Case Study – Objectives

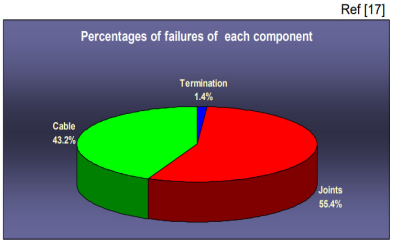
- Reiterate the importance of *Quality Assurance* for UG cable installation
- Highlight the impact of substandard installation on asset life cycle performance
- Importance of condition monitoring technologies to manage the legacy QA issues

cigre
For power system expertise

Cable Component Failures and Failure Modes

Percentage of Failures per each Component

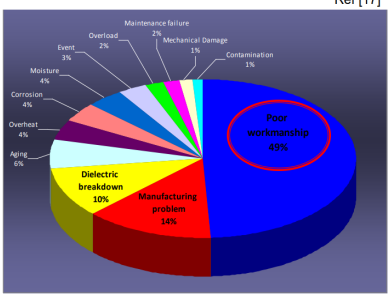
Ref [17]



Accessories: Joints or splices, and Terminations

Failure Modes

Ref [17]



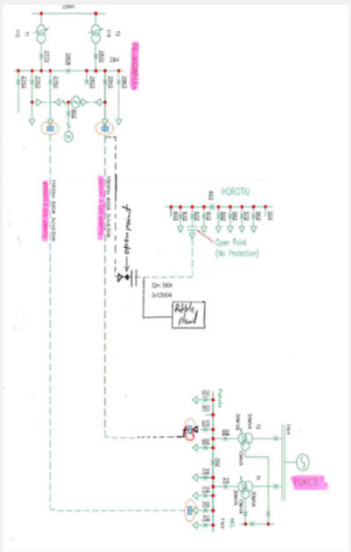
Reference: A History of Medium & High Voltage Cables – Nigel Hampton (Georgia Tech & NEETRAC)-2012 presentation
CIGRE TB 279 : Maintenance of HV Cables and Accessories – Failure mode analysis

TWH-PUK 33kV Cables- Installation Issues

Circuit Details

A. TWHCB2782 - PUKCB742
Cable length – 11,317m
Cable insulation- XLPE
Cable age - 17 years
Nos. of joints – 32

B. TWHCB2842 - PUKCB672
Cable length –11,323m
Cable insulation -XLPE
Cable age -17 years
Nos. of joints – 35



Investigations and Failure Modes

- Under crimped joints
- Severely contaminated joints



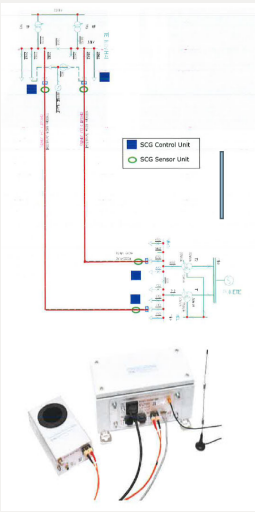

Risk Mitigation

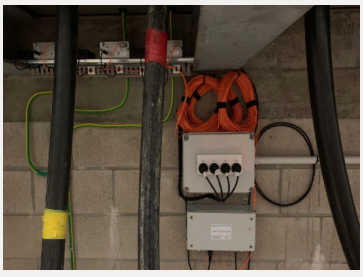
- Introduction of new offline PD test regime to achieve better quality assurance of newly installed & repaired 33kV cables
- Proactive risk management of critical TWH – PUK cables, with the help of continuous online PD monitoring
- Periodic training and refreshers for cable crew

Continuous Online Monitoring System

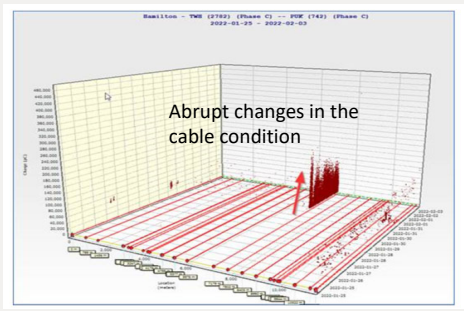
- Smart cable guard (SCG) system is synchronized double ended online PD monitoring system.
- With the help of SCG system, we can monitor the cable condition on the real time basis.

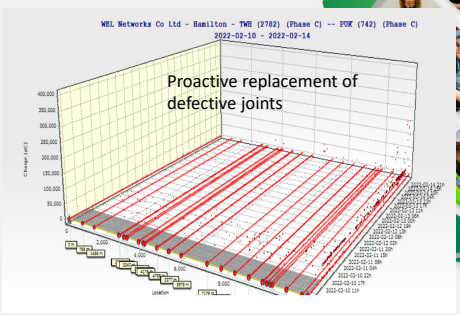
Installation of SCG System

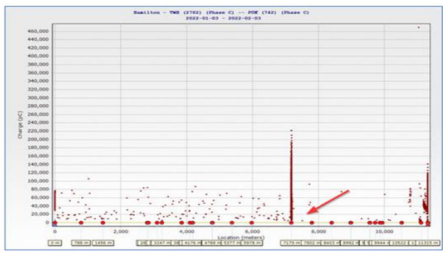


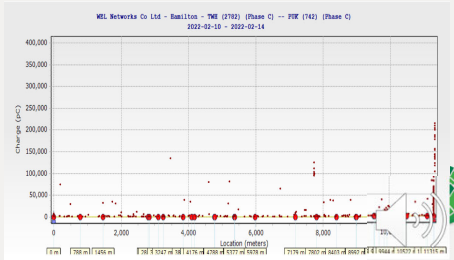


Informed Decision Making









Warning Levels : SCG System

- Level 1 : High failure probability, the advice is to replace immediately in critical circuits.
- Level 2 : Striking partial discharge activity, somewhat increased failure probability, the advice is to monitor the development over time.
- Level 3 : Some partial discharge activity, minimal increase of failure probability, normally no reason for concern (yet).

Smart Cable Guard has detected partial discharge activity indicating an increased failure probability:

- Circuit: *Hamilton - TWH (2782) (Phase C) -- PUK (742) (Phase C)*
- Location: 7179 m (± 113 m) from Hamilton - TWH (2782) (Phase C)
- Component: *Joint*
- SCG warning level: **1**

<u>Failure Probability Predictions:</u> Based on experience, averagely after assigning a level 1 warning there is a 50% failure probability within 3 years for PILC cables. For XLPE cables there is a 50% failure probability within 10 days.

Key Improvements

- Continuous online monitoring is helping WEL Networks to monitor operationally critical cables condition on the real time basis.
- Operational reliability is better managed for critical network cables with the known degradation.
- Effective prioritisation and job planning to repair known defects.

Reference:

- CIGRE TB 825: Maintenance of HV Cable Systems
- CIGRE TB 279 : Maintenance of HV Cables and Accessories
  Failure mode analysis
- *A History of Medium & High Voltage Cables – Nigel Hampton (Georgia Tech & NEETRAC)-2012 presentation*
- TE Connectivity: Failure investigation reports (TWH-PUK cables)

Questions