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程控系統資通安全精進之研究

A Study on Cyber-security Improvement in Operational Technology

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摘 要

隨著電腦網路與資料分析技術的蓬勃發展，電力運轉維護人員可透過企業網路有限制地存取調度監控系統警報訊息及運轉資訊，以即時做出最正確的運轉策略。

然而為避免駭客由開放的網際網路滲透企業網路，進而突破防火牆感染整個電力調度監控系統，於程控系統對外設置資料單向傳輸設備，限制程控系統運轉資訊只能單向傳出，而外部企業網路無法逆向存取程控系統環境，以實現程控系統網路隔離之目的。

如此單向傳輸設備與企業網路介面端所設置的防火牆之間便形成iDMZ緩衝區，於區域內增設資料同步用的鏡像報表伺服器，使電力調度監控系統具備可承受感染與快速復原的能力，讓調度中心程控系統的資通安全能夠更加完善且穩固。

Abstract

With the help of computer network and data analysis technology, the personnel responsible for power system operation may now make prompt and precise decisions with restrictive access to system alarm messages and operation information via the corporate intranet.

To block hacker intrusion into the SCADA system, a unidirectional data gateway, known as Data-Diode, must be added to the output port of the operational technology (OT) network, to ensure one-way data flow of OT network, which means any access to OT domain from corporate internet will be denied.

Furthermore, the domain between Data-Diode and the corporate firewall will take shape a so-called iDMZ (Industrial Demilitarized Zone). In this domain, we may setup a mirror report server to synchronize the data from OT network. In a worst case as cyber-attack, the mirror report server may be recovered in short time, and the OT network of SCADA will have higher degree of cyber-security and be more resilient to external attacks.

關鍵詞(Key Words)：資通安全(Cyber-security)、程控系統(Operational Technology)、監控系統(SCADA)、資料單向傳輸設備(Data-diode)、防火牆(Firewall)。

變壓器 NVTC 引線變色原因分析

Cause Analysis of Transformers' NVTC Lead Wire Discoloration

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摘要

因應某變壓器發生無電壓分接頭切換器(No-Voltage Tap Changer, NVTC)故障，同型變壓器水平展開NVTC拆除及引線短接工作，意外發現代號D51017變壓器拆下之三具NVTC部分引線有變色異狀，為查明變色原因進一步進行樣品之外觀檢視、絕緣紙聚合度試驗、掃描式電子顯微鏡(FE-SEM)與掃描式電子顯微鏡能量分散光譜儀(SEM/EDS)微區顯微結構分析等，研判部分引線因長期局部低溫過熱，發生絕緣紙劣化及硫化銅沉積(腐蝕硫)現象，造成引線變色。

Abstract

In response to an NVTC (No-Voltage Tap Changer) failure in a certain transformer, NVTC of transformer code D51017, we handed on short-circuit examination on the same type transformers, and accidentally found wire discoloration. After a series of inspections, including sample appearance, insulation paper polymerization degree test, surface scanning electron microscope (FE-SEM) surface morphology, and scanning electron microscope energy dispersive spectrometer (SEM/EDS) surface element analysis, we concluded that the discoloration was caused by lasting low-temperature overheating which led to insulating paper ageing and sulfur corrosion.

關鍵詞(Key Words)：腐蝕硫(Corrosive Sulfur)、油中氣體分析(Dissolved Gas Analysis)、無電壓分接頭切換器(No-Voltage Tap Changer, NVTC)、絕緣紙老化(Insulating Paper Ageing)。

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台電公司投入 GUEQ 能源技術服務之省思

The Reflection of Taipower's Dedication to ESCO"

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摘要"

本研究研析國內外能源技術服務產業之策略及發展現況，針對國內能源技術服務業及國外售電業投入ESCO能源技術服務現況進行蒐集與研析。其中包含營運方式、經營型態、服務範圍以及營運成效，進而瞭解未來台電公司實際運行ESCO業務時可能遭遇之問題，為台電公司投入能源技術服務運作之重要策略參考。

Abstract"

This study aims to analyze the business strategies and current status of worldwide energy service companies (ESCOs), focusing on the current situations in Taiwan and how foreign licensees of public electricity retailer may participate in ESCO industry, from the angles of business model, operation pattern, service scope, operation result, etc. The results of this study may serve as reference for Taipower to enact strategies and to deal with the future situations.

關鍵詞 *Energy Service Company、公用售電業(Licensee of Public Electricity Retailer)、節能量保證(Guaranteed Saving)、需求面管理(Demand-Side Management)、多角化經營(Business Diversification)。

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台電綠網之實體與網路行銷評析

Analysis of the Physical and On-line Marketing of Taipower Green Net

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摘要

為將台電友善環境的熱情與態度傳遞給公司員工，進而以新思維改變工作態度與日常行為，匯集邁進綠色企業的動力，2015年建置的「台電綠網」希望吸引全民參與共創更美好的明天。

2年的研究期間內，透過4場實體及7場網路行銷活動，搭配搜尋引擎優化、網路廣告、海報張貼及電子報發送等吸引民眾關注綠網，註冊為會員。研究顯示4場實體活動的使用者參加率較高，最高達300.3%，而7場網路活動的使用者參加率較低，除綠網V2.0上線舉辦的活動達42.1%外，其餘網路活動參加率皆介於2.8%~18.5%；而新會員註冊率則反之，4場實體活動的新會員註冊率皆低於15%，反觀7場網路活動，僅一場活動為37.8%，其餘活動皆高於60%，顯示網路行銷活動對提升會員註冊率有較高成效。

綠網的平均停留時間為3分15秒，而實體或網路活動的平均停留時間介於3分11秒~5分52秒，顯示辦理活動可提升平均停留時間，但實體或網路形態則無明顯的差異。

在有限經費下，綠網透過11場行銷活動，整合網路免費行銷資源及部分廣告投放，兩年招募超過1萬7千名外部會員；從三大搜尋引擎的排名顯示綠網具相當知名度，與環保署經營11年的EcoLife網具同等知名度與重要性；民眾需要環保領域的資訊時，會想起、會使用綠網，進而發揮台電綠網存在的功效。

Abstract

Taipower Green Net (TGN), established in 2015, aims to deliver environment-friendly enthusiasm to enable innovative thinking and momentum toward a green enterprise and better future. During the period of this study (2years), we held in total 4 physical and 7 on-line marketing activities to attract public attention to TGN.

In contrast, physical activities had higher participation rates (up to 300.3%), while on-line activities lower (Green Net V2.0 42.1%, the others 18.5% to 2.8%).

Nevertheless, new member registration rate of physical activities is pretty low, less than 15%. As for on-line activities, 5 above 60%, the other 2 37.82%.

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The visitor dwell time on TGN is 3 minutes and 15 seconds averagely according to our study- the longest 5 minutes and 52 seconds, the shortest 3 minutes, 11 seconds for all visits, indicating marketing activities have positive effects on increasing dwell time, regardless physical or on-line.

During the period of this study, we held in total 11 marketing activities and recruited over 15,000 external members. As the ranking of search results showed, TGN has earned the same popularity as EPA's EcoLife Clean Home Gucuobian Green Life Net. We believe in the future, when people think of environment protection, TGN will be recalled.

關鍵詞(Key Words)：電綠網(Taipower Green Net)、行銷策略(Marketing Strategy)、新會員註冊率(New Member Registration Rate)、參加率(Participation Rate)、平均瀏覽頁數(Average Viewed Pages)、平均停留時間(Average Dwell Time)、搜尋排名(Ranking of Search Results)。

國外公用售電業購電組合規劃與風險管理機制之研究 ～以法國電力公司(EDF)為例

The Planning and Risk Management Mechanism of Power Purchase Portfolio of
Licensee of Public Electricity Retailer: A Case Study of EDF

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摘 要

法國電力公司(EDF)是法國國營綜合電業，其購電組合的風險控管組織、機制與實務，皆有正面臨市場自由化、組織調整的台電公司可借鏡之處。本文針對EDF公司資產優化部門(DOAT)與交易公司(EDF Trading)的協調、集團能源市場風險管理政策(CEMRP)的落實、考核、交易實務、風險控管等重要舉措進行介紹，提供公用售電業研擬相關規範及最適發展策略之參考。

Abstract

As we all know, EDF is a state-owned and vertically integrated electric utility in France. Therefore, its organization and mechanism designs for power purchase portfolio (PPP) may very well serve as reference for Taipower to deal with its confronting issues such as market competition and organization transformation. The contents of this article, including the coordination between EDF's Asset Optimization Department (DOAT) and its trading company (the EDF Trading), the implementation and performance evaluation of EDF Group's Energy Market Risk Management Policy (CEMRP), the trading practices and measures of risk management, may serve as reference for Taipower, a licensee of Public Electricity Retailer, to draft its business strategy and relevant PPP codes compliant to the Electricity Act.

關鍵詞(Key Words)：法國電力公司(EDF)、風險控管(Risk Management)、自由化(Liberalization)。

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台電公司轉型為控股集團之最適戰略規劃與控制 推動模式

The Transformation of Taiwan Power Company into a Holding Company:
The Optimal Strategic Planning and Management Model

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摘要

我國電業法業於民國106年修正，該法第6條為台灣電力股份有限公司(以下簡稱「台電公司」)實施電業別專業分工之法源依據，台電公司將依循法定時程，轉型為控股母子公司之經營模式。本文針對控股母公司「戰略控制機能」之五大功能--「國內外投資與新事業發展」、「數位轉型戰略」、「情報管理」、「關鍵資源分配與控制」、「戰略規劃與控制」，透過案例研析、專家諮詢會議、國際電業交流、內部相關單位之訪談與分享，研擬上述五大功能之短、中、長期發展藍圖，並針對戰略規劃與控制推動模式提出建議，惟各國國情不同，本研究僅提供作為台電公司內部規劃時之參考，最終決策及具體採用作法將由台電公司內部衡量國內情勢與公司營運狀況，進行最終的評估與制定。

Abstract

According to the regulation of the Electricity Act amended and passed in 2017, Taiwan Power Company (TPC) shall get on with accounting and legal separation and transform into a holding company and two subsidiaries, a generation company (the Genco) and a grid company (the Transco). In this study, we put our focus on the major five strategic management functions of the holding company, namely “domestic and foreign investment and new business development”, “digital transformation strategies”, “information management”, “key resource allocation and control”, and “strategic planning and control.” By referring to benchmark cases and through interviews and communication with the key stakeholders, this study integrates and brings forward blueprint ideas of the optimal strategic planning and management models for the holding company. The results of this study may serve as reference for TPC to deal with the said transformation.

關鍵詞(Key Words)：控股集團(Holding Company)、轉型(Transformation)、戰略規劃(Strategic Planning)、戰略管控(Strategic Management)、新事業投資(New Business Development)、數位轉型(Digital Transformation)、情報管理(Information Management)、關鍵資源分配(Key Resource Allocation)。

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由北部核電廠二十年撞擊資料顯示臺灣北部魚類 資源之衰退現象

Declining Fish Resources in Northern Taiwan Based on Twenty Years Impingement
Data of Two Northern Nuclear Power Plants

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摘要

大多火力或核能電廠因為需要抽取大量海水做為冷卻用水，因此在汲取海水的過程會意外汲入海洋生物和垃圾進入電廠，造成「撞擊」的漁業經濟損失。本研究利用2001-2020年間在北海岸兩座核電廠(核一與核二)之撞擊資料，分析二十年間魚類群聚中物種數、個體數與生物量的變化趨勢。結果顯示兩核電廠物種數皆有明顯下降的趨勢，20年來核一廠減少113種，核二廠減少117種。甚至在2017年之後每年所採獲的魚種不到5種，個體數及生物量也有同樣下降之趨勢。過去在兩核電廠撞擊中可見週期性大量出現的六斑二齒魷、褐藍子魚與小沙丁等，從2015年至今在撞擊的採樣中皆未再記錄到有大量出現的現象。造成魚類多樣性及資源的減少原因很多，可能與過度捕撈、棲地破壞、或氣候變遷有關。

Abstract

The seawater cooling system of nuclear power plants (NPP) may accidentally draw in marine creatures and cause economic losses of fishery resources. This research aims to analyze the impingement data out of two nuclear power plants in Northern Taiwan, the 1st NPP and 2nd NPP, to understand the status of fish resources in the past two decades. The results showed fish species richness dramatically declined. 113 and 117 fish species disappeared in the surrounding waters of the 1st NPP and 2nd NPP respectively. Moreover, the species number has been recorded less than 5 after 2017. The number of individuals and biomass have been declining in the past 20 years as well. The common seasonal swarms with large biomass of *Diodon holocanthus*, *Siganus fuscescens*, and *Sardinella* spp., have not been observed since 2015. The decline of fish resources and biodiversity may be due to overfishing, habitat degradation, and/or climate change.

關鍵詞(Key Words): 撞擊(Impingement)、魚類群聚(Fish Assemblage)、核電廠(Nuclear Power Plants)、沿岸生態(Coastal Ecology)、長期資料(Long-term Data)。

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核三廠 RELAP5/DAKOTA 之最佳化估算分析模式 發展與暫態評估

The RELAP5 /DAKOTA Model and Best-estimate Analysis of Maanshan NPP

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摘要

在過去，針對核能電廠設計基準事故或嚴重事故時較常以保守的分析方法進行分析，以模擬核能系統內之一次側壓力、二次側壓力、燃料護套溫度及水位等結果。隨著電腦科技進步以及核能分析程式的演進，核能的熱水流程式大多都能模擬整個事故暫態，有別於過去本研究使用最佳化估算分析方法，從基本案例分析探討核能系統的熱水流現象，以及爐心熱傳現象對燃料護套溫度影響並透過不準度分析更進一步考慮電廠實際運轉中的系統參數偏差，探討其偏差對核能系統的影響。本研究使用美國愛荷華國家工程實驗室所發展的RELAP5/MOD 3.3熱水流分析程式，結合SNAP熱水流模式圖形化介面程式，有別於過去以文字編輯器輸入參數的方式，SNAP介面不僅能詳細呈現整個電廠系統之狀態，可提供使用者視窗化的參數輸入方式建立分析模式。本計畫成功建立RELAP5/MOD3.3 核三廠喪失冷卻水事故(LOCA)與主蒸氣管管路破裂事故(MSLB)分析模式，並耦合不準度分析程式DAKOTA進行不準度分析，最後透過Python進行數據後處理，以便往後不準度研究者快速且正確地擷取結果。

Abstract

In the past, conservative analysis approaches were widely used. Most countries followed the 10 CFR 50.46 Appendix K methodology for safety analysis. Nowadays, to bring analysis results closer to physical phenomena, Best-Estimate Plus Uncertainty (BEPU) analysis approach has become more and more popular. In this research, we adopt RELAP5/MOD3.3, an advanced thermohydraulic code developed by Idaho National Engineering and Environmental Laboratory (INEEL), together with SNAP, with the provision of a visualized input deck to allow researchers to develop analysis models simply with dragging and clicking of the mouse. The objective of this research is to establish a BEPU approach for Maanshan NPP's LOCA and MSLB analysis, by using RELAP5/MOD3.3. The analysis methods applied in this study include: the basic case

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analysis to learn the thermal-hydraulic phenomena during LOCA and MSLB and how thermal-hydraulic phenomenon may influence the cladding temperature; the uncertainty analysis to consider deviations in the real situations; the sensitivity analysis to learn how system deviations may affect the cladding temperature. With the help of RELAP5/MOD3.3, we successfully combined the interface of DAKOTA and SNAP and performed the MSLB uncertainty analysis. By the way, we use Python to capture uncertainty data.

關鍵詞(Key Words): 馬鞍山電廠(Maanshan Nuclear Power Plant)、喪失冷卻水事件 (LOCA)、主蒸氣管斷裂(MSLB)、不準度分析(Uncertainty Analysis)。