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# 秀姑巒溪流域水文與水力蘊藏量分析整合資訊平台之建置

Development of Integrated Platform for Hydrological and Hydropower Potential Analysis in Xiuguluan

## River Basin

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## 摘要

本研究目的乃應用開放原始碼地理資訊系統，整合地形分析、水文學，以及水力學理論，建置「秀姑巒溪流域水文與水力蘊藏量分析整合資訊平台」。研究中以同時具備發電、給水、防洪、灌溉等多目標之秀姑巒溪流域為研究範圍，透過水文紀錄與自動化分析模組之連結，使用者即可以滑鼠點選流域範圍內河川網路上任一位置點，進行集水區之雨量分析、流量分析、水庫壩址可能最大洪水分析、崩塌地分析、水力蘊藏量分析、流量-水位率定曲線、流量-含砂量率定曲線推求等各項水文與水力分析工作，相關計算成果可與空間資料進行整合分析，直接於地圖上展示各類訊息，而各項計算模組均提供友善的GIS空間操作介面，可降低傳統水文水理分析的繁瑣程序。本系統可提供省時且精確的方式，以進行水力蘊藏量開發規劃與維護管理。

## Abstract

The purpose of this study is to develop an integrated information platform for hydrological and hydraulic analyses in the Xiuguluan River Basin. The platform was developed using an open source geographic information system, which integrates terrain analysis, hydrology analysis, and hydraulic analysis. This pilot study covers the consideration of hydropower generation, water supply, flood control, and irrigation through the linkage between hydrological records and designed analysis modules. By using a mouse, users can select any point on the river network within the watershed, and perform rainfall analysis, flow analysis, probable maximum flood analysis, landslide analysis, hydropower analysis, discharge-stage analysis, and discharge-concentration analysis. The analysis results of this system can be integrated with spatial data to display different kinds of information directly on the platform. Each analysis module provides a user-friendly GIS operation interface, which is designed to reduce complex procedures usually found in a conventional hydrological analysis. This integrated system provides a precise and time-saving way to be used for new hydropower development, maintenance and management.

**關鍵詞(Key Words)：**水力發電(Hydropower Generation)、水力蘊藏量(Hydropower Potential)、開放原始碼(Open Source)、地理資訊系統(Geographic Information System)。

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# TAPEX 系集預報實驗於短波輻射預報之應用

Application of TAPEX Ensemble Forecasting Experiment to Short-Wave Radiation Prediction

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## 摘要

政府為加速能源轉型，訂立2025年將再生能源發展目標提升至各類能源總發電量的20%，並以風力發電與太陽能發電為推廣主力，其中太陽能光電預計2025年達到20GW的裝置容量(原6.2GW)，為增加幅度最高的再生能源。由於主控太陽能發電的太陽輻射，因無法操控而難以調度，且太陽輻射容易受天氣系統影響，使得預估發電量的不確定性提高，增加電力調度的困難性。因此，發展能夠準確預測太陽輻射量的技術，對於供電網的電力調度非常重要。本研究嘗試使用數值天氣預報模式，挑戰太陽輻射預報。考量大氣系統的隨機性及為了降低數值天氣預報的不確定性，本研究採用系集預報技術，針對主要影響太陽能發電的短波輻射進行預報，並透過分析與研究選取優化之模式組合，發展優化技術，期望增加太陽輻射預報的準確度，提供未來建置太陽光電出力預測系統，所需之長領前時間之氣象預報資訊。

## Abstract

In order to accelerate the energy transition, the government authorities concerned have been committed to the efforts of increasing renewable-based electricity to make its generation account for 20% of total system by 2025. Moreover, the development of renewable energy is designed to put emphasis on wind and solar power, and the government aims to reach a cumulative solar energy capacity of up to 20GW (the previous target being 6.2GW). The fact that the output of solar radiation is easily affected by the variability of weather results in the increased uncertainty in the forecast of renewable power generation. Therefore, using a technique which can predict the solar radiation more precisely is crucial for future power dispatching. In this study, a solar radiation forecast system is developed by leveraging the products of an Ensemble Forecast System, and the optimal members are selected based on the analysis and research. Through this study, it is expected that the accuracy of solar short-wave radiation forecast can be increased, which will provide a longer lead time of weather forecast to meet the operational requirement in the future.

**關鍵詞(Key Words)：**系集預報(Ensemble Forecast)、短波輻射預報(Short Wave Radiation Forecast)、太陽能發電(Solar Power)。

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# 系統全黑下林口超超臨界機組自主運轉之研究

A Study on the Autonomous Operation of Linkou Ultra-super Critical Unit

under Power System Blackout

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## 摘要

鑑於2017年8月15日全國分區輪流限電事件，本文審視台灣電力系統屬孤島電網，易受到大型機組跳脫等異常擾動造成電力系統頻率異常。當電力系統於頻率出現異常時，台灣電力公司依據『電力系統運轉操作章則』執行各項相對應之緊急應變措施，以防止電力系統因頻率劇烈變動等原因造成系統崩潰。若電力系統不幸淪於全黑情況下且短時間無法恢復電力供應時，林口電廠基於機組再次啟動時之輔助蒸汽需求及縮短故障恢復後的復電時間，全黑啟動機制之檢討成為無法迴避之課題。

本文探討在異頻下對機組之影響及保護機制，以及系統在全黑情況下林口電廠保留啟機用的輔助蒸汽之評估：分別為傳統的廠內用電運轉(House Load Operation)以及利用大潭電廠的全黑啟動機組轉供給林口電廠機組之廠內用電，透過以上兩種方式使林口電廠機組在全黑時能維持廠內最低負載運轉，以保留未來啟機用的輔助蒸汽源。

## Abstract

The nationwide power curtailment that occurred on 15 August, 2018 is an unforgettable event in Taiwan. Being an isolated island system, the electric power system in Taiwan is quite vulnerable to a tripping of the large power generation unit. Such kind of power unit tripping tends to lead to an abnormality in the power system frequency. When the power system is operating at an abnormal frequency, the Taiwan Power Company needs to take emergency measures in accordance with the "Power System Operating Criteria" so as to prevent the system from collapsing due to drastic frequency changes. In case the power system is unfortunately forced to turn to be a complete blackout and cannot be restored immediately, setting a proper mechanism for restarting the power system in a complete blackout will become extremely important for Linkou Power Plant.

This paper is intended to discuss the protection mechanism of the power unit under different frequencies, and the assessment of the auxiliary steam being used for unit start-up under system blackout. The discussion focuses on the traditional House Load Operation, and the use of Tatan Power Plant's blackout starter units to supply power to the Linkou Power Plant. With these two methods, it is expected that the Linkou Power Plant can maintain the minimum load in a blackout period, and preserve the auxiliary steam for future unit start-up.

**關鍵詞 (Key Words)：**電力系統運轉操作章則(Power System Operating Criteria)、全黑(Blackout)、廠內用電運轉 (House Load Operation)、汽機卸載(Load Rejection)、鍋爐孤島運轉 FCB(Fast Cut Back)、振動監視保護(VMAS)、主燃料跳脫 MFT(Main Fuel Trip)、分散式控制與資料收集系統(DCDAS)、重要馬達控制中心(EMCC-1B4A)。

# 輸電線路弱點及妨礙農耕改善經驗分享— 以 69kV 中港~潭子線#69~#73 工程為例

Experience Sharing in Improving the Weakness and Resistance of Farming for Pole in 69kV

Zhonggang~Tanzi Transmission Line

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## 摘 要

69kV 中港~潭子線之電桿設置已達 35 年之久，由於座落於農耕區，長期受水分及鹽分浸蝕，導致桿面腐蝕極為嚴重，對供電安全造成嚴重威脅，依據台電公司維護準則<sup>[1]</sup>規定必須予以汰換，以確保供電安全。

本案三座電桿(#70、#72、#73)改建面臨許多困難，例如水利用地無法取得、施工時間不足及地主抗爭等因素，且既設線路跨越私人土地，地主強烈要求移除，否則禁止台電公司進入施工，所幸透過溝通協調及施工技術得以克服萬難，最終取得民眾認同，建立公司良好形象。

## Abstract

The utility power pole in 69kV Zhonggang~Tanzi transmission line had been set up for up to 35 years. Since it was located in a farming area and long exposed to the water and salt, the surface of the power pole had corroded severely, thus threatening the safety of power supply. Based on the maintenance guidelines, it must be replaced to ensure the security of the power supply.

There were many difficulties encountered in the reconstruction of the three poles(#70、#72、#73), such as difficulties of land acquisition, lack of construction time, and problems of getting landowners' consent to allow construction. The original transmission line also crossed the private land, and the landlord strongly asked the pole to be removed. Otherwise, they may have stopped the Taipower company from entering the land to undertake construction. Fortunately, difficulties have been overcome through arduous efforts of communication and negotiation by Taipower, coupled with effective construction technology. In the end, it gained the public recognition and established good image of the TPC.

**關鍵詞(Key Words)**：輸電線路(Transmission Line)、電桿(Pole)、民眾抗爭(Civil Resistance)。

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# 發電機組模型參數驗證之法規研究

The Study of Generator Unit Model Parameter Validation Policy

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## 摘要

發電機組的模型建置及參數估測在電力系統中是十分重要的一個課題，因為建立的模型及其參數的正確與否關係著後續系統穩態、動態及暫態模擬分析的參考價值。此外，在考慮將來台灣電力系統可能進行廠網分離，發電廠及輸配線路的營運者都必須在運轉成本及系統穩定度中取得平衡，若是模型參數錯誤，將造成模擬及規劃上的錯誤，不但增加營運的成本還降低系統的穩定度。在本論文中，我們收集並比較發電機組模型參數驗證的規定或法規，並與國外專家學者交流相關執行經驗，藉此更深入了解發電機組模型參數驗證在執行上需要注意的事項及處理的方法。

## Abstract

Proper model establishment and parameters estimation for the generator unit, transmission line and transformer are quite important in the power system. This is because the reference value of a power system dynamic simulation and transient simulation is highly dependent on the correctness of the selected model and parameters. Besides, as the government of Taiwan is actively pushing for the deregulation of the electric sector, the future operators of the power generation, transmission and distribution system must achieve a good balance between financial benefit and power system stability. If the model parameters are not selected properly, that will result in incorrect system simulation and planning. Moreover, improper planning will not only lead to increased system operation costs but also adversely influence the power system operation stability. In this paper, we collect generator unit model parameters, compare them, validate them for this study purpose. We also discuss these programs with foreign experts for experience exchange in details.

**關鍵詞(Key Words)：**發電機組模型參數驗證(Generator Unit Model Parameter Validation)、動態模擬(Dynamic Simulation)、暫態模擬(Transient Simulation)。

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# 強化現行輔助服務估算機制及作業平台

Enhancement of Existing Ancillary Service Assessment Scheme and Operation Platform

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## 摘要

本研究對台電公司調度處先前所發展之「輔助服務估算機制及作業平台」進行功能強化研究，提供精進之分析模式及軟體，包括：短期負載預測、機組排程中投標機組數量及類別增加所需之數學模式、考慮網路安全之機組調度、競標決算程序步驟及相關報表建立等。本研究成果可做為台電公司擬定輔助服務成本估算機制及未來建立日前市場管理系統規格和架構的參考。本文對符合台電公司火力機組競價作業的資訊平台設計及所用的模式和測試結果做說明。

## Abstract

The goal of this research is to enhance and upgrade the functions of a power system operation analysis software - Ancillary Service Assessment Mechanism and Operation Platform - which was previously developed by System Operations Department (SOD) of Taiwan Power Company. The functions of the analysis software include short term load forecast (STLF), analytical models of different types of thermal bidding units, security constrained unit commitment (SCUC), market settlement procedure and clearing. The delivered system could serve as a platform for the system operators to assess the ancillary service costs and work out the required functional specifications for day-ahead market management system. In this report, the design of the platform that meets the need of a bidding scheme for TPC's existing thermal units is presented. The models used are elaborated on and test results are provided.

**關鍵詞(Key Words)：** 日前市場 (Day-Ahead Market)、負載預測 (Load Forecast)、機組排程 (Unit Commitment)、安全分析 (Security Analysis)、輔助服務 (Ancillary Services)。

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# 仿生奈米被動式輻射散熱

Bio-inspired Nano-passive Heat Radiators

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## 摘要

本研究探討藉由輻射散熱(或吸熱)的被動式裝置及其背後之機制。本文首先介紹兩種輻射散熱的方法：第一是利用聚甲基戊烯加入玻璃顆粒的膠膜背面鍍銀的材料散熱；第二是利用銀的奈米顆粒提供分頻利用太陽光源的方法。這兩種方法都用到一些顆粒，有共通性。這種與光交互作用的顆粒就是一種天線。我們由細菌光合作用系統學習到奈米天線的設計，可以為這些散熱實驗提供理論指導，本文並探討電磁輻射的必要條件，單向輻射的機制及萬氏古菌 (*Haloquadratum walsbyi*) 光合作用的物理機制。本文最後並用碎形語言來詮釋細菌獲光體的組成。

## Abstract

Mechanisms of passive-cooling through radiation are discussed with two examples: The first method spreads micro-particles into polymethylpentene film to improve the heat radiation; whereas the second one uses nano-particles for frequency-separation to increase the efficiency of solar cells. These two methods all use particles which interact with electromagnetic waves, which should be interpreted as antennae. Theoretically, we proposed a nanoparticle shape and material through lessons we learnt from light harvester of photosynthetic bacteria. We also studied necessary and sufficient conditions for radiation, the criteria for non-reciprocity, and proposed a physical mechanism for a light-harvesting archaeon, *Haloquadratum walsbyi*. Finally, languages of fractal are used to interpret the composition of bacteria light harvesters.

**關鍵詞(Key Words)**：太陽能電池 (Solar Cell)、絕緣奈米天線 (Dielectric Nanoantenna)、對稱破壞 (Symmetry Breaking)、被動式散熱 (Passive Heat Dissipation)、光合作用 (Photosynthesis)、古菌 (Archaea)、萬氏嗜鹽古菌 (*Haloquadratum walsbyi*)。



# 電廠導入創新設計工具之景觀規劃

Introducing Landscape Planning for Innovative Design Tools at Power Plant

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## 摘要

鑒於過去發電廠規劃設計，景觀規劃視為環評與工程之後的綠美化作業，缺乏對於當地的環境、人文、景觀、以及主要發電設施物所造成的衝擊課題深度探討，或僅研討卻未見日後落實。故本計畫以環境、景觀及人文為主軸，在考量電廠機能為前提下，進行電廠景觀規劃。以期提出符合深澳地區居民與有利公眾觀點的電廠形象，並以景觀專業導入科學化的規劃設計工具(SketchUp Pro、UAV空拍、Terra Explore Pro、Lumion)，建立可持續發展的景觀規劃綜合策略，促使景觀電廠達成在環境與觀光效益優化的目標。

## Abstract

The landscape planning for a traditional power plant construction project seems to focus merely on landscape greening required by the environmental impact assessment. It tends to neglect the aspects of local environment, humanities, landscape and the social impact of the construction, or merely discuss them rather than put them into practice. This project takes a big leap to embrace the holistic view as its main axis without sacrificing a good operation function of the power plant. We propose a integral strategy to achieve a professional planning by using special design tools like SketchUp Pro, UAV Ariel Photo machine, Terra Explore Pro, and Lumion, so as to meet the needs of local people and public interests. In this way, we also create a win-win solution to the full function of the power plant on the one hand and its environmental and tourism concerns for the local people on the other.

**關鍵詞(Key Words)：**電廠(Power Plant)、景觀規劃(Landscape Planning)、設計工具(Design Tools)、視覺衝擊(Visual Impact)。

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