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輸電鐵塔環境量測分析及塔基維護顏色管理模式精進之研究

Research on Environmental Measurement Analysis of Transmission Towers and Improvement of Tower Base Maintenance Color Management Model

林彥廷*
Lin, Yen-Ting

熊開平**
Hsiung, Kai-Ping

黃漢承**
Huang, Han-Cheng

陳憲緯**
Chen, Hsien-Wei

陳昭維***
Chen, Chao-Wei

鄒鄭翰***
Tsou, Cheng-Han

摘要

輸電鐵塔安全與環境因素存有密切關聯，塔基所在邊坡如有發生土層滑動或是土石崩落等情形時，除造成鐵塔構件損壞外，嚴重時甚將引致鐵塔傾覆倒塌；此外，近十餘年來氣候變化越趨極端，考量輸電線路規劃設計階段，須納入風力及地震力等之影響，故本研究將探究鐵塔所處環境風場之變化、地震與降雨對塔基邊坡之影響，進而檢視現行之塔基維護顏色管理模式。

本研究方法係透過設置監測儀器取得實際環境參數，並以數值模擬分析評估鐵塔所在環境風場變化及塔基邊坡穩定，最後搜集國內各單位對邊坡之評估方式，以審視塔基維護顏色管理模式並提出精進建議。

Abstract

The safety of transmission towers is closely related to environment factors. When landslide or collapse occurs on the slope where the tower foundation is located, it will not only cause damage to the tower components, but in severe cases cause the tower to overturn and collapse. In addition, considering that climate change has become more extreme in the past ten years and that transmission lines must take into account the impact of wind and earthquake forces in the planning and design stage, this study discusses the following topics: changes in the wind field in the environment where the tower is located, earthquakes and the impact of rainfall on the slope of the tower base, and review the current color management model for tower base maintenance. The research method applied in this research is to obtain actual environmental parameters by setting up monitoring instruments, and use numerical simulation analysis to evaluate the changes in the wind field in the environment where the tower is located and the stability of the tower base slope. Finally, we collect the assessment methods of slopes from various domestic units to review the color management model of tower base maintenance and provide suggestions for improvement.

關鍵詞 (Key Words)：輸電鐵塔(Electrical Power Transmission Tower)、監測系統(Monitoring System)、數值模擬(Numerical Simulation)、邊坡穩定分析(Slope Stability Analysis)、塔基維護顏色管理模式(Color Classification Standard)。

*台灣電力公司綜合研究所

**台灣電力公司輸供電事業部供電處

***青山工程顧問股份有限公司

輸電線路多端子智慧故障定位系統功能提升

Improved Functions of Smart Fault Location System for Multi-ended Transmission Lines

林子喬*
Lin, Tzu-Chiao

俞齊山**
Yu, Chi-Shan

楊俊哲***
Yang, Jun-Zhe

丁兆昇*
Ding, Zhao-Sheng

吳旻哲****
Wu, Min-Che

唐城****
Tang, Cheng

摘要

近年來由於智慧電網的快速發展，對電力輸送與調度的需求也隨之迅速成長，然而亦造成大量的二/三/四端子線路、帶有一端匯流排斷路器開路線路，以及存在一端無後備電源之用戶端線路等架構正不斷地被應用於輸電系統之中，導致在故障定位之議題上帶來全新的挑戰。為此，本文針對台灣電力公司(台電)現行「輸電線路故障定位系統」進行強化，將三端線路故障定位功能，擴展至上述新興電網架構情形、且同時考量能不受各匯流排非同步量測影響之智慧故障定位方式以進行突破。本文也優化改善現行系統中包括：電驛故障資料檢測、導線參數介接介面，以及事故即時推播等功能。本文之研究成果不僅解決實際遭遇的故障定位問題，並結合網路科技輔助工程師以更方便且直觀的操作介面來查找回報事故地點之即時狀態、管理事故與線路資訊等，以大幅減少排障時間與復電成本。

Abstract

In recent years, due to the rapid development of smart grids, the demand for the power transmission and dispatch has also grown rapidly. However, the situation has also led to a large number of two/ three/ four-ended transmission lines, lines with one off-service line branch, and lines with one load bus without any backup power source, etc., which are constantly being applied to power transmission systems, and brings new challenges to the issue of fault location estimation. In view of that, this project aims to strengthen the current "Transmission Line Fault Location System" of Taipower, extend the three-end fault location function to the above-mentioned emerging power grid architecture; at the same time, seek an intelligent fault location method that is not affected by asynchronous phasor measurements of digital relays. Additionally, in this project we also aim to optimize and improve the relevant functions of current protection relays, including relay fault data detection, line parameter interface, and real-time incident push notification, etc. The research results of this project can not only help solve the fault location problems encountered, but also significantly reduce the downtime and restoration costs if combined with network technology to assist engineers to identify the real-time status of reported fault locations and manage the incidents and line information with a more convenient and intuitive operating interface.

關鍵詞 (Key Words)：故障定位系統強化(Optimization of Fault Location System)、四端子輸電線路(Four-ended Transmission Lines)、一端斷路器開路線路(Line with One Off-service Line Branch)、一端用戶端線路(Line with One Load Bus)、導線參數介接介面(Line-parameter Interface)、電驛資料檢測(Protection Relay Data Detection)。

*國立臺北科技大學

**國立臺北教育大學

***義守大學

****台灣電力公司綜合研究所

壓入式沉箱於高水位卵礫石層施工案例探討

A Case Study of Press-in Caisson Construction in High Water Level Gravel Layers

莊凱驛*
Chuang, Kai-Yi

賴永設**
Lai, Yung-She

薛仲修**
Hsueh, Chong-Hsio

高宇**
Kao, Yu

許吉良**
Hsu, Chi-Liang

摘要

目前潛盾工法因其具降低交通衝擊、減少干擾民眾及避開多數民生管線之優勢，已被大量應用於都市區地下管路和捷運隧道工程，但在施工過程中仍有許多困境需克服，本文藉由中興工程顧問股份有限公司所承攬之台電公司監造技術服務案提出潛盾工作井案例探討。

本案例為台灣電力公司輸變電工程處北區施工處為配合政府發展離岸風力發電的政策目標，發包之「161kV 大潭(甲)~梅湖線」統包管路工程，其中二工區位處於新竹縣湖口鄉，為主要道路及住宅密集處，為降低民眾干擾和穿越台鐵軌道段而採用潛盾工法，施工路線穿越卵礫石層，考量高水壓以及避免影響周圍鄰近結構物，採用相對穩定性較高的壓入式工法施作。

本文以發進井為例說明本案壓入式沉箱相關設計考量及施工特點，且提供於卵礫石層施工克服困難方法，期能提供相關實務經驗於後續卵礫石層施工參考。

Abstract

The shield tunneling method has been widely used in underground pipelines and MRT tunnel projects in urban areas, because of its advantages of reducing traffic impact, disturbance to the public and avoiding most livelihood pipelines. However, there are still many difficulties to overcome during the construction process. This article discusses a shield tunneling technical service project proposed by Taipower and contracted by Sinotech Engineering Consulting Co., Ltd.

The afore-mentioned case is the "161kV Datan (A)-Meihu Line" turnkey pipeline project contracted by the Northern Region Construction Office of the Transmission and Transformation Engineering Department of Taipower in order to comply with the government's policy goal of developing offshore wind power generation. The second construction area is located in Hukou Township, Hsinchu County, where main roads and residential buildings are densely populated. In order to reduce public interference and cross the Taiwan Railway track section, the shield tunneling method is adopted. Since the construction route passes through the gravel layers, considering the high water pressure and avoiding affecting the surrounding and nearby structures, the relatively stable press-in caisson construction method was adopted.

This article takes the launch shaft (M2-b) as an example to explain the relevant design considerations and construction characteristics of the press-in caisson in this case, and provides methods to overcome difficulties in construction of gravel layers. The relevant practical experience may serve as reference for subsequent construction of gravel layers.

關鍵詞(Key Words)：壓入式沉箱(Press-in Caisson)、卵礫石層(Gravel Layers)、高地下水位(High Water Level)。

*台灣電力公司輸變電工程處北區施工處

**中興工程顧問股份有限公司台電大潭梅湖工程處

能源環境教育之推動實務

Energy and Environmental Education Promotion Practices

徐榮崇*
Hsu, Jung-Chung

溫桓正**
Wen, Huan-Cheng

林景庸**
Lin, Jiing-Yong

蔡幸枝**
Tsai, Hsing-Chih

黎瑞雍**
Li, Jui-Yung

姜宗瑋***
Chiang, Tsung-Wei

摘要

為凝聚能源議題管理共識，本文結合世界咖啡館與群體提案評估法，以「高中職學生能接受」為核心概念，透過盤點現況、型塑主題、議題擬定、重要性排序、判斷與決定、提出策略等步驟。針對「能源多元化」、「火力發電」、「空污探討」及「再生能源」等面向，邀請各領域專家學者進行議題擬定與意見交流。

其結果認為學生在「能源多元化」面向上應了解與關注國際公約、環境教育、環境生態及能源管理；在「火力發電」面向上應對了解與關注專業知識、優缺點、污染物及其防制及環境影響；在「空污探討」面向上應了解與關注如何防制空污、教育與生活實踐、健康及季節氣候影響；在「再生能源」面向上應了解與關注基礎知識、能源供應、環境衝擊及產業發展(就業)。

Abstract

In order to gather consensus on issues of energy management, this study combines the World Café of social science research with Nominal Group Technique (N.G.T.); uses “acceptable by senior high school and vocational high school students” as the core concept; takes steps of identifying current situation, shaping themes, topic formulation, importance ranking, judging and deciding, proposing strategies; focuses on aspects such as energy diversification, thermal power generation, air pollution discussion, and renewable energy; and invites experts and scholars from various fields to formulate topics and exchange opinions.

The results suggest that students should understand and pay attention to international conventions, environmental education, environmental ecology, and energy management in terms of “energy diversification”. In terms of “thermal power generation”, they should understand and pay attention to professional knowledge, advantages and disadvantages, pollutants and their prevention and environmental impact. In terms of “air pollution discussion”, they should understand and pay attention to how to prevent and control air pollution, education and life practice, health, and seasonal climate impacts. In terms of “renewable energy”, they should understand and pay attention to basic knowledge, energy supply, environmental impact, and industrial development (employment).

關鍵詞(KeyWords)：群體提案評估法(N.G.T.)、世界咖啡館(World Café)、能源教育(Energy Education)。

*臺北市立大學歷史與地理學系

**台灣電力公司環境保護處

***莫比吾思國際有限公司

配電工程設計輔助圖面電腦化研究

Research on Computerization of Distribution Construction Auxiliary Design

蔡森洲*

Tsai, Sen-Chou

張文奇*

Chang, Wen-Chi

沈宜絹*

Shen, Yi-Chuan

陳俊瑋*

Chen, Jun-Wei

陳慧筠**

Chen, Hui-Yun

黃智穎***

Huang, Chi-Ying

高洪維***

Kao, Hung-Wei

摘要

為建構配電工程輔助設計系統(Distribution Construction Auxiliary Design, DCAD)，考量降低圖資使用者軟體授權費用，研究採用開放源始碼(Open Source)的網頁式地理資訊系統架構開發，並探討適合現有配電規劃設計流程與配電圖資繪製準則，達到設計圖版本管控與作業流程管理，提供介接新配電工程資訊系統(NDCIS)工程設計案件，建立設計案件工單與版次管理、配電設備圖例樣板與相關設計工具、套疊各種配電主題圖，透過網頁化編輯配電工程圖、配電場(室)資料卡、人手孔資料卡等圖資，以滿足工程設計階段作業需求。

Abstract

In order to construct a Distribution Construction Auxiliary Design (DCAD) system, as well as to reduce software licensing costs for map users, this study adopts an open source Web-based Geographic Information System (WebGIS), in line with the principles of the current power distribution planning & design process and distribution mapping graphics criteria to achieve the following goals, so as to meet the operational needs of the construction design stage: design graphics version control and operating procedure management; providing interfaces with the new Distribution Construction Information System (NDCIS) engineering design cases; establishing design case work orders and version management; power distribution equipment legend templates and related design tools; overlaying various power distribution theme graphics; editing power distribution construction graphics, distribution field (room) and manual hand hole data cards and other graphics through the web.

關鍵詞(Key Words)：配電工程輔助設計系統(Distribution Construction Auxiliary Design System)、開放源始碼(Operating Procedure Management)、新配電工程資訊系統(New Distribution Construction Information System)、網頁式地理資訊系統(Open Source, Web Geographical Information System)、配電工程圖(Distribution Construction Graphics)。

*台灣電力公司綜合研究所

**台灣電力公司配售電事業部配電處

***極簡科技股份有限公司

台電多雲架構下雲端服務之研究

Study on Cloud Services under Taipower's Multi-Cloud Architecture Company

溫紹群**
Wen, Rick

許梅君**
Hsu, Mavis

王彥翔**
Wang, Jonathan

蔡修竹*
Tsai, Shiou-Jwu

潘明宏*
Pan, Ming-Horng

王仁宏*
Wang, Jen-Hung

摘要

因應台灣電力股份有限公司(以下簡稱台電公司)之十大總體策略,並考量未來經營管理模式與組織型態的同時,從基礎設施、雲端服務及多雲架構的趨勢與應用場景,將網路架構、雲平台技術、資料交換、自動化管理、備援機制、資訊安全、智慧運維、容器、微服務、開發及測試與運維三者結合、人工智慧這些技術等面向納入考量,規劃出適合台電未來發展之雲服務以及所需之資源、能力與人力。

本研究將從業務需求、現況調研及最佳實務等資訊收集作為本研究基石,了解台電公司整體經營策略與現狀、國內外雲服務最佳實踐內容、法規與行業規範的適用情形,設計適合台電公司多雲架構下的雲服務,明確各雲的定位、維運架構、安全架構、服務模式等面向的規劃方式,作為後續資源移轉、雲服務開發與開立需求功能的輸入資訊。

Abstract

In response to Taipower's ten core strategies and taking into account future business management models and organizational types, this study looks at the trends and application scenario of infrastructure, cloud services, and multi-cloud architecture, combining network architecture, cloud platform technology, data exchange, automated management, backup mechanism, information security, smart operation and maintenance, containers, micro services, development and testing and operation and maintenance, artificial intelligence and other technologies in different aspects, based on which to plan cloud services and required resource, capability and manpower suitable for Taipower's future development. This study is based on the collection of three types of information: business needs, current situation research, and best practices to understand Taipower's overall business strategy and current situation, domestic and foreign cloud service best practices, and the application of regulations and industry norms. The above information is used to design cloud services suitable for Taipower's multi-cloud architecture and clarify the planning methods of each cloud's positioning, maintenance and operation architecture, security architecture, service model, etc., as a basis for subsequent resource transfer, cloud service development and establishment of required functions.

關鍵詞 (Key Words) : 雲端計算(Cloud Computing)、多雲架構(Multi-Cloud Architecture)、雲端服務(Cloud Service)。

*台灣電力公司資訊系統處

**勤業眾信聯合會計師事務所

AMI 數據時間粒度之探討

Discussion on the Time Granularity of AMI Data

林哲毅*
Lin, Che-I

徐彬海**
Hsu, Ping-Hai

摘要

隨著全球 Advanced Metering Infrastructure (AMI) 布建數量大幅增加，各國電力公司為了擴大 AMI 的效益，紛紛投入 AMI 數據分析。AMI 數據的品質攸關 AMI 數據分析結果的準確度。然而，目前多數的研究僅從單一應用的角度探討 AMI 數據品質對於模型準確度的影響性，缺乏從不同應用面向探討。為填補這一研究缺口，本研究彙整了饋線節點電壓預測、饋線設備負載預測，以及用戶相位辨識等三種應用的國際學術研究結果，探討 AMI 數據的時間粒度(Time Granularity)粗細對於數據分析結果的影響性。同時，調查了全球各國、日本與國內對於 AMI 數據粒度的需求及規畫。在本研究中，我們還針對國內 AMI 系統若導入高粒度數據採集之時間粒度、讀取物件、布署策略及選點等規劃提出建議，這些建議可做為台電公司下世代 AMI 規劃的參考。

Abstract

With the substantial increase in the number of Advanced Metering Infrastructure (AMI) deployed globally, power companies in various countries have invested in AMI data analysis in order to expand the benefits of AMI. The quality of AMI data is crucial for the accuracy of AMI data analysis results. However, most current studies only explore the impact of AMI data quality on model accuracy from a single application perspective, and lack of discussion from different application aspects. To fill this research gap, this study summarizes the international academic research results on three applications: feeder nodal voltage prediction, feeder thermal loading prediction, and customer phase identification to explore the impact of time granularity on data analysis results. At the same time, we investigated the demand and planning for AMI data granularity in various countries around the world (including Japan and Taiwan). In this study, we also put forward suggestions on planning considerations in terms of time granularity, reading objects, deployment strategy, and point selection when introducing high granularity data collection into domestic AMI systems in the future to serve as reference for Taipower's next generation AMI planning.

關鍵詞(Key Words)：智慧電表系統(Advanced Metering Infrastructure)、數據分析(Data Analytics)、時間粒度(Time Granularity)。

*台灣電力公司綜合研究所

**財團法人工業技術研究院

模擬用過鋯合金護套之貯存長期穩定性研究

A Study on the Long-term Stability of Simulated Spent Nuclear Fuel Cladding in Dry Storage

陳仁宏*
Chen, Jen-Hung

董曉明*
Tung, Hsiao-Ming

邱琬珺*
Chiu, Wan-June

胥耀華*
Shiu, Yaw-Hwa

楊朝裕**
Yang, Chao-Yu

蔡明益**
Tsai, Ming-Yi

郭巧君**
Kuo, Chiao-Chun

摘要

本研究主要探討鋯二模擬試片在乾式貯存環境之氧化行為及高氫含量鋯四試片之拉伸測試。首先，進行鋯二模擬試片製備，先充氫至目標氫含量 100~700 ppm 後，接續將氫化試片進行預氧化使其表面生成厚度約 15~30 μm 氧化層，此模擬試片氧化實驗溫度為 350°C、400°C 及 450°C，分別在氦氣與空氣中曝露 450 天後分析其氧化行為。另外，將鋯四板材氫化至 500~1200 ppm 高氫含量條件，在 25°C~100°C 溫度區間進行拉伸測試。實驗結果顯示，在空氣環境下，氧化結果與試片氫含量高低並無相關性，鋯二模擬試片則在實驗溫度範圍內皆呈現氧化增重與氧化時間線性增加關係，並依據 Arrhenius Equation 進行氧化動力學分析。此外，在氦氣環境下則完全沒有發生再氧化現象；高氫含量鋯四的拉伸試驗顯示 1200ppm 高氫含量及室溫條件下，明顯地發生斷面縮率之韌脆轉換現象，其斷面亦觀察到準劈裂面及二次裂紋等脆性斷裂特徵，然此現象隨溫度上升而逐漸趨緩。

Abstract

The purpose of this study is to investigate the oxidation behavior of simulated Zircaloy-2 spent nuclear fuel cladding in dry storage and to conduct tensile testing of highly hydrided Zircaloy-4 plate specimens. First, a Zircaloy-2 simulation test piece is prepared. After first charging with hydrogen to a target hydrogen content of 100~700 ppm, the hydrogenated test piece is then pre-oxidized to form an oxide layer with a thickness of about 15~30 μm on the surface. The oxidation test temperatures of this simulated test piece were 350°C, 400°C and 450°C, and the oxidation behavior was analyzed after being exposed to Helium and air for 450 days respectively. In addition, the Zircaloy-4 test piece was hydrogenated to a high hydrogen content of 500 to 1200 ppm, and a tensile test was conducted in the temperature range of 25°C to 100°C. The experimental results show that in an air environment the oxidation results are not related to the hydrogen content of the test piece. The Zircaloy-2 simulation test piece showed a linear increase in oxidation weight gain and oxidation time within the experimental temperature range, and the oxidation kinetics was analyzed based on the Arrhenius Equation; moreover, no re-oxidation was observed in a Helium environment. The tensile test of the Zircaloy-4 test pieces with high hydrogen content shows that under high hydrogen content of 1200 ppm and room temperature, the ductile-brittle transition phenomenon of area reduction obviously occurs. Brittle fracture characteristics such as quasi-cleavages and secondary micro-cracks were also observed on the cross section, but this phenomenon gradually slowed down as the temperature increased.

關鍵詞(Key Words)：模擬用過護套(Simulated Spent Cladding)、鋯二合金(Zircaloy-2)、再氧化(Re-oxidation)、鋯四合金(Zircaloy-4)、氫脆(Hydrogen Embrittlement)。

*國家原子能科技研究院

**台灣電力公司核能發電事業部核能發電處