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# 建構台電陸域風電站延役或除役更新指標 及標準化決策流程

Index Determination and Standard Operating Procedure Establishment for Lifetime Extension,  
Repowering or Decommissioning of Taipower's Onshore Wind Power Stations

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## 摘 要

本研究根據風力發電機之重要維修零組件取得難易評估、考量風機健康情形及廠商維護能力、延役或除役更新風電站的投資效益比較分析、風場土地使用及民意變化、法令遵循...等面向，從學理及技術性層面分析機組持續運轉之可行性，擬定合乎台電公司需求的機組延役或除役更新指標，以建構延役決策之排除性準則及選擇性準則。本研究同時參考國外相關做法，納入其風機延壽評估作業之內涵，歸納出風電站延役或除役更新決策流程(SOP 1)及延役評估標準作業程序(SOP 2)。並利用彰工 I 期風電站現有案場資料，套用所研究出之標準作業程序進行實際評估做出決策建議。台電公司其餘屆齡風電站可依循本研究之操作流程，執行繼續營運與否之判斷及決策。

## Abstract

Based on the difficulty of obtaining important maintenance components of wind turbines, consideration of the health of wind turbines and the maintenance capabilities of manufacturers, comparative analysis of investment benefits of lifetime extension, repowering or decommissioning the existing wind power stations, changes in wind farm land use and public opinion, compliance with the regulations, this study analyzes the feasibility of continuous operation of wind turbines from the academic and technical aspects, and identifies the extension or decommissioning service index that meets the needs of Taipower, so as to construct the exclusion criteria and selectivity criteria for the extension decision. This study refers to relevant foreign practices, incorporates the connotation of wind turbine lifetime extension assessment operations, and summarizes the standard operating procedure for wind power stations' lifetime extension, repowering or decommissioning decision (SOP 1), and the standard operating procedure for wind power stations' lifetime extension assessment (SOP 2). Based on the existing case data of ChanggongI wind power station, we apply the developed SOPs to conduct actual assessment and make recommendations. Taipower's remaining wind power stations that are about to be decommissioned may follow the aforementioned SOPs to make judgements and decisions on whether to continue operations.

**關鍵詞(Key Words)**：陸域風電站(Onshore Wind Power Stations)、風力發電設備(Wind Turbine Equipment)、更新除役(Repowering Decommissioning)、延役(Lifetime Extension)、標準作業流程(Standard Operating Procedure, SOP)。

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# SF<sub>6</sub> 氣體絕緣變壓器(GIT)負載及 SF<sub>6</sub> 氣體溫度資料分析 之研究

A Study of Gas Insulated Transformer Load and Gas Temperature Analysis

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## 摘 要

近年來都會地區用電快速成長，台電公司興建變電所漸漸改採多目標變電所型式，且為確保人員及設備均處於絕對安全情況，將原傳統式之油浸式變壓器改採用絕緣介質為 SF<sub>6</sub> 氣體之變壓器；本處轄管世貿 D/S、基信 D/S、信南 D/S、中崙 D/S、新民 D/S 及福和 D/S 等 6 所變電所皆有設置 SF<sub>6</sub> 氣體絕緣變壓器，本研究針對 SF<sub>6</sub> 特性、構造、與油浸式變壓器相異點等作探討，並蒐集變壓器負載及 SF<sub>6</sub> 氣溫進行數據分析，以供嗣後本公司 GIT 運轉維護之參考。

## Abstract

In recent years, in response to the rapid growth of electricity consumption in urban area, Taipower has gradually switched to multi-purpose design in its new substations. In order to ensure the absolute safety of personnel and equipment, the original oil-immersed transformers were replaced by transformers using SF<sub>6</sub> gas as the insulating medium. Taipei Power Supply Branch is responsible for the jurisdiction of 6 substations, namely Shi-mao D/S, Ji-xin D/S, Xin-nan D/S, Zhong-lun D/S, Xin-min D/S and Fu-he D/S. The substations have all been equipped with SF<sub>6</sub> gas insulated transformers. This study discusses the characteristics, structure, and differences between SF<sub>6</sub> and oil-immersed transformers, and collects data on the transformer load and SF<sub>6</sub> temperature to serve as reference for the company's future GIT operation and maintenance.

**關鍵詞(Key Words)**：SF<sub>6</sub> 氣體絕緣變壓器(Gas Insulated Transformer, GIT)、油浸式變壓器(Oil Immersed Transformer, OIT)、鼓風機(Blower)、冷卻系統(Cooling System)。

# 風險管控查詢系統(風控帶著走)建置之研究

A Study on the Establishment of a Risk Management and Control Inquiry System

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## 摘要

2022 年興達發電廠停電事件後，本公司為了強化風險管控而成立專責風險管控中心，本研究針對停電案件之各項風險、管制資訊做一完整彙總強化功能探討，藉以提升公司營運安全和效率。目前供電系統已開發出「供電單位雲端風控填報系統」，但主機建置在本公司內網伺服器中，無法於企業網路外查閱。本研究利用網頁爬蟲技術、雲端資料庫技術及 LINE BOT API 建立了 LINE 機器人，讓每位基層同仁都能快速、正確地掌握本處各項工作的風險因子，將風險管理落實至每位員工，並可使管理階層長官即時獲得轄區系統之風險管控資訊，以維供電穩定。

## Abstract

After the Hsinta Power Plant outage event in 2022, Taipower established a dedicated center to strengthen risk management and control. This study conducts a complete summary and enhanced functional discussion of various risks and controlled information in power outage cases, in order to improve the operational safety and efficiency. The power supply system has developed a "Power Supply Unit Cloud Risk Reporting System", but the host is built on the company's intranet server and cannot be viewed outside the corporate network. This study uses web crawling technology, cloud database technology, and LINE BOT API to build a LINE bot, so that every frontline colleague can quickly and correctly grasp the risk factors of each work of the department, and implement risk management to every employee. It also allows the management level to obtain risk management and control information of the system under their jurisdiction in real time to maintain the stability of power supply.

**關鍵詞(Key Words)**：風險管控(Risk Management and Control)、網路爬取技術(Web Crawler Technology)、LINE 機器人(LINE Bot)。

# 智慧電網圖形交換之共同資訊模型研究

Research on Common Information Model for Smart Grid Graphics Exchange

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## 摘要

我國為推動節能減碳政策，將智慧電網列入「國家綠能低碳總行動方案」標竿計畫之一。本研究主要重點在於電力運轉量測資料交換標準，並包含初步圖形資料交換標準研析。根據 IEC 61970-453 國際共同資訊模型(以下簡稱 CIM)標準，詳列了智慧電網各資訊系統間圖形物件及交換模式，顯見圖形資料(包含視覺化介面)於智慧電網各資訊系統中，係重要傳遞資訊。因應各階層電力自動化系統圖形資料交換等需求，圖形資料交換在台電智慧電網中，亦是一項重要工作，因此，亟需建立共同資訊模型標準。

本研究目標為智慧電網圖形交換共同資訊模型導入及交換機制之示範、建立符合 IEC 61970-453 圖形交換標準之電力自動化系統圖形物件顯示環境，並藉推廣應用達到智慧電網圖形資料在異質性資訊系統間交換目的。

## Abstract

In order to promote energy conservation and carbon reduction policies, the government has included smart grids as one of the benchmark projects in the “National Green Energy and Low Carbon Master Action Plan”. This research aims to analyze the standards for power operation measurement data, including preliminary graphic data exchange standards. The IEC 61970-453 International Common Information Model (CIM) standard details the graphical objects and exchange modes among various information systems in smart grids. It can be seen that graphical data (including visual interfaces) is important transmission information of smart grids. In response to the graphics data exchange needs of power automation system at all levels, graphics data exchange is an important work item of Taipower’s smart grid, and there is an urgent need to establish a common information model standard.

The goals of this research are to demonstrate the introduction and exchange mechanism of a common information model for smart grid graphics exchange, to establish a display environment for power automation system graphics objects that complies with the IEC 61970-453 graphics exchange standard, and to achieve the goal of using smart grid graphics data in different environments through promotion and application.

**關鍵詞(Key Words)：**共同資訊模型(Common Information Model)、智慧電網(Smart Grid)、系統整合(System Integration)。

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# 電廠排放減量措施對空氣品質影響探討

The Impact of Power Plant Emission Reduction Strategies on Air Quality

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## 摘要

本研究以監測及模式模擬分析電廠增氣減煤措施對空氣品質的影響。監測係於興達電廠下風處設置空氣品質監測車，監測電廠減煤及非減煤時段的空氣品質。模式模擬則使用CMAQ空品模式，探討台電公司之增氣減煤措施對空氣品質的影響。

結果顯示，興達電廠減煤效益未顯著反映在空氣品質監測結果，而空氣品質模擬可看出增氣減煤措施對空氣品質有改善效益。差異原因為實際空氣品質監測結果反應所有排放源與氣象條件的影響，除電廠排放為可掌握因素外，無法量化其他因子對空氣品質的影響；而空氣品質模擬的氣象條件相同，僅改變電廠的排放量，能明確地看出減量措施的改善效益。

因此，台電公司實施增氣減煤措施對空氣品質改善有正面效益，惟整體空氣品質之改善，除電廠減量外，尚需其他排放源同時減量，以減少因氣象條件變化可能導致的空氣品質惡化。

## Abstract

This study uses monitoring and model simulation to analyze the impact of strategies for increasing gas use and reducing coal use at thermal power plants on air quality. In terms of monitoring, we set up an air quality monitoring vehicle downwind of Hsinta Power Plant to monitor the nearby air quality during coal reduction and non-coal reduction periods. In terms of model simulation, we use the CMAQ model to explore the impact of Taipower's strategies for increasing gas use and reducing coal use on air quality.

The benefits of coal reduction at Hsinta Power Plant are not significantly reflected in the air quality monitoring results, but the air quality simulation shows that the measures to increase gas use and reduce coal use have improved air quality. The reason for the difference is that the actual air quality monitoring results reflect the impact of all emission sources and meteorological conditions. Except for power plant emissions, which are controllable factors, the impact of other factors on air quality cannot be quantified. However, the meteorological conditions of the air quality simulation are the same, and the power plant emissions are changed. The improvement benefits of reduction measures can be clearly seen.

Therefore, Taipower's strategies for increasing gas use and reducing coal use have positive

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benefits in improving air quality. However, to improve the overall air quality, in addition to reducing emissions from power plants, other emission sources also need to be reduced at the same time to reduce the possible deterioration of air quality caused by changes in meteorological conditions.

**關鍵詞(Key Words)**：空氣品質監測(Air Quality Monitoring)、空氣品質模擬(Air Quality Simulation)、排放源(Emission Source)、氣象條件(Meteorological Condition)。

# 台電公司推動相關單位環境教育規劃暨資源再利用

A Case Study of Environmental Education Planning and Resource Reuse

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## 摘要

本計畫設計關於台中發電廠及尖山發電廠的環境教育課程方案，包含培訓種子教師進行現場教學，產出教材包及教學影片，以傳達重視在地環境教育與環境保護之作為。本計畫也透過環境教育活動與課程，強化台電公司主管與員工的環境素養。同時也藉著循環經濟再利用理念製作燃煤發電副產物與淨灘漂流木手作名片夾，提升台電公司綠色企業形象。

## Abstract

This project aims to design an environmental education course plan for Taipower's Taichung Power Plant and Chienshan Power Plant, including training seed teachers to conduct on-site teaching, and producing teaching materials and videos to convey the company's emphasis on local environmental education and environmental protection. This project also hopes to strengthen the environmental literacy of relevant supervisors and employees through environmental education activities and courses. At the same time, this project also uses the reuse concept of circular economy to produce handmade business card holders, made of by-products of coal-fired power generation and beach cleaning driftwood, to enhance Taipower's green enterprise image.

**關鍵詞(Key Words)**：環境教育 (Environmental Education)、課程方案(Curriculum Plans)、資源再利用(Resource Reuse)、台中發電廠(Taichung Power Plant)、尖山發電廠(Chienshan Power Plant)。

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# 萬大發電廠環境教育研究

Research on Environmental Education of Wanda Power Plant

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## 摘要

本研究計畫優化現有的教案，同時新增與時事議題相關五個教案。本廠共計四大面向、十三套環境教育課程。同時，配合導覽 APP，實現對環境教育課程的完整導覽。

本研究計畫也針對環境教育主管及講師舉辦增能講座活動，透過參訪其他優良環境教育場域與優良環境教育講師交流教學經驗，參訪觀摩，強化自我教學能力，以期能提供更好的教學品質及專業素養。

與外部單位聯合活動係透過與周遭部落及單位共同辦理活動，達到互相學習、資源共享。電廠與當地單位共同進行環境教育推廣，展現電廠對於環境教育推廣的重視，也激發喚醒民眾保護環境的共鳴意識，更建立電廠與在地部落之間的合作和支持關係的情誼，攜手開創永續經營的新合作模式。

透過這些更新和精進能力以提升場域的教育內容和遊客體驗，讓民眾能更深入地了解環境保護和生態保育的重要性。

## Abstract

This research project aims to optimize the existing lesson plans and add five new lesson plans related to current issues. Wandapower plant (WPP) has a total of 4 major aspects and 13 sets of environmental education courses. At the same time, in conjunction with the navigation APP, a complete guide to the environmental education course can be achieved.

In this research project, we organize empowerment lectures for environmental education supervisors and lecturers; arrange visits to excellent environmental education fields to strengthen self-teaching capabilities; co-organize activities with surrounding tribes and units to achieve mutual learning and resource sharing; promote environmental education with local units to show WPP's emphasis on environmental education and awaken the public's awareness of environmental protection; establish a relationship with local tribes to create a new cooperation model for sustainable management.

Through these updates and refined capabilities, the educational content and visitor experience of the site will be enhanced, so that the public can have a deeper understanding of the importance of environmental protection and ecological conservation.

**關鍵詞(Key Words)**：生態教育(Ecological Education)、原民歷史(Aboriginal History)、遊戲式學習(Game Based Learning)。

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# 通用影像分類平台操作經驗分享

General-purpose Image Classification Platform Operation Experience Sharing

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## 摘要

隨著資通訊軟硬體技術的飛速發展，人工智慧(AI)技術取得了突破性進展，並在各行各業得到了廣泛應用。在環保領域，AI 技術也具有巨大的應用潛力。本論文旨在探討通用型影像分類技術應用於環保業務的可行性並採用 NO CODE 網頁界面進行實機操作，以降低對專業程式設計技能的要求。透過通用型影像分類技術來提高各應用領域之易用性、效率以及強化其擴展性。本案以卷積神經網路(CNN)的深度學習架構進行影像分類處理，進行鍋爐系統水中氧化鐵濃度判讀和電廠海洋泡沫偵測，驗證了該技術的可行性和有效性。未來可進一步研究探討，如何將此技術應用於其他業務，以提升工作效率，促進產業發展。

## Abstract

With the rapid development of information and communication hardware and software technology, artificial intelligence (AI) technology has made breakthrough progress and has been widely used in various industries. In the field of environmental protection, AI technology also has huge application potential. This article aims to explore the feasibility of applying general-purpose image classification technology to environmental protection and to use the no-code web interface for actual operation to reduce the requirements for professional programming skills. Through general-purpose image classification technology, the ease of use and efficiency of various application fields can be improved, and their scalability can be enhanced. In this project, we use the deep learning architecture of convolutional neural network (CNN) to perform image classification processing, interpret the concentration of iron oxide in boiler water system and detect marine foam in power plants to verify the feasibility and effectiveness of this technology. In the future, further research can be conducted to explore how to apply this technology to other businesses to improve work efficiency and promote industrial development.

**關鍵詞(Key Words)**：人工智慧(Artificial Intelligence)、無程式碼(No-code AI)，深度學習(Deep Learning)，模型(Model)，訓練(Training)。

# 運用智慧工業技術協助變電所教育訓練數位轉型之 應用探討

Application of Smart Industrial Technology to Assist the Digital Transformation of Substation  
Education and Training

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## 摘要

隨著 5G 技術的發展及 Covid-19 疫情對全球造成影響，工業領域亦應與時俱進，創造工業智慧化之發展。本研究在二次變電所教育訓練中導入創新之 XR 延展實境(Extended Reality)技術，規劃 XR 遠端協作系統，並搭配 3D 可視化互動教材，實現智慧應用平台的研究目標，希望藉由 XR 遠端協作的新興工作型態，提升巡檢的工作效率及設備維護教育訓練的成效，同時能進一步創造工業智慧化及數位轉型。

本研究將制定工作流程與研究方法，並建置 XR 變電所主變故障排除系統、遠端協作 XR 通訊系統、XR 變電所智慧巡檢系統與 23kV GIS 開關內檢訓練系統。透過通訊技術，搭配 XR 硬體設備，結合跨載具多人通訊技術、空間定位技術、圖像識別技術、MR 模組開發技術，打造低延遲通訊、高效率資料傳輸，並能協助變電維護作業教育訓練進行數位轉型、輔助巡檢工作流程，達到提昇工作安全的 XR 變電所遠端協作智慧平台。

## Abstract

With the advancement of 5G technology and the impact of the Covid-19 pandemic, the industrial sector should keep pace with the times and propel forward to enhance the industrialization of intelligence. This research introduces Extended Reality (XR) technology into training and education programs for substations, devises an XR remote collaboration system, and integrates it with visually interactive training materials to achieve the research objectives of an intelligence application platform. It is hoped that through the emerging work model of XR remote collaboration, the work efficiency of inspections and the effectiveness of equipment maintenance education and training will be improved, and at the same time, it can further create industrial intelligence and digital transformation.

This research will formulate work procedures and research methods, and build an XR substation main transformer troubleshooting system, a remote collaborative XR communication system, an XR substation intelligent inspection system, and a 23kV GIS internal switchgear training system. Through communication technology, paired with XR hardware equipment, combined with cross-vehicle multi-person communication technology, spatial positioning

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technology, image recognition technology, and modularization of mixed reality development technologies, we can create low-latency communication and high-efficiency data transmission. The aforementioned intelligence application platform can not only assist substations in digital transformation for training and education, but also optimize inspection workflows to enhance work safety.

**關鍵詞(Key Words)**：混合實境(Mixed Reality)、延展實境(Extended Reality)、數位轉型(Digital Transformation)、主變壓器(69kV Power Transformer)、GIS 開關箱(Gas Insulated Switchgear)。