

拆它易
Detachable 11kV Live Jumper

團隊背景 Background of the Team



團隊名稱 Team Name	11kV架空線帶電工作團隊 11kV Live Line Work Team
成立日期 Date of Formation	2013年1月 January 2013
業務單位 Business Unit	輸電及供電業務部 Power Systems Business Group
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背景 Background

中電的宗旨是為客戶提供更穩定和優質的電力供應。現時在中電的11kV架空電纜為非高壓帶電作業設計。因此進行架空電纜保養維修工作時，需要把11kV架空電纜停電才可進行工作。這樣會引致在架空電纜內所有供電客戶都受停電影響。這個品管項目是研究應用高壓帶電技術協助公司減少客戶每年的「客戶計劃停電時間」。

The Company's objective is to deliver secure and reliable electricity to customers. The existing 11kV overhead line (OHL) network of CLP Power (CLPP) is not specifically designed for High Voltage Live Line Work (HVLW). Thus, scheduled outages for maintenance or repair work are required. Unavoidably, it will lead to power shutdown to customers in planned outages. This QCC project adopts the HVLW practices to support the Company in reducing the Planned Customer Minutes Lost (CML).

問題成因 Cause of the Problem

- 在中電的11kV架空電纜上會安裝一些掛樣式隔離設備，用處是可以把整條線路劃分成不同段落，當在架空電纜進行保養維修工作時，只需要把受影響的架空電纜段落兩端的掛樣式隔離設備打開便可以進行停電工作。
- 當保養維修工作在個別棟上進行，整段架空電纜仍然需要停電才可以進行工作。問題是所引起的停電範圍遠大於工作點，並且在整段架空電纜內所有供電客戶都受停電影響。
- 因此高壓帶電團隊成立品管項目重新設計現有11kV拉力棟上的11kV架空跳線，並配合高壓帶電絕緣棍技術拆除11kV架空跳線在計劃停電時用作隔離設備（圖一）。從而解決上述問題，在計劃停電時把停電範圍限制在工作地點，而並非已往做法需要把整段11kV架空電纜停電。
- The 11kV OHL circuit of CLPP was divided into different OHL sections and each OHL section would be separated by pole mounted isolation devices. Power outage was necessary for either maintenance or fault repairs in 11kV OHL circuit of CLPP. During outage, the conventional method was to open pole mounted isolation devices at both ends of OHL section as isolation points to de-energize the work area.
- All customers in the said OHL section lost electricity even the OHL work might only happen in a single pole location. Therefore, many customers even not locating at the work area would be affected by supply interruption during outage.
- For this QCC project, it redesigned 11kV jumper at 11kV section pole. The new designed jumper could be detached by HVLW stick technique to serve as an isolation point for outage (see Figure 1). Thus, it could limit the extent of power shutdown at the work area only rather than the traditional way to de-energize the whole OHL section.

解決方法 Solution

- 邀請有經驗的高壓帶電技術員及工程師共同討論開發此品管項目。
- 透過思維衝擊法找出問題的成因。再利用因果圖、柏拉圖（圖二）和評估矩陣分析確定和驗證問題的主因。
- 經過問題分析，組員提出若干設計準則，包括：一，能夠用高壓帶電絕緣棍技術很容易、快速及安全地拆除在11kV拉力棟上的11kV架空跳線。二，設計要求簡單和輕巧，配件要簡約和可循環再用。
- 針對問題的成因，配合設計準則等因素，組員找出三個解決方案。根據三個方案的成效比較結果，最終得出方案三「拆它易」（圖一）是完全滿足原先所定立的設計目的，在計劃停電工作時能提供臨時隔離設備。
- Experienced HVLW linemen and engineers were invited to develop this QCC project together.
- All causes were figured out with Brainstorming while the root causes were screened out and validated by Cause and Effect Diagram, Pareto Chart (Figure 2) and Evaluation Matrix.
- Based on the aforesaid information, the design criteria were agreed as follows: (1) the new designed OHL jumper at 11kV section pole could be detached by HVLW stick technique in an easier, faster and safer manner; and (2) simple & lightweight, reusable design and minimum accessories.
- In analyzing the root causes and in consideration with design criteria, the team came up with three improvement options. A thorough evaluation was then conducted and option 3 of "Detachable 11kV Live Jumper" (Figure 1) could fulfil the objectives and achieve the targets of provision of temporary isolation points for planned outage.

成果及效益 Achievement & Benefit

有形得益

- 這個品管項目協助公司減少客戶每年的「客戶計劃停電時間」0.522分鐘。
- 估計每年帶來四十萬港元成本節約。項目的收益和成本比率為1.48。

Tangible Benefits

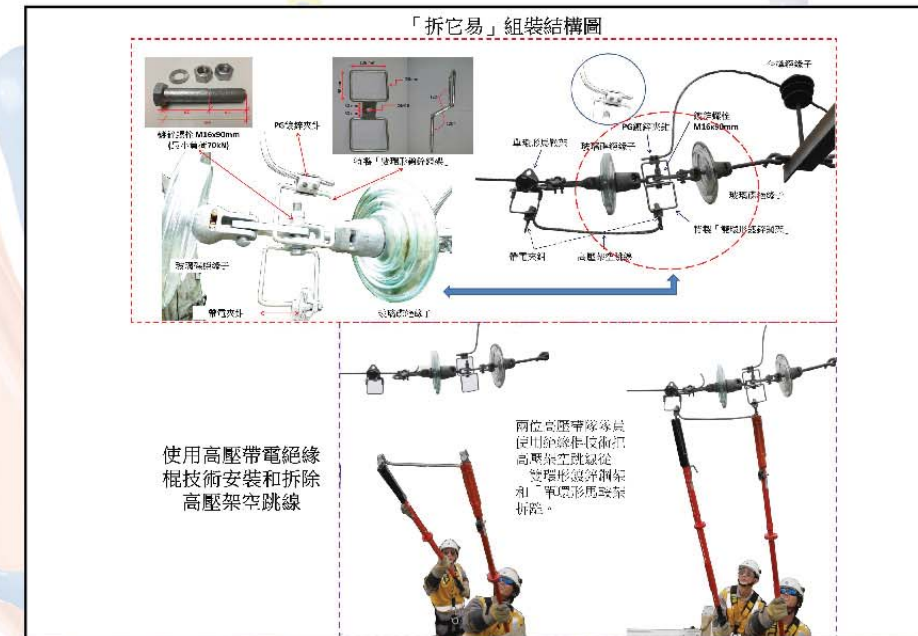
- This QCC project supported CLPP to reduce yearly Planned CML by 0.522 minutes.
- The cost saving was more than HK\$0.4M per annum and the project Worth / Cost ratio was 1.48.

無形得益

- 電能專業：中電是香港首間電力公司自主研發和應用高壓活動跳線在11kV拉打棟。在進行計劃停電時，這項設計能大幅減少停電範圍和減少受影響的客戶數目，從而減少中電客戶每年的「客戶計劃停電時間」。
- 客戶至上：使用高壓帶電技術，可以避免客戶受到不必要的停電影響，從而提升供電的可靠性。
- 社會承諾：這個項目減少客戶受停電影響，對公司和客戶帶來雙贏的結果。並提升公司良好的企業形象。
- 環境保護：所有配件可以循環使用，既環保又實用。

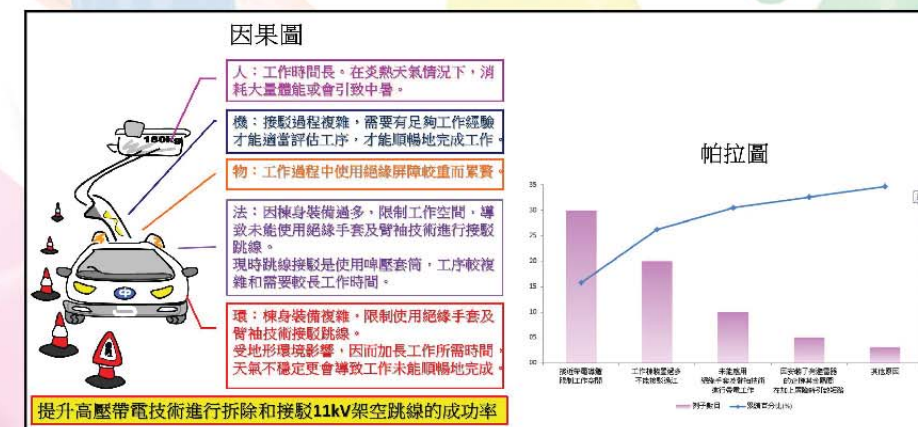
Intangible Benefits

- Power Expertise: CLPP was the first power utility in Hong Kong to develop and adopt this 11kV detachable jumper at 11kV section pole. Such design could significantly reduce the extent of power shutdown and the number of customer affected per outage which in turn contribute to the reduction of Planned CML in CLPP.
- Customer Excellent: HVLW technique was adopted which could avoid electricity supply interruption to customers. Thus, supply reliability was improved.
- Community Commitment: Customer loss of supply was reduced. This was a win-win project for CLPP and customers, which directly boosted the positive image of the Company.
- Environmental Protection: All components of this detachable jumper were reusable. This reduced waste of materials.



圖一：品管項目「拆它易」組裝結構及操作圖

Figure 1: Detailed Component and Operational Diagram for the Detachable 11kV Live Jumper



圖二：成因問題分析工具

Figure 2: Root Cause and Problem Identification by Proper Analytical Tools