台電工程月刊 864 期（8 月號）目錄

輸 變 電：

電力系統：

化學與材料：

工程技術：

其　　他：

回頁首

161kV 大潭新~林口線地下電纜管路工程(第一工區)設計階段風險評估案例分享

A Case Study of Design-Phase Risk Assessment for the 161kV Datan-Linkou Underground Cable Pipeline Engineering Project

蘇耕立*
Su, Keng-Li

莊武諺*
Chuang, Wu-Yan

藍宏智*
Lan, Houng-Chih

張涵曦*
Chang,Han-Hsi

江武照*
Chiang, Wu-Chao

摘　要

依據職業安全衛生法第 5 條工程之設計或施工者，應於設計或施工規劃階段實施風險評估，致力防止工程施工時發生職業災害。大潭新~林口線地下電纜管路工程(第一工區)由大潭 G/S 起，沿台 61 線施設，規劃推管穿越台 66 線下方及 4 處溪流，全長約 10.7 公里，沿線交通流量大，既設管線複雜，藉由設計階段風險評估及相關對策之擬定，應可有效降低後續施工風險，提升整體工程安全性。

Abstract

The Occupational Safety and Health Act specifies that risk assessment during engineering design and/or construction phases shall be implemented to prevent occupational accidents. The total length of the route of 161kV Datan-Linkou power underground cable pipeline engineering project (section one) is 10.7km or so, which starts from Datan G/S, along Provincial Highway No. 61, passing through Provincial Highway No.66 and 4 streams. Since the route is accompanied by heavy traffics and complex pipelines, risk assessment and developing countermeasures in project design phase effectively elevate the safety/security of the project.

關鍵詞 (Key Words)：設計階段(Design Phase)、風險評估(Risk Assessment)、地下電纜(Underground Transmission Line)。

*台灣電力公司輸供電事業部輸變電工程處北區施工處

應用基因演算法於變電所設備維護排程之解析

An Analysis of Maintenance Scheduling of Substation Equipment Applying Genetic Algorithm

胡城瑋* 卓明遠** 張簡敏*
Hu, Cheng-Wei Cho, Ming-Yuan Jang, Chien-Min

摘 要

本研究主要目的在於利用過去的點檢紀錄，經過人工智慧的數據分析後，找出舊有點檢的趨勢，並以變壓器或斷路器為中心，利用同時停電其上下游同步停電為一群組的方式，設定成能夠做點檢的最佳組合。本論文首先建置推估點檢群組模型，所有的設備依其上下游之關係，按照各變電所的開關廠號碼圖，均可歸類於不同的點檢群組模式，並將其設定為標準化模式，並提出成本管控的觀念，再以基因演算法，求出建議點檢組合，並滿足停電限制條件。再者本論文提出以基因演算法之智慧型方法求解，利用基因演算法之求解過程中，以實數編碼的方式進行運算；在每一次的演化過程結束時，保留適應值最佳之染色體以提高執行效率。經過實際案例做之模擬分析，本研究分別分析了本轄區之三個主要變電所包含了仁武 E/S、社武 P/S、岡山 P/S、分別做出了理想化分析與實際化分析群組模式。模擬結果顯示本論文的確對未來的設備點檢工作，及變電所設備點檢自動化是有所幫助的。

Abstract

This study seeks to improve the maintenance checks of substation equipment by applying data analysis methodology of artificial intelligence onto the past inspection records to find out the trend of the old checks. Meanwhile, we take transformers/circuit breakers as the center and simultaneous power outages and their upstream/downstream synchronous power outages as a group to enable best combinations of equipment inspections. In the initial phase of this study, we built up an estimated point-checking group model and according to the stream relationship amid each of them, along with the help of substation switchyard number map, the equipment were individually classified into different check group modes, viz, the standardized mode set for each equipment. We then applied the methodology of genetic algorithm to identify the recommended check combinations, which were least cost and met the constraints of power outages. The process of the solving was performed by real number coding, and the best fit chromosomes were withheld at the end of each evolution process to improve the effectiveness. Three major substations, Renwu E/S, SheWu P/S, and GangShan P/S, were selected as the idealized and actual analysis groups. As the results of the study indicated, the simulation is extremely helpful for the company's follow-up substation equipment inspections and automation works.

關鍵詞 (Key Words)：變電所自動化(Substation Automation)、人工智慧(Artificial Intelligence)、維護排程(Maintenance Scheduling)、基因演算法(Genetic Algorithm)。

---

*台灣電力公司輸供電事業部高屏供電區營運處
**國立高雄科技大學

電業轉型第 1 階段輔助服務及電力調度費率成本計算之合理性分析

Reasonability Analysis of the Ancillary Services and System Operating Rates under 1st Phase EMR

賴靜仙* Lai, Ching-Hsien
李愛鈴* Lee, Ai-Ling
吳爵丞* Wu, Chueh-Cheng
鄧勝元** Teng, Sheng-Yuan
徐唯耀*** Xu, Wei-Yao
吳進忠*** Wu, Chin-Chung

摘　要

本研究旨在分析電業轉型第 1 階段輔助服務及電力調度費率成本計算之合理性。透過國外資料蒐研，選擇日本、新加坡、美國 TVA 及美國 CAISO 作為探討對象，進行輔助服務及電力調度費率與批發市場電價及終端價之占比分析，並檢視我國費率成本計算方式之合理性。由分析結果顯示，台電公司目前提出之輔助服務費率計算方案費用比例接近國外電業，約占批發市場電價 2%。在電力調度費率中，因台電正處於轉型階段，即將更新電力調度之軟硬體設備及新增電力市場營運人員，故電力調度費用占比略低於其他國家。另外，在電力調度費率計算公式中，相較於國外作法，建議後續修改輸配電業各項費率計算公式時，將傳輸損失費用獨立於電力調度費率計算，避免因傳輸損失對費率造成影響。

Abstract

This study aims to analyze the reasonability of ancillary services (AS) and system operating (SO) rates under the legal framework of Taiwan's 1st phase electricity market reform (EMR). The major contents of this study include a literature review of foreign cases, such as Japan, Singapore, TVA, and CAISO (AS and SO expenses and their percentages to wholesale and retail prices), and the reasonability of cost calculation and rate setting in Taiwan. The major findings of this study: (1) the percentage of AS rate proposed by TPC is very similar to those in foreign countries around 2% of the wholesale market prices, (2) the SO rate proposed is kind of lower than foreign countries, since TPC has not yet accomplished its organizational transition, its EMS not yet updated, and the personnel responsible for market operation not yet recruited, (3) in the future, the transmission loss charge may be separated from the SO fee to avoid adverse impact to the electric prices.

關鍵詞 (Key Words)：電業轉型(Electricity Reform)、輔助服務費率(Ancillary Services Rate)、電力調度費率(System Operating Rate)。

---

*台灣綜合研究院
**台灣電力公司綜合研究所
***台灣電力公司輸供電事業部電力調度處

煤灰多元化再利用研究

A Study on Diverse Reuse of Coal Ash

黃然* Huang, Ran
徐敏晃** She, Ming-Huang
邱智勇**[*] Chiu, Zhi-Yong
郭麗雯*** Quo, Lih-Wen
劉紹仲**** Liu, Shao-Chung
林榮茂**** Lin, Jung-Mao

摘　要

本研究旨在探討煤灰多元化再利用之途徑，首先調查國內外煤灰再利用情況，並依據國內煤灰產銷現況，建議較佳的再利用化途徑及導入策略。有關試驗計畫包括：(1)評估燃煤底灰作為水泥原料的可行性；(2)高飛灰摻量混凝土之配比及材料性質試驗。此外，本研究舉辦3 場宣導說明會並建議台電公司優化現有供料模式，並修正公共工程飛灰混凝土使用手冊及草擬高飛灰摻量低強度混凝土施工綱要規範。最後，進行煤灰出口可行性評估及台電煤灰申請環保署環保標章之可行性，並參與國際研討會並將交流資訊及成果提供台電公司，可作為後續研究方向參考。

Abstract

This study aims to explore the approaches of coal ash reuse. We firstly investigated domestic and foreign applications. According to the production and sales status in Taiwan, we then put forward a number of approaches/strategies for coal ash reuse and recycling. Two testing programs had been correspondingly carried out to fulfill the goal of the study : (1) the feasibility of utilizing bottom ash as cement raw material, (2) optimal mix proportions of high volume fly ash concrete. The achievements of this study include: (1) organized three workshops, (2) optimized the current coal ash supply process of TPC, (3) modified manuals and regulations related to high volume low strength concrete, (4) evaluated the feasibility of coal ash exports, (5) evaluated the feasibility of applying EPA green label, (6) provided international seminar information to serve as reference for follow-up studies.

關鍵詞 (Key Words)：煤灰(Coal ash)、控制性低強度回填材料(CLSM)、水泥生料(Cement Raw Materials)、高飛灰混凝土(High Volume Fly Ash Concrete)、卜作嵐材料(Pozzolanic Materials。

---

*國立臺灣海洋大學河海工程學系名譽教授
**財團法人臺灣營建研究院
***台灣電力公司綜合研究所
****台灣電力公司水火力發電事業部發電處

【板橋 P/S 新設三孔涵洞】工程規劃案例

A Case Study on the Engineering Planning of Banqiao Primary Substation's 3-Region Electricity Culvert Construction Project

余大任* 楊仲豪* 謝明達* 黃立志*
Yu, Da-Ren Yang, Zhong-Hao Xie, Ming-Da Haung, Li-Zhi

摘 要

板橋 P/S 三孔涵洞規劃目的係配合【板橋 P/S 改建工程】執行周邊線路改接，新設具地下空間之結構物供至少 16 回特高壓電纜、50 回配電饋線引接入 110 年落成之新型屋內式板橋 P/S 變電所。

自 104 年 4 月板橋 P/S 用地屬性變更後，台電輸變電工程處北區施工處於現有板橋 P/S 既設設備區設計新 3 孔涵洞，每孔淨尺寸 240(寬)x360cm(高)，因必須穿越眾多送電中設備且受限於 L 型地界線內之險惡區域，產生超過 6 項設計困難點。

本篇工程案例將以地下涵洞土木設計專業知識，詳列工程設計上所遭遇之瓶頸，並以現場施工可行性為基礎，逐一提出解決的方案。

Abstract

We initiated the Banqiao Primary Substation 3-Region Culvert Project to cooperate with the electric line rectification of the Banqiao Primary Substation Reconstruction Project. The new underground structure will be capable to accommodate at least 16 circuits UHV and 50 circuits HV cable lines, among the others, to be connected to the indoor Banqiao Primary Substation scheduled to be completed in 2021. April 2015, the land attribute of Banqiao Primary Substation was altered. Therefore, an engineering design of 3-region culvert located at the sharp areas of Banqiao Primary Substation were raised by the Northern Region Construction office, TPC. The net size each of the regions is 7.9ft (width) x 11.8ft (height). The project has confronted with over 6 design predicaments due to that there were so many power transmission equipment to traverse but constrained by the L-shaped boundary line. In this paper, we list in details the engineering design bottlenecks encountered and the corresponding solutions eventually jumped out.

關鍵詞 (Key Words)：三孔/三域涵洞(3-Region Culvert)、環形效應(Ring Effect)、直井(Naoi)、隔間牆(Compartment Wall) 、預鑄節塊推進(Precast Segmental Launching)、預鑄節塊吊放(Precast Segmental Hanging)、場鑄銜接(Cast in place Connecting)、雙向版(Two-Way Slab)、預留筋(Dowel)。

---

*台灣電力公司輸供電事業部輸變電工程處北區施工處

我國電力交易平台預擬架構之研究

A Study on the Preliminary Energy Trading Platform Design in Taiwan

蔡金助* 吳進忠*
Tsai, Chin-Chu Wu, Chin-Chung

賴靜仙** 吳霽庭** 吳爵丞**
Lai, Ching-Hsien Wu, Chi-Ting Wu, Chueh-Cheng

摘 要

本研究旨在研擬我國電力市場之高層次設計及電力交易平台之架構。經參考國外電力市場設計、盤點我國法規要求及考量國內外國情之差異，我國電力市場成立初期將以簡單化、集中化、低風險為目標。此外，為滿足《電業法》之要求，電力交易平台應納入容量充裕性、提高輔助服務運用彈性、提供綠能交易、促進需量反應與儲能發展及精進調度排程等功能。

為達成上述目標及功能要求，本研究建議可透過建立容量市場、日前市場、即時市場及小時前調整等程序，以滿足供電穩定目標，促進電力批發市場部分競爭。

Abstract

This study aims to bring forward a preliminary energy trading platform (ETP) framework design for TPC's reference. After surveying related foreign cases, regulations and the uniqueness of Taiwan electricity market, it is concluded that the preliminary stage ETP for Taiwan will be embedded with three prerequisites, namely simplicity, concentration and risk avoidance. In addition, the ETP design needs to accommodate the functions specified in the Electricity Act, e.g. capacity adequacy, flexibility of ancillary services, renewable energy trading, and the follow-up developments of demand response (DR), energy storage, scheduling, etc. To achieve the said goals, the following sub-markets/procedure, to ensure stable power supply when transitioning to a new electricity market, are proposed- Capacity Market, Day-ahead Market, Real-time Market and Hour-ahead Balancing Mechanism.

關鍵詞 (Key Words)：電力市場(Electricity Market) 、電力交易平台(Energy Trading Platform)、電業法(the Electricity Act)。

---

*台灣電力公司輸供電事業部電力調度處
**台灣綜合研究院

台電公司經營績效結構分析及管理平台建置與應用

A Study on Structural Analysis of TPC Operating Performance and Implementation and Applications of Management Platform

徐造華*
Hsu, Tsao-Hua

陳麗容**
Chen, Li-Jung

黃偉光**
Huang, Wei-Kuang

楊豐碩****
Yang, Feng-Shuo

洪育民***
Hung, Yu-Min

陳政宏**
Chen, Cheng-Hung

摘　要

國際燃料價格於民國 92 年起大幅上漲，政府為減緩對產業衝擊、照顧民生及穩定物價，電價未足額調整。台電公司持續吸收上漲成本的結果，導致 95 年開始出現虧損，累積虧損逐年攀升。

面臨外部環境不斷變化與衝擊下，台電公司配合經濟部於 101 年 4 月成立「台電及中油公司經營改善小組」，積極檢討經營成本與績效，並力求改善組織效能，在 103 年終止連續八年虧損，創造出 140 億元之盈餘，104 年盈餘更達到 636 億元，累積虧損陸續減少。為持續進行加強與改善工作，於 105 年開始採行事業部制，藉由會計分離與廠網分工等變革，對內強化成本意識，對外回應社會期待，以落實發、輸、配、售電之經營權責，提升公司整體之經營績效。

本研究依事業部組織架構，發展經營績效分析方法以及管理平台，透過量化與分析，評估同仁的貢獻與努力，除提供經營管理階層參考，亦能使外界更瞭解台電公司經營績效成果，及員工所付出之努力。

Abstract

To cope with sharp increases of global fuel prices during the year of 2003, the tariffs reviewed by the government regretfully had not been able to fully reflect the associated costs. The political considerations behind could include stabilizing the commodity prices, taking care of the public livelihood, and mitigating the impacts to the industrials. As a consequence, Taiwan Power Company (TPC) started to record losses in 1995, and ever since then the deficit enlarged.

Confronted with rapid changes of external environments, the Ministry of Economic Affairs (MOEA) set up a task force in 2012 to improve the operating performance of TPC and CPC (the Chinese Petroleum Corporation. The said situation terminated in 2014. TPC presented the surplus of NTD14 billion that year, and NTD 63.6 billion next year. The accumulated deficit had been decreasing ever since then. To reinforce operating performance, TPC engaged in organizational restructuring and established divisions in 2016. To properly respond to societal expectations, measures of accounting separation and separation of generation and grid functions among the others have been implemented ever since to make solid the accountability of cost separation.

This study aims to provide a study case evaluating operating performances and employee

contributions. The results of the study will serve as a reference for TPC management and the external stakeholders.

關鍵詞 (Key Words)：經營績效(Operational Performance)、可控因素(Controllable Factor)、不可控因素(Uncontrollable Factor)、無形績效(Intangible Performance)、事業部(Divisional Structure)。

---

*台灣電力公司副總經理
**台灣電力公司企劃處
***台灣電力公司綜合研究所
****台灣經濟研究院