.

(e) 可再生能源發電系統的設計應使用三相逆變器或三個相同的單相逆變器，務求令輸出的電流能平均分配於電網的三相內。此做法有助盡量減少三相供電系統出現電壓與電流不平均的情況，並確保能盡用配電系統的設備容量。然而，如電力公司正供應或將會供應單相電予有關場地，則此措施並不適用。

Design a REPS with three-phase inverter or three identical single-phase inverters to supply current which is balanced over the three phases to the Grid. This would minimise voltage and current unbalance in the three-phase supply system and would ensure that the capacity of the Distribution System can be fully utilised. However, this provision is not applicable if the site is being supplied or will be supplied with single-phase power from the Utility.

效能與監測

Performance and Monitoring

9



9.1 擁有人可考慮添置以下裝置，以作研究或記錄用途：

The following provisions can be considered by the Owner for his own research or record purpose:

- (a) 額外的控制及監測裝置，用以量度及監測可再生能源發電系統的效能。
Additional control and monitoring facilities to measure and monitor the performance of the REPS.
- (b) 數據收集及匯報系統，以提供實時數據、數據摘要及故障報告。
A data collection and reporting system to provide real time data, data summaries and failure reports.



10.1

在可再生能源發電系統投入供電之前，有一點十分重要，就是擁有人應先徹底檢查有關系統，並進行功能/安全測試，以確保系統已按照本技術指引的技術要求及其他就個別情況所附加的技術要求，妥為設計及校驗。電力公司或會要求擁有人為與電網接駁的可再生能源發電系統進行某些指定測試，並派員實地察看測試的進行，或至少要求獲知測試結果。只有當擁有人及電力公司均接納測試程序及結果後，接駁電網安排才會通電。現建議下述的測試及校驗程序：

Before the REPS is energised, it is important that the Owner has carried out a thorough inspection and functional/safety tests to ensure that the REPS has been properly designed and commissioned in accordance with the technical requirements of this Technical Guidelines and other case-specific technical requirements. The Utility may specify and witness certain tests of the grid-connected REPS, or at least be informed of the test results. The grid connection arrangement will only be energised after the test procedures and test results are both accepted by the Owner and the Utility. The following testing and commissioning procedures are recommended:

- (a) 檢查所有延時設定值是否已妥為設定及測試。
To check that all potential levels of time delay settings are properly set and tested.
- (b) 檢查防孤島功能的操作。
To check the operation of the anti-islanding function.
- (c) 檢查所有隔離點的操作。
To check the operation at all isolation points.
- (d) 檢查所有警告牌、設備標籤及電路圖是否已展示於適當的地點。
To check that all the warning labels, equipment labels and circuit diagrams are displayed in appropriate locations.
- (e) 檢查及記錄可再生能源發電系統的電壓及電流輸出，包括功率因數、直流電水平及總諧波失真率等。
To check and record the voltage and current output of the REPS including power factor, DC level and total harmonic distortion etc..

安裝後擁有人的責任

Post-installation Obligations of the Owners

11



11.1 當可再生能源發電系統正常操作後，擁有人應為發電系統安裝檢測電錶。如電力公司提出要求，擁有人應定期（例如每兩個月）向電力公司提供系統的電力輸出資料。電力公司亦可能會安裝檢測電錶，以監測系統的電力輸出量。

After the REPS is put into normal operation, the Owner should install check meters and provide the Utility with information on the electricity output of the REPS on a regular basis, e.g. bi-monthly, if requested by the Utility. The Utility may also install check meters to monitor the electricity output of the REPS.

11.2 建議安排註冊電業工程人員定期檢查可再生能源發電系統。擁有人可以考慮《電力條例》下《電力（線路）規例》就固定電力裝置訂定的規定，作出相類的檢查安排。建議擁有人向電力公司提交相關的檢查證明書及核對表。

Periodic inspection of the REPS by Registered Electrical Worker is recommended. The Owner can consider adopting an inspection arrangement similar to the requirements as stipulated in the Electricity (Wiring) Regulations of the Electricity Ordinance for fixed electrical installation. The Owner is recommended to submit relevant inspection certificate and checklist to the Utility.

11.3 電力公司或會派員進行實地巡查，並要求擁有人就其可再生能源發電系統的操作進行核證測試。因此，電力公司可能要求擁有人安排其工作人員進入有關場地和提供測試結果。

The Utility may conduct on-site inspections and request the Owner to perform verification tests on the operation of the REPS. In this regard, the Utility may request the Owner to provide access and the test results.

11.4 擁有人須編制製一本操作及維修保養手冊，記錄操作及維修保養可再生能源發電系統所需的一切程序，包括所有保護設定值及測試結果。該手冊內有關與電網接駁的操作程序細節，應獲得擁有人及電力公司雙方同意。該手冊應定期予以檢討，並在有需要時作出修訂。

It is important for the Owner to compile an operation and maintenance manual to record all procedures needed to operate and maintain the REPS including all protection settings and test results. Regarding grid connection operational procedures which form part of this manual, the details should be agreed by the Owner and the Utility. This manual should be reviewed regularly and modified where necessary.

11.5 如可再生能源發電系統的額定功率有所更改或發電系統曾經改裝，擁有人應通知電力公司。此外，當可再生能源發電系統解除運作時，亦須知會電力公司。

The Owner should inform the Utility on any change in power rating or modification of the REPS. In addition, the Utility will also need to be informed when the REPS is decommissioned.



12.1 與申請接駁電網事宜有關的電力公司聯絡資料，載列於附錄 I。
The contact information of the Utility for grid connection applications is given in Appendix I.

12.2 有意裝設可再生能源發電系統的擁有人在構思階段便與電力公司接觸是有好處的，因為此舉確保電力公司能在發電系統的設計敲定前，就接駁電網事宜提供意見。擁有人可分階段向電力公司提交列於附錄 II 的輔助資料，例如描述發電系統的相關資料、設計圖、電路圖等。

It would be advantageous for the prospective Owner to make contact with the Utility from inception. This ensures that the Utility can provide advice on the grid connection aspect before the design of the REPS is finalised. Supporting information, such as relevant literature describing the REPS, layout drawings, circuit diagrams listed in Appendix II, can be submitted in stages to the Utility.

12.3 擁有人及電力公司應議定擬建的可再生能源發電系統與電網接駁的最恰當安排。此外，雙方亦應商定有關接駁的條款和條件。
The Owner and the Utility should come to an agreement on the most suitable connection arrangement for the proposed REPS. Both parties should also discuss and reach an agreement on the terms and conditions of grid connection.

12.4 擁有人及電力公司亦應議定可再生能源發電系統的校驗日期，以及電力公司派員實地察看的測試項目。
The Owner and the Utility should also agree on a commissioning date for the REPS and the tests to be witnessed by the Utility.

本地及海外標準和實例裝置電路圖

Local and Overseas Standards and Circuit Diagrams of Examples of Installations

13



13.1 與電網接駁的可再生能源裝置的相關本地及海外標準、守則及實務指引，載列於附錄 III。該等文件在設計與電網接駁的可再生能源發電系統時，可作為參考資料。

A list of local and overseas standards, codes and best practices relating to grid-connected RE installations is given in Appendix III. These documents can be used as reference materials in the design of grid-connected REPS.

13.2 四個實例裝置的電路圖載列於附錄IV。該等電路圖展示在編製本技術指引時相關例裝置的配置，以闡明不同設計者採用的接駁電網安排。由於沒有標準的接駁電網安排，因此應按個別情況設計每個裝置。

Circuit diagrams of four examples of installations are given in Appendix IV. These circuit diagrams show the configurations of those installations at the time of compiling this Technical Guidelines, for the purpose of illustrating the grid connection arrangements adopted by various designers. There are no standard grid connection arrangements and each installation should be designed on a case-by-case basis.



1. 中華電力有限公司

CLP Power Hong Kong Limited

聯絡部門 Contact division / department	可再生能源服務熱線 Renewable Energy Service Hotline
電話號碼 Telephone number	2678 2626
電郵地址 Email address	csd@clp.com.hk
網址 Website	www.clpgroup.com

2. 香港電燈有限公司

The Hongkong Electric Company, Limited

聯絡部門 Contact division / department	輸配電科配電策劃部 Distribution Planning Department of Transmission and Distribution Division
郵寄地址 Postal address	香港中央郵箱915號 G.P.O. Box 915, Hong Kong.
負責人職位 Post of responsible person	配電策劃部總工程師 Chief Distribution Planning Engineer
電話號碼 Telephone number	2814 3459
傳真號碼 Facsimile number	2843 3163
電郵地址 Email address	mail@hkelectric.com
網址 Website	www.hkelectric.com

申請與電網接駁時須提交的 特定資料

Typical Information to be submitted with Grid Connection Application

附錄 Appendix II



技術繪圖最好能按原來大小編印，並提交一式兩份。

Submitted technical drawings would better be in duplicate and in original size.

最初須提交的資料包括：

Information to be submitted initially should include:

1. 申請人資料 Information of Applicant	
(a)	姓名 Name
(b)	郵寄地址 Postal address
(c)	電力公司帳戶號碼 / 電錶編號（適用於現有客戶） Utility account number / meter number (for existing customer)
(d)	聯絡電話號碼 Contact telephone number
(e)	傳真號碼 Facsimile number



2. 擬建的可再生能源發電系統裝置的資料
Information of the Proposed REPS installation

(a)	裝置的地址 Address of installation
(b)	預計投入運作的日期 Expected commissioning date
(c)	可再生能源技術類型（例如：光伏技術、風能、混合式等） Type of RE technology (e.g. photovoltaic, wind, hybrid.)
(d)	發電設備的技術規格 Technical specifications of power generation equipment i) 總額定功率 Aggregated power rating ii) 電力輸出為單相或三相 Single-phase or three-phase electricity output
(e)	預計每年產生的電量（千瓦小時） Expected annual generation (kWh)
(f)	現場有否其他已知的可再生能源發電系統裝置 Any other known REPS installation on site

3. 工程人員聯絡資料
Engineering Contact Information

(a)	聯絡人姓名 Name of contact person
(b)	郵寄地址 Postal address
(c)	聯絡電話號碼 Contact telephone number
(d)	電郵地址 Email address
(e)	安裝小型可再生能源發電系統裝置的經驗 Experience in small renewable energy system installations



4. 簡述可再生能源發電系統的操控模式

Brief Description of the Mode of Operations and Control of the REPS

(a)	顯示可再生能源發電系統實體位置及其他已安裝或將會安裝的主要電力設備的技術繪圖 Technical drawings illustrating the physical locations of the REPS and other major electrical equipment installed or to be installed
(b)	顯示與電網接駁的建議及相關電錶/供電位置詳情的配電系統單線電氣圖 Single-line electrical diagrams of the Distribution System showing details of the proposed grid connection and the associated metering points/supply points
(c)	主要設備的資料，例如技術規格 Major equipment information, e.g. technical specification
(d)	可再生能源發電系統的操作程序 REPS operation procedures
(e)	可再生能源發電系統的測試及校驗程序 REPS testing and commissioning procedures



本地守則及規則 Local codes and rules

標題 Title
《電力（線路）規例工作守則》（機電工程署） Code of Practice for Electricity (Wiring) Regulations, EMSD
《供電則例》（香港電燈有限公司） Supply Rules of The Hongkong Electric Company Limited
《供電則例》（中華電力有限公司） Supply Rules of CLP Power Hong Kong Limited

與電網接駁的一般技術標準/指南/推薦規範（一般只有英文版） General technical standards/guides/recommendations on grid connection (in general, only English version is available)

標準/指南/ 推薦規範 Standards/Guides/ Recommendations	標題 Title
美國電機暨電子工程師學會標準 1547a - 2014 IEEE Std 1547a - 2014	美國電機暨電子工程師學會標準 — 分散式發電資源與電力系統互聯 — 修訂1 IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems - Amendment 1
美國電機暨電子工程師學會標準 1547.1a - 2015 IEEE Std 1547.1a - 2015	美國電機暨電子工程師學會標準 — 分散式發電資源與電力系統互聯的設備的驗證測試程序 — 修訂1 IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems - Amendment 1



<p>美國電機暨電子工程師學會標準 1547.2 - 2008 IEEE Std 1547.2 - 2008</p>	<p>美國電機暨電子工程師學會1547 (TM) (美國電機暨電子工程師學會標準－分散式發電資源與電力系統互聯) 的應用指南 IEEE Application Guide for IEEE Std 1547(TM), IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems</p>
<p>美國電機暨電子工程師學會標準 1547.3 - 2007 IEEE Std 1547.3 - 2007</p>	<p>美國電機暨電子工程師學會分散式發電資源與電力系統互聯的監察、信息交換及控制指南 IEEE Guide for Monitoring, Information Exchange, and Control of Distributed Resources Interconnected with Electric Power Systems</p>
<p>英國能源網絡協會工程推薦規範 G59/3-1, 2014 Energy Networks Association, Engineering Recommendation G59/3-1, 2014</p>	<p>嵌入式發電機組與公共電力供應商配電系統接駁的推薦規範 Recommendations for the Connections of Embedded Generating Plant to the Public Electricity Suppliers' Distribution Systems</p>
<p>英國能源網絡協會工程推薦規範 G83/2, 2012 Energy Networks Association, Engineering Recommendation G83/2, 2012</p>	<p>經典型試驗的小型嵌入式發電機（每相16安培或以下）與低壓配電系統並排接駁的推薦規範 Recommendations for the Connection of Type Tested Small-scale Embedded Generators (Up to per 16A Phase) in Parallel with Low-Voltage Distribution Systems</p>



光伏系統與電網接駁的技術標準/指南/推薦規範（一般只有英文版）
Technical standards/guides/recommendations on grid connection of PV systems (in general, only English version is available)

標準/指南/ 推薦規範 Standards/Guides/ Recommendations	標題 Title
國際電工技術委員會標準 60364-7-712-2002 IEC 60364-7-712-2002	建築物的電氣裝置 — 第7-712部分：特殊安裝和位置的要求 — 光伏供電系統 Electrical Installations of Buildings-Part 7-712: Requirements for Special Installations or Locations - Solar Photovoltaic (PV) Power Supply Systems
國際電工技術委員會標準 61727-2004 IEC 61727-2004	光伏系統 — 電網介面的特性 Photovoltaic (PV) Systems - Characteristics of the Utility Interface
國際電工技術委員會標準 61724-1998 IEC 61724-1998	光伏系統性能監察 — 測量、數據交換和分析指引 Photovoltaic System Performance Monitoring - Guidelines for Measurement, Data Exchange and Analysis



與供電質量有關的技術標準/指南/推薦規範 (一般只有英文版)
Technical standards/guides/recommendations on power quality (in general, only English version is available)

標準/指南/ 推薦規範 Standards/Guides/ Recommendations	標題 Title
國際電工技術委員會技術標準61000-3-4: 1998 電磁兼容性 — 第3-4部分 IEC TS 61000-3-4:1998 Electromagnetic Compatibility-Part 3-4	額定電流大於16安培的設備的低壓供電系統的諧波電流限值 Limitation of Emission of Harmonic Currents in Low - Voltage Power Supply Systems for Equipment with Rated Current Greater than 16 - A
國際電工技術委員會技術標準61000-3-5: 2009 電磁兼容性 — 第3-5部分 IEC TS 61000-3-5: 2009 Electromagnetic Compatibility-Part 3-5	額定電流大於75安培的設備的低壓供電系統的電壓波動和閃變限值 Limitation of Voltage Fluctuations and Flicker in Low - Voltage Power Supply Systems for Equipment with Rated Current Greater than 75 - A
國際電工技術委員會標準61000-3-12: 2011 電磁兼容性 — 第3-12部分 IEC 61000-3-12: 2011 Electromagnetic Compatibility-Part 3-12	接上公共低壓系統而每相輸入電流大於16安培及等於或少於75安培的設備的諧波電流限值 Limits for Harmonic Currents Produced by Equipment Connected to Public Low - Voltage Systems with Input Current > 16 A and ≤75 - A Per Phase



國際電工技術委員會標準61000-4-7: 2002 + A1: 2008 電磁兼容性 — 第4-7部分 IEC 61000-4-7: 2002 A+1: 2008 Electromagnetic Compatibility-Part 4-7	測試與測量技巧 — 供電系統及所接駁設備的諧波與間諧波測量及量度儀器通用指引 Testing and Measurement Techniques - General Guide on Harmonics and Interharmonics Measurements and Instrumentation, for Power Supply Systems and Equipment Connected
美國電機暨電子工程師學會標準 519-2014 IEEE Std 519-2014	電力系統的諧波控制推薦規程和要求 Recommended Practice and Requirements for Harmonic Control in Electric Power Systems

備註 Note	
(a)	國際電工技術委員會的刊物可在該委員會的網店購買： http://webstore.iec.ch/ The IEC publications can be purchased from the IEC Webstore: http://webstore.iec.ch/
(b)	美國電機暨電子工程師學會的刊物可在該學會的網站購買： http://standards.ieee.org/ The IEEE publications can be purchased from the IEEE Standards website: http://standards.ieee.org/
(c)	英國能源網絡協會的刊物可在該協會的網站購買： http://www.energynetworks.org/ Energy Networks Association publications can be purchased from Energy Networks Association website: http://www.energynetworks.org/

實例裝置電路圖

Circuit Diagrams of Examples of Installations

附錄 Appendix IV

電路圖註解

Explanatory notes for the circuit diagrams

1	<p>本附錄的電路圖旨在顯示不同設計者採用的接駁電網安排，不應視作與電網接駁的系統的標準接駁安排。</p> <p>These circuit diagrams are given here for the purpose of illustrating the grid connection arrangements adopted by various designers, and should not be taken as standard arrangements for grid-connected systems.</p>
2	<p>電路圖中的圖形符號大致符合國際電工技術委員會標準 60617 — 圖解用圖形符號所載的規定。</p> <p>The graphical symbols generally conform to IEC 60617 - Graphical Symbols for Diagrams.</p>
3	<p>下文簡述電路圖所示部分主要組件的功能。</p> <p>The functions of some of the principal components shown in the circuit diagrams are briefly described below.</p>

光伏陣列 PV array

光伏陣列的組成，是由光伏組件（及/或附設於建築物的光伏層壓板）先串接成光伏串，然後光伏串再並排連接。

The PV array is made up of PV modules (and/or BIPV laminates) connected in series to form strings. Then with these strings further connected in parallel.

陣列組合箱/分陣列組合箱/直流電接線箱

Array combiner box/sub-array combiner box/DC junction box

光伏串在該等箱子裏並排連接，繼而與逆變器連接。所需的阻流二極管、電湧放電器及直流電熔斷器都安裝在該等箱子裏。

The PV strings are connected in parallel in these boxes, for connection to the inverters. The necessary blocking diodes, surge arrestors, and DC fuses are incorporated into these boxes.



逆變器 Inverter

逆變器把光伏陣列輸出的直流電轉換為交流電。逆變器具備功率調節功能，以控制可再生能源發電系統的諧波電流及輸出功率因數。安裝在逆變器內或外的隔離變壓器有助防止直流電注入配電系統。

The inverter converts the output DC of PV array into AC. It has a power conditioning function to control the harmonic currents and the output power factor of the REPS. The isolation transformer installed inside or outside the inverter helps to prevent the injection of DC into the Distribution System.

逆變器兼備以下功能：

The following functions are also incorporated into the inverters:

(a)	<p>最大功率輸出點追蹤 (MPPT) 功能 — 不斷調校直流電的電壓，以確保在太陽輻射照度不斷變化的狀況下，光伏陣列都能產生最大功率。</p> <p>Maximum Power Point Tracking (MPPT) function-to continuously adjust the DC voltage to ensure that maximum power will be generated by the PV array under the varying solar irradiance conditions.</p>
(b)	<p>防孤島功能 — 斷路時間須符合電力公司的要求，以便電網不論基於何種原因而停止供電時，自動使逆變器與配電系統脫離。</p> <p>Anti-islanding function - with tripping time as required by the Utility, to disconnect the inverter automatically from the Distribution System in the event that the Grid is de-energised for whatever reasons.</p>
(c)	<p>頻率/電壓過低/過高保護功能 — 當電網的頻率及/或電壓超出正常範圍時，使逆變器與配電系統脫離。</p> <p>Under/Over-frequency/voltage protection function - to disconnect the inverter from the Distribution System when the frequency and/or voltage of the Grid falls out of normal range.</p>
(d)	<p>自動重接功能 — 當電網的頻率及/或電壓在既定時限內（該時限須與電力公司議定）回復至正常操作範圍時，把逆變器和配電系統重新接上。</p> <p>Auto-reconnection function - to reconnect the inverter back to the Distribution System when the frequency and/or voltage of the Grid resumes to normal operational range for a pre-defined period of time (with such time period to be agreed with the Utility).</p>

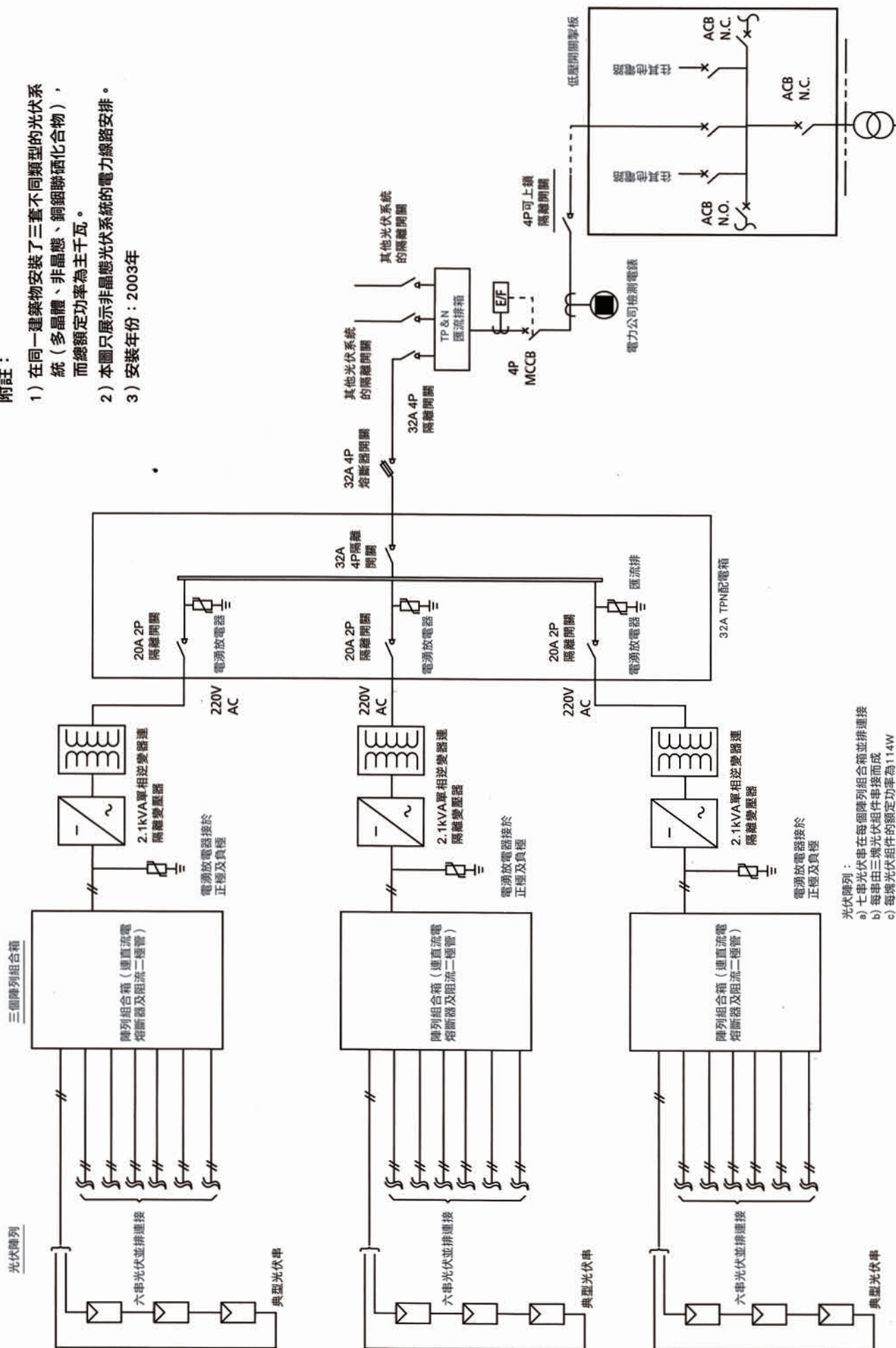


(e)	<p>同步檢測功能 — 確保只會在逆變器輸出和配電系統同步操作時，逆變器才會和配電系統接上。</p> <p>Synchronisation check function - to ensure that connection of the inverter to the Distribution System will only take place when the inverter output and the Distribution System are operating in synchronism.</p>
<p>在實例三，防孤島功能是以獨立的防孤島櫃方式設置。</p> <p>In the case of Example 3, the anti-islanding function is arranged in a separate anti-islanding panel.</p> <p>如有多台逆變器而其輸出是並排連接的，逆變器的保護設定值會稍有不同，以便在異常的狀況下可按序斷路及其後可按序自動重接。</p> <p>In the case of multiple inverters with their outputs connected in parallel, the protection settings of the inverters will differ slightly to allow for sequential tripping under abnormal conditions and sequential auto-reconnection afterwards.</p>	
<p>交流電配電箱 AC distribution board</p> <p>如多台逆變器系統而設，逆變器的交流電輸出經隔離變壓器後會在交流電配電箱互相連接，以便再經主隔離開關和配電系統連接。</p> <p>If installed for a multi-inverter system, the AC outputs of the inverters (after isolation transformers) are connected together in the AC distribution board, for further connection to the Distribution System through the main isolating switch.</p>	
<p>電力公司的檢測電錶 Utility's check meter</p> <p>電力公司或會要求安裝檢測電錶，以記錄光伏系統產生和輸出的電量。</p> <p>This may or may not be required by the Utility. Its function is to record the electricity generated and sent out by the PV system.</p>	
<p>主隔離開關（四極、可上鎖） Main isolating switch (four-pole, lockable)</p> <p>這是一個以人手操作的可上鎖隔離開關（或斷路器），讓獲授權的電業工程人員在有需要時，能夠以手動方式把光伏系統和配電系統隔離。</p> <p>This is a manually operated lockable isolating switch (or circuit breaker) to allow authorised electrical workers to manually isolate the PV system from the Distribution System whenever necessary.</p>	

實例一：7.2 千瓦光伏系統電路圖(與電網單點接駁)

附註：

- 1) 在同一建築物安裝了三套不同類型的光伏系統（多晶體、非晶態、銅鎳聯硒化合物），而總額定功率為主千瓦。
- 2) 本圖只展示非晶態光伏系統的電力線路安排。
- 3) 安裝年份：2003年



米伏陣列：

- a) 七串光伏串在每個陣列組合箱並排連接
b) 每串由三塊光伏組件串接而成
c) 每塊光伏組件的額定功率為114W

附註：

- 1) 在同一建築物安裝了三套不同類型的光伏系統（支式、遮光罩式、天窗式），而總額定功率為55千瓦。
- 2) 本圖只顯示支架式光伏系統的電力線路安排。
- 3) 安裝年份：2002年

直流電接線箱

隔流二極管接於正極

六串光伏
並排連接

旁通二極管

300V DC

2P MCCB

40A TP MCCB

功率調節單元

10kW 逆變器

20kVA 升壓隔離變壓器

40A 4P MCCB(可上鎖)

200A TPN 開關

屋頂電線房內的MCCB箱

測量櫃

電力錶及分析儀

電湧放電器接於三相

300V DC

2P MCCB

40A TP MCCB

10kW 逆變器

3個電湧吸收器
(極對地, 極對極)

六串光伏
並排連接

旁通二極管

18塊光伏組件串接
(典型光伏串)

開關櫃

電力公司變壓器

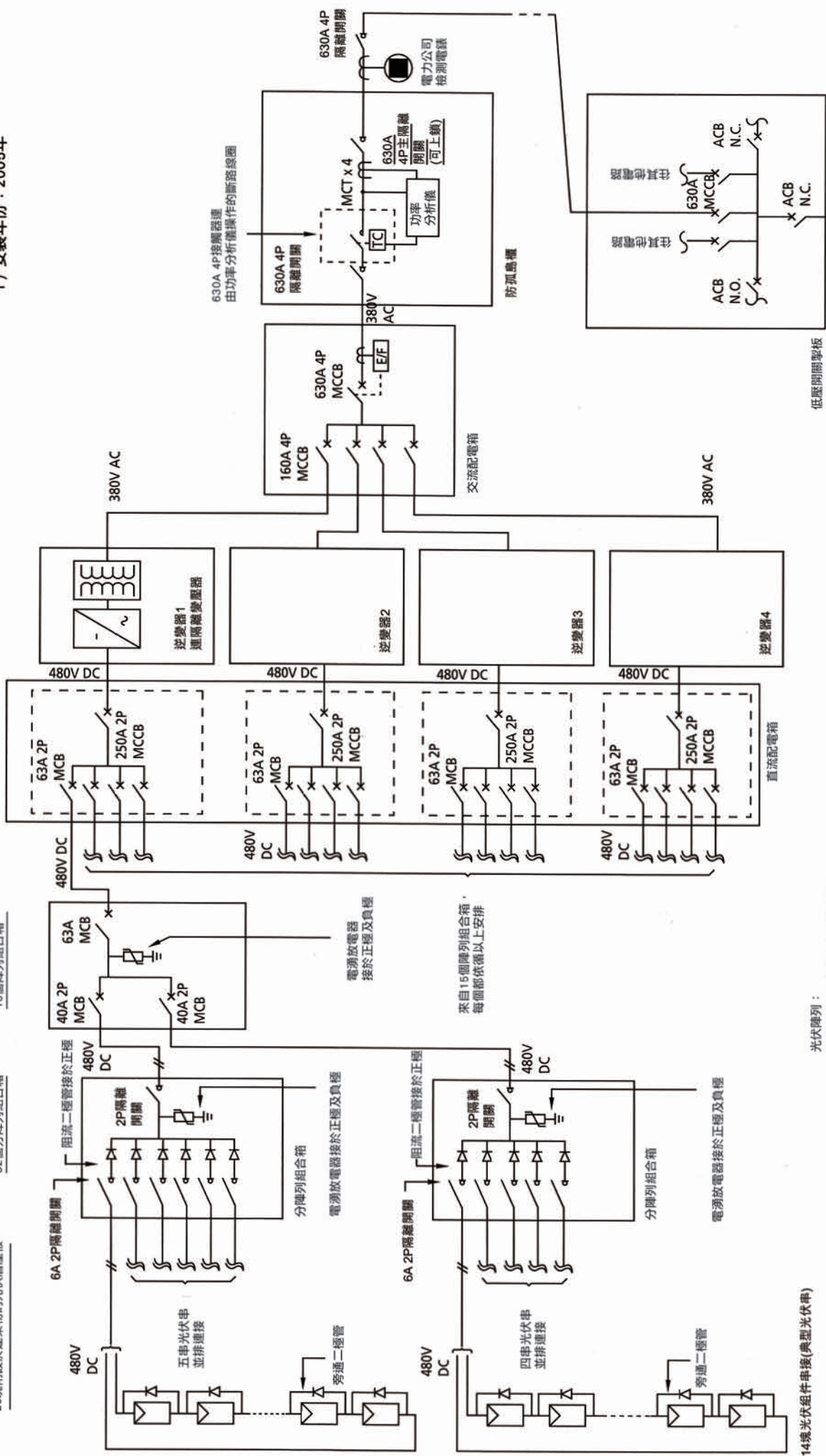
來自遮光罩式系統

來自天窗式系統

a) 由14串光伏串並排連接而成
b) 每串由18塊光伏組件串接而成
c) 每塊光伏組件的額定功率為題W

實例二：20千瓦光伏系統電路圖(與電網多點接駁)

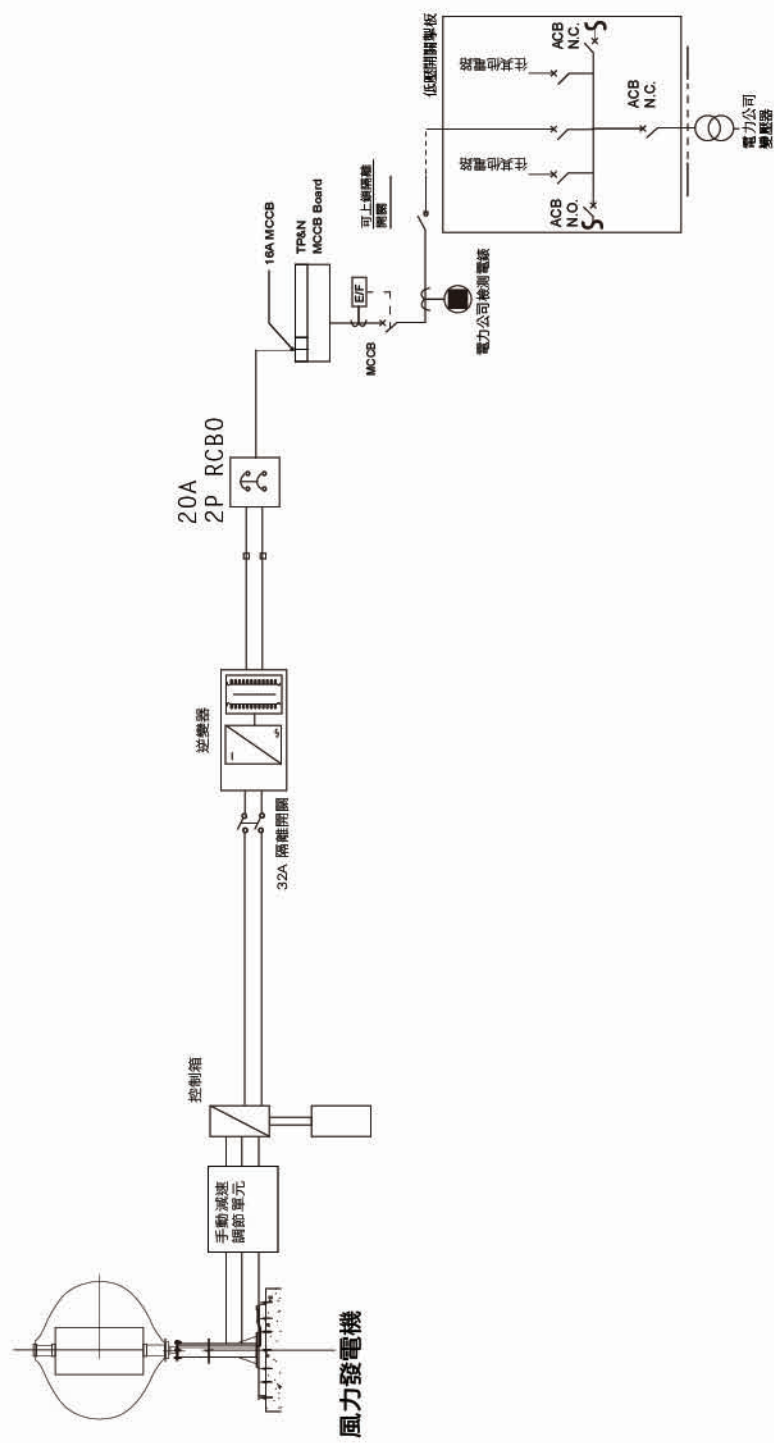
附註：
1) 安裝年份：2005年



光伏陣列：
a) 總共有171串光伏串並排連接
b) 168串光串以相同方式連接，每串由於14塊光伏組件串接而成
c) 總共有2357塊光伏組件及20塊附設於建築物的光伏層壓板
d) 每塊光伏組件的額定功率為150W，每塊光伏層壓板的額定功率為270W

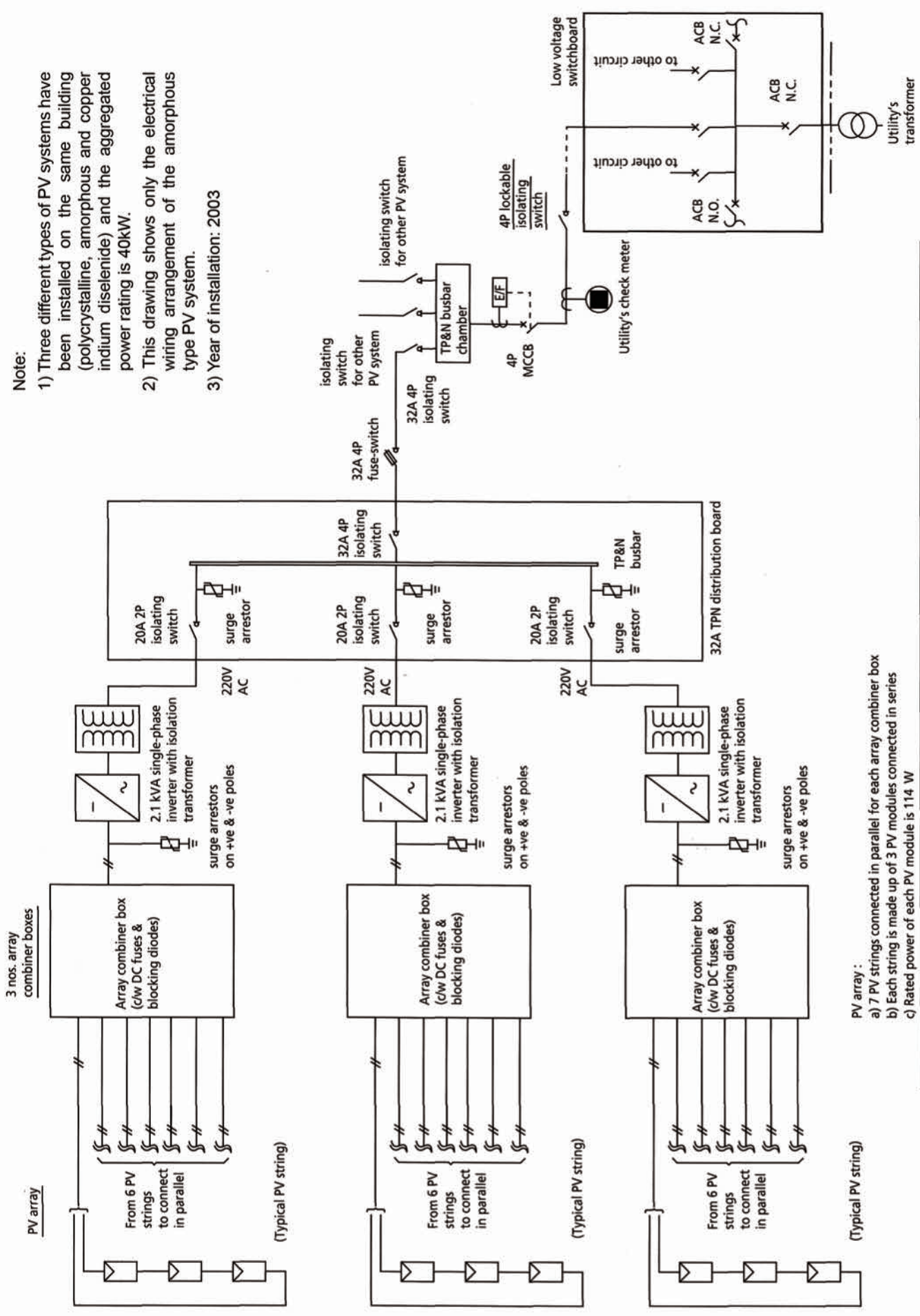
實例三：350千瓦光伏系統電路圖(與電網單點接駁，>200千瓦)

附註：
1) 本圖只顯示風力發電系統的電力
線路安排。



實例四：小型風力發電系統電路圖 (與電網單點接駁)

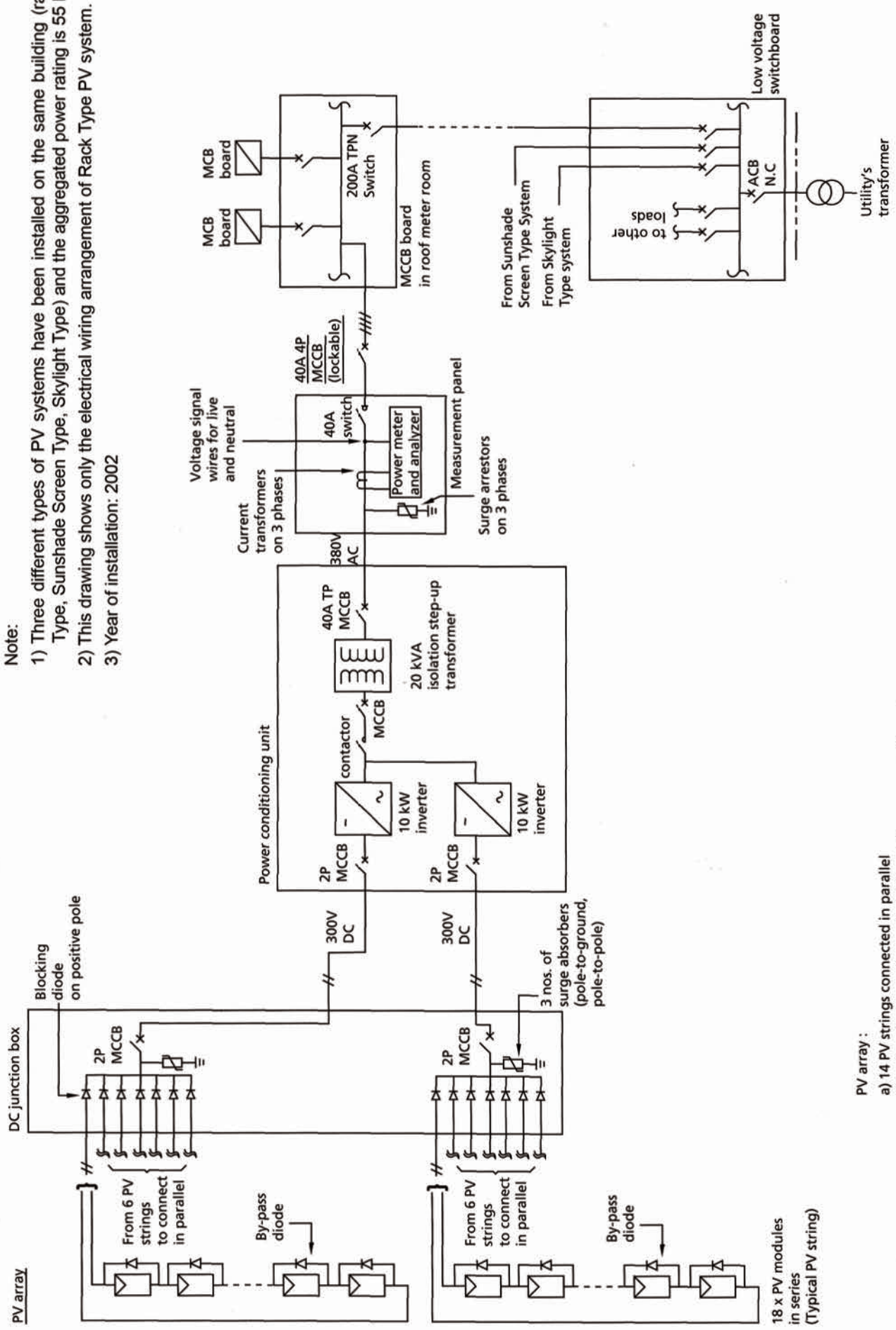
- Note:
- 1) Three different types of PV systems have been installed on the same building (polycrystalline, amorphous and copper indium diselenide) and the aggregated power rating is 40kW.
 - 2) This drawing shows only the electrical wiring arrangement of the amorphous type PV system.
 - 3) Year of installation: 2003



- PV array :
- 7 PV strings connected in parallel for each array combiner box
 - Each string is made up of 3 PV modules connected in series
 - Rated power of each PV module is 114 W

Example 1 - Circuit diagram of a 7.2 kW photovoltaic system (single grid-connection point)

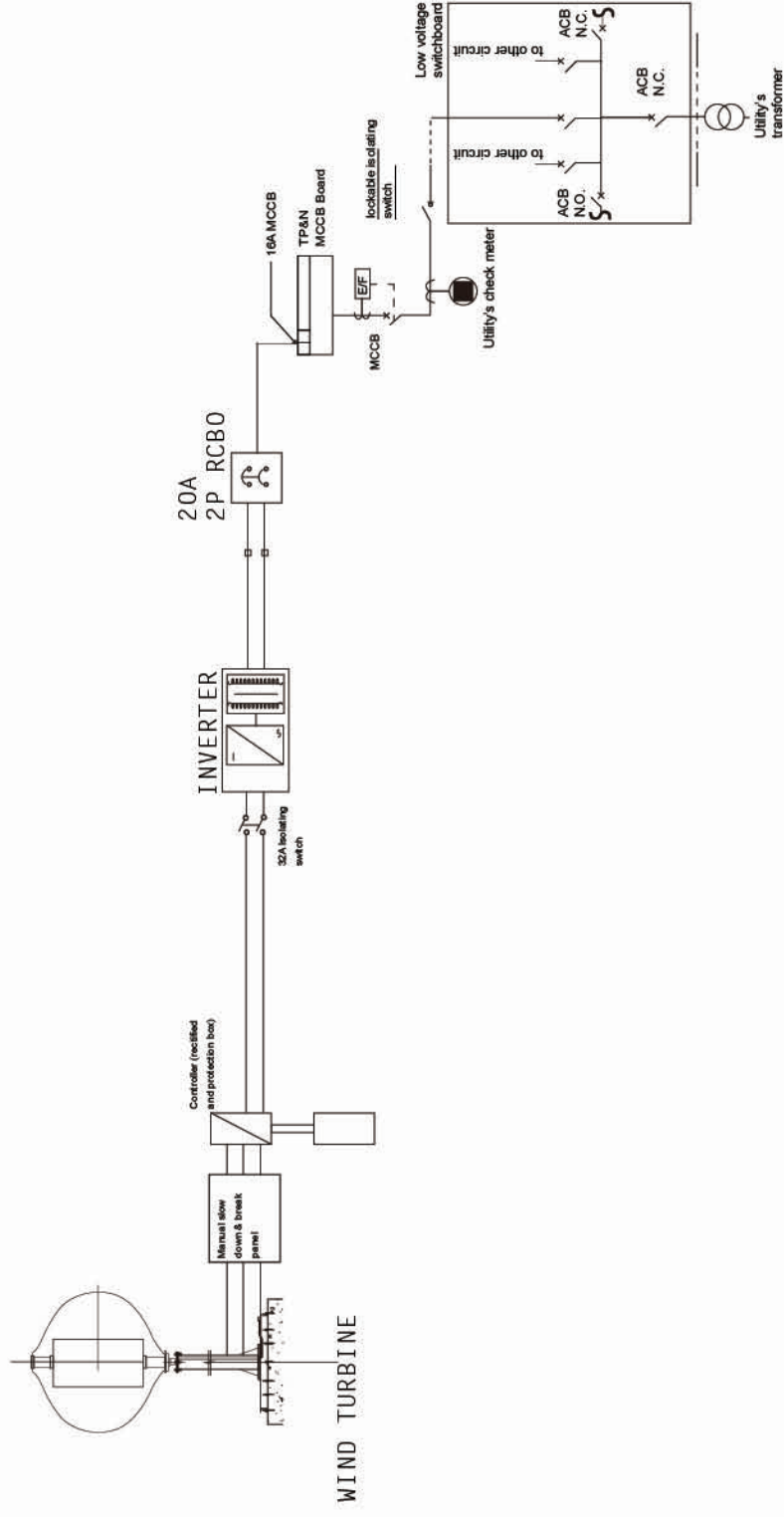
Note:
 1) Three different types of PV systems have been installed on the same building (rack Type, Sunshade Screen Type, Skylight Type) and the aggregated power rating is 55 kW.
 2) This drawing shows only the electrical wiring arrangement of Rack Type PV system.
 3) Year of installation: 2002



- PV array :
- a) 14 PV strings connected in parallel
 - b) Each string is made up of 18 PV modules connected in series
 - c) Rated power of each PV module is 80 W

Example 2 - Circuit diagram of a 20 kW photovoltaic system (multiple grid-connection point)

Example 3 - Circuit diagram of a 350 kW photovoltaic system (Single grid-connection point, >200kW)



Note:

- 1) This drawing shows only the electrical wiring arrangement of wind turbine system.

Example 4 - Circuit diagram of a small wind turbine system (single grid-connection point)

機電工程署



EMSD

機電工程署

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