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協三機鍋爐氮氧化物減排之優化燃調

Combustion Adjustment of Hsieh-Ho Unit 3 to Reduce NOx Emissions

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摘　要

協和發電廠肩負著台灣北部之供電重任，此外為了符合環保法規及善盡社會責任，電廠排放的氮氧化物(NOx)設有總量管制，因此公司希望於110年7月夏季來臨之前，協三機能預先經由鍋爐優化燃調，達成降低NOx排放量，即時提高可用供電量，電廠遂於110年5月起正式委託綜研所主導施行本項改善案。

考量COVID-19疫情嚴峻，本案規劃以遠距互動方式進行安全管制下的燃燒調控作業，由綜研所與協和發電廠組成燃調小組，歷經兩個月的共同努力，已分段達成高負載(455 MW)及低負載(150 MW)的De-NOx燃調任務; 最後獲得改善成果：(1)高載達到NOx減量13%(由153.1ppm降至133.2ppm)，低載達到NOx減量22.6%(由99.8ppm降至77.3ppm)，在空汙總量管制下每年可增加供電量; (2)達成與增設FGR設備之相同成效(即NOx減量10%~15%)，可樽節新台幣3.6億元巨額設備投資費用，有形效益極為顯著。

Abstract

Hsieh-Ho power plant is obliged to maintain stable power supply of Northern Taiwan. Nevertheless, the restriction of total nitrogen oxides (NOx) emission by regulations forms a ceiling on its generation output. To reduce NOx emission and thus increase generation output, Taipower embarked on optimizing the combustion adjustment of the boiler of Hsieh-Ho unit 3 and looked forward to accomplishing the project by 2021 summer. The project was handed to Taiwan Power Research Institute (TPRI) in May 2021.

Considering the severity of the COVID-19 epidemic, the combustion adjustment was carried out in a remote and interactive way. After two months' joint efforts, the team comprised of TPRI and HPP successively accomplished the De-NOx combustion adjustment of high load (455 MW) and low load (150 MW) De-NOx combustion adjustments. Namely, NOx reduction of high load 13% (from 153 ppm to 133 ppm) and low load 23% (from 100 ppm to 77 ppm). As a result, the generation output of the plant has since then increased. In short, this project achieved the same effect of investing on FGR equipment to achieve 10%~15% NOx reduction, and saved 360 million NTD expenditure, not to say the elevated generation output. The benefits are extremely significant.

關鍵詞(Key Words)：燃燒器均流(Burner Balancing)、燃燒調整(Combustion Adjustment)、氮氧化物(NOx)、煙氣再循環(Flue Gas Recirculation)。

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回頁首

電力變壓器內部故障初期診斷方法研討

Study on Initial Diagnosis Method for Internal Faults of Power Transformers

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摘　要

電力變壓器正常運作與否關係到電力系統運行的可靠性與安全性，因此在電力變壓器內部故障初期診斷出絕緣劣化是一個很重要的課題，本文依IEEE Standard C57.104-2019 DGA解釋流程圖來判斷DGA目前屬於何種狀態、需採取何種措施，再以日本電氣協會-主導氣體類型診斷法則，來判斷為何種故障屬性，最後以線上局部放電超高頻感測器診斷變壓器內部是否放電現象，能早期預知變壓器的缺陷，以防患發生停電事故於未然，未來期盼能利用人工智慧與大數據分析輔助故障診斷決策系統，更能提升判斷準確度。

Abstract

Normal operation of transformers is crucial to the reliability and safety of power system. Therefore, it is a very important to diagnose insulation deterioration of the internal faults of transformers at an early stage. In this study, we abide by IEEE's Standard C57.104-2019 DGA interpretation flow chart to judge the state of DGA and seek for measures to be taken, and the leading gas type diagnosis rule of Japan Electric Appliance Association to determine the fault attribute. Finally, we use online partial discharge ultra-high frequency sensors to diagnose whether there is a discharge phenomenon inside the transformers to foresee the defects before the occurrence. In the future, we look forward to applying the said analytical methodology of artificial intelligence and big data to assist fault diagnosis and decision-making, as well as raising the accuracy of judgment.

關鍵詞(Key Words)：局部放電(Partial Discharge, PD)、油浸式電力變壓器(Oil-immersed Power Transformer)、可燃性氣體總量(Total Combustible Gas, TCG)、油中溶解氣體分析(Dissolved Gas Analysis, DGA)、超高頻感測器(Ultra-High Frequency, UHF Sensor)、相位解析局部放電圖譜(Phase Resolution Partial Discharge, PRPD圖譜)。

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論美國分散式能源資源之電力市場競爭政策及法規

Study of Market Competition Policy on FERC's Orders Aiming for Distributed Energy Resources

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摘　要

本研究旨在探討因應需量反應與儲能系統等分散式能源資源之技術進步，美國與時俱進所制定的相關政策法規，並藉由案例分析，了解其中可供我國學習參考之電力市場競爭政策意涵。首先、說明聯邦能源管制委員會所增訂或修改之需量反應與儲能系統相關行政命令，其次探討行政命令所衍生之相關案例與爭議。最後，從分散式資源整合的角度，觀察公用事業微電網計畫的公平交易機制。藉此了解在引進此種新興潛在競爭者過程中，美國電業管制機關如何制定配套措施，降低電力市場的不確定性，以維護電力市場自由及公平競爭。

Abstract

In views of the technology progress of distributed energy resources (DERs), e.g., demand response and energy storage system, the article aims to explore the recent regulations of USA and their implications for Taiwan, from the perspective of market competition policy. We first explore the orders issued by the Federal Energy Regulatory Commission (FERC) regarding demand response and energy storage system, and select some of the cases for discussion. In terms of the integrated resource planning of DERs, we study on the fair-trade mechanism of SDG＆E's microgrid project and the supporting measures adopted by FERC, to ensure fair competition and reduce uncertainty on electricity market when introducing potential competition into the markets.

關鍵詞(Key Words)：分散式能源資源(Distributed Energy Resources)、需量反應(Demand Response)、儲能系統(Energy Storage System)、聯邦能源管制委員會(Federal Energy Regulatory Commission)、競爭政策(Competition Policy)、潛在競爭(Potential Competition)。

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回頁首

台電公司高雄區營業處氣候變遷調適研究

A Study on Climate Change Adaptation Strategies for Kaohsiung District Office of Taipower

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摘　要

全球氣候變遷預期將增加極端氣候災害發生的頻率及強度。電力設施是重要民生設施，一旦遭受氣候變遷衝擊而損害，不但會造成產業、社會經濟等嚴重傷害，更將影響人民生活品質。台灣電力公司是我國最主要的電力供應者，也是唯一的綜合電業業者，為降低氣候變遷對電力系統之衝擊，確保電力穩定供給，本文以用電戶數偏高之台電公司高雄區營業處作為研究對象。

首先透過風險辨識由原先的24項氣候衝擊項目篩選出12項進行災害潛勢分析，並從中彙整最具衝擊的9項進行各項設施的危害度與脆弱度評估，接續針對此9項氣候衝擊下各項設施之風險評估結果，得知風險等級3(含)以上之設施，於二次變電所及調度中心有4項氣候衝擊；高壓饋線有4項氣候衝擊，並提出對應的調適策略。最後透過上述評估，提出高雄區營業處之調適建議方案，其結果可作為後續其他配電單位平行展開之參考。

Abstract

Extreme weather caused by global climate changes is will leading to the increase of the frequency and intensity of natural disasters. Damages eElectric power infrastructure damages caused by climate changes not only result in serious industrial and economic impacts, but also quality of human life. As a state-owned and vertically integrated electric utility in Taiwan, Taiwan Power Company is responsible for ensuring domestic stable power supply. To ensure the aforesaid goals, Kaohsiung District Office, owning the largest number of households, was selected as the target of this research.

In this study, we first identify 12 items out of 24 potential items susceptible to climate impacts; then, select 9 major items to further assess their vulnerability and risk to decide which are the high-risk facilities. As the results of the study indicate, secondary substations, dispatching centers, and high-tension poles are susceptible to respectively four kinds of major climate impacts. It is expected that the results of this study along with the countermeasures may serve as reference for the other district offices.

關鍵詞(Key Words)：氣候變遷(Climate Change)、二次變電所(Second Substation)、高壓饋線(High Tension Poles)、危害度(Hazard)、脆弱度(Vulnerability)、風險評估(Risk Assessment)、調適策略(Adaptation Strategy)。

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EPDM 回收再利用-人手孔蓋之抗滑塗層方案開發

Application of EPDN Recycling- Anti-skid Coating Solution for Manhole Cover

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摘　要

台電公司近年持續推動循環經濟發展，如:電廠煤灰或退役電力設備資源再利用，並發展台電文創、海洋牧場等，以可延續使用生命，創造循環經濟價值為主要預期。現今在電力系統中，相當多的材料都需具有高機械性、電氣性、耐熱性與衝擊強度等特性，故現今高分子材料技術皆追求前述特性，並將該材料應用於電力系統需求中。在大量使用這些材料所開發出來相關的電器設備時，例如：風機葉片、高分子礙子、遮蔽用的被覆罩等器材。其相對應的回收或是環保技術卻尚未及時跟上腳步，目前對於熱固樹脂廢棄物尚未開發出有效的回收技術，通常只能透過掩埋和焚燒來處理，惟會產生環境污染和資源損耗等問題。同時全球因資源再生和環境保護意識提高，各國勢必得發展相關的回收技術來面對。本篇針對配電系統中，高壓肘型插頭用料EPDM進行工程再應用之測試。

Abstract

In recent years, Taipower continues promoting circular economy, e.g., reuse of coal ash from power plants and decommissioned electric equipment, cultivating cultural and creative activities, engaging in ocean ranch R&D, etc. Modern power systems are highly mechanical, electrical, heat-resistant and impact-proof. As we can see, polymer material and its related technologies have been used widely in today's power systems, fan blades, polymer barriers, covering covers for shielding-you name it. Nevertheless, the corresponding recycling and environmental protection technologies fail to keep up. For example, effective recycling technology for thermosetting resin wastes is not yet at hand. The said wastes can only be dealt with by landfilling and incineration-causing serious environment pollution and also a waste of resources. At the same time, due to the raising awareness of resource recycling and environmental protection, worldwide countries have no other way but to develop relevant recycling technologies to deal with the situation. This article aims to introduce the engineering re-application test of EPDM for high-voltage elbow plugs of distribution systems.

關鍵詞(Key Words)：循環經濟(Circular Economy)、熱固性高分子(Thermosetting Polymers)、三元乙丙橡膠(EPDM)。

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回頁首

台電公司與民營電廠購售電合約續約探討

Renewing the Power Purchase Agreements between Taipower and Independent Power Producers

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摘　要

政府為因應劇增之電力需求，自民國84年起陸續推動開放民營電廠設置政策，適時為電力市場提供穩定可靠電力來源。然而，各階段與民營電廠簽訂之購電合約自113年起將陸續到期，考量近年來各家民營電廠仍持續致力於提升機組發電效率及環保設備減排精進改善，加上台灣土地資源有限，不易開發新廠址興建電廠，既設民營電廠之廠址及電源線路乃珍貴資源，台電公司除應及早研議與購售電合約屆期之民營電廠續約事宜外，同時應適時檢討開放新民營電廠以達成穩定供電之政策及台電公司永續經營目標。爰此，本文將深入探討台電公司既有購電合約續約及新機組購電作業策略規劃，以提供台電公司購電策略之參酌依據。

Abstract

To cope with increasing electricity demand and to maintain stable power supply, the government started to promote Independent Power Producers (IPPs) in 1995. However, the PPAs that Taipower signed with IPPs at various stages will successively expire starting from 2024. In recent years, IPPs have improved their generation efficiency and pollution emission in view of environmental protection. Moreover, due to Taiwan's limited land resource, it is not easy to develop new sites to construct power plants. As a result, the plant sites and power lines of existing IPPs are considered precious resources. In addition to discussing PPA renewal with IPPs, Taipower shall review the possibility of establishing new IPPs to maintain stable power supply and sustainable business operation of the company. This study aims to explore the issues and strategic planning of PPA renewal and recruiting new PPAs to serve as reference for Taipower in formulating power purchase strategy.

關鍵詞(Key Words)：民營電廠(Independent Power Producer, IPP)、購售電合約續約(Renewal of Power Purchase Agreement)、購電策略(Power Purchase Strategy)。

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低放建議候選場址母岩(硬頁岩)吸附特性研討

Study on the Adsorption Characteristics of LLW Candidate Site Host Rock (Argillite)

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摘　要

本研究研析國內進行台東縣達仁鄉建議候選場址處置母岩(硬頁岩)吸附研究成果，並探討國內進行核種吸附實驗的相關程序。實驗操作方面，吸附實驗樣品不建議高溫烘乾以避免質變、岩樣粒徑應有一致範圍以利成果比較、固液比依ASTM D4319的建議值維持為0.25，並以動力吸附實驗搭配即時動力吸附模式擬合和非線性回歸檢驗分析，以確認實驗吸附平衡所需時間。硬頁岩吸附實驗顯示，南田地區硬頁岩主要由石英(Quartz)和雲母(Muscovite)等礦物組成；比表面積介於6.44至11.20 m^2/g；陽離子交換容量介於6.33×10^{-5}至27.7×10^{-5} eq/g。南田地區水質氧化還原電位介於-4.9 mV至43.7 mV；酸鹼值介於6.8至7.88。單核種的吸附Kd值：Cs核種平均為22.0 mL/g、Co核種平均為399.1 mL/g至2513.7 mL/g、Sr核種平均為10.3 mL/g；核種競合的吸附Kd值：Cs核種平均為19.5 mL/g、Co核種平均為210.6 mL/g至2762.3 mL/g。台東縣達仁鄉建議候選場址的母岩與地表水特性符合『低放射性廢棄物最終處置設施場址禁置地區之範圍及認定標準』第4條之地球化學條件。

Abstract

This study aims to analyze the domestic researches on the adsorption of host rock (argillite) at the candidate site of Daren, Taitung, and discuss the operating procedures of nuclide adsorption experiments. Regarding the operating procedures, we recommend adsorption experiment samples not to be dried at high temperatures to avoid qualitative changes. The particle size of the rock samples shall have a consistent range for comparison results. The solid-liquid ratio shall be maintained at 0.25 according to the recommended value of ASTM D4319. The equilibrium time may be confirmed by dynamic adsorption experiments with real time kinetic adsorption model fitting and non-linear regression test. Adsorption experiments show that the argillite in Daren is mainly composed of quartz and muscovite; the specific surface area ranges from 6.44 to 11.20 m^2/g; the cation exchange capacity ranges from 6.33×10^{-5} to 27.7×10^{-5} eq/g. Besides, the redox potential of surface water of Daren ranges from -4.9 mV to 43.7 mV; the pH value ranges from 6.8 to 7.88. The average Kd value of single nuclide is 22.0 mL/g of Cs, 399.1 mL/g to 2513.7 mL/g of Co, and 10.3 mL/g of Sr. For competing experimental results: 19.5 mL/g of Cs and 210.6 mL/g to 2278.1 mL/g of Co. The geochemistry characteristics of host rock and surface water of Daren satisfy the requirements of "Guidelines for Restriction Areas of Low-level Radioactive Waste Final Disposal Facilities".

關鍵詞(Key Words)：建議候選場址(Candidate Site)、硬頁岩(Argillite)、核種(Nuclide)、吸附(Adsorption)。

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