# 台電工程月刊925期(9月)目錄

# 火力電廠閥件洩漏對熱耗率影響之評估

Assessment of the Impact of Valve Leakage on Heat Rate in a Thermal Power Plant

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## 摘 要

為了提升機組效率，和平電廠近年來陸續進行低壓汽機之更換，惟設備更換後進行性能提升驗證時，發現其中一部機組熱耗率改善量不如預期，由於測試時的運轉條件並不理想且有環路洩漏發生，因此不易釐清造成熱耗率不如預期之主要原因及其影響。本研究藉由建立汽機環路之熱功性能分析模式，參考業界使用之閥件洩漏評估方法、電廠運轉數據與現場對於隔離閥件下游溫度之量測數據，來推估閥件洩漏對於系統熱耗率之影響。評估結果顯示高壓飼水加熱器的緊急洩水閥洩漏導致汽機環路熱耗率增加約 40.6 kJ/kWh，相當於基準線熱耗率的 0.51%。本研究之成果為電廠提供了更換閥件之有力依據，電廠於發現該洩漏後也迅速採取行動降低了效率損失，相關成果也提供了閥件內漏影響評估之寶貴經驗。

## Abstract

To improve unit efficiency, the Hoping Power Plant has recently undertaken the replacement of its low-pressure steam turbines. However, during subsequent performance verification, one unit exhibited less-than-expected improvement in heat rate. Due to suboptimal test conditions and suspected cycle leakage during the assessment, it was difficult to clearly identify the primary cause and quantify its effect on overall thermal performance.

This study develops a thermodynamic performance analysis model for the steam turbine cycle, incorporating industrial-standard methods for valve leakage assessment, plant operating data, and field measurements of downstream temperatures from isolation valves. By combining simulation analysis with actual measurement data, the study estimates the impact of valve leakage on system heat rate. The evaluation results indicate that leakage from the emergency drain valve of the high-pressure feedwater heater led to an increase in the cycle heat rate of approximately 40.6 kJ/kWh, equivalent to 0.51% of the baseline heat rate.

The findings provide strong technical justification for valve replacement and supported the plant's timely corrective actions to mitigate efficiency loss. Moreover, the methodology and results of this study offer valuable insights into the evaluation of internal valve leakage and its effect on the thermodynamic performance of thermal power units.

**關鍵詞(Key Words)**：熱功性能分析(Thermal Performance Analysis)、閥件洩漏(Valve Leakage)、熱耗率(Heat Rate)、火力電廠(Thermal Power Plant)。

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回首頁

# 首創地下電纜人孔管障採兩段式慣性定位查找處置案例

A Pioneering Case of Two-stage Inertial Positioning for Locating Underground Cable Manhole Obstacles

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## 摘　要

鑑於強化電網韌性任務，啟動老舊充油電纜設備汰換工作，其中 161kV 板超~城中線充油電纜於民國 63 年建置運轉迄今已達 50 年之久，列為首要汰換計畫，然其電纜路徑行經台北市都會區重要街道，施工前令人最擔憂的是既設管路及人孔的狀況，評估在電纜拆除或延放過程中發生管障，辦理管障開挖處理，勢必大幅延宕工進，甚至使輸電線路無法恢復供電，影響城中 P/S 供應總統府博愛特區供電穩定，施工期間，遭遇到不可預期管障問題，其中人孔查找採 2 區段進行慣性定位確認位置，方使電纜汰換任務順利完成。

## Abstract

To enhance power grid resilience, Taipower has launched a replacement program for aging oil-filled cable systems. Among the priority projects is the 161kV Banchao-Chengzhong oil-filled cable line, which has been in operation since 1974, now exceeding 50 years of service. As this cable traverses critical urban streets in Taipei's metropolitan area, the condition of the existing conduits and manholes poses major concerns prior to construction. Any unforeseen obstacles during cable removal or installation would not only significantly delay project progress but could also jeopardize the restoration of power supply, thereby affecting the stability of electricity delivery from the Chengzhong primary substation to sensitive areas such as the Presidential Office and the Boai Special District.

During the course of construction, unanticipated pipeline obstacles were encountered. In particular, locating a problematic manhole required a two-stage inertial positioning approach to accurately determine its position. The successful application of this technique was crucial in overcoming the obstacles and ensuring the timely completion of the cable replacement project.

**關鍵詞(Key Words)**：管路(Pipeline)、管障(Pipeline Obstacles)、人孔(Manhole)、聚氯乙烯樹脂(Polyvinyl Chloride, PVC)、慣性定位系統(Inertial Positioning System)。

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# 新建變電所不同規模所內 AC 電源規劃設計之研討

A Study on the Planning and Design of AC Power Supply in New Substations of Varying Scales

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## 摘　要

變電所內用電設備規劃架構，因工程內容不同而有所差異，目前變電工程可分為新建變電所、開閉所、屋外型模組化工程及變電所整所改建等類型，都需要設置所內用電設備，還需特別考量該設備電源端引接方式，原則上從新設變壓器二次側引供，惟僅新設 1 台變壓器時就需向本公司當地轄區營業處申請市電模式，因此所內用電引接方式會依變電工程規模之設計規畫有所不同，容易造成設計人員規劃時發生錯誤或遺漏相關設計，因此本文研討分析變電所所內用電不同架構性與差異性，以及施工階段需申請臨時電源程序及加入系統後改接正式用電方式，並彙整所內用電規劃設計之流程，以提升新進人員設計能力，強化變電所 AC 電源規劃核心技術。

## Abstract

The architectural planning of AC power equipment in the substations varies and depends on the nature and scale of the engineering project. Current substation projects in Taiwan include newly constructed substations, switchyards, outdoor modular substations, and complete reconstructions. All of these require internal AC power supply equipment, and special consideration must be given to how the power is sourced.

In principle, internal power is supplied from the secondary side of newly installed transformers. However, if only a single transformer is installed, it becomes necessary to apply for a temporary utility power supply from the local Taipower branch. As a result, the AC power connection strategy must be adapted to the scale and type of the substation project, which often leads to design inconsistencies or omissions, especially among less experienced designers.

This study analyzes the structural variations and design considerations of internal AC power equipment across different substation types. It also outlines the procedures for applying for temporary power supply during the construction phase and the transition to formal power supply upon grid integration. Finally, the study consolidates a standardized planning and design process to enhance the capabilities of new engineers and strengthen core technical competencies in substation AC power supply planning.

**關鍵詞(Key Words)**：所內用電設備(AC Power Equipment In The Substation)、開閉所(Switchyard)、屋外型模組化(Outdoor Modular Equipment)、市電模式(Utility Power Mode)。

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# 封印鎖管理機制探討與管理系統建置之研究

A Study on the Management Mechanism and System Development of Seal Locks

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## 摘　要

本研究訪談相關單位分析現有封印鎖管理制度，探討如何進行導入資訊化之流程與方法，以及介接新營業櫃檯作業電腦化系統(NCPS)、新電費開票系統(NBS)、手提小電腦抄表系統(HCS)等系統之作業流程，再規劃建置封印鎖管理系統與封印鎖作業資料填報 APP，以滿足封印鎖完整的生命週期管制，自封印鎖入庫、領用、新品退回、銷毀、調用、拆裝資料填報等處理作業，並提供庫存查詢、部門及負責人管理、工作日誌建立與發布作業、電號與電表建立管理、表別群組管理、抄表資料檔匯入作業、派工及負責人之工作管理、CT、PT 施工管理、異常管理、系統資訊盤點等管理作業功能需求，為此系統建置之重要目標。

本案建置封印鎖管理系統與封印鎖作業資料資料填報 APP，透過簡易行動化介面來收集拆裝資料填報，提供封印鎖管理系統之維運作業紀錄，利用資訊技術輔助管理過程，達到有效減少資料維護人力。

## Abstract

This study investigates the existing seal lock management system through interviews with relevant departments, aiming to explore the procedures and methods for digitalization. It further examines how to integrate this system with other operational systems such as the New Counter Processing System (NCPS), New Billing System (NBS), and the Handheld Computer-reading System (HCS). Based on this analysis, the study proposes the development of a comprehensive seal lock management system and a mobile application for seal lock operation reporting. These tools are designed to support the full lifecycle management of seal locks, including warehousing, issuance, return of unused items, disposal, reallocation, installation, removal, and data reporting.

The proposed system will also offer functions such as inventory inquiries, department and personnel management, work log creation and publishing, meter and account number management, meter group management, import of meter reading data, task assignment and tracking, management of CT and PT installations, anomaly reporting, and system information auditing. These features constitute the core objectives of the system's development.

By implementing the seal lock management system and its companion mobile app, the project aims to streamline data collection related to seal installation and removal through an intuitive mobile interface. This approach not only enhances the operational efficiency of the seal lock management process but also significantly reduces the manpower required for data maintenance by leveraging information technology.

**關鍵詞(Key Words)**：封印鎖管理系統(Seal Lock Management System)、虛擬化架構(Virtualization Architecture)、新營業櫃檯作業電腦化系統(New Counter Processing System)、新電費開票系統(New Billing System)、手提小電腦抄表系統(Handheld Computer-reading System)。

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# 配電變壓器負載變化預測及利用率分析

Prediction of Load Variation and Utilization Analysis of Distribution Transformers

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## 摘 要

本研究針對配電變壓器負載變化預測與利用率分析需求，設計並實作一個網頁操作系統。系統採用前後端分離架構：前端以 React 實作操作介面，並透過 AJAX 與後端交換資料；後端以 FastAPI 整合 NBS、MDMS、DMQS 等多來源負載資料，並搭配 PostgreSQL 資料庫記錄運算結果與用戶資訊。系統具備變壓器查詢、標註變壓器、負載分割和閥值管理等功能，使用者可即時掌握年、月、日不同時段的用電變化，並檢視超出閥值之標註變壓器資訊；後端則提供資料匯入、閥值設定、變壓器匯出及帳號權限管理等功能，確保系統維運與資安。負載分割功能可模擬用戶轉移至新設變壓器後之最大利用率變化，協助工程現場預先規劃，降低試誤成本。本成果提供準確、直觀的介面，期能協助相關操作人員提升效率與方便性，並降低台電公司之供電損失，進一步提高電網可靠度與安全性。

## Abstract

This study presents the design and implementation of a web-based system aimed at forecasting load variations and analyzing utilization rates of distribution transformers. The system adopts a decoupled front-end and back-end architecture: the front-end interface is developed using React and communicates with the back-end via AJAX, while the back-end, built with FastAPI, integrates multi-source load data from the NBS, MDMS, and DMQS systems. A PostgreSQL database is employed to store computational results and user-related information.

Key system functionalities include transformer query, annotation, load segmentation, and threshold management. Users can monitor real-time power consumption patterns across annual, monthly, and daily timescales and access alerts for transformers exceeding predefined thresholds. The back-end supports data import, threshold configuration, transformer data export, and user permission management, ensuring stable system operation and information security.

Notably, the load segmentation function enables simulation of utilization rate changes following customer reallocation to newly installed transformers. This supports proactive field planning and reduces trial-and-error costs. The system offers a precise and intuitive interface that enhances operational efficiency and convenience for personnel. It also contributes to reducing supply-side losses for Taipower and bolstering overall grid reliability and safety.

**關鍵詞(Key Words)**：配電變壓器(Distribution Transformers)、負載估測(Load Estimation)、利用率(Utilization Rate)、智慧電表(Smart Meters)。

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# 結合物聯網之智慧光電儲能於金門地區之應用研究

A Study on the Application of IoT-Enabled Intelligent Photovoltaic Energy Storage Systems in Kinmen

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## 摘 要

為配合台灣 2025 年綠能(滲透率)發電占比 20%與金門低碳島 2.0 執行策略，在分散式電力取代集中式電廠的減碳概念下，本研究利用於國立金門大學建置之兩套具 3.3kWp 太陽能裝置容量與 5.5kWh 儲能系統之智慧光電儲能系統作為分散式小型電廠，透過物聯網(Internet of Things, IoT)的能源管理系統(Energy Management System, EMS)進行調控，並進行案場運作最佳化之研究與應用。兩套設備分別建置於金大機車棚與金大中山林兩案場，其中金大機車棚案場已於 2023 年 9 月初起進行試運轉並調校相關參數，且於 2024 年 2 月 22 日辦理啟用典禮正式對外開放使用。兩示範案場之主要負載以金大機車棚來說主要為電動機車充電及夜間照明，金大中山林校區則為教室的照明。

## Abstract

To align with Taiwan's 2025 target of achieving a 20% share of green energy in electricity generation and the implementation of Kinmen Low Carbon Island 2.0 strategy, this study explores the application of decentralized smart photovoltaic energy storage systems (PV-ESS) in Kinmen. Embracing the carbon reduction concept of replacing centralized power generation with distributed microgrids, the study utilizes two intelligent PV-ESS units installed at National Quemoy University (NQU), each equipped with a 3.3 kWp solar panel system and a 5.5 kWh energy storage module. These systems function as small-scale decentralized power stations managed by an Internet of Things (IoT)-based Energy Management System (EMS) to optimize real-time energy operation and control.

The two demonstration systems are located at the NQU motorcycle parking shed and the Zhongshanlin Campus. The system at the parking shed began trial operation and parameter calibration in early September 2023 and was officially inaugurated and opened to the public on February 22, 2024. The primary loads for the demonstration sites are electric motorcycle charging and nighttime lighting at the parking shed, and classroom lighting at the Zhongshanlin Campus.

In summary, this study examines the operational performance, load characteristics, and optimization potential of IoT-enabled decentralized PV-ESS applications in support of regional low-carbon transition goals.

**關鍵詞(Key Words)**：低碳島 2.0 (Low Carbon Island 2.0)、再生能源儲能設備(Renewable Energy Storages)、能源管理系統(Energy Management System)、人工智慧(Artificial Intelligence)、時間電價(Time of Use)、物聯網(Internet of Things)

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# 產業間用電關聯與電力景氣即時預報

Inter-Industry Electricity Consumption Linkages and Real-Time Forecast of Power-Based Business Cycle Indicators

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## 摘　要

電力是現代企業生產與經濟發展的關鍵投入，亦為產業景氣的重要指標。本研究提出科學且可驗證的方法，將每月產業用電變化轉換為月頻經濟指標。首先，採用 Hamilton (2018) 方法改進 HP Filter 的端點問題與虛假動態關係[1]，建構穩健的燈號識別系統；其次，結合機器學習與總體經濟短期預測，考量工業生產指數、各業國內生產毛額及產業間用電關聯，並採用 LSTM 模型進行預測。研究發現，自 2023 年起，台灣製造業內部用電行為分歧，高科技產業(如電子零組件製造業與電腦、電子產品及光學製品製造業)很大程度影響整體製造業的用電行為。模型回測結果顯示，本研究可有效評估產業景氣並呈現用電領先與落後型態。然而，部分傳統產業與所選變數的關聯性較低，影響預測準確度。未來，若能納入更能反映傳統產業用電特性的變數並優化模型調整，將進一步提升預測準確性與適用範圍。

## Abstract

Electricity is a critical input for modern industrial production and economic growth, and also serves as a leading indicator of overall business activity. This study proposes a scientifically sound and empirically verifiable approach to transform monthly changes in industrial electricity consumption into a high-frequency economic indicator. First, the Hamilton (2018) filter is adopted to overcome endpoint issues and spurious dynamics associated with the traditional Hodrick-Prescott (HP) filter, enabling the construction of a more robust signal identification system. Second, machine learning techniques are integrated with short-term macroeconomic forecasting by incorporating Industrial Production Index, sectoral Gross Domestic Product (GDP), and inter-industry electricity consumption linkages. The Long Short-Term Memory (LSTM) model is employed to predict electricity-based business cycle signals.

Empirical results reveal that since 2023 electricity consumption behavior within Taiwan's manufacturing sector has shown increasing divergence. In particular, high-tech industries, such as electronic component manufacturing and the production of computers, electronic products and optical devices, have had a disproportionate influence on the sector's overall electricity usage patterns. Backtesting results demonstrate the model's effectiveness in evaluating industrial business cycles and distinguishing between leading and lagging electricity consumption signals. However, the relatively weak linkage between the selected variables and some traditional industries reduces forecast accuracy. Future improvements, such as incorporating variables better tailored to the electricity usage characteristics of traditional sectors and enhancing model calibration, are expected to further improve predictive accuracy and the model's applicability across a broader range of industries.

**關鍵詞(Key Words)**：長短期記憶(Long Short-Term Memory, LSTM)、電力景氣燈號(Power-Based Business Cycle Indicators)、即時預報(Real-time Forecast)。

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# 探討亞鄰國家電價配套措施-燃料價格調整機制

An Analysis for the Electricity Pricing Support Measures in Neighboring Asian Countries: Fuel Price Adjustment Mechanisms

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## 摘 要

由於各國電力市場自由化程度不同，電價訂定方式與管制措施上各異。近年來，俄烏戰爭影響導致全球能源價格急劇高漲，特別對於高度仰賴進口能源的國家，短期內燃料價格快速波動可能加劇電業營運困難。過去台電公司為了顧及民生與經濟發展，未能充分反映發電成本，導致累積虧損逐年增加。故本文將專注於探討各國電價訂定及燃料調整的機制，透過蒐集亞鄰國家先進電業(含日本東電、韓國韓電及香港港燈)現行電價訂定方式及其燃料調整制度，分析其面對相同燃料價格波動時所採行的策略及其執行情況，並進一步探討制度實施與財務虧損之間的關聯性，提供未來我國在電價配套措施上參考與借鏡。

## Abstract

Due to varying degrees of electricity market liberalization, countries adopt different approaches to electricity prices setting and regulatory measures. In recent years, the Russia-Ukraine war has triggered a surge in global energy prices, posing significant challenges to countries heavily dependent on imported energy. In Taiwan, Taipower has prioritized social welfare and economic development, often failing to fully reflect fuel and generation costs in electricity tariffs, resulting in escalating financial losses.

This study focuses on the electricity pricing frameworks and fuel cost adjustment mechanisms implemented in selected advanced utilities in neighboring Asian countries, including Tokyo Electric Power Company (TEPCO) in Japan, Korea Electric Power Corporation (KEPCO), and CLP Power in Hong Kong. By examining how these utilities respond to similar fluctuations in fuel prices, particularly in terms of strategy design, implementation practices, and regulatory flexibility, this research analyzes the relationship between price adjustment mechanisms and financial sustainability. The findings aim to provide valuable insights and policy references for enhancing Taiwan's future electricity tariff design and support mechanisms.

**關鍵詞(Key Words)**：電力市場(Electricity Market)、燃料調整機制(Fuel Price Adjustment Mechanisms)、能源價格(Energy Prices)。

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