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離岸風力發電加強電力網計畫(第一階段區塊開發)

Power Grid Construction Plan (the First Stage Zonal Development) for Offshore Wind Connection

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摘 要

為滿足離岸風力第一階段區塊開發政策目標及開發業者併網之需求，台電公司除盤點既設可併網容量外，亦推動離岸風力發電加強電力網工程，以最大化離岸風電併網。

「離岸風力發電加強電力網計畫(第一階段區塊開發)」為本公司第二次配合離岸風電併網需求提出之加強電力網專案計畫，計畫內容為提供離岸風電於桃園、新竹、苗栗、臺中及彰化地區併網之相關工程，預定於 2031 年底完成本計畫工程，可增加 10 GW 之併網容量。

Abstract

To meet the policy objectives of the first stage offshore wind power zonal development and the grid connection needs of developers, Taipower not only takes inventory of the existing grid connection capacity, but also promotes power grid construction plan to maximize offshore wind power grid connection capacity.

The “Power Grid Construction (the First Stage Zonal Development) Plan for Offshore Wind Connection” is the second power grid construction plan proposed to meet the needs of offshore wind power grid connection, aiming to provide related projects for offshore wind power grid connection in Taoyuan, Hsinchu, Miaoli, Taichung and Changhua areas. It is scheduled to be completed by the end of 2031, which can increase the grid connection capacity by 10 GWs.

關鍵詞(Key Words)：離岸風電(Offshore Wind)、區塊開發(Zonal Development)、離岸風力發電加強電力網(Power Grid Construction Plan for Offshore Wind Connection)。

二氧化碳地質封存先導試驗規劃可行性評估研究

Feasibility Assessment Study on Carbon Dioxide Geological Storage Pilot Test

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摘 要

台電公司因應國家減碳政策，推動有關二氧化碳地質封存之可行性評估，期待未來能將二氧化碳地質封存相關技術及經驗於台電公司內部紮根，並落實於碳封存、深鑽井工程、環境監測及儲集層管理等業務推動執行。本計畫為進行碳封存先導試驗場址選址、可行性研究與計畫開發先期工作，規劃核心工作項目包括：(1)目標場址評選與初步調查、(2)先導試驗初步規劃與設計、(3)灌注相關風險分析模擬、(4)施工及監測計畫擬訂等。

透過本計畫所得成果，期能有利於台電公司對外說明二氧化碳地質封存試驗計畫概念，並開發國內首座二氧化碳地質封存的先導試驗場址。

Abstract

In response to the government's carbon reduction policy, Taipower is conducting a feasibility assessment on carbon dioxide geological storage, looking forward to taking carbon dioxide geological storage related technologies and experience into the company in the future and implementing them in carbon storage, deep drilling projects, environmental monitoring, reservoir management and other businesses. This project is the preliminary work of site selection, feasibility study and plan development for the carbon storage pilot test site. Its major work items include: site selection and preliminary investigation, preliminary planning and design of the pilot test, injection-related risk analysis and simulation, construction and monitoring plan formulation, etc. The results obtained through this project are expected to help the company explain the concept of the carbon dioxide geological storage test plan to the public and develop Taiwan's first pilot test site for carbon dioxide geological storage.

關鍵詞(Key Words)：二氧化碳地質封存(Carbon Dioxide Geological Storage)、儲集層管理(Reservoir Management)、風險分析(Risk Analysis)。

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由國際案例研析我國碳定價制度發展之方向

International Case Studies on the Development Direction of Taiwan's Carbon Pricing System

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摘 要

碳定價主要分為碳稅/費及總量管制與排放交易兩種制度，是全球實踐淨零碳排的重要政策工具。我國於 2023 年 2 月 15 日公布之《氣候變遷因應法》明訂 2050 淨零排放之目標，並將碳費及總量管制與排放交易入法。電力部門為我國能源部門之主要排放者，未來在電氣化及去碳化與能源轉型路徑下，用電量勢必會增加。依據氣候法第 28 條第 2 項，生產電力之直接排放源，得檢具提供電力消費之排放量證明文件，向中央主管機關申請扣除前項第一款之排放量。此規範避免碳費重複徵收，並確保排碳成本由使用者承擔。然而，未來我國實施總量管制與排放交易制度時，極可能參考國際作法，將電力部門納入總量管制之對象。本文透過研析國際溫室氣體減量相關議題、參考國際主要碳市場之運行模式與國際間電力業因應碳定價之策略，提供我國電力部門因應未來碳定價政策制度之建議。

Abstract

There are two main forms of carbon pricing mechanism, one is carbon taxes/fees, and the other is cap-and-trade system. The two are also important policy tools for the global implementation of net-zero carbon emissions. The Climate Change Response Act that came into effect on February 15, 2023 clearly sets the goal of net-zero emissions in 2050, and incorporates carbon fees and cap-and-trade into law. The power sector is the main emitter of Taiwan's energy sector. In the future, under the path of electrification, decarbonization and energy transformation, electricity consumption is bound to increase. According to Paragraph 2 of Article 28 of the Climate Change Response Act, direct emission sources that produce electricity may provide emission certification documents for electricity consumption and apply to the central competent authority for the deduction of emissions specified in Paragraph 1 of the preceding paragraph. This specification avoids duplication of carbon fees and ensures that carbon emissions costs are borne by users. However, when Taiwan implements the cap-and-trade system in the future, it is likely to refer to international practices and include the power sector as a subject of cap-and-trade control. This article aims to provide suggestions for Taiwan's power sector to respond to future carbon pricing policy by analyzing issues related to international greenhouse gas reduction, and referring to the operating models of major international carbon markets and the strategies of power sectors in various countries in response to carbon pricing.

關鍵詞(Key Words)：碳定價(Carbon Pricing)、碳稅/費(Carbon Taxes/Fees)、總量管制與排放交易(Cap and Trade)、電力部門(Power Sector)、淨零排放(Net-zero Emissions)、巴黎協定(Paris Agreement)、溫室氣體(Greenhouse Gases, GHGs)、碳市場(Carbon Market)。

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台中電廠九號機後爐灰水力輸送系統改善為氣力輸送系統

Upgrading Taichung Power Plant's Unit 9 Hydraulic Coarse Fly Ash Handling System to a Pneumatic Ash Handling System

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摘要

台中火力發電廠九號機機組裝置容量為 550 MW)之省煤器(Economizer, ECO)、空氣預熱器(Air Pre Heater, APH)之灰斗所沉積的煤灰(亦稱為後爐灰)，其原始建廠設計為使用海水輸送至灰塘進行掩埋。然而在運轉 30 多年後，灰塘容納後爐灰的能力已達到極限。因此將整套後爐灰的水力輸送系統升級為氣力輸送系統，將舊有使用海水連續輸送方式改善為壓縮空氣作為動力，經由輸灰桶批次輸送，並將後爐灰改為輸送至鍋爐底灰斗，再經沉水式刮板鍊運機(Submerged Scraper Conveyor, SSC)與鍋爐底灰一起送至濕式底灰倉內。本文章分享系統設計考量、系統配置以及起機調適所遭遇之問題與解決方式。

Abstract

The coal ash, also known as coarse fly ash, deposited in the economizer (ECO) and air preheater (APH) ash hoppers of Taichung Power Plant's Unit 9 (550 MW), was originally designed to use seawater to transport to the ash pond for burial. However, after more than 30 years of operation, the ash pond has reached its capacity limit. Therefore, the original hydraulic ash handling system was upgraded to a pneumatic ash handling system. The latter uses compressed air as power and deploys ash transmitters to convey coarse fly ash in batch mode. The coarse fly ash is first conveyed to the boiler hopper, and then through the submerged scraper conveyor (SSC), together with the bottom ash, to the bottom ash silo. This article introduces the design considerations, system configuration, problems encountered and solutions during the system upgrade and commissioning period.

關鍵詞(Key Words)：氣力輸送系統(Pneumatic Ash Handling System)、後爐灰(Coarse Fly Ash)、系統升級與調適(System Upgrade and Commissioning)。

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燃料試驗資訊系統之研究

Laboratory Information Management System for TPRI's Fuel Testing Business

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摘 要

本研究完成台電綜研所燃料試驗資訊系統之研究(TPRI Fuel LIMS)，整合實驗室內部作業流程管理及實驗室外部客戶服務等功能，使實驗室從試驗件收件、派工、試驗數據輸入、報告產生與列印之流程完整電腦化，並具備儀器數據匯入功能，客戶亦可利用網頁，查詢所屬試驗件試驗進度及歷史數據，以提高綜研所油煤組實驗室工作效率，亦有助於增進客戶服務水準。

Abstract

This study aims to establish a laboratory information management system (LIMS) for the fuel testing business of Taipower Research Institute (TPRI). Its main content includes integrating the laboratory's internal workflow management and external customer service functions, so that the laboratory's processes (such as task receipt, work assignment, inputting test data, report generation and printing) can be completely computerized. The new system has the function of importing instrument data, which can allow customers to use the web page to query the test progress and historical data of their test pieces. In short, this study will not only help improve the laboratory efficiency of the Oil and Coal Division, but also help improve the quality of customer service.

關鍵詞(Key Words): 實驗室資訊管理系統(Laboratory Information Management System, LIMS)、資料庫(Database)、燃料試驗(Fuel Testing)、歷史數據(History Data)。

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新開發雲端輸電電纜延線拉力檢討網頁

Newly Developed Cloud Transmission Cable Extension Tension Review Webpage

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摘 要

藉由 Google 免付費「GAS 程式」結合「HTML 網頁開發語言」建構於雲端硬碟，前端則由 HTML 網頁語言建立使用者介面，負責檢討資料輸入及輸出功能，後端則為 GAS 程式環境進行撰寫「輸電電纜延線拉力檢討計算」功能，GAS 程式整合前後端功能，即可由網路連至專屬雲端網頁，進行開發雲端電纜延放拉力檢討，尤其是面對管線大幅彎曲段，必須謹慎檢討電纜拉力及側壓力是否符合設計規範規定，適用於現場會勘或設計規劃方案時應用，以維電纜供電及運轉安全。

Abstract

This project uses Google's free "Google App Script (GAS) program" combined with "HTML web page development language" to build a cloud hard drive. The front-end uses the HTML web page language to create a user interface, which is responsible for reviewing data input and output functions. The back-end is the GAS program environment to write the "power transmission cable extension tension review calculation" function. By integrating the front-end and back-end functions through the GAS program and connecting to a dedicated cloud webpage through the Internet, it is possible to conduct a cloud-based cable extension tension review. Especially when facing large bends in pipelines, it is necessary to carefully check whether the cable tension and lateral pressure comply with the design specifications. It is suitable for use in on-site surveys or design planning to maintain stable power supply and the safety of transmission cable operation.

關鍵詞(Key Words)：管路(Pipeline)、側壓力(Lateral Pressure)、GAS 程式(Google App Script Program)、超文本標記語言(Hyper Text Markup Language)。

水輪發電機推力軸承動壓潤滑油膜數值模擬分析

Numerical Simulation Analysis of Hydrodynamic Lubricating Oil Film of the Thrust Bearing of a Hydropower Generator

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摘 要

國內某水庫所屬水輪發電機組自民國 76 年啟用運轉至今，因其推力軸承運轉溫度偏高，機組運轉全程被迫需持續啟動頂舉油泵以建立油膜使軸承降溫。本文為探究其因，以計算流體力學(CFD)數值模擬方法針對該機組之推力軸承動壓潤滑油膜特性及承載力進行計算模擬分析。結果表明：推力軸承動壓潤滑油膜厚度愈大，其承載力愈小。在使用頂舉油泵之油膜較停用多 124~127 公噸承載力。機組轉速愈高及潤滑油黏度愈大；油膜承載力則愈大。在固定油膜厚度下，軸承傾斜角度愈大，則油膜承載力愈大。文末指出軸承傾斜角度不足為機組推力軸承動壓潤滑機制失效之主要原因。

Abstract

A hydropower generator unit belonging to a domestic reservoir was put into operation in 1987. Recently, due to the high operating temperature of the thrust bearing, the unit was forced to continuously start the lifting pump throughout the operation to create an oil film to cool the bearing. In order to explore the reasons for the above situation, this project uses computational fluid dynamics (CFD) numerical simulation method to conduct calculation and simulation analysis on the hydrodynamic oil film characteristics and the capacity of the thrust bearing of the unit. The results show that the greater the thickness of the oil film, the smaller the capacity of the hydrodynamic lubricating oil film of the thrust bearing, and the oil film of the lifting oil pump in use has a bearing capacity of 124~127 metric tons more than when it is deactivated. In addition, the higher the speed of the unit and the greater the viscosity of the lubricating oil, the greater the oil film bearing capacity. Finally, under the condition of fixed oil film thickness, the greater the bearing inclination angle, the greater the oil film bearing capacity. In summary, insufficient bearing inclination angle is the main reason for the failure of the hydrodynamic lubrication mechanism of the thrust bearing of the unit.

關鍵詞 (Key Words)： 水輪發電機 (Hydropower Generator)、動壓潤滑 (Hydrodynamic Lubrication)、可傾式推力軸承 (Tilting Thrust Bearing Pad)、頂舉油泵 (Lifting Pump)、計算流體力學 (Computational Fluid Dynamics)。

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鋼纜磁漏性非破壞檢測施工案例探討— 以揚清橋鋼纜及結構安全檢測工作案為例

Using Non-Destructive Magnetic Flux Leakage Method for Steel Cable Inspection

- Take Yangqing Bridge Steel Cable and Structural Safety Inspection Work Case as an Example

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摘 要

108 年南方澳大橋發生倒塌之憾事，喚起國人對特殊型橋梁檢測之重視，然而國內橋梁鋼纜系統大多僅採用相對發展成熟之「索力(微振)檢測法」進行量測，雖能得知索力是否異常，仍無法精確鎖定鋼纜受損位置及模擬破壞行為。原理為因此已在金屬加工領域上受廣泛應用之「磁漏性檢測法」，成為攻克上述技術難題之曙光，原理為利用永久磁鐵將鋼纜磁化後使缺損位置產生漏磁場，進而使用感測器接收後進行解析，本次受測鋼纜受損情形皆符合 DIN EN12927 標準，使用安全無虞；國外雖已有應用該檢測法於橋梁建築物針對鋼纜完整性進行評估之案例，惟國內橋梁應用甚少，有鑑於揚清橋橋型特殊，並且所處天然環境嚴苛，本廠於 112 年特別納入磁漏性檢測法，針對揚清橋有疑慮之鋼纜系統實施總體檢，以有效確保橋梁結構安全，降低用路風險，達成供電穩定目的。

Abstract

The unfortunate collapse of the Nanfang'ao Bridge in 2019 aroused the Taiwan people's attention to the inspection of special bridges. However, most steel cable systems of domestic bridges use the "Ambient Vibration Test" method (relatively mature) for measurement. Although the aforementioned method can determine whether the cable force is abnormal, it cannot accurately locate the damaged position of the steel cable and simulate the damage behaviors. Therefore, the "Magnetic Flux Leakage" (MKL) method that has been widely used in the field of metal processing has become the dawn of overcoming the above technical problems. The MKL method uses a permanent magnet to magnetize the steel cable to generate a leakage magnetic field at the defect location, and then use a sensor to receive and analyze it. The damage to the steel cables tested this time all complied with the DIN EN12927 standard. Although there have been cases abroad where MKL method has been used to evaluate the integrity of steel cables in bridge buildings, the method has rarely been used in Taiwan. In view of the special structure of the Yangqing Bridge and the harsh natural environment, we specially incorporated MKL method in 2023 and carried out an overall inspection of the steel cable system of the Yangqing Bridge to ensure the safety of the bridge structure, reduce the risk of road use, and achieve the purpose of stable power supply.

關鍵詞(Key Words)：鋼拱橋(Steel Arch Bridge)、鋼纜(Steel Cable)、橋梁檢測(Bridge Inspection)、磁漏性檢測法(Magnetic Flux Leakage, MFL)。

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核種特性對劑量評估的影響研討

Study on the Impact of Nuclide Characteristics on Dose Assessment

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摘 要

本研究以定濃度源和脈衝源的邊界條件，考量核種吸附作用與衰變作用，建立一維核種遷移方程式，並以國際間常用的處置安全評估程式-GoldSim 進行驗證。以案例探討衰變鏈核種比活度受吸附作用與衰變作用的影響，發現(1)當母核種與子核種具相同的遷移特性(即相同的擴散特性與吸附特性)時，母核種與子核種的長期平衡或瞬時平衡關係不會受遷移特性影響；(2)在相同比活度發生時間(t_a)前，母核種的比活度會大於子核種的比活度，在此時間之後，則子核種比活度會高於母核種比活度，相同比活度發生時間(t_a)不會因距離而異。此外，參考我國低放射性廢棄物主要核種清單與活度，並納入各核種衰變鏈以探討總活度與劑量率變化影響，分析結果顯示核種吸附作用將改變貢獻主要活度與主要劑量的核種排序，並改變最大活度發生時間與最大劑量發生時間的關係。

Abstract

This study uses the boundary conditions of the constant concentration source and the pulse source, considers the adsorption and decay effects of nuclide, establishes a one-dimensional nuclide migration equation, and verifies it with GoldSim, a commonly used international disposal safety assessment software. A case study was conducted to explore the influence of adsorption and decay effects on the specific activity of decay chain nuclides. It was found that (1) when a parent nuclide and a daughter nuclide have the same migration characteristics, i.e., the same diffusion and adsorption characteristics, the secular or transient equilibrium between the parent nuclide and daughter nuclide will not be affected by migration characteristics; (2) before the same specific activity occurrence time (t_a), the specific activity of a parent nuclide will be higher than the specific activity of a daughter nuclide. After t_a , the specific activity of the daughter nuclide will be higher than the specific activity of the parent nuclide, and t_a will not vary with distance. In addition, with reference to the nuclide list and activity of low-level radioactive waste in Taiwan, and incorporating the decay chain of each nuclide to explore the impact in total activity and dose, the analysis results show that the adsorption effect of nuclides will change the order of nuclides that contribute the main activity and main dose, and change the relationship between the maximum activity occurrence time and the maximum dose occurrence time.

關鍵詞 (Key Words)： 衰變鏈 (Decay Chain)、吸附作用 (Adsorption Effect)、衰變作用 (Decay Effect)。

核電廠嚴重事故模擬技術提升與爐心有燃料過渡階段 案例應用

Simulation Technology Improvement for Severe Accidents in Nuclear Power Plants and Case
Application Analyses for the Pre-defueled Phase

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摘 要

本計畫由台電公司核安處委託國家原子能科技研究院原子能系統工程研究所執行，計畫期程自 110 年 10 月 19 日至 113 年 10 月 18 日共計三年。本計畫主要進行核一、二、三廠 MAAP5 模式及用過燃料池模式更新，並進行爐心有燃料過渡階段案例應用分析，本計畫可增進嚴重事故模擬與事故處理能力，完整建立各種電廠狀態下的事故模擬分析技術，強化緊急計畫演習之內容，並提升電廠營運安全。

Abstract

This project was entrusted by the Department of Nuclear Safety of Taipower and implemented by the Nuclear System Engineering Office of the National Atomic Research Institute (NARI). The project period lasted for a total of three years, from October 19, 2021, to October 18, 2024, and has two main purposes. The first is to update the MAAP5 model and the spent fuel pool model for Chinshan, Kuosheng, and Maanshan nuclear power plants (NPPs), and the second is to conduct case application analyses for the pre-defueled phase. This project will help enhance nuclear power plants' capabilities in severe accident simulation and accident handling, establish comprehensive accident simulation analysis techniques under various power plant conditions, strengthen the content of emergency plan drills, and improve power plant operational safety.

關鍵詞(Key Words): 嚴重事故分析 (Severe Accident Analysis)、用過燃料池 (Spent Fuel Pool)、爐心有燃料過渡階段 (Pre-defueled Phase)、技術移轉訓練 (Technical Transfer Training)、模組化事故分析程式 5.06 版(MAAP5.06)。

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