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金門地區儲能系統及再生能源併網量情境解析

Scenario Analysis of the Energy Storage System and Renewable Energy Grid Connection Demand in Kinmen

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摘 要

本研究預估 113 年 Q4 時 PV 最高出力相較於 112 年將增加 8.57MW，而 113 年冬季中午平均負載相較 112 年則僅增加 1.3MW；且 113 年長效型儲能將有 4MW/24MW 併網。面對此複雜之運轉情況，台電公司須預為因應。研究結果表明：若 113 年冬季午間時段負載為 32.7MW，現有短效型儲能 I+III 期(合計 4MW/2MWh)可滿足 N-1 需求。3 部 4MW 柴油機組搭配長效型儲能 II+IV 期(合計 5.8MW/34.8MWh)可滿足 113 年 Q4 之再生能源併網需求。

Abstract

According to the estimates of this study, the maximum PV output in the fourth quarter of 2024 in Kinmen (the same below) will increase by 8.57MW compared to 2023, the average load at noon in winter in 2024 will only increase by 1.3MW compared to 2023, and there will be 4MW/24MWh long duration energy storage system (ESS) connected to the grid in 2024. Faced with this complex operating situation, Taipower must respond in advance. As the study results show, if the load is 32.7MW during the noon period in the winter of 2024, the existing short duration ESS I+III (4MW/2MWh) can meet the situation of N-1 contingency. Three 4MW diesel units paired with long duration ESS II+IV (5.8MW/34.8MWh) can meet the renewable energy grid connection demand in the fourth quarter of 2024.

關鍵詞(Key Words)：儲能系統(Energy Storage System, ESS)、短效型儲能(Short Duration ESS)、長效型儲能(Long Duration ESS)、再生能源(Renewable Energy)。

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儲能系統對配電饋線最大可併網容量之衝擊分析

Impact of Energy Storage Systems on the Maximum Hosting Capacity of Distribution Feeders

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摘 要

台電公司調度處計劃在 114 年達到 1GW 的儲能系統容量目標。透過大量儲能併聯電力系統，提供快速充放電能力以進行調頻輔助服務及削峰填谷，維持系統安全穩定。由於目前設置之儲能系統多併聯於配電系統上，需考量其對配電饋線的影響，方可確保配電系統穩定運轉。本文研析適當的儲能併網策略，並參照調度處自動頻率控制輔助服務的充放電曲線及運轉現況，建立儲能系統充放電功率推估模型。分析在不違反電壓幅度、電流、反向功率流、總線損及總電壓偏差等限制下，計算饋線的最大可併網容量，據以評估儲能系統對配電饋線的影響。此成果可作為區營業處評估儲能充放電併網容量的參考範例。

Abstract

The Dispatch Center of Taipower plans to reach the target of 1 GW energy storage system (ESS) capacity by 2025, so as to provide rapid charging and discharging capabilities through a large number of ESSs connected to the power system to provide services such as frequency regulation, peak-shaving and valley-filling to maintain system security and stability. Since most of the ESSs currently installed are connected to the distribution system, their impact on the distribution feeders needs to be considered to ensure stable operation of the distribution system. This project aims to analyze appropriate ESS grid connection strategies , and establish an ESS charging and discharging power estimation model (calculate the maximum grid connection capacity of each feeder without violating the limits of voltage magnitude, current, reverse power flow, total line loss and total voltage deviation) with reference to the charging and discharging curves and operating status of the ancillary service of automatic frequency control (AFC) provided by the Dispatch Center to evaluate ESS's impact on distribution feeders. The results of this project may serve as a reference for the District Business Offices to evaluate the maximum hosting capacity of distribution feeders.

關鍵詞(Key Words)：儲能(Energy Storage)、配電系統(Distribution System)、可併網容量(Hosting Capacity)、調頻輔助服務(Ancillary Service of Frequency Regulation)、系統衝擊分析(System Impact Analysis)。

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全球氫能技術發展及電力系統應用

The Development of Global Hydrogen Energy Technology and Its Application in Power Systems

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摘　要

本研究對全球氫能技術發展，如綠氫生產、綠氨生產、氫氣輸儲及燃燒發電等領域進行標竿案例研究，彙整各領域案例的發展現況、未來展望及產生的效益，提出全球氫能發展趨勢觀測。研究顯示：(1)目前綠氫生產(電解產氫)發展規模已達百萬瓦等級，預計 2030 年前可擴大至百萬瓩等級，並以鹼性及質子交換膜電解技術為市場主流。(2)綠氨生產多數與綠氫生產整合，澳洲將是未來全球主要綠氨出口國，預計 2030 年後可大量出口綠氨。(3)各國根據地理位置及資源特性發展各自不同的氫能輸儲模式，歐陸國家以管線為主，亞太國家則以海運建立跨國氫能供應鏈。(4)各國針對氫氨混燒發電推動數個示範驗證計畫，現役機組目前安全且可行的氫氨混燒比例介於 20~30%，若要提升混燒比例，現役機組必須進行改造與更新。

Abstract

This study first conducts benchmark case studies on issues related to the development of global hydrogen energy technology, including green hydrogen production, green ammonia production, hydrogen transportation and storage, and combustion power generation; then summarizes the current development, future prospects and expected benefits of relevant cases in each field; and finally puts forward the observations of global hydrogen energy development trends.

As the study results show, the current development scale of green hydrogen production (electrolysis) has reached the MW level, and is expected to expand to the GW level by 2030, with alkaline and proton exchange membrane electrolysis technologies as the market mainstream. Next, most green ammonia production is integrated with green hydrogen production. Australia will be the world's major green ammonia exporter in the future and is expected to export a large amount of green ammonia after 2030. In addition, countries develop different hydrogen transmission and storage models based on geographical location and resource characteristics. European countries mainly rely on pipelines, while Asia-Pacific countries establish transnational hydrogen supply chains through sea transportation. In summary, various countries have promoted several demonstration and verification projects for co-firing power generation. The current safe and feasible co-firing ratio of active unit is between 20% and 30%. To increase the co-firing ratio, existing units must be modified.

關鍵詞(Key Words)：氫(Hydrogen)、氨(Ammonia)、混燒(Co-firing)。

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回首頁

161kV 深美~世貿~虎林線#12 鐵塔主柱補強、鐵塔包建、增設臨時橫擔驗證案例

Case Sharing of 161kV Shinmei~Shimao~Hulin #12 Tower Main Post Reinforcement, Surround Build Tower, and Temporary Cross Arm Construction

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摘 要

一般兩回線輸電鐵塔包建更換施工，分為兩回線同時停電施作或採單回線輪停 3 次方式辦理，現今常因電力系統潮流負載及風險評估因素，致採兩回線同時停電進行鐵塔更換工作之可行性，已是微乎其微不可行，僅能退而求其次以單回線輪停方式施工，以確保供電系統安全。鐵塔於包建過程中，發生既設鐵塔與新設包建鐵塔主柱材相互衝突，無法繼續包建工作，經與設計部門及承攬商研擬對策及應變方案，決定採增設臨時橫擔方式，於世貿側安裝臨時單回線供電，接續拆除既設鐵塔衝突部分，並協商增加 2 次單回線停電，俾使鐵塔包建工作順利完竣。

Abstract

Generally speaking, there are two ways for the replacement construction of two-circuit transmission towers. One is to cut off the power for both circuits at the same time, and the other is to cut off each circuit line three consecutive times. Nowadays, due to power flow and risk assessment factors, it is almost impossible to cut off both circuits at the same time. The only alternative is to use a single-circuit rolling outage method to ensure stable power supply. During the course of this project, the existing tower and the main post of the new contracted tower conflicted with each other, making it impossible to continue the construction work. After discussing countermeasures and contingency plans with the design department and the contractor, it was decided to install a temporary cross arm on the side of the World Trade Center as a temporary single-circuit power supply to remove the part that conflicted with the existing tower, and negotiated to add 2 single-circuit power outages so that this project can be successfully completed.

關鍵詞(Key Words)：包建鐵塔(Surround Build Tower)、兩回線輸電線路鐵塔(Two-circuit Transmission Line Tower)、鋼心鋁絞線(Aluminum Conductor Steel Reinforced)、最大工作張力(Maximum Working Tension)、等高弛度(Equal Height Sag)。

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輸電鐵塔之環境風場數值模擬研析

Numerical Simulation Analysis of the Environmental Wind Field of Transmission Towers

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摘 要

輸電鐵塔的穩定性容易受到風力、地震力或邊坡災害等外在環境因素威脅，因此，必須於建造前之設計階段事先採取嚴謹評估環境因素可能對鐵塔產生的作用力大小，以避免鐵塔受外力作用後，發生鐵塔構件挫曲變形或損壞倒塌；其中有關環境風場作用在鐵塔上的風力大小，目前雖已有設計標準可依循，然而現今氣候漸趨極端，實有必要重新評估並檢視現行的設計標準是否仍足以抵抗極端氣候下的風力。

因每座鐵塔所處位置和地形均不盡相同，所承受的風力勢必多少會有所差異，故本研究採較保守之評估方式，挑選 19 處位於氣候衝擊敏感區之鐵塔進行環境風場模擬分析，模擬方式係採用數值模擬分析套裝軟體，模擬結果除可用於評估極端風力下之鐵塔受風力大小是否可能超出設計標準之外，亦可同時了解地形環境對於鐵塔受風力之影響為何。

Abstract

The stability of transmission towers is easily threatened by external environmental factors such as wind forces, seismic forces, or slope disasters. Therefore, it is essential to rigorously assess the force that environmental factors may exert on the tower during the design phase before construction to prevent the tower components from buckling, deformation, or collapse due to external forces. Regarding the wind force acting on the towers, there are currently design standards to follow. However, as the climate is becoming more and more extreme, it is necessary to re-evaluate whether the current design standards are still sufficient to withstand the wind forces under extreme weather conditions.

As the location and terrain of each transmission tower are different, the wind forces it withstands will vary. Thus, this study adopts a more conservative evaluation approach and selects 19 transmission towers located in climate impact sensitive areas for environmental wind field simulation analysis (using numerical simulation analysis software). The simulation results can be used to evaluate the magnitude of the wind force on the transmission towers under extreme wind conditions (whether it may exceed the design standards), and help to understand the impact of the terrain environment on the wind forces and the transmission towers.

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)。

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台中電廠七號機 BFPT 調節級葉片斷裂之破損分析

Fracture Analysis of #7-1 BFPT Regulating Stage Blade of Taichung Power Plant

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摘 要

台中電廠#7-1 BFPT 調節級葉片發生斷裂事故，此為相同機型之首例，影響機組發電效率，故進行破損肇因分析。針對台中電廠#7-1 BFPT 調節葉片，收集相關設計、運轉資料，經尺寸量測及實體三維模型建立後，進行材料機械性質檢驗、金相分析、模態測試、力學分析及材料破損分析，最後研判腐蝕疲勞破壞為造成整起事件的根因。

Abstract

Earlier, a breakage accident occurred in the #7-1 BFPT regulating stage blade of Taichung Power Plant (the first of its kind). Since it affected the power generation efficiency of the unit, we conducted an analysis of the cause of the damage. After collecting relevant data on the design and operation of the #7-1 BFPT regulating blade of Taichung Power Plant, and after dimensional measurement and establishment of a physical three-dimensional model, we conducted material mechanical property inspection, metallographic analysis, modal testing, mechanical analysis and material damage analysis, and finally determined that corrosion fatigue damage was the root cause of the entire incident.

關鍵詞(Key Words)：鍋爐飼水泵驅動汽輪機 (Boiler Feed Pump Turbine)、破損分析(Fracture Analysis)、有限元素法(Finite Element Method)、腐蝕疲勞破壞(Corrosion Fatigue Damage)。

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核一廠高燃耗用過核子燃料特性程式分析

High Burnup Spent Nuclear Fuel Characteristic Analysis of Chinshan Nuclear Power Plant

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摘 要

本研究主要探討核一廠爐心不同運轉模式對高燃耗燃料特性之影響。首先，利用爐心模擬程式取得代表燃料棒之爐心運轉功率歷史，再利用核子燃料行為分析程式(FRAPCON-4.0)進行計算，以取得相關燃料特性數據，包含燃料護套氫含量、燃料護套氧化層厚度、燃料棒內壓、分裂氣體釋出率及護套環向應力等。分析結果顯示護套氫含量與護套氧化層厚度會隨著累積燃耗增加而增加，然而不同的運轉模式會導致燃料棒即使在較低的總累積燃耗情況下，其分裂氣體釋出率、燃料棒內壓及退出至用過燃料池的護套最大環向應力都有可能較高之情況。

Abstract

This study mainly discusses the influence of different operation modes on the high burnup fuel characteristics of Chinshan Nuclear Power Plant. First, we use the core simulation program to obtain the history of the in-core operation modes of the high burnup fuel rod, and then apply the fuel behavior analysis program (FRAPCON-4.0) to calculate and obtain relevant fuel characteristic data, including the hydrogen pickup of cladding, the oxide thickness of cladding, the internal pressure of the fuel rod, the release rate of the fission gas, and the cladding hoop stress in the spent fuel pool. The analysis results show that the hydrogen pickup and oxide thickness of cladding will increase as the cumulative fuel rod burnup increases. However, different operation modes (even at a lower total cumulative burnup) might result in higher fission release rate, internal pressure of the fuel rod and cladding hoop stress.

關鍵詞(Key Words)：高燃耗燃料特性(High Burnup Fuel Characteristics)、核燃料程式分析(Nuclear Fuel Code Analysis)、爐心運轉模式(In-core Operation Modes)。

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核電廠爐心填換分析驗證與用過核子燃料營運相關技術發展

Analytical Verification of Nuclear Power Plant Core Reload and Technological Development Related to Spent Nuclear Fuel Back-end Management

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摘 要

為確保核電廠的爐心營運安全，台電公司一直致力於自主分析技術的建立與發展、保有一套獨立於廠家的爐心營運分析程式集。每個填換燃料週期都進行爐心設計獨立驗証，確認所有爐心設計安全參數都符合設計限值，而且符合運轉安全規範，確保燃料廠家每個填換燃料週期設計安全無虞。

本計畫除了完成各個核電廠每一個週期填換燃料爐心設計的平行驗證工作外，其他相關成果包括：建立核三廠升降載控制棒位預測系統、完成核三廠停機前二週期爐心燃料佈局策略評估、完成核三廠 BEACON 系統研究並建立自主 PWR 爐心監測系統、擴大支援用過核燃料後端營運工作、臨界分析技術擴大應用於用過核燃料處置設施等。此外，亦多次運用分析技術支援電廠運轉緊急需求。

Abstract

To ensure the safety of core operation in nuclear power plants (NPPs), Taipower has been committed to the development and establishment of independent analysis technology to maintain a set of core operation analysis programs independent of the vendors. Core design is independently verified for each fuel reload cycle to confirm that all core design safety parameters meet the design limits and comply with the operating safety specifications to ensure that the design for each fuel reload cycle is safe.

In addition to completing the parallel verification of the core design for each cycle of each nuclear power plant, other achievements of this project include: (1) developed a control rod position prediction system for the third (Maanshan) NPP; (2) completed strategic assessment of the core fuel layout in the final two cycles before the shutdown of Maanshan NPP; (3) completed the BEACON system study and developed an independent PWR core monitoring system for Maanshan NPP; (4) expanded the support for spent nuclear fuel back-end operation; (5) expanded criticality analysis technology to spent nuclear fuel disposal facilities. Besides, analysis technology had been applied many times to support emergency needs of power plant operation.

關鍵詞(Key Words)：爐心設計(Core Design)、用過核燃料(Spent Nuclear Fuel)、後端營運(Back-end Management)。

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