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港燈 HK Electric

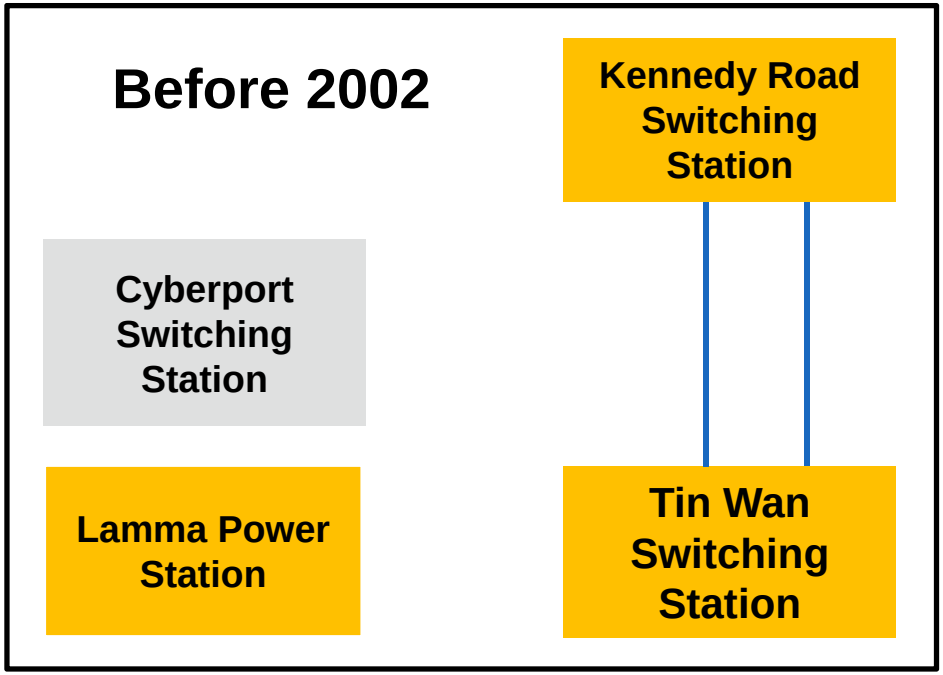
130+ 推動永續未來 Powering for Sustainability

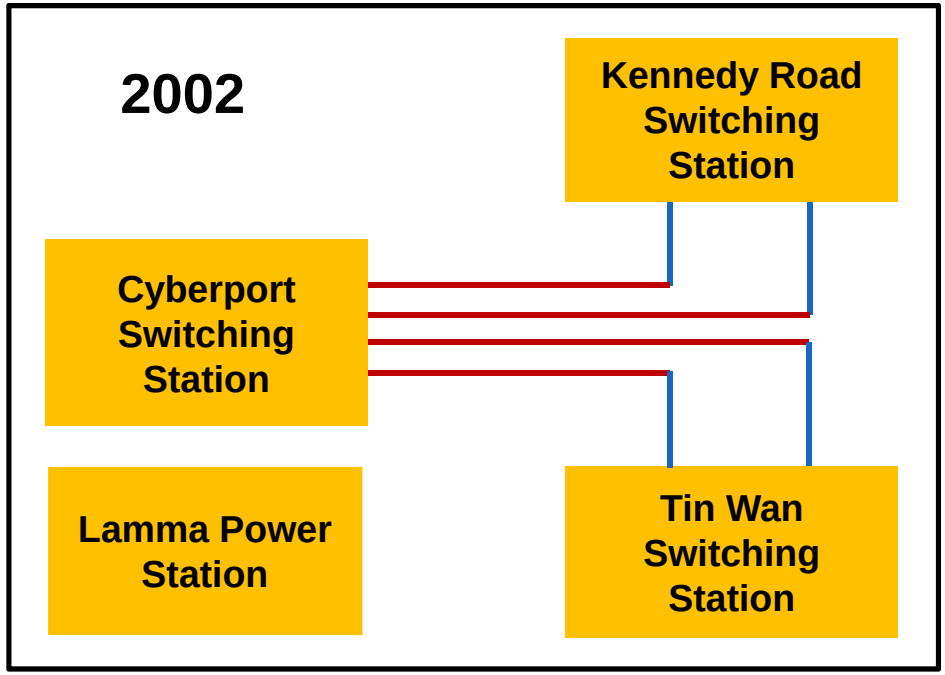
26 June 2023

Incident of a 275-kV Fault in HK Electric's Power System on 19 April 2023

Background

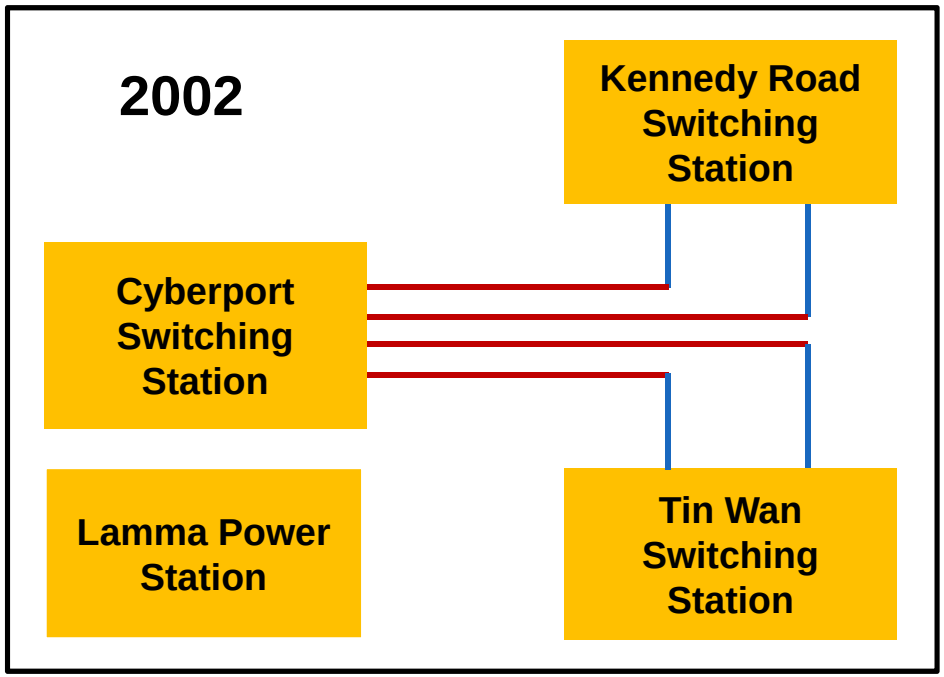
- Cyberport 275-kV Switching Station was commissioned in 2002. It was planned to be supplied by two submarine cable circuits from Lamma Power Station
- To meet the load demand of Cyberport development before the commissioning of Lamma – Cyberport submarine cable circuits, Cyberport 275-kV Switching Station was first commissioned by laying four 275-kV cable circuits through Kai Lung Wan Cable Tunnel connecting to Tin Wan and Kennedy Road 275-kV Switching Stations.

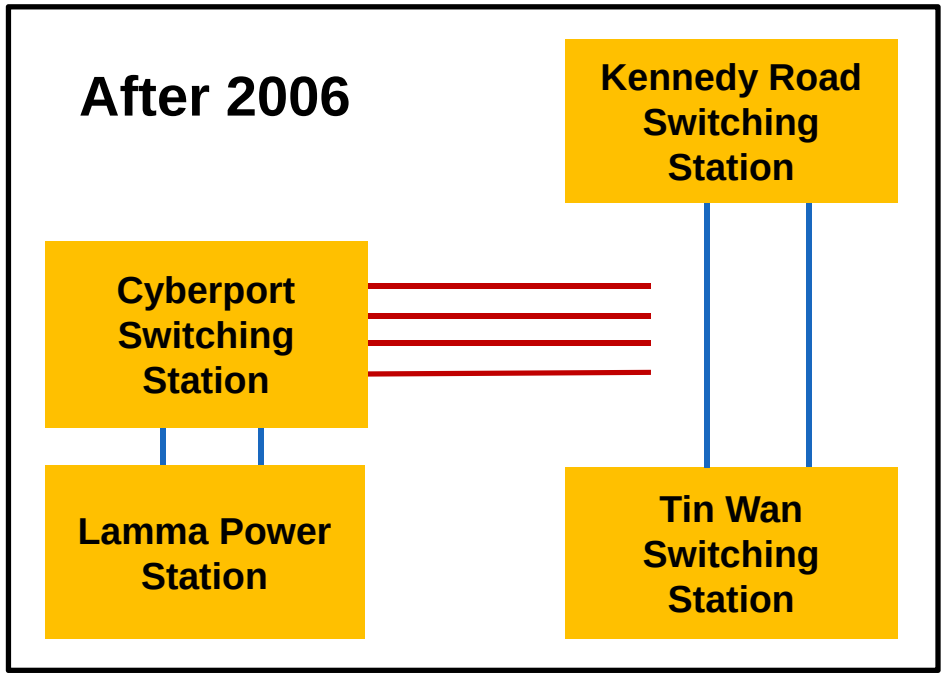




Background

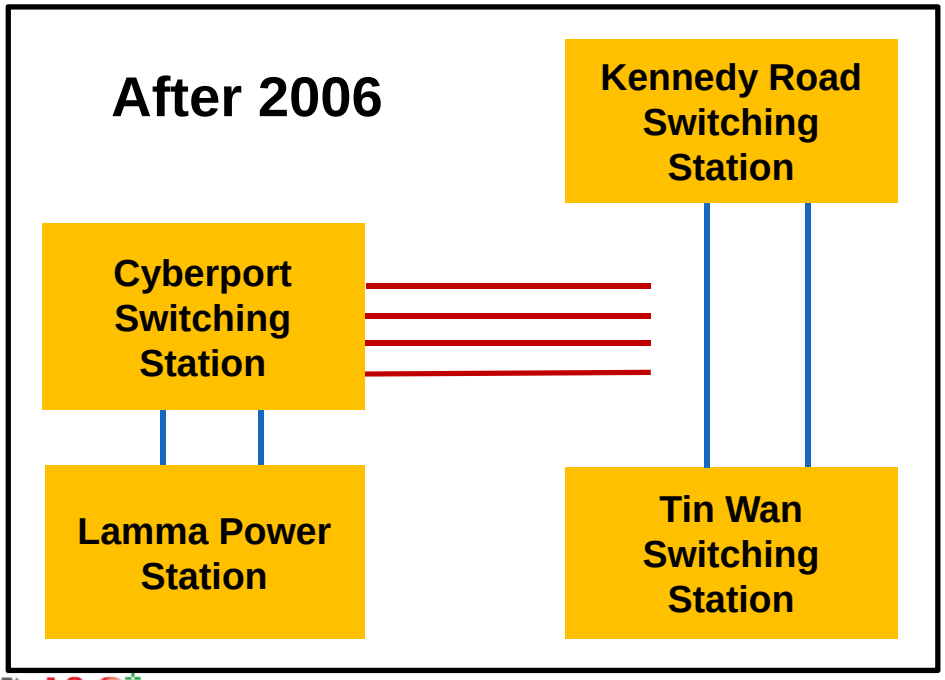
- Lamma – Cyberport 275-kV submarine cable circuits were commissioned in 2006
- The four 275-kV cable circuits for initial commissioning of Cyberport Switching Station had become spare after the restoration of Tin Wan – Kennedy Road 275-kV cable circuits .

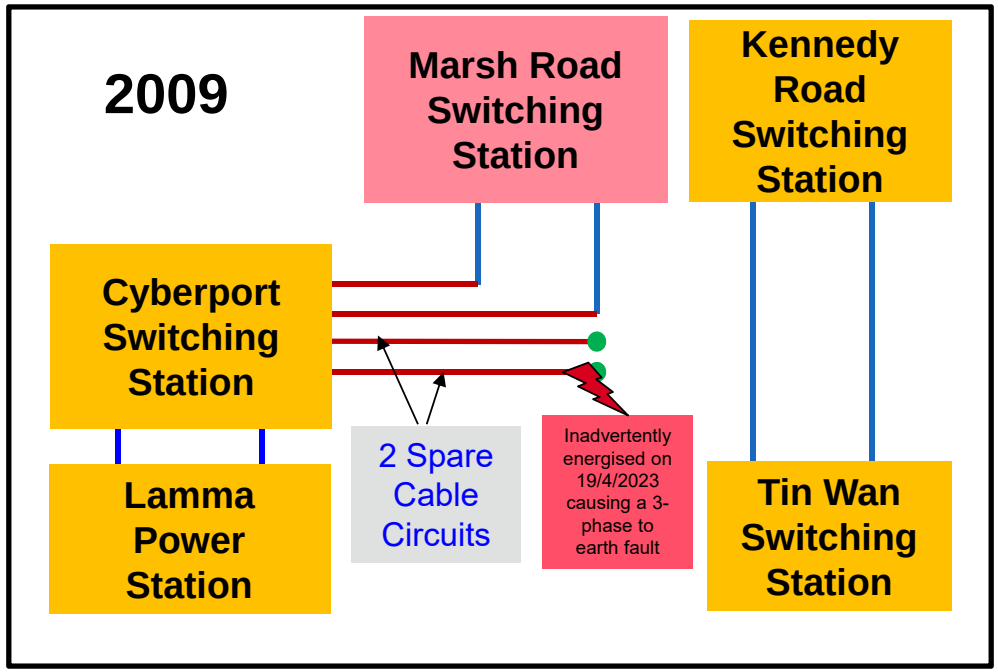




Background

- To reinforce the power supply to HK Island North, two of the four spare 275-kV cable circuits were extended to Marsh Road Switching Station in 2009. The other two cable circuits remain as spare
- These two spare cable circuits have been connected to the switchgear at Cyberport Switching Station since first commissioning. One of the circuits was inadvertently energised during switchgear commissioning after refurbishment work on 19/4/2023, causing a 275-kV 3-phase to earth fault.





Refurbishment Work

1. The refurbishment of the concerned gas-insulated switchgear (GIS) of Cyberport 275-kV GIS was just completed at the time of incident

2. GIS refurbishment is scheduled to be carried out around every 20 years by in-house experienced technicians under the immediate supervision of personnel of the switchgear OEM

3. Before the refurbishment, the switchgear isolators of spare GIS bays had been locked open to avoid inadvertent operation

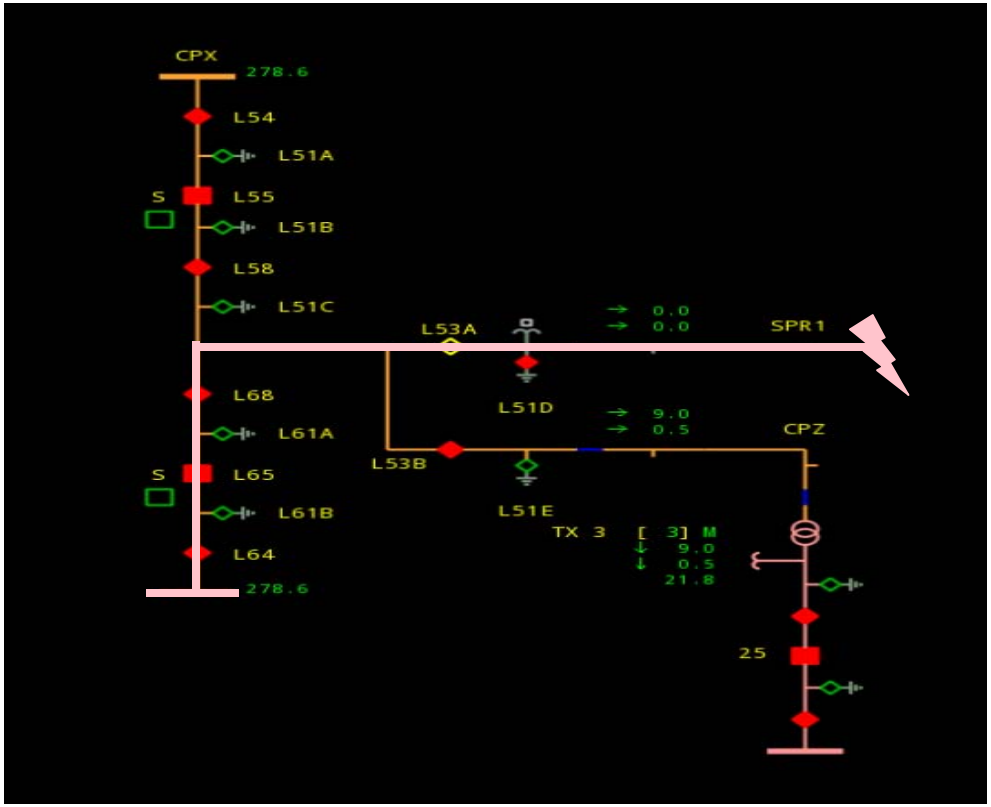
4. Refurbishment involves inspection of all parts of the GIS and replacement of worn-out parts. The scope of inspection also includes the concerned spare GIS bay.

Refurbishment Work

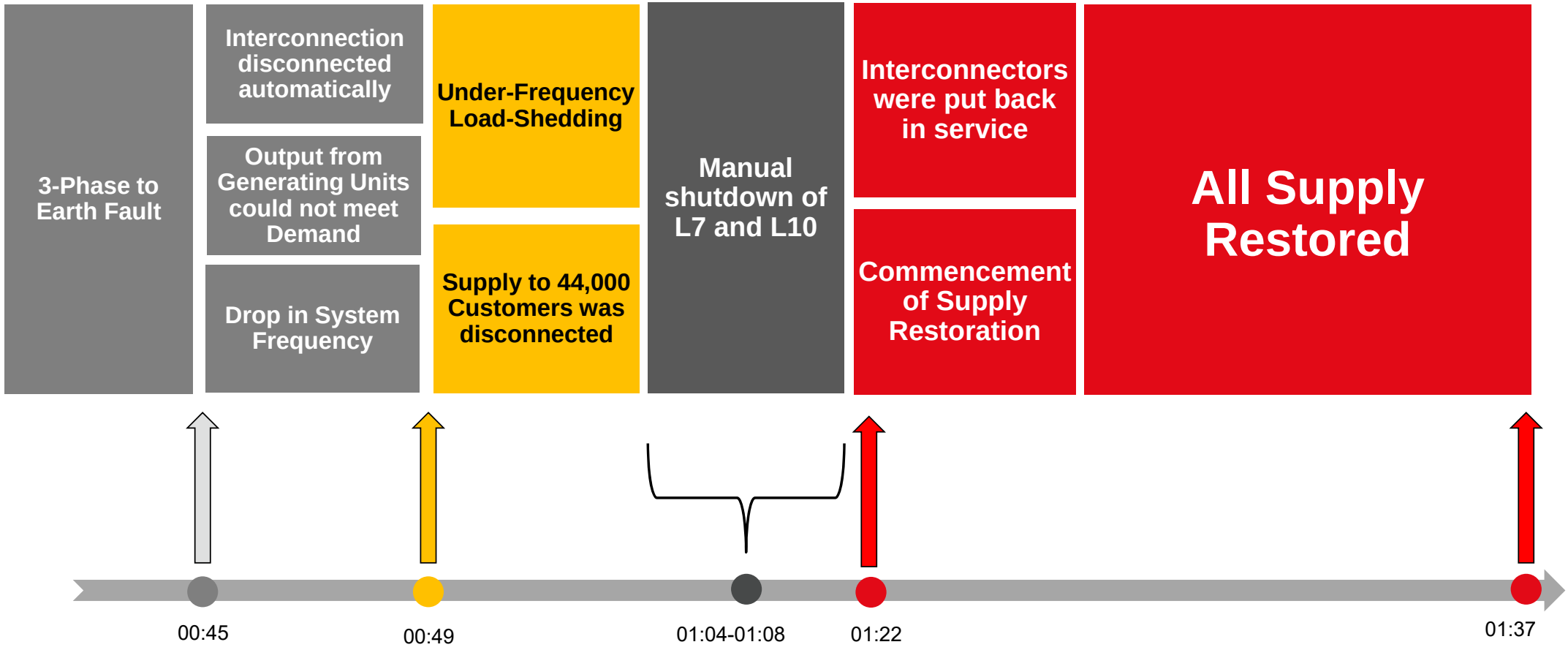
5. To ensure quality of work, all refurbished GIS portions have to undergo recommissioning

6. To minimize the impact of unforeseeable events on our customers, all recommissioning works are required to be carried out in mid-night

7. In the course of GIS recommissioning, the spare cable circuit was inadvertently energised causing a 3-phase fault.

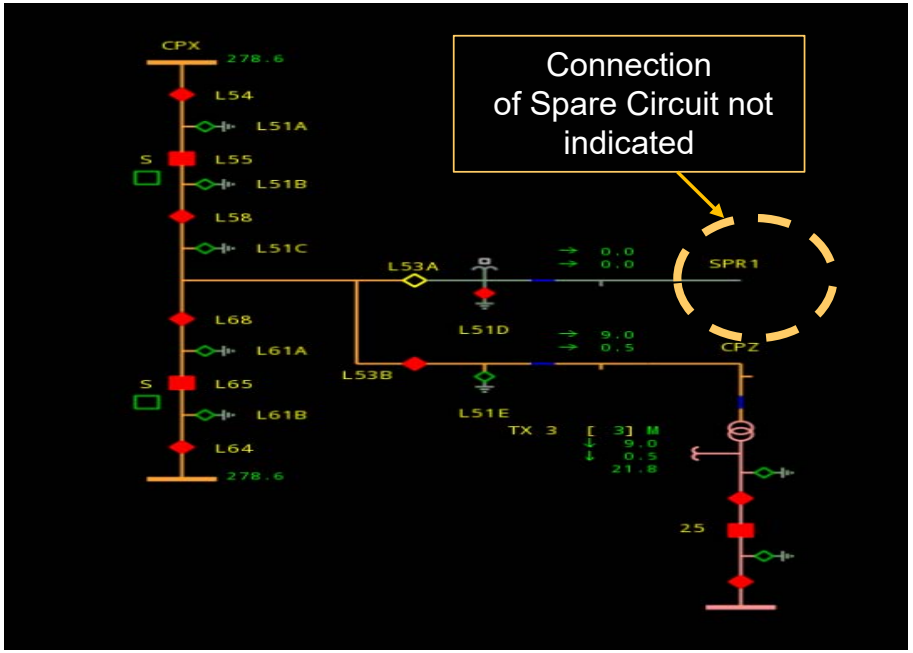


Sequence of Events



Incident Causation

1. The transmission network diagram had already been updated in 2009 after network change. However, the EMS diagram used for commissioning only includes in-service cables rather than all cables and this caused a 3-phase fault during commissioning
2. On-site labels were insufficient to indicate whether a spare cable circuit is connected to the switchgear
3. The engineer in charge was unable to identify whether the concerned GIS was connected to a spare cable circuit in his on-site inspection
4. No compulsory counter-check requirement for commissioning of refurbished GIS
5. Consequential voltage dip and power disturbance affected two generating units in Lamma Power Station.



Other Investigation Findings

1. All protection operations in this incident were correct and according to the design

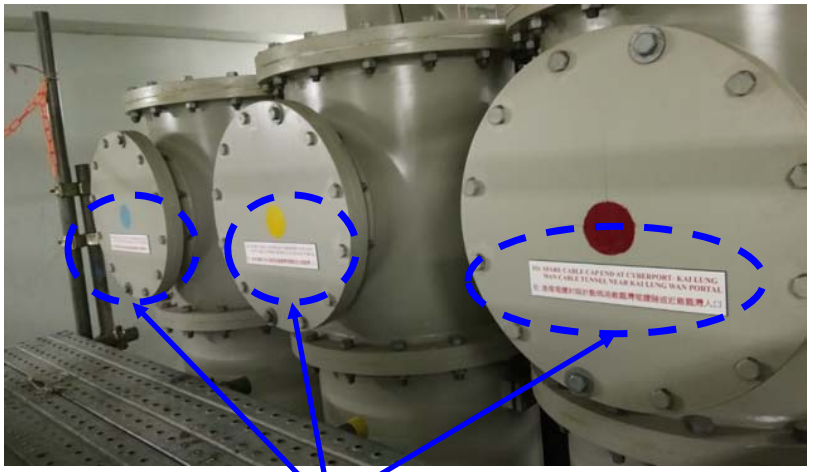
2. Actions taken by the operation engineers in response to the severe disturbance to the generating units and the process of supply restoration by engineers in the System Control Centre to affected customers were assessed and found to be appropriate

3. The incident was not related to either adequacy of resources or quality of refurbishment work.

Recommendations and Improvement Measures

Five improvement measures have already been implemented:

1. Suspended all transmission GIS refurbishment works until the relevant guidelines are established
2. Checking and disconnection of all four identified spare transmission cable circuits from the associated GIS
3. Detailed labels have been added to the GIS. The relevant EMS diagrams have also been updated
4. Resources were re-allocated to check the integrity of critical equipment in transmission system
5. Counter-checking requirement has been adopted for recommissioning of all GIS after refurbishment.



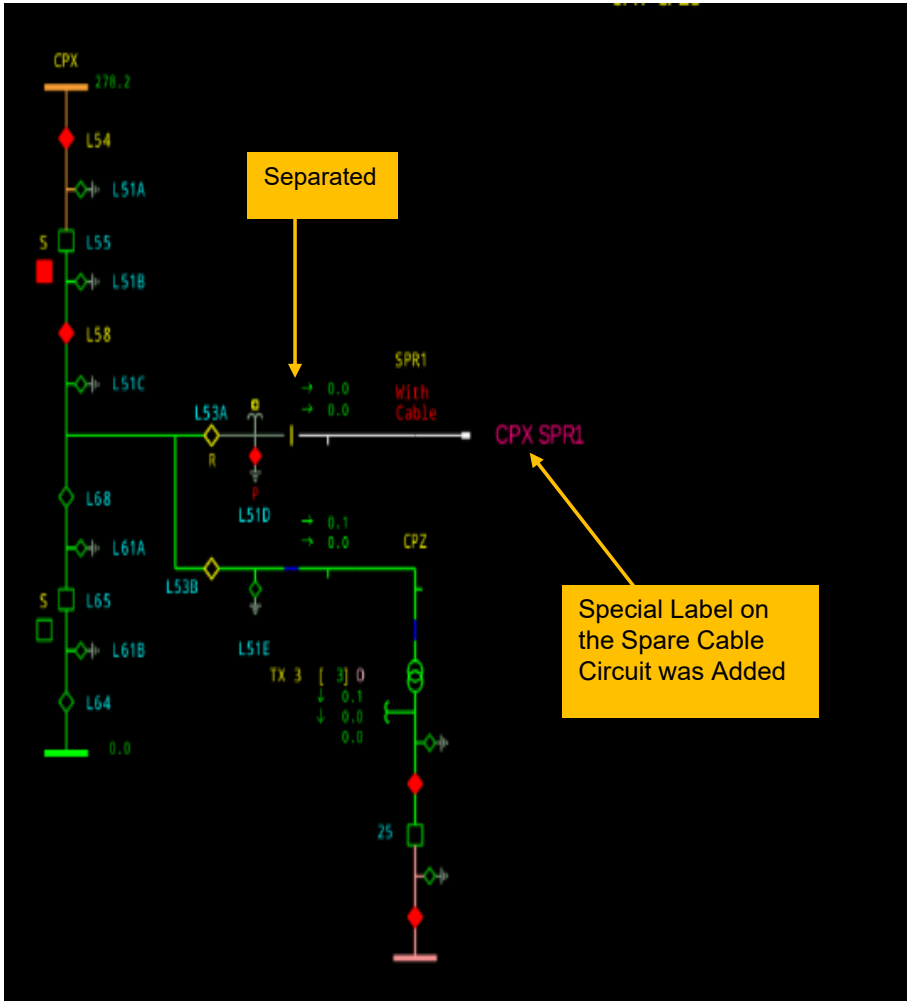
Details of the cap end cable have been added

Recommendations and Improvement Measures

Seven recommendations are being followed up :

1. Instruction for updating Site Labels and EMS Circuit Diagrams will be established
2. Complete segregation of Spare Cable Circuit from GIS
3. Training of Engineers
4. Risk Assessment and Enhanced Procedures for Commissioning of Transmission Equipment

- Items 1 to 4 will be completed by Q3 2023



Recommendations and Improvement Measures

5. Fault Ride-through Capability of Generating Units
6. Operation of Customer Emergency Services Centre
7. Engaging Advisory Service.

- The recommendations on fault ride-through capability of generating units will be finalised by end 2023
- Proposal to enhance the operation of Customer Emergency Services Centre will be finalised in Q3 2023
- An Advisory Committee was established in June 2023 and recommendations for improvement will be ready by end-August 2023.

Thank You