

## **APPLICATION OF CIGRE TECHNICAL BROCHURE TB537 TRANSFORMER OIL FIRE DAMAGE SURVEY REPORT**

In June 2015, a phase to earth fault was recorded on B phase on the HV side of the generator transformer by a MiCOM relay. An oil fire was then ignited on the transformer main tank.

Photographic evidence, taken after the oil fire was extinguished, provided evidence that the HV bushing on B phase (terminal 1V) had failed catastrophically. The observation that the porcelain envelope of B phase HV bushing had scattered explosively up to 30m away from the 1V terminal location, together with the MiCOM relay event records, provide irrefutable evidence that bushing failure of the 1V terminal was causal to this failure event.

The organisation concerned and consultant involved in the investigation referenced CIGRE Technical Brochure 537 to calculate the effect model of this transformer oil fire. Technical Brochure 537 was published in 2013 by WG A2.33 (convened by CIGRE Australia member Arne PETERSEN) and considers recommendations for good Transformer Fire Safety Practices which can aid transformer designers and users to define and apply best practices in the domain of transformer fire.

In this case, reference to and application of the mathematical model detailing in the Brochure allowed the confirmation of catastrophic failure of oil impregnated condenser bushings being the most likely cause of this transformer oil fire. The model provided then allowed the heat release rate and mass burning rate (for this particular transformer oil pool fire) to be calculated. The CIGRE brochure also provides a table with the expected incident heat flux on nearby objects using pool fire diameter and distance as determinants. These oil fire effect consequences were then used to correlate with observed fire damage and make recommendations for asset replacement or repair.

Photographs taken at the time when the fire was active were used to cross check the mathematical model as well as introduce an enhancement correction to the oil fire diameter caused by the prevailing wind.

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### **Western Power - Using CIGRE as a benefit to improve its Asset Management Strategies**

Western Power is a long term CIGRE member and contributor and is becoming a leader in asset management in the utilities sector within Australia.

Western Power has undertaken a review of all its asset management systems processes and procedures and questioned if they are best practice and right for their business, assets and people. A large part of their research has utilised CIGRE documentation and references. These documents are helping Western Power align their business to the "To Be" world in which they aim to operate to be safe, reliable and affordable.

Some examples are:

- A) In the development of the power transformer strategy Western Power heavily relied on the CIGRE Technical Brochure 248 "Guide on Economics of Transformer Management". More specifically they have used the risk management techniques in CIGRE documentation for managing their transformer population. Through using the CIGRE guide they will be able to better target both capital and operational plans to make the best use of available resources. Western Power have also used the economic formula from the guide to aid in the replace versus repair decision making process and have used Technical Brochure 165 "Life Management of Circuit Breakers" on their switchgear strategy development.

Western Power have also referenced CIGRE Technical Brochure 445 "Guide for Transformer Maintenance", TB 443 "DGA in Non-Mineral Oils and Load Tap Changers and Improved DGA Diagnosis" and will be giving credit to TB 494 and TB 625 to help us finish out their condition to action rules.

- B) During a review of the procurement processes for primary plant such as Power Transformers and Shunt reactors Western Power developed a factory audit document that was aligned to the key features of the CIGRE Brochure 530: "A Guide for Conducting Factory Capability Assessment for Power Transformers". They now have a method that covers many aspects of the audit process and this will allow them to ensure that Western Power has quality suppliers who meet their needs within their works.

Additionally Western Power have utilised the Brochures 204 and (more recently) 529 for supporting their need to carry out detailed design reviews.

- C) To further improve their procurement processes Western Power has followed many of the guidelines set out in the Brochures 528, 529 and 530 for the Transformer Procurement Process. They used these documents as a guide on how to improve the way they approached the procurement process and have made substantial changes to improve their processes.

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## **Australian Panel D2 (Information Systems and Telecommunications) identifies benefits of CIGRE membership.**

All CIGRE Australia members realise some generic benefits through having access to international work and global networks, however during 2015, members of the Australian Panel D2 – Information Systems and Telecommunications identified some specific benefits members have realised through CIGRE membership and participation in technical work.

- Members from TransGrid, AusNet Services and Snowy Hydro have over a period of time discussed the problems associated with supporting ageing communication assets carrying line protection systems for the NSW-Victoria High Voltage interconnectors as well as local communications problems in the remote Snowy Mountains region. These discussions and meetings saw the

genesis of the concept of retrofitting Optical Ground Wire (OPGW) on the 330KV transmission towers in the Snowy Mountains region and northern Victoria. This has resulting in significant savings for the three organisations involved.

- A common theme of the Australian and International D2 meetings has been the topic of achieving resilience to cyber-security attacks on the critical infrastructure of the power industry. Experiences on this topic are confidentially shared every year at the Australian panel meetings allowing each of the members to benefit from each other's experiences and ideas in working to improve the security of their systems.
- Experiences gained from various disasters (floods, cyclones, bushfires, earthquakes, snow storms, etc) are often shared. Last year the Australian panel produced a significant contribution for the CIGRE international working group WG D2.34 who are currently producing a Technical Brochure on this topic area for information systems and telecommunications. Discussions on the Victorian bushfires has assisted TasNetworks to implement preventative measures which subsequently save one of their radio repeater sites.
- APD2 also produces some presentations aimed at education and professional development of members concerning telecommunications and information systems issues that are peculiar and specific to the power industry or arise from changing standards that will impact utilities. This year TasNetworks presented on the impact of Electric Potential Rise (EPR) on telecommunications systems. A number of those present were surprised at the dangers of some types of service delivery in this environment. This issue, is often not well understood by young telecommunications engineers migrating to the power industry from a carrier environment. Additionally at this meeting, attendees were updated on the changes being made by ACMA to radio spectrum usage and on changes to "pathways and spaces" standards.
- Various vendors and consultants are also members of the APD2 panel. Although APD2 is agnostic to specific suppliers or consultants, ( as are all CIGRE Panels and Working Groups) the forum provides the opportunity for these panel members to develop the requirements for their products and services through the better understanding of the needs of the power industry. Likewise utility members have the opportunity of better understanding technology trends and the different approaches to choose from, and have the benefit of networking to explore future options themselves.
- Since 2003 the power industry in general has been faced with the migration to packet based communications for service delivery. This is an area of considerable information exchange and continuing evolution of ideas facilitated by the APD2 panel. Transpower, although a relatively early

adopter of packet based communications was interested this year to learn of the work done by Energex and other utilities in establishing test labs to facilitate achieving the 'holy grail' in this area - carrying protection services via packet based communications. This networking of engineers and IT professionals working on solving the same problem will lead to many follow-on discussions, sharing of results and ultimately real benefits for many organisations during coming years.