

台電工程月刊 909 期(5月)目錄

環境與永續：

ENVIRONMENT AND SUSTAINABILITY：

- 碳捕存技術地質封存潛能評估及環境建構楊明偉 等.....(1)
Geological Storage Potential Assessment and Environmental Construction
of Carbon Capture Technology.....Yang, Ming-Wei et al.(1)
- 國際商業規模碳捕捉技術實廠案例分析.....高靖棣 等.....(18)
Case study of Worldwide Commercial-scale Carbon Capture TechnologyKao, Ching-Ti et al.....(18)
- 高空間解析度空品監測網建構方法與空品數據分析研究.....王玉琳 等.....(33)
IoT-based Air Quality Monitoring System with High Spatial Resolution and
Data AnalysisWang, Yu-Lin n et al.(33)

工程技術：

ENGINEERING TECHNIQUES：

- 固態技術於電力系統之應用概況與展望.....江文莊 等.....(41)
Overview and Prospects of the Application of Solid-state Technology in
Power Systems.....Jiang, Wen-Zhuang et al..(41)

售電與用戶：

ELECTRICITY RETAILING AND CUSTOMERS：

- 客服中心語音資料全文轉譯暨智能文本分析平台系統建置與應用之
研究王國榮 等.....(52)
Research on the Construction and Application of Speech-to-Text Transcription
and Intelligent Text Analysis Platform for Taipower's Customer
Service Center.....Wang, Kuo-Jung et al.(52)
- 應用智慧電表資料進行長者生活作息分析陳玉芬 等.....(62)
Using Smart Meter Data to Analyze the Elderly's Lifestyle PatternsChen, Yu-Fen et al.(62)

核 能：

NUCLEAR ENERGY：

- 高完整性容器(HIC)試驗議題研討陳智隆.....(75)
Study on Testing Issues of High-Integrity Containers (HICs)Chen, Chih-Lung.....(75)
- 自製加馬相機系統初始設定及其性能評測梁鑫京 等.....(94)
Initial Setting of Self-Made Gamma Camera and Performance EvaluationLiang, Hsin-Chin et al.(94)
-
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碳捕存技術地質封存潛能評估及環境建構

Geological Storage Potential Assessment and Environmental Construction of Carbon Capture Technology

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摘要

本研究係蒐研國際間碳封存工程規範的相關文獻，提出在我國本土進行二氧化碳地質封存場址評選時，評估封存場址(Storage Site)的二氧化碳封存量。為完成此工作目的，本研究逐一進行(1)研析國際碳封存資源管理標準及潛能評估方法、(2)研析國際碳封存場址篩選及評比之方法、(3)進行本土碳封存場址篩選規範建議、(4)潛在封存場址潛能評估、以及(5)建立碳封存場址開發之風險評估方法學等程序。本研究另亦研析各國主要執行 CCS 計畫之進展，了解國際推動 CCS 相關業務可能面臨之困難與民眾關切議題，並考量國內情勢與民情進行分析，用於推動國內 CCS 資訊交流，提出碳捕存技術於國內推廣之具體策略，並進行國內首次大規模的民意調查，取得重要民眾關心議題，做為未來強化 CCS 在公眾交流的重要工作方向。

Abstract

This study aims to analyze the relevant literature on international carbon storage engineering specifications so as to evaluate the carbon dioxide storage capacity of the geological storage sites in Taiwan. In order to accomplish the aforementioned purposes, this study carried out the following work items in sequence: analyzing international carbon storage resource management standards and potential assessment methods; analyzing international carbon storage site screening and evaluation methods; conducting local recommendations for carbon storage site screening specifications in Taiwan; potential assessment of potential storage sites; and establishment of risk assessment methodology for carbon storage site development and other procedures. This study also analyzes the progress of major CCS plans in various countries to understand the difficulties and public concerns that may be faced in promoting CCS-related businesses internationally. We also take into account the domestic situation and public opinion for analysis, which can be used to promote domestic CCS information exchange and propose carbon specific strategies for promoting capture and storage technology in Taiwan. In addition, a large-scale public opinion survey for the first time in Taiwan was conducted to obtain important issues of public concern, which will serve as an important work direction for strengthening CCS public communication in the future.

關鍵詞 (Key Words)：二氧化碳捕集與封存(Carbon Dioxide Capture and Storage)、封存場址(Storage Sites)、CCS 民意調查(CCS Opinion Poll)、環境評估(Environmental Assessments, EAs)、公眾宣傳(Public Outreach)。

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國際商業規模碳捕捉技術實廠案例分析

Case Study of Worldwide Commercial-scale Carbon Capture Technology

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摘要

碳捕捉封存技術在各國因應淨零碳排的情景下是不可或缺的技术，其可有效捕集點排放源的二氧化碳，包含天然氣開採業、化工業與電力業都可倚賴此技術來減碳。碳捕捉技術之延伸應用如搭配生質燃料或以空氣中直接捕捉二氧化碳技術，更可達到負碳排的效益。近年隨著永續燃料的興起，搭配碳捕捉與封存技術可生產低碳或零碳燃料來協助航空業、船運業與交通業達成減碳目標。

國際上最早且最廣泛採用碳捕捉技術的行業屬天然氣開採產業，其它如化工業與電力業也有部分安裝碳捕捉設施的實例。因二氧化碳捕捉技術會根據不同行業而有差異，導致過往相關整理資訊較少，本文致力於收集與分析各行業中較具代表性的商業化規模碳捕捉案例，希望提供給讀者對於碳捕捉技術更全方面的資訊。

Abstract

Carbon capture and storage technology (CCS) is an indispensable technology for countries to respond to the scenario of net-zero carbon emissions. It can effectively capture carbon dioxide from point emission sources, including the natural gas extraction industry, chemical industry and electric power industry, which can rely on this technology to reduce carbon emissions. The extended application of carbon capture technology, such as using biomass fuel or directly capturing carbon dioxide from the air, can even achieve the benefit of negative carbon emissions. With the rise of sustainable fuels in recent years, CCS technology can be used to also produce low-carbon or zero-carbon fuels to help the aviation, shipping and transportation industries achieve carbon reduction goals. The natural gas extraction industry is the earliest and most widely used industry to adopt CCS technology. Other industries such as the chemical industry and the electric power industry also have some examples of installing carbon capture facilities. Because carbon dioxide capture technologies vary according to different industries, there is little relevant information compiled in the past. This article is dedicated to collecting and analyzing some representative commercial-scale carbon capture cases in various industries, hoping to provide readers with more comprehensive information on carbon capture technology.

關鍵詞(Key Words): 碳捕捉與封存技術(Carbon Capture and Storage, CCS)、案例分析(Case Study)、商業化規模(Commercial-scale)。

高空間解析度空品監測網建構方法與空品數據分析研究

IoT-based Air Quality Monitoring System with High Spatial Resolution and Data Analysis

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摘要

近年因受到高濃度懸浮微粒的侵害，國人對於懸浮微粒可能造成身體健康危害的認知提高。尤其針對中部空氣品質議題更是受到國人關注。台電公司在日趨嚴格之環評要求下，開始進行一系列的高度自我監控管理。本計畫始於 111 年 8 月開始進行微型空品感測器佈建作業，共完成 26 點佈建工作。希望透過增加電廠外城鄉空品感測器布點數，提高電廠周遭區域的空品地圖解析度。為維持感測器偵測效能，本計畫亦完成四次巡檢作業，抽檢率皆達 30% 以上，符合環境部規範。本報告分析 111 年 8 月~ 112 年 7 月微型空品感測器 PM_{2.5} 濃度與定點風場風向資訊。利用科學數據歸納出氣團路徑，客觀分析污染好發路徑，釐清電廠周遭氣團傳輸路徑，提升台電建構環境監測物聯網之能力。最後，本計畫亦提供感測器維運作業指引，可有效維持感測器精準度與使用壽命。

Abstract

In recent years, due to exposure to high concentration of suspended particulates, public awareness of the possible health hazards they may cause has increased. Especially the issue of air quality in central Taiwan has attracted attention of the general public. Under the increasingly stringent environmental impact assessment requirements, Taipower began to conduct a series of highly self-monitoring management. This project began with the deployment of air box in August 2022, and a total of 26 points of deployment work have been completed. It is hoped that by increasing the number of ground monitoring sites in urban and rural areas outside the power plants, the resolution of the air quality map in the area around the power plants can be improved. In order to maintain the detection performance of the sensors, we completed four on-site inspection operations, with the sampling rate reaching more than 30%, which is higher than the Ministry of Environment's standard of 10%. This article addresses the PM_{2.5} concentration and fixed-point wind field information of the aforementioned sensors from August 2022 to July 2023, and utilizes scientific data to summarize the air mass paths, objectively analyze the pollution-prone paths, and clarify the air mass transmission paths around the power plants to enhance Taipower's ability to build an environmental monitoring Internet of Things. Finally, this article also provides guidance on sensor maintenance operations to effectively maintain sensor accuracy and service life.

關鍵詞(Key Words)：細懸浮微粒(Fine Suspended Particulate)、空氣品質監測(Air Quality Monitoring)、感測器巡檢(Air Box On-site Inspection)、風場路徑(Wind Trajectory)、感測器維運指引(Air Box Maintenance Guidelines)。

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固態技術於電力系統之應用概況與展望

Overview and Prospects of the Application of Solid-state Technology in Power Systems

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摘要

隨著再生能源占比逐漸提升，微電網之應用也越來越普遍。再生能源輸出大部分為直流輸出，而負載可分為交流負載與直流負載。其中，變壓器為作為發電、輸電、配電與用戶之間的樞紐點，肩負著電力分配的重要角色。因此，本文針對變壓器的固態化特性與應用來做說明。固態變壓器(Solid-state Transformer, SST) 使用電力電子技術，除有傳統變壓器隔離的效果，同時還具備整合交直流電壓、功率因素校正、穩定電壓/頻率、提供虛擬慣量等功能。在資料中心、充電站以及軌道牽引系統等領域，皆有使用固態變壓器的可能性。然而，應用於配電系統或微電網目前還有成本、壽命與系統相容性等諸多重要議題之挑戰需要克服。因此，本研究進行國內外固態變壓器資料蒐集以瞭解其關鍵技術與應用於電力系統之概況與展望。

Abstract

As the proportion of renewable energy gradually increases, the application of microgrids is becoming more and more common. Most of the renewable energy output is DC output, and the load can be divided into AC load and DC load. Among them, transformers serve as the pivot point between power generation, transmission, distribution, and the end users, and play an important role in power distribution. Therefore, this article discusses the solid-state characteristics and applications of transformers. Solid-state transformers (SSTs) use power electronic technology. In addition to the isolation effect of traditional transformers, they also have the functions of integrating AC and DC voltage, power factor correction, voltage/frequency stabilization, and providing virtual inertia, etc. In fields such as data centers, charging stations and rail traction systems, there is the possibility of using solid-state transformers. However, when applied to power distribution systems, there are still many important challenges that need to be overcome, such as cost, lifespan, and system compatibility. Therefore, this study collects domestic and foreign solid-state transformer information to understand the key technologies, overview and prospects of SSTs' application in power systems.

關鍵詞(Key Words)：微電網 (Microgrid)、固態變壓器(Solid-state Transformer, SST)、虛擬慣量 (Virtual Inertia)。

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客服中心語音資料全文轉譯暨智能文本分析平台系統 建置與應用之研究

Research on the Construction and Application of Speech-to-Text Transcription and Intelligent
Text Analysis Platform for Taipower's Customer Service Center

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摘要

本研究建立語音全文轉譯暨智能文本分析平台，利用語音辨識和文本分析技術提升台電客服中心錄音資料價值。使用台電業務領域詞和來電錄音內容對聲學及語言模型進行調校，建立對話文本資料庫和全文檢索引擎，定義具體的文本分析應用，包括熱詞分析、主題分析、情緒分析、意圖問句辨識和對話摘要。提供文本資料探索和監控工具輔助資料探勘與知識發掘過程，藉以洞察客戶心聲、提升客服評鑑效率、降低特殊事件風險。最後將文本分析產出結合對話檢索分析功能進行視覺化呈現，提升客服應用便利性，並整合客服中心管理流程，打造數據驅動文化，以 AI 輔助專業真人決策，以正確客觀的分析資料對台電客服業務流程發揮助益，並持續精進優化以產生更多加值效益。

Abstract

This research aims to establish a speech-to-text transcription and intelligent text analysis platform to enhance the value of recorded data of Taipower's customer service center using speech recognition and text analysis technology. First of all, we use Taipower's business domain terms and incoming call recording content to adjust the acoustic and language models, establish a dialogue text database and full-text search engine, and define specific text analysis applications, including keyword analysis, topic analysis, sentiment analysis, intent question recognition, and conversation summaries. Secondly, text data exploration and monitoring tools are provided to assist the data mining and knowledge discovery process to gain insight into the voice of customers, improve customer service evaluation efficiency, and reduce the risk of special events. Finally, the text analysis output is combined with conversation search and analysis function for visual presentation to improve the convenience of customer service applications and integrate customer service center management processes to create a data-driven culture. At this point, AI can assist professional real-person decision-making, and continue to optimize Taipower's customer service business processes with correct and objective analysis data to generate value-added benefits.

關鍵詞 (Key Words)：語音辨識(Speech Recognition)、客服中心(Customer Service Center)、文本分析(Text Analysis)、人工智慧(Artificial Intelligence)、客戶心聲(Voice of the Customer)、數據驅動(Data Driven)。

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應用智慧電表資料進行長者生活作息分析

Using Smart Meter Data to Analyze the Elderly's Lifestyle Patterns

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摘要

智慧電表資料可用來進行長者生活模式分析，偵測異於平常狀況並進行預防性處理，日本各電力公司也有應用智慧電表在長者照顧的實際應用案例。本研究的目的即應用台電智慧電表資料進行長者生活作息分析，將智慧電表數據闡釋成為長者生活作息模式，當發現生活作息模式有異常時，能夠即時的通知遠端子女或照顧者。本研究擷取智慧電表數據，計算背景用電閾值，將用電量轉換為電器設備使用與否，計算電器使用行為的四週常模與活躍分數後進行單日生活作息「活躍度」與「規律性」評估。本研究建置的「健康狀態儀表板」資訊呈現之主要對象是子女、照顧者，期望讓子女了解長者的生活作息狀態，觸發子女對長者的關懷與聯繫。根據本研究系統易用性評估，健康狀態儀表板的「資料即時性」是影響使用者評價最重要之因素。

Abstract

Smart meter data can be used to analyze the elderly's lifestyle patterns, detect unusual conditions and take preventive measures. In Japan, various electric companies also have practical application cases of smart meter in elderly care. The purpose of this research is to use Taipower's smart meter data for analysis in order to interpret the elderly's lifestyle patterns. When abnormalities in daily life patterns are detected, remote family members or caregivers can be notified in real time. The content of this research includes capturing smart meter data, calculating the background electricity consumption thresholds, converting electricity consumption into whether an electrical appliance is used or not, calculating the four week norm and activity score of electrical appliance usage behavior, and then conducting a daily life schedule "activity degree" and "regularity" assessment. The "Health Status Dashboard" built in this research is mainly intended for children and caregivers. It is hoped that children can understand the living conditions of elderly and trigger their care and connection with the elderly. According to the System Usability Scale of this research, the "data immediacy" of the health status dashboard is the most critical factor affecting user evaluation.

關鍵詞 (Key Words): 智慧電表(Smart Meter)、高齡者家居照護(Elderly Home Care)、生活作息節律(Lifestyle Patterns)。

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高完整性容器(HIC)試驗議題研討

Study on Testing Issues of High-Integrity Containers (HICs)

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摘要

我國《低放射性廢棄物最終處置及其設施安全管理規則》第 4 條要求未達標準的低放射性廢棄物應使用高完整性容器進行最終處置，但《低放射性廢棄物最終處置盛裝容器審查規範》未明確說明高完整性容器應進行的試驗項目或通過標準，本研究探究低放法規使用高完整性容器的緣由，並研討高完整性容器的設計要求，再彙整國際間低放處置場使用的容器並其品質要求，從而研析應進行那些試驗項目後，應可滿足我國法規對申請處置容器的要求。比較我國與國際間近地表低放處置場的處置窖設計，可知目前我國低放處置場的處置窖設計應可滿足《低放射性廢棄物最終處置及其設施安全管理規則》對未達標準的低放射性廢棄物之處置要求，並可確保最終處置安全。

Abstract

Article 4 of the "Rules for Final Disposal of Low Level Radioactive Waste and Safety Management of the Facilities" requires that low-level radioactive waste (LLW) that does not meet standards shall be disposed in high-integrity containers (HICs). However, the "Regulations on Review of Containers for Final Disposal of Low-level Radioactive Waste" does not clearly state the test items or passing standards that HICs should undergo. This study explores the reasons for the use of HICs in LLW regulations, studies the design requirements of HICs, summarizes the containers used in international LLW disposal sites and their quality requirements, and then analyzes which test items should be carried out to meet the regulation requirements in Taiwan. By comparing the design of disposal vaults at near-surface low-level radioactive disposal sites in Taiwan and internationally, it shows that the current design of disposal vaults in Taiwan should be able to meet the regulation requirements of the "Rules for Final Disposal of Low Level Radioactive Waste and Safety Management of the Facilities" regarding low-level radioactive waste that does not meet the standards, and ensure the safety of final disposal.

關鍵詞(Key Words)：高完整性容器(High-Integrity Containers, HICs)、處置窖(Disposal Vault)、試驗項目(Test Items)。

自製加馬相機系統初始設定及其性能評測

Initial Setting of Self-Made Gamma Camera and Performance Evaluation

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摘要

為滿足除役過程中相關的管制輔助需求，包含拆除物分類輔助、拆除現場評估、豁免或外釋監管輔助、牆地面熱點偵蒐等輔助與安管用途，本單位開發自主設計的加馬相機，以滿足上述的核污染顯像需求。先前已完成一套具有實際施作可行性之加馬相機硬體工程規格訂定，並撰文描述紀錄，本文則就軟、硬體開發實作、整合安裝等工程過程進行說明，再以實測方式瞭解、評估系統現階段設置下之功能與性能。初步結果顯示本機偵測與顯像性能優良，可滿足主要核污染顯像應用需求，唯外釋監管表面污染項目之管制標準數值甚低，現階段的短焦廣角準直器零件並不合適，可再行設計合用零件更換以滿足低活度應用之需要。

Abstract

In order to meet the relevant control and safety management needs during the decommissioning and dismantling process of nuclear facilities, which includes four main anticipated task, namely, jar/box classification, field survey and evaluation, exemption/clearance measurement and structural surface hot-spot survey, a purpose-derived Gamma camera was developed to meet the above-mentioned needs. Previously we had completed the formulation of a set of practical implementation feasibility of Gamma camera hardware engineering specifications and written a description record. In this article, we intend to explain the engineering process of the Gamma camera system's software and hardware development, integration and installation and software implementation, and then use actual measurements to understand and evaluate the functions and performance of the system under its current configuration. Preliminary results show that the detection and imaging performance of this machine is excellent and can meet the needs of radiation hot-spot imaging and searching. However, restricted by the low control standards for externally released surface contamination items, the current short-focus and wide-angle collimator parts are not suitable and have to be designed and replaced to meet the needs of low-activity applications.

關鍵詞(Key Words)：加馬相機(Gamma Camera)、影像感測頭(Imaging Probe)、核污染顯像(Hot-spot Imaging)、性能評測(Performance Evaluations)。