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風力發電機鹽害污損葉片雷擊試驗之研究

Study of Lightning Strike Test on ESDD Defaced Wind Turbine Blade

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摘要

本研究旨在透過風力發電機葉片之閃絡電壓、接地線之落雷電流及雷擊能量等三項指標，估測葉片鹽害沉積污損。首先，依據 IEC 60507(2013)標準，將五種不同類型的等效鹽沉積密度(Equivalent Salt Deposit Density, ESDD)模擬為風力發電機葉片的鹽害污損。再者，參考 IEC 60061-1(1989)標準之升降法(Up and Down Method)，求取每類型鹽害污損葉片之 50%閃絡電壓(50% Flashover Voltage, FOV)。每一次完成雷擊衝擊電壓試驗同時，由高頻比流器(High-Frequency Current Transformer, HFCT)量測出接地線之落雷電流波形。由於所測落雷電流波形屬於非週期性訊號，本文採用功率頻譜密度(Power Spectral Density, PSD)方法，計算各種鹽害污損狀況下落雷電流之雷擊能量。最後，實驗結果證明，本文所提的方法能夠在風力發電機靜止狀態下有效與準確的求取葉片鹽害污損程度。

Abstract

This study is designed to propose an approach for monitoring the impact of the lightning strike on those wind turbine blades with salt contamination. First, based on IEC 60507(2013) standards, five different classes of equivalent salt deposit density are simulated in terms of salt contamination on wind turbine blades. Second, in accordance with the IEC 60061-1 standards, the lightning strike signals of the salt contamination of wind turbine blade can be measured by the high frequency current transformer in the laboratory. The up-and-down method for determination of the 50% flashover voltage was applied to lightning strike. The lightning energy is calculated by using the power spectral density. Finally, experimental results validate that the proposed approach can determine the extent of equivalent salt deposit through occurrence of lightning strike.

關鍵詞(Key Words)：鹽害污損(Salt Contamination)、雷擊衝擊電壓(Lightning Impulse Voltage)、高頻比流器(High Frequency Current Transformer)、功率頻譜密度(Power Spectral Density)、等效鹽沉積密度(Equivalent Salt Deposit Density)。

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1070206 花蓮地震緊急應變處置經驗分享

Experience Sharing of Emergency Response Intervention of Hualien Earthquake on February 6, 2018

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摘要

1070206花蓮地震除造成部分建築物倒塌、橋墩變形、道路龜裂及多人傷亡等災情，本處轄區變電所及連接站設備亦遭受損壞，所幸短時間內迅速完成階段性復舊工作。此次地震造成地下電纜及管路受損，依供電單位過去的經驗看來，地下輸電管線於斷層帶受地震損壞此為首例，除採取緊急階段性補強措施，並對於輸電管路、人孔及其地下電纜機電設備檢點及評估外，亦召開專家小組會議凝聚共識並研擬具體方案，加速後續補強及修復任務，以降低施工時供電事故風險，確保系統穩定供電。倘未來新設地下電纜線路位置無法避開斷層帶，其設計階段可考慮採用抗震裕度(蛇行段佈設)克服，以降低地震受損程度；日後如遇到類似地震災損，在研擬對策時可減少摸索時間，立即反應緊急應變處置，以防止事故擴大。

Abstract

On February 6, 2018, a strong earthquake hit Hualien Area, causing serious damages to this area and resulting in the collapse of some buildings, deformation of the bridge piers, cracks of roads, injuries and deaths of some people. In addition, even electric substations and electric connection stations of Taipower there were also damaged. Fortunately, a rehabilitation work had been successfully completed within a short time. This earthquake had damaged a lot of the underground electric cables and pipelines. Based on the experience of electricity supply, this is the first time that the underground power transmission pipelines located within a fault zone have been damaged by an earthquake in Taipower system. In addition to adoption of the reinforcement measures, the inspection and evaluation of power transmission pipelines manholes, its underground cables and electromechanical equipment, an emergency panel meeting has also been held to build consensus among rehabilitation working members about how to formulate an effective response program. The purpose of those efforts is to accelerate the subsequent restoration tasks after a quake, thereby reducing the risk of expanding the extent of power failures and maintaining the stable power supply of the system during the rehabilitation process. The experience this time indicates that although some underground electric cable lines may still be laid within a fault zone in the future, an adequate seismic safety margin (layout of snake-like section) can be adopted to deal with these problems and therefore to reduce the degree of damages caused by an earthquake. It is hoped that in case of the similar earthquake that may happen in the future, the groping time for reconstruction work can be reduced using effective countermeasures to take immediate response to prevent damage expansion.

關鍵詞(Key Words)：災害統計(Damage Statistics)、輸電地下電纜(Underground Transmission Cable)、地震(Earthquake)、管路(Pipeline)、PCV 被覆層損傷(PVC Jacket Damaged)。

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簡易電力交易平台運算核心軟體評估

Evaluation of Operating Core Software Applied to a Simplified Power Market Exchange Platform

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摘要

本文目的是為台灣電力公司（以下簡稱台電公司）評估未來在台灣電力市場環境下使用商業應用軟體進行電力市場操作之可行性。首先比較幾項國外常用於電力市場交易之商業軟體，針對其功能性、靈活性、與成本等表現評比，推薦一項適合台灣目前和未來電力市場環境之應用軟體，並簡介幾項此軟體符合台電公司需求的重點功能。執行面上，本文提出使用該軟體執行電力市場最佳化的時序流程，在擬訂一個電力市場數據整合框架後，接著依據台電公司電力系統的實際營運狀況進行軟體建模及功能的評估與測試，包含火力機組、抽蓄水力機組、民營電廠機組、需量反應、以及大甲溪串流式水力模型。另外，為了實現具有電網安全限制之機組排程，本研究嘗試利用既有的台電公司PSS/E電網模型匯入至此軟體，加以調整與修正，以實現其功能。最後，藉由分析案例測試的結果驗證建構模型的可信度，並且提供預期可降低軟體模擬執行時間的方法，以提供台電公司作為參考。

Abstract

The purpose of this project is to evaluate the feasibility of making use of a commercial application software at the Taiwan Power Company (i.e. TaiPower) for Taiwan's future electricity power market. The project first assesses and compares the most popular commercial application software currently being used in the other electricity markets by evaluating its functionality, flexibility, applicability and costs. It is hoped that the most suitable software solution can be selected and recommended to be implemented in order to meet Taiwan's current and future power market needs. During the implementation, the project selects a chronological production cost model to optimize the energy resource scheduling for Taiwan Power Company (Taipower). After developing an integrated data process for testing the software application, the Taipower system and the actual operating conditions are modeled and simulated to evaluate the software's functions and operational capabilities. Key operating variables contained in the modeling includes: thermal units, Da-Chiahsi cascade hydro units, pump-storage generating facilities, and independent power producers' dispatchable generation as well as demand response resources. In order to meet the transmission system reliability standards, the research team carries out an "import process" to incorporate Taipower's existing transmission model (PSS/E grid model) for power flow analysis into the system scheduling optimization. Finally, the implemented model is calibrated by a series of test case analyses and is compared with the actual generation scheduling in the hourly basis. At the end, the methods for improving the execution time of the software simulation are evaluated and provided as a reference for performing Taipower system simulation.

關鍵詞(Key Words): 機組排程(Unit Commitment)、電力交易平台(Power Market Exchange Platform)。

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**德瀚資訊有限公司顧問

***台灣電力公司電力調度處

北美電業機構對電力調度運轉機制之研析

Study on Power Dispatching Rules of System Operator in North America

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摘要

人們對於全球暖化與降低對石化燃料的需求促進了再生能源的大量發展，然而再生能源的間歇與不穩定特性使得傳統的電力系統日亦複雜以及增加電業機構對於電力調度上的困難，並造成系統可靠度降低，而台灣近年面臨傳統機組退役與再生能源的發展快速增加，如何提高電力系統於調度上的彈性以及系統的強健性便顯得相當重要，由於北美地區對於再生能源以及電力市場有著多年的發展經驗，可供我國在調度相關制度上之參考。本文針對 ERCOT、CAISO、PJM 等三個北美主要的電業機構於系統調度上最常使用的輔助服務進行探討，並特別著重於調頻輔助服務、熱機輔助服務以及冷機輔助服務的相關制定規則與採購量的決定，這些研究成果可供我國未來發展相關調度規則的重要參考。

Abstract

With the rising concern over the issue of global warming and need for reducing carbon emissions, developing renewable energy seems to be considered a favorable solution in this regard. The government is planning to substantially increase the share of renewable energy generation in the power system while making an effort to accelerate the decommission of the aged thermal power units. With rapidly growing penetration of renewable energy, it is important to improve the dispatching flexibility and robustness of the existing power system operation. In the past, the electricity markets and renewable energy developed in North America have been running for many years so that the operating experiences there can serve as a good reference for formulating operation rules of the power dispatching in Taiwan. This paper is intended to analyze and discuss the ancillary services market operating rules in regard with regulatory governance, spinning and non-spinning reserve service of the three independent system operators in North America: Electric Reliability Council of Texas (ERCOT), California Independent System Operator (CAISO), PJM Interconnection (PJM). The study results offer an important reference for development of operation and dispatching rules of the power system in Taiwan.

關鍵詞(Key Words): 備用容量(Reserve Margin)、備轉容量(Operating Reserve)、輔助服務(Ancillary Services)、電力市場 (Electricity Market)。

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排除廢熱提升發電效率

Improving Efficiency of Power Generation through Removing Waste Heat

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摘要

本研究引介兩種藉由輻射散熱提升發電效率的方法：第一是利用特殊材料提供藉由熱轉換機械能的發電系統的散熱方法；第二是利用奈米顆粒提供分頻利用太陽光源的方法。本文並藉由細菌光合作用系統提供分頻奈米顆粒的具體解決方法。

Abstract

To boost the efficiency of various power generation methods, this paper proposes two methods of removing waste heat through radiation: firstly, special materials are used to improve the effectiveness of heat radiation for those power plants which generate electricity by transforming heat into mechanical energy; secondly, a frequency-separation method to increase the efficiency of solar cells using nano-particles is introduced. We also propose the best nanoparticle shape through lessons we learnt from light harvesting photosynthetic bacteria.

關鍵詞(Key Words)：太陽能電池 (Solar Cell)、奈米天線 (Nanoantenna)、散熱(Heat Dissipation)。

我國低壓 AMI 推動策略－模組化電表及通訊測試平台

The Promotion Strategy of Low-Voltage AMI in Taiwan –
Modular Meter Design and Communication Evaluation Platform

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摘要

我國 103 年已推動高壓 2.4 萬戶、低壓 1 萬戶智慧電表(AMI)建置。因通訊技術演進日新月異且低壓 AMI 之通訊技術、介面標準等都尚未統一，故研擬模組化智慧電表推動策略。有利於我國大規模 AMI 推動之通訊選用彈性。因此，規劃一系列通訊測試平台，以利廠商技術驗證。

本研究蒐集國際智慧電表推動採用之策略(含規範與架構)，並考量我國AMI推動經驗、國家標準及廠商建議等。以綜合考量AMI功能需求及電表設計策略，確保未來AMI長期推動具體可行。而國際AMI通訊技術眾多，為客觀瞭解各種技術基於台灣建築環境之適用性，故規劃一系列測試平台，以驗證各廠商之通訊技術於台灣環境的適應性。同時，為考量AMI大規模推動之配套議題，更協助爭取專用頻段及檢討電表檢校規費與年限等議題。因此，本研究旨在規劃我國長期AMI推動之發展策略及環境塑造。

Abstract

As of 2014, a total of 24,000 high-voltage meters and 10,000 low-voltage smart meters had been deployed across the country. Due to rapid advance in AMI communication technology and lack of common protocol in recent years, it is believed that a better solution to modular smart meters is to keep flexible and adoptable in the selection of communication technologies for large-scale AMI deployment in Taiwan. As a result, a comprehensive communication evaluation platform is needed to be well established to verify those technologies being used among equipment suppliers.

This study collects international AMI promotion strategies (including RFPs and structures), with the substantial considerations being given to Taiwan AMI promotion experiences, national standards(CNS), and suppliers' recommendations. It is also believed that we need to take into consideration the requirement for proper function of AMI and development strategies of modular meters to ensure the success of implementing a deploying program. Since there have been many kinds of AMI communication technical solutions around the world, this project is designed to establish a platform to objectively evaluate the communication technologies suitable for the buildings of Taiwan. At the same time, it also considers the large-scale AMI deployment issues, such as application of dedicated radio band, meter calibration fee and period, etc. Therefore, the purpose of this research is to formulate a long-term AMI promotion and development strategy and outline a good environment where AMI can continue to develop.

關鍵詞(Key Words)：智慧電表(Smart Meter)、通訊測試平台 (Communication Testing Platforms)、智慧電表基楚建設(AMI)、公用事業頻段(Utility Frequency Band Reservation)、電表校驗(Metering Calibration)。

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淺談放射性廢棄物最終處置計畫的需求管理

The Primary Study about the Requirements Management of the Final Disposal Program for Radioactive Waste

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摘要

對於一長期且分階段逐步實施的放射性廢棄物最終處置計畫，如何開發一種工具，能以靈活、開放及有效方式執行，並取得社區民眾同意或進一步積極參與，是為此長程計畫執行成敗的關鍵。此工具不僅要能強調處置計畫的靈活性、透明度和願意配合概念及修訂各階段各項決定，更要隨時間衍化反映出計畫期間在環境、科學技術、政治、經濟及社會等的變化，俾利於各項決策歷程的傳承。這個特殊的管理工具源自目前國際上各核能先進國家積極推行的「需求管理(RM)」概念，而依此概念發展出來的結構化應用系統就是「需求管理系統(RMS)」。

台灣發展之需求管理系統RMS雛型包括兩部分，其一為配合2017年報告初稿內容研發需求管理系統雛型，另一為納入審查程序於需求管理系統RMS之雛型。後者之加入有助於完善需求管理系統RMS之發展，我們的做法是在審查資料庫之資料格式上盡量保持與需求/文件資料表同樣格式，使二者在建置過程中盡量保持其一致性，而有利於未來整體需求管理系統RMS融入品管與品保作業之發展需要。

Abstract

The key factor to developing an effective tool used for successful implementation of a radioactive waste disposal program is to make it help us obtain a community consent and promote active public participation in a flexible, transparent and effective manner. This tool should allow us to put emphasis on the flexibility, transparency and willingness to adapt to the changing concepts and revisions of the various stages of the decision. In addition, over the time it also needs to reflect requirement for the changes in the environment, science and technology, politics, economics and society during the project implementation. This special management tool is derived from the concept of “requirements management (RM)”, which has been actively promoted by advanced nuclear power countries in the world. The structured application system developed based on this concept is the “requirements management system (RMS)”.

There are two parts for developing the requirements management system (RMS) prototype in Taiwan. One is to develop the RMS prototype that is in accord with the 2017 draft report, and the other is the prototype of the RMS with quality control and quality assurance (QC/QA). The addition of the latter helps improve the development of RMS. Our approach is to make the requirements and document database sheets under our review maintain the same formats, so that they are as consistent as possible during the project implementation process. It is of great benefit for us to allow the future development of the overall RMS to be integrated into the QC/QA operations.

關鍵詞(Key Words)：放射性廢棄物(Radioactive Waste)、最終處置計畫(Final Disposal Program)、需求管理(Requirements Management)、需求管理系統(Requirements Management System)、品管(Quality Control)、品保(Quality Assurance)。