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應用物聯網技術之配電電桿即時狀態智慧監測系統

Real-time Status Smart Monitoring System for Distribution Poles Using Internet of Things
Technology

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摘要

配電系統龐大又繁雜，全台共有 314 萬根電桿、142 萬具變壓器、1 萬條饋線、24 萬處配電場室，在電力系統中扮演相當重要的角色。而數量最多的電桿，遍布全台灣地區，為重要民生基礎設施，若發生異常災害，對於終端用戶的影響首當其衝，因此對於電桿的維護與管理更是重要且急迫的議題。基於半導體製程突破，資通訊技術蓬勃發展，使得感測設備成本下降與無線通訊網路傳輸速率大增，應用物聯網技術實踐智慧電網更加容易。因此本研究基於物聯網技術開發一套「電桿即時狀態智慧監測系統」，以精進電桿維護管理為目標，對於電桿設備導入智慧化系統，即時監測電桿傾斜與震動狀態，並應用無線射頻網路與 NB-IoT 兩種傳輸模式測試通訊的可行性，並加以評估感測設備建置成本，並開發電桿狀態即時監測平台，以圖像化界面開發網頁平台，提供現場單位監管設備使用，以期可使台電維運單位可更便利且更有效率，即時掌握電桿設備狀態，併更進一步提升電力系統穩定性與可靠度。

Abstract

The power distribution system is a vast and complicated network. There are about 3.14 million electric poles, 1.42 million transformers, 10,000 feeders, and 240,000 power distribution rooms in Taiwan, which play a very important role in the power system. Among them, the largest number is the electric pole, which spreads all over Taiwan and is an important infrastructure for people's livelihood. If an abnormal disaster occurs, the end users will be the first to be affected. Therefore, the maintenance and management of electric poles is an important and urgent issue. Based on the breakthrough of semiconductor manufacturing process, the vigorous development of information and communication technology has reduced the cost of sensing equipment and greatly increased the

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transmission rate of wireless communication networks. It is much easier to apply Internet of Things (IoT) technology to practice smart grid today. Therefore, this research develops a “Smart Pole Real-time Status Monitoring System” based on IoT technology, with the goal of improving the maintenance and management of electric poles to introduce a smart system to monitor the tilt and vibration status of electric poles in real time, and apply two wireless transmission modes (the radio frequency network and NB-IoT) to test the feasibility of communication and evaluate the construction costs of sensing equipment. At the same time, a real-time monitoring platform for pole status with a graphical interface to provide on-site supervision is developed. It is hoped that Taipower’s maintenance and operation units will thus be more convenient and efficient, the status of the poles will be grasped in real time, and the stability and reliability of power system will be further improved.

關鍵詞 (Key Words) : 智慧電桿 (Smart Electric Pole) 、無線監測技術 (Wireless Sensing Technology) 、物聯網 (Internet of Things) 、數據分析 (Data Analysis) 、智慧巡檢 (Smart Inspection) 。

電費催收管理系統與用戶信用評比資料庫研究

Research on Electricity Bill Collection Management System and User Credit Rating Database

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摘 要

因應大數據世代來臨，台電公司擬使用電子化方式留存各項催收紀錄，並記錄用戶繳費情況，建置繳費信用評比資料庫，俾利未來大數據之應用，提升未來電業自由化後之競爭力，同時優化用戶服務品質，符合外界期許，塑造公司優良企業形象。

本研究案規劃了取消現行綠單預先列印和現場收費的作業流程，並利用從電費帳務管理系統接收的新離線欠費檔的進行欠費資料的處理與催收、終契等資料的產製，再結合與其他系統的服務介接，完成了電費催收管理系統(BDMS)的建置，可於現場使用行動裝置操作系統，所提供的作業功能將有效提升電費欠費催收作業的效率。本研究案同時也設計了欠費用戶信用評比指標與評分方式，建置完成的信用評比資料庫中的有欠費用戶定期信用評比分級結果，可應用於欠費催收處理作業中瞭解個別用戶過去表現情形，以及未來對全部用戶服務的優化和差異化服務。

Abstract

In response to the advent of big data, Taipower intends to use electronic methods to keep its electricity bill collection records and customer payment status; next, to build a payment credit evaluation database to facilitate the application of big data in the future so as to enhance the company's competitiveness in a liberalized electricity market; what's more, to optimize the company's customer services to meet public expectation and create good corporate image. To revoke the current workflow of pre-printing and on-site charging, we plan to develop a new Billing Debt Management System (BDMS), which uses offline arrears files received from the company's Billing Account System(BAS) to process the arrears data and produce contract termination data, etc. The new system can be used on-site as a mobile operating device, which is helpful to improve the efficiency of the company's electricity bill collection operations. At the same time, this project develops credit evaluation indicators and rating methods for arrears users. The grading results of arrears users in the completed credit evaluation database can be applied to arrears collection

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processing operations to understand the past performance of individual users, as well as the optimized and differentiated services for all users in the coming future.

關鍵詞(Key Words)：流程精進(Process Optimization)、信用評比(Credit Scoring Database)、欠費催收(Debt Colleciton)、行動裝置(Mobile Device)、電費催收管理系統(Billing Debt Management System)。

電源整合規劃因應高占比間歇性再生能源的變革

Revolution of Integrated Resource Planning Coping with High Penetration Intermittent Renewable Energy Resources

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摘要

電源整合規劃(Integrated Resource Planning, IRP)是由長期電源規劃衍變而來，長久以來，為了滿足電力供需平衡的安全穩定運轉，電業必須進行發電、售電及輸配電系統的長期規劃。近年來，因採用具大量間歇性再生能源，受其發電量不確定性之影響，迫使在 IRP 評估時須增加不確定性因素，而大大提高了各種長期規劃的挑戰性。尤其在再生能源占比高的歐美電力市場，十多年來，已相繼提出許多因應措施以緩解再生能源對電源整合規劃所造成之衝擊，本論文之宗旨在專注說明電源整合規劃的變革與釐清謬誤；說明廣泛受用的 IRP 準則、機制與程序；研析因應大量再生能源電源整合規劃之精進做法。同時在國內外綠能政策及環保意識日益高漲的趨勢下，也探討電源整合規劃必須包括的能源政策、民生經濟議題，電源組合的經濟效益、以及人民對電力品質和合理電價等訴求，才可符合未來電力服務的需求。

Abstract

Integrated Resource Planning (IRP) is derived from long-term power resource planning. For a long time, to maintain demand and supply in balance so as to ensure security, reliability and stability of power system operation, Power companies have to carry out long-term planning to coordinate its generation, electricity sales, and transmission & distribution (T&D) operations. In recent years, due to the interconnection of a large amount of intermittent renewable energy (RE), the need to evaluate uncertainty in the IRP processes increases significantly. In Europe and North America where RE accounts for a high proportion, many countermeasures have been put forward for the last 10 years to alleviate the impact of RE on IRP. The purpose of this research focuses on explaining the revolution of IRP and clarifying the fallacies; explaining the widely used IRP guidelines, mechanisms and procedures; and analyzing the refined IRP practices in response to high penetration RE scenarios. In addition, with the increasing awareness of green energy policies and environmental protection here and abroad, it is necessary for IRP to address topics such as energy policy, people's demand for cleaner energy at a reasonable price, livelihood and overall economic issues, economic benefits of generation mix, so as to meet the needs to access safe, reliable and high quality electric services.

關鍵詞(Key Words): 電源整合規劃(Integrated Resource Planning, IRP)、備轉容量(Operating Reserve Capacity)、備用容量(Reserve Capacity)、無法供電機率(Lost of Load Probability, LOLP)、電源有效承載能力(Effective Load Carrying Capacity, ELCC)、容量擴充模型(Capacity Expansion Model, CEM)、生產成本模型(Production Cost Model, PCM)。

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建構公用售電業整合行銷策略與商業模式研究

Integrated Marketing Strategy and Business Model for a Public Utility Licensee Engaging in Electricity Retailing Business

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摘要

盱衡國外售電市場開放經驗，既有綜合電業或售電業均面臨用戶及售電量流失困境。因此，台電公司業務處行銷部門為因應 106 年 1 月 26 日公布施行之《電業法》可能帶來公用售電業之不良衝擊，近年來已積極針對如何強化產品開發、提升用戶服務品質及行銷策略進行研究，期許滿足用戶需求，維繫客戶忠誠度，進而增加營收。本文主要探討建構公用售電業整合行銷策略與商業模式研究，藉以達成優化用電申請作業流程、提升經營利基，以及強化市場競爭力三大目標。最後，透過檢視台電公司目前行銷業務執行現況，分析與規劃短中長期公用售電業最適行銷組織架構與功能，以因應可能二次修法開放售電市場競爭與數位科技之發展趨勢。

Abstract

Based on the experience of opening up electricity retail markets in foreign countries, the incumbent electric utilities, e.g., integrated electric utilities or retailers, will face the dilemma of losing customers and electricity sales. In response to the adverse impacts that the Electricity Act promulgated for implementation on January 26, 2017, the Marketing Department of Taiwan Power Company has been actively focusing on strengthening product development, improving service quality and marketing strategies to achieve the goals of meeting customer needs, maintaining customer loyalty and increasing revenue. This article focuses on how to construct integrated marketing strategies and business models for a public utility licensee engaging in electricity retailing business, so as to achieve the three goals of optimizing the application process of electricity, improving the business operating niche, and strengthening the market competitiveness. Finally, through reviewing the company's current marketing business implementation status, we analyze and plan the most suitable marketing organizational structure and functions for the said public utility licensee in the short, medium and long term, in order to cope with the trends after the next stage amendment of the Electricity Act-open electricity retail market competition and the advent of digital technology.

關鍵詞(Key Words)： 整合行銷策略(Integrated Marketing Strategy)、商業模式(Business Model)、行銷專責組織(Marketing-specialized Organization)。

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國際間低放射性廢粒狀樹脂處理方法及真空乾燥法 技術研究

Research on International Low-level Spent Radioactive Resins Treating Methods & Thermo-
vacuum Drying Technology

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摘要

國際間廢粒狀離子交換樹脂(廢粒狀樹脂)處理方法包含：固化法、氧化分解法、脫水乾燥法等。其中真空乾燥法為深具應用潛力的處理技術，非但沒有二次廢棄物之產生，且操作簡單、技術成熟，又有減容效果。根據美國核管會(NRC)之技術立場，廢粒狀樹脂之累積輻射吸收劑量低於 10^8 雷得(Rads)，不會影響核電廠或處置場的營運安全。目前核能電廠暫存之廢粒狀樹脂屬 A 類放射性廢棄物逾9成以上，若乾燥後以高性能混凝土容器(HPCC)盛裝已能處理大部分樹脂，且能符合安定化標準。

本研究以真空乾燥法降低廢粒狀樹脂之含水率及體積，並盛裝於 HPCC 以達長期貯存或處置之標準。由於廢粒狀樹脂在低含水率時內部結合水較難蒸發出來，因此真空乾燥流程採漸進式提高熱源溫度及降低乾燥槽壓力(提高真空度)。浸泡氯化鈷水溶液之模擬用過粒狀樹脂在經6小時真空乾燥後，含水率皆能降低至10%以下。而將模擬用過粒狀樹脂貯存於 HPCC 存放一年期間，皆無內部蓄壓狀況，而含水率亦無明顯上升趨勢。

Abstract

At present, the methods for treating spent radioactive resins around the world include: solidification, oxidative decomposition, dehydration drying, etc. Among them, thermo-vacuum drying is a treatment technology with great application potential. Not only does it not generate secondary waste, but it is also simple to operate, mature in technology, and has a volume reduction effect. According to the technical position of the US Nuclear Regulatory Commission (NRC), when the cumulative radiation absorbed dose of spent ion-exchange resins (IERs) is lower than 10^8 Rads, it will not affect the operational safety of nuclear power plants or disposal sites. At present, more than 90% of the spent IERs temporarily stored in nuclear power plants are Class A radioactive waste. Most of the resins can be dried and packed in a high-performance concrete container (HPCC) and meet the stabilization standards.

In this study, the moisture content and volume of spent radioactive resins were reduced by vacuum drying, and packed in HPCC to meet the long-term storage or disposal standards. Since the

internal bound water of the spent radioactive resins is difficult to evaporate when the water content is low, the thermo-vacuum drying process gradually increases the temperature of the heat source and reduces the pressure of the drying tank (increasing the vacuum degree). The moisture content of simulated resins soaked in cobalt chloride aqueous solution can be reduced to below 10% after thermal-vacuum drying for 6 hours. When the simulated resins are stored in HPCC for one year, there is no internal pressure accumulation, and the moisture content has no obvious upward trend.

關鍵詞(Key Words)：低放射性廢棄物(Low-level Waste, LLW)、離子交換樹脂(Ion-exchange Resin)、真空乾燥(Thermo-vacuum Drying)、高性能混凝土容器(High Performance Concrete Containers, HPCC)。

除役核電廠部分廠址外釋之管制與執行實務初探

A Preliminary Study on the Regulations and Implementation Practices of Partial Site Release for the Decommissioning of Nuclear Power Plants

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摘要

部分廠址外釋為除役核電廠執照終止前的一個選項，在確保公眾健康與安全的原則之下，經由申請及審查管制程序，可先行外釋部分廠址供無限制使用，藉此達到活化土地資產、保護環境生態及確保人民財產自由之目的。目前為止，美國已有許多核電廠完成部分廠址外釋的案例，且管制機關也已制訂完善的法源規範及標準審查計畫與指引。鑒於國內過去並未曾有過部分廠址外釋的經驗，未來在 25 年的除役期間可能會有相關的需求，除了設施經營者應瞭解部分廠址外釋的做法與要求之外，管制機關也應強化法源基礎與管制缺口。本文由管制面向探討美國除役核電廠部分廠址外釋的法規架構、管制程序、審查方針以及劑量評估審查指引等，並由執行實務面向瞭解部分廠址外釋之特性偵檢、執照文件變更請求、劑量評估方法等，藉此掌握除役核電廠部分廠址外釋的管制要點與具體做法。

Abstract

Partial site release is an option prior to the approval of license termination for decommissioning nuclear power plants (NPPs). Under the principle of ensuring public health and safety, through application and regulatory review procedures, part of the plant site can be released first for unrestricted use, so as to achieve the purpose of activating land assets, protecting environment and ecology, and ensuring people's freedom of property. So far, there have been many NPPs in the United States that have completed partial site release, and the regulatory agency has also formulated comprehensive regulations and standards to review and guide the related plans. In view of the fact that there has been no experience in the release of NPP site in Taiwan, there may be related needs during the 25-year decommissioning period in the future. In addition to the fact that facility operators should understand the practices and requirements of partial site releases, regulatory agencies should also strengthen the legal basis and make up regulatory gaps. This article discusses the regulatory framework and procedures, review guidelines for NPP partial site release in the United States from a regulatory perspective, such as characterization survey, request of license amendment program, dose modeling approach, so as to grasp the main points and practices of partial site release for the decommissioning of NPPs.

關鍵詞(Key Words)：核電廠除役 (Decommissioning of Nuclear Power Plants)、部分廠址外釋 (Partial Site Release)、多機構輻射偵檢與現場調查手冊 (Multi-Agency Radiation Survey and Site Investigation Manual, MARSSIM)、最終狀態偵檢 (Final Status Survey)、導出濃度指引水平 (Derived Concentration Guideline Level, DCGL)。

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