台電工程月刊 865 期（9 月號）目錄

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應用 DPIS 簡化配電規劃工作研究

Study on Simplifying Distribution Planning by Applying DPIS

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摘　要

現行台電各區處規劃課年度例行作業所需資訊，皆須由規劃人員至不同應用系統下載資料後輸入至 Excel 計算，其資料在彙整過程往往費時費力，為評估及開發適合台電配電處及各區營業處規劃部門使用之作業平台及系統，整合台電現有系統資訊，重新建構一套「配電規劃工作整合應用系統」，藉由開發相關人機介面與彙整作業流程所需資訊，以取代現有繁瑣的資料彙整步驟，提供各區處規劃人員查詢運用例行所需之中長程負載預測、變電所全停轉供方案、線路損失統計、饋線緊急搶修及復電順序、計畫性分區輪停各饋線停電範圍、停電要求書等相關報表製作，進而可分析區域性供電狀況、解析負載潮流、負載成長趨勢、供電電壓及分散型電源裝置容量等相關資訊，使規劃人員能充分掌握供電區域弱點，及早規劃因應改善方式，並達到資料共享、整合分析資訊平台，強化配電規劃作業效能，滿足多元作業需求。

Abstract

At present, annual routine operation information required by the Planning Section in the district office of Taiwan Power Company (TPC) is downloaded by the planning personnel via different application systems and used as inputs for Excel calculation. The aforesaid data integration procedure is time-consuming and laborious, therefore it is necessary to develop a new operation platform with corresponding information system, called the Distribution Planning Integrated Application System (DPIAS), to replace the old procedures. DPIAS can not only provide human-machine interface for the planning personnel to handle the daily routines such as midterm & long term load forecasting, load switching during blackouts, line loss statistics, feeder emergency repair & sequence of power supply restoration, power rationing, graph and chart making, but also help analyze regional power supply, power flows, load growth trend, voltage of power supply, capacity of distributed generations, to meet the requirements of mastering weakness of the district's power supply area, planning improvement measures, data sharing, integrated analysis of information platform, and strengthening the operation efficiency of distribution system .

關鍵詞 (Key Words)：配電系統(Distribution System)、配電規劃工作整合應用系統(Distribution Planning Integrated Application System)、資料彙整(Data Integration)、負載預測(Load Forecast)、分散型電源(Distributed Generation)。

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回頁首

電網運轉頻率及電壓規範探討

Investigation of Operational Frequency and Voltage Specifications for Power Grids

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摘　要

各國電網規範直接與發電特性與電網運轉有關，頻率響應需求在獨立的系統，如英國及愛爾蘭，較大型互聯系統如歐洲大陸的法國輸電系統嚴格。不同類型發電型態，例如風力發電及太陽能發電等再生能源，併聯至電網後，可能需修改既有電網運轉頻率與電壓規範。本文收集國內外運轉頻率及電壓規範，探討傳統發電機與再生能源發電系統併網後的故障穿越(Fault Ride Through, FRT)或低電壓穿越(Low Voltage Ride Through, LVRT)的能力及頻率控制策略。本文內容可協助電業管制機關管理電網頻率控制效能及訂定適當的運轉頻率及電壓規範。

Abstract

The grid codes of most countries around the world are closely related to their power system's characteristics of generation and grid operation. For instance, frequency response(FR) requirements of isolated power systems such as the UK and Ireland are usually stricter than large interconnected power systems such as French in continental Europe. The specifications of grid operation has a need to be modified before renewable generations such as wind and solar powers can be connected into the system. The main purposes of this study are threefold, namely (1) collect operational frequency and voltage specifications around the world, (2) investigate the power grid's capabilities of connecting traditional and/or distributed generations, such as the Fault Ride Through(FRT) and Low Voltage Ride Through(LVRT), (3) frequency control strategies for the said interconnection. The results of this study may assist the regulatory authority in improving the performance of frequency control and stipulating relevant specifications.

關鍵詞 (Key Words)：電網規範(Grid Code)、頻率響應(Frequency Response)、再生能源(Renewable Energy)、頻率控制策略(Frequency Control Strategy)、故障穿越(Fault Ride Through)、低電壓穿越(Low Voltage Ride Through)。

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以鴨子曲線為例-基於電池壽命估測之最適儲能系統規劃程序

Taking a Duck Curve as an Example - Optimal Energy Storage System Planning Program Based on Battery Life Estimation

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摘 要

本文針對鋰鐵電池為電能單元的儲能系統提出一套基於電池壽命估測之最適儲能系統規劃程序，以求得最適當的容量建置，避免過度投資。本程序的目標有兩個，第一個是計算儲能系統所需最低額定容量，第二個是計算符合最低投資成本之最適額定容量。最後針對兩種配合基載發電排程調度案例進行最適儲能規劃，結果顯示，透過規劃程序會找到高於最低額定容量之最適額定容量，而建置最低額定容量將會導致更昂貴的總投資成本。

Abstract

In this paper we propose an optimal capacity determination procedure for energy storage systems, based on a lifetime estimation of lithium iron phosphate battery. To obtain the most appropriate capacity and avoid excessive investment, we need to optimize two objective functions: (1) to calculate the minimum capacity for a required energy storage system, and (2) to calculate the optimal capacity meeting the requirements of minimum investment. The major findings of our simulations from two base load power plant dispatch cases are (1) the optimal capacity could be found through the planning process, and (2) the minimum capacity installation would lead to higher overall costs.

關鍵詞 (Key Words)：儲能系統(Energy Storage System)、電池壽命估測(Battery Lifetime Estimation)、最適額定容量(Optimal Nominal Capacity)、規劃程序(Planning Process)。

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雲端資料中心建置之規劃研究

Cloud Data Center Construction Design and Research

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摘 要

本案研究國內外資料中心之關鍵成功因子，並結合台電台中液化天然氣接收站冷能回收利用及蒸發氣供固態燃料電池產生低碳電力之優勢，透過冷能回收取代冰水主機之空調架構及自主低碳電力取代市電之電力架構，打造全球第一座使用冷能回收加自主低碳電力並取得高可靠 TIA-942 Rated 3 認證與高能源效率美國綠建築白金級認證之雲端資料中心。經本團隊使用能源模擬軟體驗證後，台電雲端資料中心機房能源使用效率小於 1.25，優於國內機房能源使用效率平均值 2.0。本研究案利用冷能回收優勢創造亞熱帶地區之綠色奇蹟，打造出國內最優質雲端資料中心。

針對營運階段，本研究歸納具世界競爭力雲端資料中心之營運標準，藉由持續厚植台電高可靠、高能源使用效率及機房管理之技術能量，打造具世界競爭力之雲端資料中心。

Abstract

By exploring the key success factors of domestic and foreign cloud data centers and evaluate the advantages of the following two applications, namely (1) cold energy recovery in Taichung LNG receiving terminal, and (2) low emission power generated by boiled off gas with solid oxide fuel cells, this study aims to construct the world's first cloud data center, certified by the TIA-942 Rated 3 (standing for highly reliable), and the LEED Platinum (standing for high energy efficiency), by replacing the existing chillers and the grid power with a cold energy recovery system and on site low carbon emission generation. The PUE of the cloud data center verified by eQuest is less than 1.25, superior to a national average of 2.0. By taking advantages of the cold energy recovery technology, we have built up a high quality cloud data center and a green miracle in subtropical region. Entering a new stage, Taiwan Power Company (TPC) will keep on operating a world class cloud data center with the shared worldwide information of this study.

關鍵詞 (Key Words)：液化天然氣(Liquefied Natural Gas, LNG)、冷能回收(Cold Energy Recovery)、固態氧化物燃料電池(Solid Oxide Fuel Cell, SOFC)、低碳電力(Low Emission Power)、能源使用效率(Power Usage Effectiveness, PUE)、能源模擬程式(the Quick Energy Simulation Tool, eQuest)。

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電業用戶服務策略研究

A Study on Electric Utilities' Customer Service Strategies

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摘 要

在電業改革進程中，台電公司將由綜合電業轉型為公用售電業並負擔供電義務，且售電費率受電價費率審議會管制，在完全競爭市場中，價格競爭策略運用空間有限。為了提升台電公司的市場競爭力，本文蒐集 7 個國家、11 個電業案例，歸納 15 項用戶服務策略。依據國外電業提供情形、用戶付費與否，大致可將服務策略分為三大類，分別為基礎性服務、進階性服務與選擇性服務。本文透過國外文獻蒐集研提台電公司用戶服務策略，俾利未來面對其他售電業者之競爭時，台電公司能更提升服務品質與內涵，培養用戶忠誠度，留住客戶提升公司營收。

Abstract

Along the process of Electricity Market Reform (EMR), Taiwan Power Company (TPC) has to transform from a vertically integrated utility into a Licensee of Public Utility Retailer (公用售電業)- responsible for the obligation of power supply and its tariffs will remain regulated by the Electricity Price Review Committee (電價費率審議會). In a perfect-competition market, the room for strategic price competition is quite limited. To enhance TPC's market competitiveness, fifteen strategies regarding customer services, selected from seven foreign countries' eleven electric utility cases, have been collected and divided into three categories (based on the situations of service provision and whether they are free or chargeable), namely (1) basic services (free of charge), (2) advanced services (chargeable), and (3) optional services (it depends). The results of this study can not only help TPC enhance service quality, customer satisfaction, and customer loyalty, but also help retain the company's customers and revenues in the face of fierce market competition.

關鍵詞 (Key Words)：電業自由化(Electricity Deregulation)、公用售電業(Public Retail Electric Provider)、用戶服務策略 (Customer Service Strategies)。

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引進民間經營綠能博物館之分析研究案

Analysis of the Introduction of Private Business on Green Museum

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摘 要

為了宣導、推廣能源之重要性，增加民眾對能源及綠色議題之認知，在 2017 年 12 月，臺中市政府向台電公司爭取建造綠能博物館，基地選址於臺中市清水區梧棲觀光漁港北側。本研究案為針對綠能博物館進行相關可行性分析及研擬場館規劃方案，期望串聯臺中海洋生態館、濱海自行車道、高美濕地等周邊特色景點，並引進民間經營創意與效率，共同打造一座符合綠能精神的展示館，形塑優質旅遊地區，帶動海線觀光旅遊產業。在打破社會對能源負面看法的同時，也讓大眾了解台電公司投入綠能的努力。

Abstract

December 2017, Taichung City Government petitioned on Taipower's behalf to build a green museum in the north of Wuqi Fishing Harbor to promote the importance and public awareness of green energy. This paper aims to introduce the feasibility analysis and planning framework of the museum stadium, which include (1) the under-planning museum will connect surrounding attractions such as the Taichung Marine Ecology Museum, the Coastal Bicycle Lane and the Gaomei Wetland, (2) bring in the creativity and efficiency of private business management, (3) the exhibition hall of the museum stadium will be in line with the spirit of green energy and beneficial for local tourism, and (4) let the public see the efforts of Taipower.

關鍵詞 (Key Words)：綠色能源 (Green Energy)、民間經營(Private Business)、海線觀光(Sea Line Sightseeing)、可行性分析(Feasibility Analysis)、主題樂園(Theme Park)。

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回頁首

106 年台灣地區家用電器普及率調查

The Investigation of Year 2017 Penetration Rate of Household Electrical Appliances in Taiwan

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摘 要

近年來，由於社會、經濟等大環境改變，家電業者提升電器之效能，並推出許多新興家電，再加上民眾對於節電意識的提升，使得家用電器用電量有所變化，對表燈用戶的用電影響實為值得關注的議題。本研究透過多元調查方式(電話調查、面訪調查、網路調查)瞭解台澎金馬地區家用電器普及率，俾供用電消費分析及政府相關節能政策制定參考之依據。

本研究有效樣本數共計 8,177 份，包含表燈營業 1,084 份與表燈非營業 7,093 份(電訪調查 5,090 份、網路調查 2,003 份)。研究結果顯示，表燈用戶與營業用戶以電風扇普及率最高，分別為 95.4%與 85.3%；非營業用戶以電冰箱(99.5%)普及率最高。不同營業區電器普及率部份，電暖器與除濕機北部地區普及率較高；太陽能熱水器、電捲門與電鍋/電子鍋南部地區普及率高。

Abstract

In recent years, the electricity consumption patterns of household electrical appliances have shown a trend of changes, the results of evolving social and economic environments, improving efficiency of electrical appliances, public awareness of the importance of energy conservation, etc. How this phenomenon will evolve in the future is an issue worth attention. In view of these, this study aims to investigate the penetration rates of household appliances in the territory of Taiwan, Penghu, Kinmen and Matsu (TPKM) to serve as a reference for government policy. There are a total of 8,177 valid samples from the surveys (phone, interview and online. Among them, 1,084 are from TPC's commercial customers and 7,093 non-commercial customers (5,090 from telephone surveys and 2,003 from online surveys). The main results of our study are as follows: (1) electric fans have the highest penetration rates for the user categories of Meter Rate Lighting Service (95.4%) and the Commercial (85.3%), (2) refrigerators have the highest penetration rate for the user category of Non-Commercial (99.5%), (3) due to geographical characteristic difference, the penetration rates of electric heaters and dehumidifiers in the north are higher than those in the south, (4) the penetration rates of solar water heaters, electric roll doors and electric/electronic pans in the south are higher than those in the north.

關鍵詞 (Key Words)：家用電器(Household Electrical Appliances)、普及率(Penetration Rate) 擁有者平均台數(Average Number of Owners)。

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系統健康度指標在台電公司核能電廠之應用

Application of System Health Index in Taipower Nuclear Power Plants

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摘　要

第一核能發電廠於 104 年開始「系統健康度指標」(SHI)相關作業，本廠原本並未設置有效之機制以監測重要系統之系統健康的弱點，往往僅以事後之檢討來擬定改善措施與防範再發生類似事件，此作法屬於落後(Lagging)指標，無法事先預防設備可靠度降低及避免發電損失。參考 EPRI TR 107434 System Monitoring by System Engineers 系統監測計畫範本，以量化趨勢監測的方式，提前偵知設備劣化的現象，此作法屬於領先(Leading)指標，並參考美國電廠作法及本公司管控機制等，綜合評估後的「系統健康度指標」計分表(Scorecard)，建立並且納入本廠程序書，本指標精神與美國之先進作法接軌，符合世界核能發電協會(WANO)最高標準要求，有助於增進本公司核能電廠之設備可靠度績效。

Abstract

System Health Indicators (SHI) and its relevant operations was firstly adopted by Chinshan Nuclear Power Plant (CNPP) in 2015, but CNPP did not have an effective mechanism to monitor the health weaknesses of the plant's important systems at that time. Improvement measures were more often developed based on after-the-event reviews, lagging indicators unable to prevent/avoid decrease of equipment reliability and power loss. By referring to EPRI TR 107434 System Monitoring by System Engineers and management & control measures (管控機制) of the company (Taipower), an innovative method with comprehensive evaluation of the SHI scorecard (enable CNPP to detect equipment deterioration in advance, by quantifying the monitoring trend) has been applied and incorporated into the CNPP procedures. This latter (an leading indicator, not only in line with the advanced practices of the USA, but also in parallel to the standards of the World Association of Nuclear Operators (WANO)) will definitely add values to Taipower's NPP reliability performance.

關鍵詞 (Key Words)：第一核能發電廠(Chinshan Nuclear Power Plant)、系統健康度指標(System Health Index)、落後(Lagging)、領先(Leading)、計分表(Scorecard)。

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機器人於核電廠之應用與關鍵技術

Application and Key Technologies of Robot in Nuclear Power Plants

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摘　要

輻射對人體是有害的，然而人類對能源的需求又不得不依靠核能發電來滿足。隨著核電廠的發展和大眾對核能安全的重視，利用機器人代替人在核環境中工作，以減少核電廠現場工作人員的輻射劑量，解決了人員無法直接操作核電廠設施衝突的關鍵，已成為世界各國的共識。本文介紹了機器人在核電廠中的研究和應用，包括正常情況下的日常監測、設備維護和福島事故的緊急救援等，並分析了核電廠用機器人的關鍵技術。

Abstract

Nuclear radiation is harmful to human health, but dispensable for human energy needs. Accompanied with increasing public attention to nuclear safety, replacing manpower in nuclear power plants (NPPs) with robots in order to reduce the operators' radiation dose has become a worldwide consensus. In this paper we would like to introduce the researches and applications of robots in NPPs, covering daily monitoring and equipment maintenances under normal conditions, the emergency rescues in the Fukushima Daiichi accident, and our analyses on key robot technologies.

關鍵詞 (Key Words)：機器人(Robot)、核能電廠(Nuclear Power Plant)、輻射防護(Radioprotection)。

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回頁首

土壤輻射量測系統製作

The Implementation of Soil Radiation Measurement System

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摘 要

本文說明一套包含軟體及硬體之土壤輻射量測系統之製作，該量測系統係以兩根 4 吋x4 吋x16 吋的碘化鈉偵檢器進行土壤之輻射量測，並透過適當的演算法來計算土壤中 ^{137}Cs 的活度及比活度。此土壤輻射量測系統除了性能良好之外，其人機介面亦很友善，操作容易，有利於系統進行線上運轉。

Abstract

In this paper, we would like to describe the process of implementing a soil radiation measurement system including the software and hardware in need. We used two 4”×4”×16” sodium iodide detectors to measure the soil radiation, and picked out an appropriate algorithm to calculate the activity and specific activity of ^{137}Cs in the soil. The characteristics of the aforesaid soil radiation measurement system include (1) good performance, (2) friendly human-machine interface, (3) easy to operate, and (4) apt for online operation.

關鍵詞 (Key Words)：碘化鈉偵檢器(NaI Detector)、活度(Radioactivity)。

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