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# 新再生能源管理資訊系統之彈性應用程式與資料庫架構設計

Flexible Application and Database Architecture of New Renewable Energy Management System

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## 摘要

近年來配合政府推動再生能源政策，機關及企業陸續投入再生能源發電系統之建置，台灣電力公司為有效管控及追蹤再生能源申設案辦理進度，已建置再生能源管理資訊系統 (Renewable Energy Management System, REMS)，提供區處服務中心、規劃課、營業課及檢驗課等部門登載管理各項案件資訊，惟該系統所需提供之服務日益擴大，早已超出原設計負荷量，且統計方式係以報表呈現，不易了解再生能源發展全貌，此為亟待改善之目標。本系統以既有再生能源管理資訊系統為基礎，重新建構完整的新再生能源管理資訊系統 (New Renewable Energy Management System, NREMS)，以便記錄辦理併聯申請案件作業，管理相關申請案件辦理情形及追蹤後續發展趨勢，並能隨時查詢相關之統計資訊，期望進一步提升管理再生能源之成效。

## Abstract

In recent years, in order to cooperate with the government's renewable energy policies, government agencies and private enterprises have successively invested in the construction of renewable energy power generation systems. To effectively control and track the progress of renewable energy application projects, Taipower has established a Renewable Energy Management System (REMS) to provide information to relevant departments of its district offices to log in, record and manage application information. However, the services required by the system are expanding day by day, and have already exceeded the original design load. Moreover, the statistics are presented in reports, making it difficult to understand the full picture of renewable energy development. This is an urgent need for improvement. Based on the existing renewable energy management system, in this study, we reconstruct a New Renewable Energy Management System (NREMS). The functions of the new system include: recording and handling related renewable energy connection application cases, managing the processing status

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of related application cases and tracking subsequent developments, and querying relevant statistical information at any time, in the hope of further improving the effectiveness of renewable energy management.

**關鍵詞(Key Words)：** 再生能源(Renewable Energy)、再生能源管理資訊系統(Renewable Energy Management System)、新再生能源管理資訊系統(New Renewable Energy Management System)、併聯申請(Connection Application)、統計資訊(Statistics)。

# 虛擬同步發電機於電網之應用與評估研究

Research on the Application and Evaluation of Virtual Synchronous Generators in Power Grid

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## 摘要

近年來，隨著再生能源滲透率的增加，未來變流器(Inverter)在電力系統的占比將逐漸提高。然而，再生能源發電系統不具備像傳統同步發電機有轉動慣量與阻尼效應，進而造成電力系統慣量下降。當電力系統遭受擾動時，對電力系統的穩定度勢必會造成較大的影響。基於上述的原因，根據傳統同步發電機的搖擺方程式與電力電子轉換器之控制技術，讓變流器具有類似傳統同步發電機的動態特性(虛擬同步機(Virtual Synchronous Generator, VSG))，是目前電力電子界努力的方向。本文旨在模擬分析當電力系統遭受干擾時，虛擬同步機是否具有緩和及抑制頻率變化率(Rate of Change of Frequency, RoCoF)，及支撐電網的效果，以適應未來再生能源滲透率高的電力系統。

## Abstract

In recent years, with the increase of renewable energy, the proportion of inverter-based resources (IBR), such as PV and wind turbines in the power system, will gradually increase in the future. However, renewable energy power generation systems do not have the rotational inertia and damping effects of traditional synchronous generators (SG), resulting in a decrease of power system inertia. When the power system suffers a disturbance, it will inevitably have a greater impact on the stability of the power system. Based on the aforementioned reasons, the swing equation of traditional synchronous generators and the control technology of power electronic converters are used to make the inverter-based resources have dynamic characteristics similar to traditional synchronous generators, which are the concept of virtual synchronous generator(VSG) and the current direction of efforts of the power electronics industry. This article aims to simulate and analyze whether the virtual synchronous machine has the effect of easing and suppressing the rate of change of frequency (RoCoF) and supporting the power grid when the power system suffers interference, so as to adapt to the future power system with high renewable energy penetration rate.

**關鍵詞(KeyWords)**：基於變流器的資源 (Inverter-based Resource, IBR)、虛擬同步機(Virtual Synchronous Generator, VSG)、虛擬慣量(Virtual Inertia)。

# 電力轉直供業務分析與精進研究

A Study on Analyzing and Improving the Business of Power Wheeling and Direct Supply

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## 摘要

為配合電業法修正及再生能源相關政策，如用電大戶、再生能源設置及企業 RE100 綠電等需求，因應未來大量轉直供服務申請案件，現行轉直供營運規章、契約、申請流程等，恐無法滿足利害關係人所需。

因此，本研究主要目標為協助台電公司規劃適合轉直供利害關係人之電能轉直供營運規章及服務申請流程，以達成精進申請流程與流程電子化改善目標，縮短業者申請及審查作業時程。本研究完成營運規章、契約與申請流程，以及流程電子化研擬建議方案，包括將結構分為規章、契約與附約等三層級之規劃建議，並透過未來資訊系統電子化，針對全新案件、契約變更，設計其快速通關之分流機制與審查處理程序。

本研究亦選擇轉直供現行作業之重要課題，進行問題分析與提出建議方案。期盼對於未來推動電力轉直供業務得以更加便捷。

## Abstract

In order to comply with the amendments to the Electricity Act and renewable energy-related policies (such as the needs of large electricity consumers, renewable energy installations, and corporate RE100 green electricity), and in response to a large number of application cases for switching to power wheeling and direct supply services in the future, the current operating regulations, contracts, and application procedures may not be able to meet the needs of stakeholders.

In view of this, the main objective of this study is to assist Taipower in planning the operating regulations of power wheeling and direct supply and service application process suitable for the stakeholders, so as to achieve the goal of streamlining and electronicizing the application process and shortening the application and review process. This study has completed the development of operating regulations, contract and application process for power wheeling and direct supply services, as well as the proposal for electronicizing the application process, including suggestions for dividing the structure into three levels (regulations, contract and attachment). In addition, through the electronicization of the information system, a diversion mechanism and reviewing procedures for rapid clearance are designed for new cases and contract changes.

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In addition to the above, this study has also selected several important issues that are relevant to current power wheeling and direct supply operations, and proposed useful solutions, so as to make it easier to promote the business of switching to power wheeling and direct supply in the future.

**關鍵詞 (Key Words)**：電業法(Electricity Act)、電能轉供(Power Wheeling)、併網型直供(Grid-Connected Direct Supply)。

# 整合配電規劃資訊系統與配電級再生能源可併容量查詢系統之網頁化功能設計

Web-based Distribution Planning Information System (DPIS) Combined with Distribution Renewable Energy Hosting Capacity Inquiry System

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## 摘要

為持續精進再生能源審查作業，本案已將儲能系統、光儲系統及太陽光電等再生能源資源進行系統衝擊分析，重新開發網頁版新配電規劃資訊系統(New Distribution Planning Information System, NDPIS)，提供區處審查人員針對申請併網案件，透過改善變壓器容量、更換導線線徑規格、新設饋線、新設分歧導線、新設變壓器、降低申請併網容量等方式，藉由多點計算併網衝擊分析評估新申請案件，以檢視是否符合併聯技術要點條件，試算出建議可行方案，大幅降低審查整理資料與重複試算所需時間，加速處理作業提升人員效率。期望未來此平台能提供申請者與相關單位，作為配電圖資審查再生能源併網之應用參考，透過快速便捷的工具，簡化再生能源併網審核作業，加速推動再生能源併網應用，達到資訊化整合管理成效。

## Abstract

In order to improve the review process for renewable energy, this study has conducted system impact analyses on renewable energy resources such as energy storage systems, photovoltaic energy storage systems, and solar photovoltaic, and redeveloped a web version of New Distribution Planning Information System (NDPIS), so that Taipower's district office personnel can use various methods such as improving transformer capacity, changing wire gauge specifications, installing new feeders or branch feeders, installing new transformers, and reducing the requested grid-connection capacity to review grid connection applications; conduct multi-point calculations to evaluate the impact analysis of new application cases; and try out feasible solutions to significantly reduce the time required for review; thus accelerate the processing operation. It is hoped that in the future the platform can provide applicants and relevant units with a reference for renewable energy grid connection application and through fast and convenient tools simplify and accelerate the renewable energy's grid connection review process to achieve the goal of integrated information management.

**關鍵詞(Key Words)**：再生能源(Renewable Energy)、儲能系統(Energy Storage Systems)、光儲系統(Photovoltaic Energy Storage System)、太陽光電(Photovoltaic)、新配電規劃資訊系統(New Distribution Planning Information System)。

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# 用戶關係管理平台與應用發展研究

Research on CRM Platform and Application Development

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## 摘要

台電公司因面臨電業法修正與能源轉型等環境變化，須建構並逐步擴建用戶關係管理(以下簡稱 CRM)平台，滿足未來一站式服務與各種新興業務之需求，以助於台電公司因應未來變動並提升競爭優勢。本研究進行 CRM 之規劃，透過蒐集分析國外電業建置 CRM 的案例及安排台電內部各部門需求訪談、外部 CRM 解決方案供應業者拜訪，及訪視三位領域專家，綜整產官學建議後，提出符合台電需求規範之資料介接與軟硬體建置建議，確保在未來 CRM 平台建置完成後，能有效精進台電對外業務溝通渠道及優化內部作業流程提升整理服務品質。

## Abstract

Due to environmental changes such as the amendment of the Electricity Act and the energy transition policy, Taipower needs to establish and gradually expand a customer relationship management system (CRM) to meet the demands of future one-stop services and various emerging businesses, so as to help the company cope with the future changes and enhance competitive advantage. The purpose of this study is to conduct CRM planning. By collecting and analyzing cases of CRM implementation in foreign electric industries and arranging demand interviews with various departments within Taipower, visits from external CRM solution providers, and interviews with three experts in the field, after comprehensively integrating the suggestions from industry, government and academia, we propose a solution that meets Taipower's demand specifications for data integration and hardware/software construction to ensure that, after the completion of the future CRM platform, Taipower can effectively improve its external business communication channels and optimize internal operating procedures to improve the company's service quality.

**關鍵詞(Key Words)**：CRM 用戶關係管理(Customer Relationship Management, CRM)、能源轉型(Energy Transformation)、顧客賦能(Customer Empowerment)、需量反應(Demand Response)。

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# 住宅部門電力消費模型實證研究

An Empirical Study on Electricity Consumption Model of Residential Sector

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## 摘要

本研究首先透過文獻回顧的方式，檢視此類調查資料於電業領域加值應用的可能性；接著再以調查資料為基礎，透過數據分析的方式檢視住宅用戶的異質特徵與電力消費之間的關聯，具體的數據分析流程包含資料預處理、模型建置以及參數優化等。量化實證結果顯示，儘管調查資料並非推估本期用電量的最佳選擇，模型表現仍會隨資料漸趨完備而逐漸改善，同時可觀察到某些非主要電器的特徵變數顯示出高重要性。最後，依據前述文獻回顧與數據分析結果，提出未來家用電器與用電行為調查可精進之方向，以及可向用戶提供之加值應用服務。

## Abstract

This study first examines the possibility of value-added application of residential sector survey data in the field of the electric power industry through a literature review. Then, based on the survey data, we examine the relationship between the heterogeneous characteristics of residential users and electricity consumption through data analysis. The specific data analysis process includes data preprocessing, model construction, and parameter optimization. The quantitative empirical results show that although the survey data is not the optimal choice for estimating electricity consumption in a specific period, the model performance will gradually improve as the survey data becomes more complete. It can also be observed that some characteristic variables of non-major electrical appliances show high importance. Finally, based on the aforementioned literature review and data analysis results, we propose directions in which future surveys for improving household appliance and electricity consumption behavior can be improved, as well as value-added application services that can be provided to users.

**關鍵詞(Key Words)**：機器學習(Machine Learning)、類神經網路(Neural Network)、家用電器普及狀況調查(Household Electrical Appliances Survey)。

# 智慧型 LED 照明燈具性能標準之研究

Study on Performance Standards of Intelligent LED Lighting Fixtures

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## 摘要

本研究主要為探討各國對於燈具之標準，除了解各國間標準的差異並對我國廠商所售之 LED 智慧型照明燈具進行分析外，並比較燈具廠商所提供之光通量、發光效率、色溫、及演色性等規格。此外，對燈具之智慧功能彙整分析，並根據燈具所具有之智慧功能進行分類，以為對智慧型 LED 照明燈具研擬出相關性能測試之標準草案。

目前國內對於智慧 LED 燈具的規範尚不多，智慧 LED 燈具標準草案有助於奠定智慧型燈具及相關標準的方向，進使智慧型燈具得有更完善的規範。

## Abstract

This study mainly explores the standards for lighting fixtures in various countries. In addition to understanding the differences in standards among countries, analyzing the intelligent LED lighting fixtures sold by local manufacturers, and comparing the specifications provided by lighting fixture manufactures (such as the luminous flux, luminous efficacy, color temperature, and color rendering index), it also aims at consolidating, analyzing and classifying the intelligent functions of lighting fixtures, in order to develop a draft of performance testing standards for intelligent LED lighting fixtures.

Currently, there are not many specifications for intelligent LED lighting fixtures in Taiwan. The draft standards proposed in this study will help establish and improve the relevant standards.

**關鍵詞(Key Words)**：智慧燈具(Intelligent Luminaire)、智慧照明(Intelligent Lighting)、法規標準(Regulatory Standards)、規範(Specification)。

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# 用過核子燃料處置罐體之峰值溫度分析

## Peak Temperature Analysis of Spent Nuclear Fuel Disposal Canisters

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### 摘要

目前一般在進行多重障壁系統之熱傳分析時，主要係把處置罐內外部視為一均質圓柱實體；然而，若欲深入了解罐體內部熱引致之溫度場及其安全問題，則須詳細建置其內部構造之分析模型。本文旨在採行有限元素方法，考量處置罐體複雜之幾何及材料配置情況，針對其內部之溫度峰值進行數值運算分析，並進一步觀察間隙熱輻射之影響效應，期能作為後續相應之參考依據，以確保處置環境穩定與安全之圍阻功能。

### Abstract

At present, when conducting heat transfer analysis of multiple barrier systems, the disposal canisters are generally regarded as homogeneous cylindrical entities. However, if we want to deeply understand the temperature field caused by heat inside the canisters and related safety issues, we must build a detailed analysis model for the internal structure of the canisters. This article aims to use the finite element method, and after due consideration of the complex geometry and material configuration of the canisters, conduct numerical calculations and analysis on the peak temperatures inside the canisters, and observe the effects of gap thermal radiation to serve as a reference for subsequent correspondence and ensure the stability and safety of the disposal environment.

**關鍵詞(Key Words):** 用過核子燃料(Spent Nuclear Fuel)、處置罐(Disposal Canister)、峰值溫度(Peak Temperature)、熱傳(Heat Transfer)。

# 第一核能發電廠離廠再確認中心建物及周圍環境整治之營建工程概述

Overview of the Construction Project of Chinshan Nuclear Power Station's Clearance Confirmation Center

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## 摘要

核能電廠進入除役階段後任何所需之預算均須使用核能發電後端營運基金(簡稱後端基金)，台電公司第一核能發電廠一號機及二號機因運轉執照屆期，分別於 107 年 12 月 5 日及 108 年 7 月 15 日停止運轉，108 年開始進入除役階段，108 年 8 月之後所需除役營運費用均需於後端基金編列預算。離廠再確認中心建物及周圍環境整治案為核能電廠除役後廠房內大型受污染可解除管制之設備或大型物件之除役作業，需有大型倉庫使廢棄物離廠無輻射安全顧慮，完成後可以有效減少電廠倉貯壓力，進而順利推動整體除役工作，但是大多數為無放射性污染，或污染低於一定程度而可解除管制之廢棄物，可運離電廠處理、資源回收、再利用。本篇文章簡介本案營建工程之施工初始之品質管理計畫、整體施工計畫至驗收和完工揭牌等過程。

## Abstract

According to relevant regulations, after a nuclear power plant enters the decommissioning stage, any budget it requires must come from the Nuclear Back End Management Foundation. The unit 1 and unit 2 of Taipower's Chinshan Nuclear Power Station (CSNPS) stopped operating on December 5, 2018 and July 15, 2019 respectively due to the expiration of their operating licenses. They began to enter the decommissioning stage in August 2019. All subsequent decommissioning operating expenses need to be budgeted in the said back-end foundation. The remediation project of the buildings and surrounding environment of the Clearance Confirmation Center (CCC) is the decommissioning operation of large-scale contaminated equipment or large objects in a nuclear power station that can be deregulated after the station is decommissioned. A large warehouse is needed to allow waste to leave the station without radiation safety concerns. Once completed, it can effectively reduce the storage pressure of the station, thereby smoothly promoting the overall decommissioning work. However, most of them are wastes that have no radioactive contamination, or whose contamination is below a certain level and can be deregulated. They can be transported away from the power station for processing, resource recovery, and reuse. This article introduces the initial quality management plan, overall construction plan, and even the acceptance and completion unveiling process of the construction project.

**關鍵詞(Key Words)**：台電公司(Taiwan Power Company)、第一核能發電廠(Chinshan Nuclear Power Station)、核能發電後端營運基金(Nuclear Back End Management Foundation)、除役(Decommissioning)、離廠再確認中心(Clearance Confirmation Center)。

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