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ISO 19901-2 離岸結構物地震力與建築物耐震設計之比較分析

蔡英廷*
Cai, Ying-Ting

劉維祥*
Liou, Wei-Hsiang

許哲崙*
Hsu, Che-Lun

摘　要

本公司為配合政府綠能政策，積極推動離岸風力發電計畫，並於民國 107 年 2 月完成「離岸風力發電第一期計畫-示範風場新建工程」決標工作，其針對離岸構造物的地震力評估工作需特別注重。國際上離岸風力發電之設計地震標準一般採用 DNV 及 API 作為其設計規範，其設計地震力最終多指向 ISO 19901-2 規範，現行國內耐震設計規範仍以內政部頒佈之「建築物耐震設計規範及解說」為圭臬。本文將以彰化風場為例，參考中興工程顧問公司於本計畫「基本設計階段」訂定之地震危害度分析(PSHA)，採用 ISO19901-2 標準作為設計地震規範，以詳細法決定設計地震參數，並與「內政部建築物耐震設計規範及解說」計算之靜態設計地震力比較其結果。本文建議，快速且保守求得離岸構造物地震力可先以部頒耐震規範先行估算。增加考量近斷層效應、地盤條件及再現週期修正等影響，合理修正連結兩者的相互關係，於設計階段將具有效之參考價值。

Abstract

On the Changhua Offshore Wind Farm Project, Sinotech Engineering Consultants, Ltd. adopted the ISO 19901-2 Earthquake Code to evaluate the seismic loading at the Front End Engineering Design (FEED) stage. The methodology features two level earthquakes, Extreme Level Earthquake (ELE) and Abnormal Level Earthquake (ALE), to design and review the Structural integrity during the project's service life. The purpose of this study is to crosscheck the seismic loading effect in the FEED report, by adapting the current building code (Seismic Design Specifications and Commentary of Buildings, SDSCB) with two level earthquakes (MCE&DBE). The comparison of ISO 19901-2 and SDSCB shows close proximity assuming that importance factor equals to unity. Since offshore structures are characterized by dynamic loading, the method to crosscheck seismic effects must be carefully addressed to be in line with site-specific concern at the formal design stage.

*台灣電力公司營建處

以資料探勘技術預測風力發電量之研究：
彰工風力發電站案例

Wind Power Generation Prediction Using Data Mining Technique:

The Case of Chang Kung Wind Farm

許志義*　　　　　　　　張家源**　　　　　　　　羅偉***

Hsu, Jyh-Yih　　　　　Chang, Chia-Yuan　　　　　Lo, Wei

摘　要

　　本研究以台灣電力公司提供的風力發電機數據作為研究資料，採用統計方法分析每台風機的發電量狀況，找出發電量異常之風機，並探究季節轉換對發電量是否有影響。另外，結合中央氣象局觀測資料查詢系統提供的歷年氣象數據，依據不分季、季風與海陸風等天氣因素建立發電量預測模型，為探討各演算法對預測結果的影響，藉由隨機森林、支援向量迴歸、人工神經網路、最近鄰居法與線性迴歸等找出預測誤差最低之演算法，最後使用演算法進行特徵選取，最佳化其結果。

　　實驗結果發現，採用變異數分析三十一台風力發電機其平均發電量最低的 5 台風機，彼此間有顯著差異，可能是因為風機之架設位置或維修狀況等因素造成。並且，採用獨立樣本 T 檢定得知東北季風及海陸風時段其分析結果為顯著，意味著風力發電量的數值在此期間或許能得到更精確的預測。

Abstract

This study takes wind power generator data provided by Taiwan Power Company as the research materials to conduct statistical analyses on each generator's power generation condition. We first identifies generators with abnormal power generation and whether season's change affects power generation. Next, by studying the Central Weather Bureau CODiS's (CWB Observation Data Inquire System) weather observation data over the years, we creates power generation prediction models based on different weather factors, e.g. all-seasons-included, monsoons, sea and land breezes, to examine how different algorithms may impact the prediction results. Then, we employs random forest, support vector regression, artificial neural network, and k-nearest neighbors algorithm and linear regression to identify the algorithm with the least prediction error. Finally, we utilize the algorithm to perform feature selection and optimize the results.

As the experiment results indicate, upon applying analysis of variance, the 5 generators with the least average power generation among the total 31 show significant variance among each other. This may be attributed to the factors such as the generator's location or maintenance condition. Moreover, by applying the independent samples t-test, we learn that the northeast monsoon time period and the sea and land breeze time period exhibit the most significant analysis results, indicating that the prediction of wind power generation capacity during the said periods is more accurate.

關鍵詞 (Key Words)：風力發電量預測(Wind Power Generation Prediction)、隨機森林(Random Forest)、支援向量迴歸(Support Vector Regression)、人工神經網路(Artificial Neural Network)、最近鄰居法(*K*-nearest Neighbor)、特徵選取(Feature Selection)。

*國立中興大學資訊管理學系暨應用經濟學系所
**國立中興大學資訊管理系所
***國立台灣大學國際企業管理系所

協和計畫發展海洋牧場相關研究：
海域生態及漁業資源調查

Study on the Marine Farming of Hsieh-Ho Power Plant:

Marine Ecology and Fishery Resource Investigation

李孟洲*　　　　　　　　　冉繁華*　　　　　　　　　陳璽年**
Lee, Meng-Chou　　　　　Nan, Fan-Hua　　　　　Chen, Hsi-Nien

摘　要

　　台電公司預期將進行協和發電廠之天然氣接收站改建計畫，為評估後續以天然氣接收站為核心，營造海洋牧場之方向及可能性，本研究進行全年期生態、環境與漁業資源調查。結果顯示，海域生態皆為北部海域常見之物種，未發現特有種及保育物種；海域環境調查結果顯示，協和電廠沿近海域之水質、海水金屬元素、海水微生物與底泥金屬元素皆與天然海域相似，適合用於海洋生物及藻類養殖；鄰近漁港捕撈方式多以一支釣為主，以鰺科及鯖科魚類為主要漁獲種類，以常溫活體或冰藏方式保存。本研究初步建立協和電廠周遭海域之基礎資料，未來建議可持續進行長期監測調查，並導入數值模擬技術，進行生態環境模擬評估，以作為未來協和電廠興建天然氣接收站與海洋牧場之評估依據。

Abstract

　　Taiwan Power Company is planning to build a liquefied natural gas (LNG) terminal at Hsieh-Ho power plant. To evaluate the feasibility of constructing an LNG terminal-based marine farm we conducted a year-long investigation with three major research aspects. In the aspect of marine ecology, it is found that the biological species are commonly seen in the North coast of Taiwan; no endemic or protected species have been detected. In the aspect of environment assessment, it is found that the water quality, metal element index and microorganisms in the adjacent waters and bottom sediments of Hsieh-Ho power plant are similar to those of natural ocean.

　　In the aspect of fishery resources, it is found that (1) the fishing methods in the neighboring fishing ports are mainly pole and lines boote and hand lining, (2) the catch is stored in living or ice storage at room temperature, and (3) Carangidae and Scombridae are the major catch species. This study has preliminarily established a database of Hsieh-Ho power plant seaside. To serve as a basis for assessing the feasibility of LNG terminal construction and marine farming at Hsieh-Ho power plant, ecosystem modeling, long-term investigation and agent-based modeling technology sourcing will be suggested in the future.

關鍵詞 (Key Words)：協和電廠(Hsieh-Ho Power Plant)、天然氣接收站(LNG Terminal)、生態(Ecology)、環境(Environment)、漁業資源(Fishery Resources)、海洋牧場(Marine Farming)。

*國立臺灣海洋大學水產養殖學系
**台灣電力公司綜合研究所

興達發電廠空壓系統節能評估研究

Energy-Saving Assessment of Hsinta Power Plant's Compressed Air System

劉源隆*
Liu, Yuan-Long

吳政宏*
Wu, Cheng-Hung

陳國義*
Chen, Kuo-Yi

鄭光志*
Cheng, Kuang-Chih

趙浩廷**
Chao, Hao-Ting

周茗禾**
Chou, Mi-Huo

摘　要

　　台灣電力公司在國內扮演重要供電角色，同時也為節能減碳的先驅。本計畫為評估興達火力發電廠空壓系統之運行現況，協助空壓系統操作達到較佳之運轉效率與能耗效益應用。原空壓系統用氣量尖峰負載高且標準差大，導致用氣需求大，建議更改操作順序，降低尖峰負載，可減少一台 3,000 HP 空壓機運作，每年節省 518 萬度電，如再將低壓需求之廠用儀用獨立供氣，減少壓損及空氣增壓之電費，每年共可省 674 萬度電，回收年限 0.78 年。

Abstract

　　Taiwan Power Company plays an important role in domestic power supply; meanwhile, it is also the pioneer of energy saving and carbon reduction. The purpose of this study is to assess the current status of Hsinta power plant's compressed air system. High air peak consumption and standard deviation leads to a great demand for soot blowing. It is recommended that the operational method to be changed to reduce the peak load, which can help reduce the need for a 3,000 HP air compressor and save up to 5.18 GWh electricity annually. It is also recommended that factories and instruments with low pressure demand to install independent compressed air system to reduce pressure loss and electricity consumption due to pressurization. This may save 6.74 GWh electricity annually, and the pay-back period of this additional investment is about 0.78 year.

關鍵詞 (Key Words)：節能評估(Energy Saving Assessment)、空壓系統(Compressed Air System)、吹灰空壓機(Soot Blower Air Compressor, SBAC)、排放閥(Blow-Off Valve, BOV)。

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*台灣電力公司環境保護處
**工業技術研究院綠能與環境研究所

以創新思維調整空間配置
解決空間不足無法增設輸電電纜案例

Adjust the Conduit Space Layout with Innovative Thinking to Solve
Increasing Underground Cables Lacking Sufficient Space

李智偉*　　　　　　　　　　　　　　　　　　張文旗*
Li, Chih-Wei　　　　　　　　　　　　　　　　Chang, Wen-Chyi

摘　要

　　地下輸電線路新建管道佈設空間，除要面臨地下障礙物閃避、道路施工路證申請，甚至民情陳抗排除，要符合供電時程需求，是一大困難與挑戰。爰此，既設輸電線路設備延伸利用，相較於新建管道佈設空間，可減少成本、避免挖掘路證申請、民情陳抗等問題，且為最有效達成供電時程之方式；惟需藉由縝密規劃設計、妥適施工排程，方能在供電無虞情形下，達成供電目標。

　　本文說明 69kV 漁港~高航分歧四櫃線，檢討、分析整體空間佈設，利用過港隧道之共同管道內僅剩備用空間之餘裕，更改支臂形式及長度『以變換支臂長度換取佈設電纜空間』，並妥適規劃施工排程、協調，期提供未來辦理地下電纜新增設規劃與選擇之參考。

Abstract

　　Underground obstruct avoidance, road construction permit application and protest exclusion are the common factors delaying the schedule requirements of newly-built underground conduits. Extended use of existing transmission lines not only help reduce the overall costs of underground conduits, but also assure on time power supply. But, on time schedule relies on precise planning and design and proper schedule arrangement. This article describes the planning contents of the 69kV Yu Gang - Gao Hang - Si Gui transmission line, including (1) review and analyze the overall space layout, (2) utilize the spare space in the common duct to alter the rack type and its length to accommodate the layout of the cable space, and (3) proper planning and coordination of construction schedules, to serve as a reference for the underground cables to be planned and built in the future.

*台灣電力公司輸供電事業部輸變電工程處南區施工處

人孔蓋座降埋與快速開孔工法

Underground Manhole Cover and Quick Opening Method

許文*　　　　　　　　　　　　　游凱誠*

Xu, Wen　　　　　　　　　　　　Yu, Kai-Chen

摘　要

　　交通網路之建設提升了社會大眾的便利性，同時，人們為追求生活品質，對於公共設施的要求亦同樣關注，在所有公共設施中，維生管線則佔有極高的比率，諸如電力、電信、自來水與天然氣等攸關民生管線，即屬於政府重要公共工程，其建設刻不容緩。各管線單位在節省土地資源、減低景觀破壞之考量下，已實施管線地下化多年。管線地下化雖然某種程度降低對環境景觀的衝擊，但不可否認的管線設施於使用過程中需針對路面進行經常性之開挖，並設置人孔蓋或手孔蓋，以便於管線維護及事故搶修時，施工人員得以快速進行上述管線的安裝、維修或檢查工作。

　　然而，若施工人員於開挖後回填不實或孔蓋設置方式失當，將導致路面下陷、孔蓋周邊鋪面破損，以及孔蓋與路面不齊平之情形發生，非但影響觀感與舒適性，甚者危及用路人行車安全。為此，主管機關近年來推行路平專案等措施，將孔蓋施工方法進行修正，讓孔蓋埋藏於地面下，即孔蓋蓋上後，再於其上方鋪設混凝土或瀝青，以維持道路的平整。

Abstract

　　Public facilities, taking transportation network for example, has created high welfare for the public. On the contrary, in pursuit of life quality, the public is　extremely concerned about the public facilities. A large part of the public facilities is life support pipelines, such as electricity, telecommunication, tap water, and natural gas, which are important and pressing public works of the government. To save land resources and reduce landscape damage, underground engineering has been implemented for many years by the agencies responsible for the pipelines. Underground pipelines help reduce environmental impact, but the road surface often has to face the situation of excavation. In front of this situation, manhole/handhole covers will be favorable for the construction personnel to execute pipeline maintenance and electrical accident rush repair, such as installing, repairing and inspecting the pipelines.

　　However, impractical backfill and incorrect hole cover setting after excavation may cause road sinking, damage of the pavement around the hole cover, andr hole cover not level with the road surface, which are not only unsightly but also have an impact on road users'safety. In view of this, the administration concerned in recent years has implemented the Lupin Project among otehrs to modify the hole cover construction method, i.e. undergrounde hole cover and laying concrete or asphalt on the hole cover to maintain the level of the road.

關鍵詞 **(Key Words)**：孔蓋結構(Hole Cover Structure)、人孔蓋座降埋(Manhole Cover Buried Down)、快速開孔(Quick Opening)、RF 偵測模組(RF Detection Module)。

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*台灣電力公司輸供電事業部高屏供電區營運處

節能服務整合資訊系統建置研究

Implementation of the Energy Saving Service Integrated Information System

楊新全*	賈方霈*	王玟菁*
Yang, Shin-Chuan	Jia, Fang-Pei	Wang, Wen-Jing

戴台平**	林偉琦**	黃致祥**
Day, Tai-Pyng	Lin, Wei-Chi	Huang, Chih-Hsiang

摘　要

　　本研究的主要任務是建置節能服務整合資訊系統，透過單一系統達成台電公司外部及內部節約能源目標管控。

　　外部節約能源方面，包括透過系統辦理百瓩以上用戶節電服務以及社區節電服務。所要完成的工作項目包括：1.規劃、設計與建置訪談問卷內容、資料庫及問卷資料轉置程式；2.規劃、設計與建立主要用電器具資料庫；3.篩選與建立尚有節能潛力之用戶資料庫；4.輔助用戶進行各項用電改善作業，並彙總推廣作業成果及績效；5.舉辦服務訪問與各項節約用電宣導會、進行社區節電服務及訪問，宣導空調節約用電，提供輸入、維護與上傳核定報表功能，訂製標準作業流程，並完成各單位教育訓練課程。

　　內部節約能源方面，包括透過系統辦理台電公司發、輸、配、售電各單位填報用電、用水、用油資料統計，俾利管控節能。所要完成之工作項目包括：1.規劃、設計與建置生產性及非生產性單位電號資料庫，與 NBS 系統介接以取得每月用電度數資料；2.規劃、設計與建置每月累積用量單位超量排名；3.規劃、設計與每月當月節約率排名，並篩選各前三名；4.規劃、設計與建置提醒功能，以郵件通知經辦人上傳能源用量報表及鍵入當月用量資料；5.用電量及節電量資料圖像視覺化，以尋找出有節電潛力的單位；6.規劃、設計與建置區營業處之年度 EUI 值，以檢視是否已達各區營業處年度目標。

　　另外須將現行「用戶節能追蹤查核系統」及「節約能源用量系統」之用電資料庫資料全數轉置入本案開發之整合系統。

Abstract

The aim of this study is twofold. One is to build a new integrated information system to control the internal and external energy saving service targets set by Taiwan Power Company (TPC). The other is to transfer the data currently stored in the database of User Energy Saving Tracking System (UESTS) and Energy Conservation System (ECS) to the newly built Integrated Information System. UESTS is the information system aiming for TPC customers with contract capacity equal or over 100 kW and the communities. ECS is the information system to supervise and control departmental usage of electricity, water, and oil within TPC.

關鍵詞 **(Key Words)**：節能服務(Energy Saving Service)、整合資訊系統(Integrated Information System)。

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*台灣電力公司綜合研究所
**環域科技股份有限公司

北部核一廠及核二廠附近海域浮游動物之季節性演替與分佈調查

The Distribution and Seasonal Succession of Zooplankton in the Waters Adjacent to Nuclear Power Plants I and II in Northern Taiwan

曾立鈞*　　　　林志銘*　　　　蕭世輝**　　　　黃將修*
Tseng, Li-Chun　　Lin, Chih-Ming　　Hsiao, Shih-Hui　　Hwang, Jiang-Shiou

摘　要

浮游動物之分佈與豐度常受到溫度、鹽度與水團的互動而改變。本研究的主要目的在調查北台灣兩座核能電廠鄰近海域之浮游動物季節間組成變化，以及核電廠冷卻系統的溫排水對浮游動物群聚結構所產生的影響。本研究於 2015-2017 年間使用海研二號研究船進行 21 個測站水表層樣品的採集。所有的樣品分析結果顯示浮游動物的優勢大類為：哲水蚤 (相對豐度, RA: 51.35%)、夜光蟲 (RA: 19.56%)、歧口水蚤 (RA: 8.34%)、其他幼生 (RA: 3.08%) 與其他十足類 (RA: 2.93%)。每立方米海水中的浮游動物個體數 (平均值 ± 標準誤差) 變化範圍為 80.67 ± 70.62 至 1199.66 ± 1167.37 之間。經 one-way ANOVA 檢測的結果發現，浮游動物的平均數量在第一季顯著低於其他三個季節的調查值 ($p < 0.05$)。在空間分佈變化的分析中，發現核二廠外海域浮游動物的平均豐度顯著高於核一廠外海域 ($p < 0.001$)。以測站距離的空間分佈來看，浮游動物的密度在距核電廠不同距離的測站間沒有顯著的差異存在 ($p > 0.05$, one-way ANOVA)。浮游動物的大類出現數以出、入水口處測站為最低，顯著的低於 500 公尺至 5 公里處的測站 ($p < 0.05$, one-way ANOVA)。本研究結果顯示浮游動物分佈與組成具有空間上的差異與季節性消長的變化，且離岸距離 500 公尺之外的水域，浮游動物群聚結構不受核電廠運轉之冷卻用溫排水影響。

Abstract

The distribution and abundance of zooplankton are commonly affected by factors, such as changes of temperature, salinity and the interplay with water masses. This study aims to investigate the seasonal changes of zooplankton composition in the adjacent waters of two nuclear power plants (NPPs) in Northern Taiwan and how warm drainage from NPP cooling system may affect the assemblages of zooplankton. With the help of a research ship named the Ocean Research Vessel-II, surface samples from 21 stations were collected from 2015 to 2017. The results of analysis demonstrated that among all samples, the most dominant taxon was Calanoida, relative abundance (RA) 51.35%, followed by *Noctiluca* sp. (19.56%), Poecilostomatoida (8.34%), other larva (3.08%), and Chaetognatha (2.93%). The total abundance (TA) of zooplankton varied from 80.67 ± 70.62 to 1199.66 ± 1167.37 (individuals m^{-3}). The result

*國立台灣海洋大學海洋生物研究所
**國立臺北教育大學自然科學教育學系

of one-way Analysis of Variance (ANOVA) indicated that the average TA of the zooplankton collected from January to March was significantly lower than those collected in the other three seasons of the year($p < 0.05$). The results of the spatial distribution analysis indicated that the average TA of the zooplankton samples collected from the adjacent waters of the Second Nuclear Power Plant (short as the Kuosheng NPP) was significantly higher than those collected from the adjacent waters of the First Nuclear Power Plant (short as the Jinshan NPP) ($p < 0.001$, one-way ANOVA). As for the spatial distance analysis, no significant difference was found regarding the average TA of zooplankton collected from stations at different distances from the coast ($p > 0.05$, one-way ANOVA). Furthermore, the least zooplankton taxa variety had been recorded at the inlet and outlet stations. This number was significantly lower than at stations 500 m to 5 km away from the coast ($p < 0.05$, one-way ANOVA). This study reveals substantial spatial variations in zooplankton distribution and assemblages. In the waters beyond 500 m off the coast, the structure of the zooplankton was not affected by warm drainage discharged by the NPP.