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發電機定子線圈絕緣處理研究與應用

Research and Application of Insulation Treatment for Generator Stator Coil

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摘要

為提升發電機運轉之可靠性，如何讓定子線圈絕緣材料不在機組運轉中破壞是一項重要課題。通常絕緣材料會因電應力、機械應力、熱等因素劣化及施工缺陷造成絕緣破壞，而導致發電機故障。因此大修時，針對定子線圈絕緣特性進行檢測(部份放電，介質損耗因數、絕緣電阻、定子線圈絕緣評估)及絕緣改善處理(電暈防制)以達到定子線圈絕緣壽命延長及確保發電機能正常運轉。

Abstract

In order to improve the reliability of the generator operation, keeping the stator coil insulation materials from being damaged during a unit's operation is an important issue. Insulation materials usually confronts the problems related to insulation failures due to deterioration of electrical stress, mechanical stress, higher temperatures and other factors, which may lead to a malfunction of the generator. Therefore, during a unit overhaul, inspection of the insulation characteristics of the stator coil (partial discharge, dielectric loss factor, insulation resistance, stator coil insulation evaluation) and insulation improvement treatment corona control should be performed to achieve life extension of the stator coil insulation and ensure normal operation of the generator.

關鍵詞(Key Words)：定子線圈絕緣處理(Stator Coil Insulation Processing)、部份放電儀器校正作業(Calibration Partial Dis-charge Instrument)、真空加壓含浸(Vacuum Pressure Impregnation)系統、半硬化階段(B-stage)之熱壓系統。

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電驛飛鷹計畫執行成果報告

A Project for an Actively Approach to Inspecting Protective Relay Problems

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摘要

目前辦理數位式電驛維護定檢週期確保數位式電驛運轉及狀態正常，另加上數位式電驛故障警報以告知電驛維修人員修復，但這都是被動等待的方式。本計畫分為兩種方式同時進行，一為使用電驛乙太網路系統對運轉中之數位電驛及示波器搜尋問題點，使用電驛或示波器連線軟體對電驛或示波器連線，如無法連線則立即處理電驛或示波器無法連線問題，除立即改善問題外，並依問題作分類及統計，做為設備未來全面汰換計畫之依據；另一個則依問題點依其廠牌、型式作水平展開全數修正，以避免相同問題再次發生。改用主動出擊方式尋找電驛問題點並加以改善及水平展開修正，以減少電驛問題發生。

Abstract

At present, Taiwan Power Company has been carrying out maintenance and inspection of digital power relays on a regular basis and inform maintenance personnel of any failure alarms if they are found during the inspection process - in order to make the digital relays work properly. However, the existing methods seem to be passive. In contrast, this project uses two new methods: One method is to use the existing Relays Ethernet System to identify the problem of the digital relay and oscilloscope. Digital relay, oscilloscope software, and Relays Ethernet System are utilized to test those relays and oscilloscopes. If the relay or oscilloscope does not respond properly, it indicates that there must exist problems in the relay or oscilloscope. In addition to the immediate solving of the problems, the classification and statistics of problems are used as the basis for the replacement of equipment in the future. The other method is to use the identified problem and solving experience to the same type of relay with aim of making improvement in future inspections. As such, this project uses an active approach for searching for hidden problems in all relays, which can improve the effectiveness of making the relay function properly. This is because same type of relay may have the same relay problems. Although the same problem has not occurred in other identical relays, the study results of this project can be used to improve Taipower's capability for solving problems of other identical relays.

關鍵詞(Key Words)：網路交換器 (Switch)、智慧型電子裝置(Intelligent Electronic Device)、最小跳脫持續時間計時器(Min. Trip Duration Timer)。

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電力變壓器局部放電測量分析與診斷—以機科 D/S#1DTR 為例

Measurement Analysis and Diagnosis for Partial Discharge of Power Transformer

A Case Study for #1 Distribution Transformer at Jike Distribution Substation

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摘 要

本次於變壓器共通導口進行部份放電量測過程中發現有異常訊號，開蓋後發現導口內橫向導體支持件有5處裂痕現象但未發現放電燒焦痕跡，將有裂痕支持件汰換後於遞升加壓過程仍有發現異常的波形，再次開蓋發現仍有20處支持件有裂痕並要求廠商更換。根據TCG氣體分析比對及查閱相關技術報告，研判並未有部份放電的情形發生，推測為內部振動現象。未來除縮短絕緣油抽樣送試週期外，並持續於每次取油抽樣後進行超音波部份放電量測以確保供電穩定。

Abstract

An abnormal signal was found during a process of measuring the partial electric discharge at a transformer common duct. After the dismantling of the transformer, 5 supports of the lateral conductor in the duct were found to show traces of cracks; however, no evidence of scorches arising from partial electrical discharge was found. When raising the voltage of the transformer, the abnormal signals were still found even after replacing the supports. After dismantling it again, Taipower asked the supplier to change 20 supports after the some cracks were found. According to the TCG gas analysis and consulting related technical reports, our judgment was that there was no partial discharge in this case. It was speculated that this is because of an internal vibration phenomenon occurring within the transformer. As for the future, it is suggested that in addition to shortening the oil delivery test cycle, an acoustic analysis should be conducted after each partial electric discharge detection is made to transformers in order to ensure stable power supply.

關鍵詞 (Key Words)：共通導口(Common Duct)、支持件(Support)、可燃性氣體總量 TCG(Total Combustible Gas)、部份放電(Partial Discharge)、超音波(Acoustic Emission)。

運用無人載具於送電中清掃輸電線路礙子可行性及加 值應用之研究

Research on the Feasibility and Value - added Application of Unmanned Vehicles in Sweeping
Voltage Insulator on Power Transmission Line

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摘 要

本研究提出利用商用無人載具替代現有人工方式清掃礙子之構想。本研究蒐集國內外商用無人飛行載具應用於輸電系統高壓輸電線路礙子清理工法，進行可行性研究，並採用實驗法、觀察法與文獻研究法等方式，探討商用無人載具代替現有直昇機搭配人工清洗之可行性，並進行法規研析、相關增值應用規劃、成本效益評估，並配合台電選擇特定線路段進行實測，最後彙整各工作項目之成果，進行研析並針對無人載具及高壓清洗機之關鍵規格提出建議，以做為後續研究規劃之參考依據。

Abstract

This study is intended to propose a method of using commercialized unmanned aerial vehicle (UAV) as an alternative method for cleaning insulators of transmission lines. The study collects domestic and foreign commercialized UAV application on cleaning insulator of high-voltage transmission lines in power transmission systems, and carry out feasibility study – through experiment, observation, and literature research - to explore the feasibility of using UAV to perform insulator cleaning. The study also conducts regulatory analysis, relevant value-added application planning, cost-benefit assessment, and in conjunction with Taipower, selects specific transmission line segments to perform field trial. After summarizing the results of each work item, this study proposes a set of key specification of UAV and the high-pressure washer, which can be used as a reference for future research plans.

關鍵詞(Key Words)：無人載具(Unmanned Aerial Vehicle)、輸電線路(Power Transmission Line)、礙子(Voltage Insulator)、活線礙掃(Energized Line Insulator Cleaning)、無人機應用(UAV Application)、無人機法規(UAV Rule)。

基於 IEC 61850 標準之 IED(含 SCADA 系統)互操作性 實體驗證

The Interoperability and Integrated Verification of Intelligent Electronic Devices with Supervisory Control and Data Acquisition Based on IEC 61850 Standard

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摘要

本公司為配合政府政策，積極發展智慧電網以因應各式再生能源併入系統運轉，變電所智慧化扮演著溝通協調的重要角色。變電所智慧化技術係整合資訊科技、網路通訊及智慧化設備管理系統，使變電所設備運轉更具穩定及可靠。在智慧化變電所內經常將智慧電子裝置(IED)設計運用於傳統系統保護外，另提供設備狀態監測功能。然而，不同廠牌 IED 之通訊協定如果不一致，將導致系統無法整合，IEC 61850 標準制定的目的即為統一變電所各設備元件之通訊協定，使不同廠牌設備具有互操作性。

為避免後續擴增及維護困擾，本研究規劃針對不同廠牌 IED 間之互操作性及 SCADA 軟體是否可整合不同廠牌之 IED，進行實體驗證，以利本公司未來發展 IEC 61850 標準之智慧化變電所，並可結合分散式再生能源，建構高互操作性之智慧型電網。

Abstract

In accordance with the government energy policy, Taiwan Power Company has been actively developing the smart grid in response to growing penetration of renewable energy in the power system. Therefore, making substations smart will play an important role in effective communication and coordination. Information technology, network communication and intelligent equipment management system are increasingly integrated into the technology being used in substations to make their operation more stable and reliable. Aside from the traditional protection function, Intelligent Electronic Devices (IEDs) also provide the monitoring functions in a smart substation. If communication protocols of various brands of IEDs are mutually inconsistent, they cannot be integrated. Therefore, the major objective of the IEC 61850 standard is to unify the communication protocols of IEDs in substations to make interoperability possible.

To meet the need for possible equipment expansion in the future and to solve maintenance problems, this study proposes the interoperability and integrated verification of IEDs with SCADA to benefit the development of smart substations based on IEC 61850 standard. At the same time, smart substations can be combined with distributed renewable energy resources to establish a high-interoperability smart grid.

關鍵詞(Key Words)：互操作性(Interoperability)、一致性測試(Conformance Test)、智慧電子裝置(Intelligent Electronic Device)、數據採集與監控系統(SCADA)、智慧化變電所(Smart Substation)。

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以工程方法克服塔基用地取得困難案例分享— 以 161kV 鉅工~斗工#43 塔基工程為例

Case Studies for Overcoming Tower Sites That Obtain Difficult Cases by Engineering Methods

Take 161kV JU-GONG~DOU-GONG #43 Tower Foundation Project for Example

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摘要

為維護供電安全，本公司逐年辦理老舊輸電鐵塔改建，因近年來社會風氣改變，鐵塔、變電所等電力設備已變成民眾嫌惡設施，土地取得困難，所以目前多利用原有鐵塔自有土地辦理改建，但是鐵塔原地改建，因在舊有送電鐵塔範圍內新建新的鐵塔基礎，要考量許多施工介面及工法，透過現場的測量及繪圖軟體的模擬建置，規劃適合的基礎型式，有助日後避免施工上的困難。

本篇要分享的改建案例是位於南投縣鹿谷鄉161kV鉅工~斗工#43塔基工程，因#41~#43區間導線與地面垂距偏低，亟需改建鐵塔以提高導線高度，且鐵塔屬義大利製SAE鐵塔，使用迄今已逾50年，配合供電處推動改建老舊鐵塔時程而興工。在啟動改建案之後，規劃原地擴建基礎，卻無法取得擴建土地，並發現現有鐵塔未座落於地籍圖自有土地內，經相關組課研商對策後，採用改造型鐵塔，並選用雙樁連梁基礎形式，以工程手法克服鐵塔實際位置與用地位置偏移情形，解決地權用地無法取得之困難，並節省用地面積，使整體包建成本降低，增加供電穩定。

Abstract

In order to maintain the safety of power supply, Taiwan Power Company (TPC) have been conducting renewal of aged transmission towers for years. Due to the rapid change of social environment, power industry facilities - such as transmission towers and substations - have become NIMBY (Not In My Yard) targets, making it difficult for TPC to acquire lands for power facility installations. However, as a tower reconstruction work is carried out, its foundation usually must be renewed within a limited area where the aged transmission tower is located. Considering construction interfaces and methods, it is necessary to survey the site and make relevant simulation by graphics software to choose a suitable foundation type, aiming to avoid construction difficulties in the future.

The case study of the tower reconstruction focuses on the renewal of a tower foundation for the 161kV JU-GONG~DOU-GONG #43 - located in Lugu Township, Nantou County. Due to the low vertical distance between the conductors #41~#43 and the ground, it is necessary to rebuild the tower to raise the height of the wire. Moreover, the tower is an SAE, made in Italy, which has been used over fifty years. The tower renewal work was initiated in accordance with a reconstruction

project for aged iron towers being carried out by the Power Supply Branch. After starting the reconstruction project, it was found that the land necessary for subject construction could not be acquired as originally planned. After consultation with company's relevant sections, it was decided to use a modified iron tower and select the foundation type of two pile and coupling beam. In this case, the engineering methods were utilized to overcome the problems related to the displacement between tower's original location and new location, thereby solving the problem of land acquisition and saving the land space. By those engineering methods, we managed to reduce construction costs and ensure the power supply stability.

關鍵詞(Key Words)：鐵塔改建(Tower Reconstruction)、原地包建(In Situ Construction)、地籍偏移改建(Reconstruction for Cadastral Deviation)

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大同 P/S 161kV GIS 及主變壓器汰換工程規劃設計

A Planning and Design for Replacement of 161kV GIS and Main Transformer in Datong Substation

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摘要

大同P/S 161kV GIS 及主變壓器設備自民國67年加入系統運轉迄設備汰換當年(106年)已達服務年限(GIS：25年，主變壓器：30年)，相關設備均已老舊劣化，備用零件取得不易，且維護困難。考量供電品質、功能及設備維修成本增加等因素，故著手進行汰換工作。

設備汰換期間受限於開關場建築物無法拆除、土壤液化潛勢區及設備搬運路徑狹隘等環境因素，以及仍須保留69kV開關場做電力融通、停電期間系統運轉安全與2017年世界大學運動會開幕在即(106年8月19日)急需用電之供電壓力，故本案在規劃設計之初即配合前開條件檢討最適方案，期能節省工程費用及減少停電時間。

考量施工程序、施工風險、停電時間、工程介面及供電安全等問題，本案經多次現場勘查及開會檢討結果採161kV 線路及主變壓器同時停電方式施工，並每月期召開工程管控會議，滾動式檢討工進、施工品質及工安等事項，終使設備於106年7月14日順利加入系統，提升大同P/S轄區供電能力。

Abstract

Since the year 1978 when they came into operation, 161kV GIS (Gas-Insulated Switchgear) and MTR (Main Transformer) installed at Datong substation had been in service in the TPC power grid for a long time. In general, the operational service life is designed to be 25 years for GIS and 30 years for MTR. Because of aging and degradation, difficulties in continued supply of spare parts and in maintenance, increased costs of maintenance, and consideration of ensuring power supply quality, a carefully-managed planning must be made for the replacement of 161kV GIS and Main Transformer in Datong substation.

There were many factors that should be considered regarding the working environment at Datong Substation. For example, buildings surrounding the existing facilities are not allowed to be removed or demolished; there exists a potential of soil liquefaction at the site; and characteristics of narrow equipment-carrying path are expected to make the renewal work more difficult. Meanwhile, careful considerations should be given to the power interchange of 69kV transmission system, security of power system and the opening of "Taipei 2017 Universiade". Therefore, Taipower needs to design and plan the best solution to equipment replacement to save engineering costs and shorten the duration of power outage.

Additionally, Taipower also needs to consider construction consequence, risk of engineering, duration of power outage and safety of power supply. So, it was eventually decided that the 161kV

GIS and Main Transformer should be replaced at the same time. On the other hand, the 161kV power line and Main Transformer in Datong substation were taken out of service at the same time. During the equipment renewal process, the discussion meeting was held every month to periodically review the engineering schedules, engineering quality and industrial safety. Because of those efforts, the renewed equipment started to be operational in TPC power grid on July 14,2017 and improved the power supply capability of Datong substation.

關鍵詞(Key Words)：電力變壓器 (Power Transformer)、氣體絕緣斷路器(Gas Insulated Switch Gear)、設備汰換(Replacement of Equipment)、維護(Maintenance)。

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模擬核種擴散之 GoldSim 區塊模組數量研討

Study on the Numbers of GoldSim Cell Module for Nuclide Diffusion Migration Simulation

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摘 要

本研究運用三區塊模型與五區塊模型之解析解，與GoldSim區塊模組建構的區塊模型進行比較，結果顯示兩者具有相當一致的結果，證實運用GoldSim區塊模組可有效地建構核種擴散模型；以GoldSim的3個至18個區塊模組模擬核種擴散現象，結果顯示在不同觀測點上，達到一定的區塊數量後，該處的核種濃度變化便不受區塊數量影響而趨於一致；區塊數量與核種擴散長度及擴散係數值有關，而與注入源的濃度無關；比較GoldSim區塊模組和數值分析程式(連續模式)模擬核種擴散的結果，結果顯示區塊模組的核種濃度模擬結果較連續模式的模擬結果為高，意指區塊模組會獲得較為保守的模擬結果。

Abstract

This study compares the analytical solutions of three cells model and five cells model with the model established by GoldSim cell modules. It shows that analytical solutions and GoldSim models present consistent simulation results, which proves that GoldSim cell modules can be applied to establish a nuclide diffusion model. By using three to eighteen GoldSim cell modules to simulate nuclide diffusion phenomenon, the simulation result shows that the observed points with certain number of cell modules present a similar concentration distribution. The number of cells is related to the diffusion length and diffusion coefficient value, regardless of the injective source concentration. According to the simulation results of the GoldSim cell module and numerical analysis software with continuous model, it shows that the concentration of simulation by the cell module is higher than the others. It means that simulated concentration of cell module is expected to present more conservative values.

關鍵詞(Key Words)： 區塊模型(Cell Model)、連續模型(Continuous Model)、GoldSim。

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