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輸電鐵塔結構分析模擬與監測技術研究

Structural Analysis and Monitoring Technologies of Power Transition Tower Structures

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摘　要

台灣輸電線路大部份以架空形式建置，鐵塔則為輸電線路中不可或缺之重要支持結構。當小區域的鐵塔受災害損壞或倒塌時，極有可能引發大區域範圍斷電連鎖反應，因此，鐵塔結構安全為輸電線路供電系統維持正常服務性的主要關鍵。本研究建置可詳實反映真實鐵塔結構行為的分析模型，透過對輸電鐵塔(含基礎)受地震、風力及坡體滑動等外力作用之反應進行研究，藉由各種破壞模式之境況模擬，掌握輸電線路鐵塔與所受災害之行為模式，研擬相關分析方法提供線路設計單位之參考與運轉維護單位對送電中鐵塔提供安全健檢參考。同時透過現地鐵塔裝設微振動感測器與監測系統，執行現地試驗量測回饋分析，驗證模擬程式之正確性，並進一步基於現地試驗量測經驗，研擬出適合輸電輸電鐵塔現地之健康診斷技術。本計畫有系統地進行輸電線路鐵塔結構安全分析技術研究，可供線路風險評估之依據及研擬有效的因應對策與安全預警機制參考。

Abstract

In Taiwan, most electric power transmission lines are of overhead type and linked by steel towers as support structure. The importance of the steel towers comes from the fact that their safety significantly influences the reliability of power supply through transmission lines. This paper is intended to study and discuss the tower structure in the electric transmission system. The research focuses on studying the dynamic characteristics and discussing structural behavior of tower when under the forces of winds, earthquakes and landslides respectively. The possible modes in the failure of the power transmission tower are discussed, and relevant structure models are established for the scenario simulation analysis. The dynamic characteristics and the structural responses in the different cases of loading - such as by winds, earthquakes and landslides - are deeply investigated. The research results could be used to effectively manage power transition towers for disaster prevention based on proper structural life-cycle consideration.

關鍵詞(Key Words)：輸電鐵塔(Transmission Tower)、鐵塔結構分析(Tower Structural Simulation)、鐵塔結構監測(Tower Structural Monitoring)。

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配電級再生能源管理系統建置可行性研究

Feasibility Study of Distribution Renewable Energy Management System

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摘　要

為確保未來台電配電系統在導入大量再生能源發電系統，仍能有效維持供電電壓品質，本計畫選擇台電區處試辦建置配電級再生能源管理系統，內建DPIS系統之再生能源併網衝擊分析軟體，配合PV系統預估發電量，以執行潮流分析推估饋線匯流排電壓並產生變流器輸出功因控制決策。為配合台電配電系統運轉之開關操作，本計畫亦與台電人員選擇測試饋線執行饋線負載轉供之變流器監控，並完成24戶PV用戶之現場實測，驗證DREAMS系統執行太陽光電之遠端遙控，收集PV系統之實功虛功與電壓值，並以DPIS軟體進行電壓變動之模擬並和實測值作比較，以強化未來台電導入DREAMS系統後，對提升配電系統電壓品質之效能。

Abstract

To achieve the goal of renewable energy development in Taiwan, it is expected that large amount of PV systems will be integrated into Taipower distribution systems in the near future. This project aims to provide a pilot distribution renewable energy advanced management system (DREAMS) in one of the Taipower's service districts. The impact analysis tool of DPIS was designed to solve the problems related to bus voltage variation by considering the influence of PV power generation output change and to help make the decision making for proper control of PV inverters. With the integration of DAS and DREAMS, the controls of the PV inverters are executed in advance to prevent the problem of over-voltage after the switching operation of power load. For the demonstration of DREAMS, the feeders with at least 24 PV systems for the purpose of test were selected after discussing with Taipower engineers. The execution of remote control of PV inverters is performed and the active/reactive power outputs with bus voltage are collected to verify the effectiveness of DREAMS for the maintenance of system voltage for the distribution feeder with high penetration of PV system. The test results are compared with the simulation of DPIS to demonstrate the effectiveness of raising system service quality by DREAMS.

關鍵詞(Key Words)：配電級再生能源管理系統 (Distribution Renewable Energy Management System)、再生能源 (Renewable Energy)、智慧變流器 (Smart Inverter)。

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22.8kV 等級架空配電裝置技術分析研究

22.8kV Overhead Power Distribution unit Study

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摘 要

為提升供電能力、減少線路壓降、改善供電品質、減少線路損失、減少饋線及管路數量、減少變電所設置、簡化電壓等級並與國際接軌，台電公司擬推行將配電架空線路電壓等級由11.4kV提升至22.8kV。由於以往架空線路之桿距、風壓等計算並未將桿上變壓器納入考量，若未來電壓等級提升至22.8kV後，各項架空線路配電設備等級將隨之提升，對架空線路之應力影響勢必須重新檢討，因此本研究計畫綜合相關規章及分析既設架空配電線路後，提出適切的線路及電桿強度之計算公式及評估方法精進建議。

Abstract

In order to increase the power supply capacity, reduce voltage drop, improve the supply quality, lessen line loss, decrease feeder and the number of pipelines, cut down on construction of additional substations, simplify voltage grade, and meet international standards, Taiwan Power Company is planning to upgrade the voltage of distribution overhead lines from 11.4kV to 22.8kV. Without full consideration given to the transformer installation on the electricity power pole while making calculation in the past studies concerning the distance between overhead line poles and the related wind forces, if the voltage grade is to be upgraded to 22.8kV in the future, the overhead line distribution equipment grade will also needs to be upgraded concurrently. Accordingly, the stress force effect on the overhead line must be reviewed again. As such, this research aims to review related regulations and analysis overhead distribution lines in order to propose suitable line pole strength calculation formula and precious assessment method for the overhead distribution line design and the relevant regulations for 22.8kV power distribution design and guidelines for the related equipment.

關鍵詞 (Key Words)：電桿(Pole)、架空配電線路(Overhead Distribution Line)、風壓(Wind Pressure)。

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中十機引風機高速運轉高振動及伴隨出口煙道高振動之原因分析與改善案例

A Case of Analysis and Improvement of the High Vibration of High-speed Operation of Induced Draft Fan of Unit 10 and the Accompanying High Vibration at the Outlet Flue Duct in Taichung Power Plant

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摘 要

本改善案之目的為改善中十機引風機高速(890RPM)運轉高振動及伴隨著出口煙道高振動的問題。改善計劃中，我們大膽地假設將本改善案展開為兩大主題，一為煙道高振動之原因探討；二為引風機高速運轉高振動之原因探討。以有效的研究方法找出高振動的主要肇因並研擬對策。在加強引風機本身剛性與出口煙道作結構上的調整後，中十機引風機已可高速運轉，且出口煙道穩定，無振動劇烈現象。實現引風機可高速運轉與提供夏季機組滿載發電的機會。

Abstract

The purpose of this case is to solve the problem of high vibration of high-speed operation of Induced Draft Fan of Unit 10 and the accompanying problem of high vibration at the outlet flue gas ducts in Taichung Power Plant. To formulate an improvement plan, we had made a bold assumption that the improvement plan could be made based on the analysis of two major relevant issues. The first issue is to explore the causes of high vibration of the flue gas ducts. The second issue is to investigate the causes of high vibration of high-speed operation of induced draft fans. The focus of the study efforts is on identifying the main cause of high vibration and developing relative strategies by utilizing an effective method. After making improvement in strengthening the stiffness of induced draft fan and modifying the structure of the outlet flue gas duct, the induced draft fan of Unit 10 can be run at a high operation speed while the outlet flue remains stable without intense vibration. With the improvement efforts made, the induced draft fan can run at high-speed operation, allowing the power unit to operate smoothly under full load in summer.

關鍵詞(Key Words)：引風機(Induced Draft Fan)、出口煙道(Exit Flue)、振動 (Vibration)。

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台電公司智慧財產權管理成果強化計畫

Reinforcing the IPR Management Capability of Taiwan Power Company Project

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摘　要

本計畫主要工作包含建立智財管理流程機制與辦理培訓課程與輔導。一方面，本計畫查訪台電公司智財管理現況，分析其不足之處，依其需要，修訂與新增智慧財產相關規範，協助台電公司建立嚴謹的智財管理規範、流程及表單等機制。另一方面，辦理智慧財產創造與保護相關課程，以及一對一 Coaching 輔導，培育台電公司智財業務推動種子團隊，並協助提出專利申請。

經由導入研發規劃、智財創造、智財保護、智財維護、智財商品化等各階段所需要的智財管理運用規範，以及訓練課程及諮詢輔導，以補強台電公司智財管理於組織人力上、訓練規劃上、規章制度上等面向之不足。

期能以本計畫強化精進台電公司內部的智慧財產有效管理，從而建構強而有力的產品、技術、智財組合，規劃具戰略效益的智財保護及專利布局策略。本計畫希望協助台電公司達到增加智財成果產出、確保智財成果權益及智財成果的自由運用(Free To Operate, FTO)、完善智財管理、強化智財競爭力、支撐企業策略與公司的願景。

Abstract

This project begins with reviewing deficiencies in the present intellectual property (IP) management system of Taiwan Power Company in the hope of correcting these deficiencies in all aspects, and then goes to assist Taiwan Power Company in strengthening its IP management and operations.

The main content of the project include: establishing the system of IP management and processes, organizing the IP training courses, and providing consultations. First, this project investigates the present status of IP management in Taiwan Power Company, and analyzes the deficiencies in the present IP system – including the aspects of IP management organization, human resource, IP training plans, IP regulations, etc. in the company. After that, based on the findings and the company's needs, the project proposes recommendations, revises or adds to TPC's IP regulations, and assists Taiwan Power Company in establishing a more robust IP management system - including regulations, relevant implementation processes, and forms, etc. In addition, the project organizes courses about IP creation, IP protection, and one-to-one personnel coaching course. The project also includes provision of the IP training lessons, which is designed to cover the basic IP concepts, advanced use of IP knowledge, provision of assistance in training the seed personnel for IP enforcement; and then assist the company in filing the patent applications.

To sum up, this project is intended to strengthen the internal IP management system so that the Taiwan Power Company is able to provide high-quality services, more advanced technologies, IP portfolios and to build strategic IP protection and future IP road map. Besides, this project is expected to help the Taiwan Power Company effectively increase its IP outputs, assure IP rights, and free to operate (FTO) its IP outputs, improve its IP management, enhance its IP competitiveness, and support the corporate operational strategies and future visions.

關鍵詞(Key Words)：智慧財產權(Intellectual Property Rights)、智財管理制度(IP Management System)、智財培訓與輔導(IP Training and Consultation)、智財創造(IP Creation)、智財保護(IP Protection)。

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日本 JPDR 及東海核電廠除役經驗於我國之應用與借鏡

Study of Japan's Decommissioning Experience of JPDR and Tokai Nuclear Power Plants for Their Possible Application in Taiwan

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摘　要

我國核能電廠自今年(2018)底開始，即將開始核一廠除役工作，除了台灣電力公司為主責業主外，國內核能相關研究機構及顧問公司，皆高度關切未來之工作規劃及分配，盼有機會能參與國內核後端之盛事，建立我國自主發展之除役技術基石，並於未來可將此經驗應用到國際上，輸出我國之核能除役技術。本報告剖析日本已完成除役之日本動力示範用反應爐(JPDR)及正在除役中的東海電廠1號機，對其除役歷程及各種工程規劃，包括除役計畫起訖、除役計畫書申請、核可或變更、工作分解架構(WBS)安排及進度、各種技術應用(如組件除污、電漿火炬切割、金屬外釋等)，深究其優缺點及考量因素，盼可應用於我國即將面臨之除役工作。

Abstract

The decommissioning work of the First Nuclear Power Plant is planned to start by the end of 2018 in Taiwan. Aside from Taiwan Power Company taking the full responsibility for implementation of the decommissioning work, related nationwide research institutes and engineering companies will be involved through ways of being a work partner with TPC or being awarded job contracts and work assignments. The decommissioning work of nuclear facilities is the most important event in the field of nuclear backend in recent years in Taiwan. Experiences obtained from nuclear decommissioning could also be transferred to other countries in the near future. This report analyzes process of decommissioning and engineering plans from JPDR and Tokai-1 NPP in Japan- such as plan kickoff, permit application, approval, and plan revisions, WBS arrangements, technical application of decontamination, plasma cutting and free release of clearance metals. Those items are fully studied and evaluated in detail. The experience obtained from the study can be applied in Taiwan accordingly.

關鍵詞(Key Words)：日本核能電廠(Japan's Nuclear Power Plants)、日本動力示範用反應爐(Japan Power Demonstration Reactor, JPDR)、東海電廠(Tokai Nuclear Power Plant)、除役(Decommissioning)、廢棄物管理(Waste Management)。

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核電廠執照管制熱流暫態分析技術研究與應用

Development and Application of Transient Thermal-Hydraulic Analysis Method in NPP

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摘　要

本計畫由台電公司核安處委託核能研究所核子工程組執行，計畫期程自103年8月1日至107年7月31日共計四年。本計畫的主要成果是整合了過去國內已發展建立的核反應器安全分析技術，完成18本分析報告並整合成17本專題報告，函送主管機關原能會進行執照申請。本期計畫規劃有4大技術領域，包括設計基準事故輻射劑量、中子穩態計算程式驗證、圍阻體次隔間分析方法論，以及計算流體力學應用分析，17 本報告有9本已經完成審查工作；其餘報告則依管制單位意見排定時間。

Abstract

This project was entrusted by Department of Nuclear Safety of Taiwan Power Company and conducted by the Division of Nuclear Engineering of INER. The project started from 2014 to 2018, lasing for 4 years. The purpose of this program is to develop the transient analysis methodologies for Nuclear Power Plants in Taiwan. The project aims to complete 18 analysis reports and incorporate them into 17 special topic reports for submittal to AEC to review for future licensing applications. Four main fields are proposed in this project, including radiation dose calculation in DBA, benchmark analyses in neutronics, analyses of containment sub-compartment, and computational fluid dynamics (CFD) applications. Nine special topic reports have completed review process. The remaining reports are already prepared for review depending on the authority's time frame.

關鍵詞(Key Words)：核電廠(Nuclear Power Plant)、執照分析技術(Licensing Analysis Method)、暫態分析(Transient Analysis)。

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