On-Line Condition Monitoring in the Substation of the Future

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Chairman of CIGRÉ SCB3 - Substations

IEEE – PES T&D Conference and Exposition
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Overview

• Introduction
• Safety
• CIGRÉ and Study Committee B3 - Substations
• The Big Picture
• Trends in Substations
• How are we doing with on-line technologies?
• What's holding us back?
• Conclusions
# Introduction

## Qualifications
- BE Electrical, Honours (First Class) 1993
- Graduate, Advanced Management Program, University of Adelaide, 1998
- Graduate, Australian Institute of Company Directors 2002

## Affiliations
- Graduate Australian Institute of Company Directors (GAICD)
- Fellow Institute of Engineers, Australia (FIEAust), PEng
- Registered Professional Engineer (RPEQ)
- Chairman CIGRE Study Committee B3 since 2012
- Endorsed Asset Management Assessor, BSi PAS-55
- Member Asset Management Council

## Experience
- 37 years in industry including General Manager
- Experience includes: Generation, Transmission, Distribution
- Presented more than 35 papers on asset management and design
- SKM Global Practice Leader for “Substations”
- Senior Manager and Asset Manager for T&D utilities since 1995.
Safety
Common Industry Problems

Labour Productivity:
- Labour costs high
- Increased level of management
- Skill shortages, staff retention
- Staff (and consultant) resistance to change!
- De-engineering of organisations, reducing innovation

Capital Delivery:
- Regulation, industry unbundling and privatisation
- Design standards & procurement options
- We need to do more with less!
Who is CIGRÉ?

Conseil International des Grands Réseaux Électriques
International Council On Large Electric Systems

• Founded in Paris in 1921
• Worldwide non-profit association.
• Addresses issues related to the development, operation and management of electric power systems
• Design, construction, maintenance and disposal of equipment and plants.
• 8000 members in 89 countries
Study Committee B3 - Substations

- Strategic Advisory Group
- SC B3 Secretary
- Customer Advisory Group
- Tutorial Advisory Group

Study Committee
24 Regular Members, 14 Observer Members, 2 Special Reporter, all WB Convenors

- B3.13 Reducing replacement time of HV Equipment
- B3/C1/C2.14 Circuit Configuration Optimisation
- B3.36 Special Considerations for AC Collector Systems and Substations associated with HVDC connected Wind Powers Plants
- B3.35 Substation earthing system design optimisation through the application of quantified risk analysis
- B3.30 Guide to minimize the use of SF6 during routine testing of electrical equipment
- JWG B3/B1.27 Factors for investment decision GIL vs. Cables for AC Transmission
- WG B3.24 Benefits of PD diagnosis on GIS condition assessment
- WG B3.37 Internal arc effects in medium voltage switchgear (1-52kV) - mitigation techniques
- B1/B3.33 Feasibility of a common dry type interface for GIS and Power cables of 52 kV and above
- B3.31 Air insulated substations design for severe climate condition
- B3.32 Saving through optimized maintenance of Air insulated Substations
- B3.38 Management of risk in Substations
- B3.34 Expected impact of future grid concept on substation management
SC B3 Global Membership


**SC B3 – Study Subjects 2013/14**

**PS 1: Substation Developments to address future needs**
- Integration of new approaches to grid automation in Transmission and Distribution substations
- Impact of new grid developments on substation design
- Off shore substations
- Low cost and fast deployment distribution substations

**PS 2: Life-cycle management of substations**
- Renovation, refurbishment, extension and up-rating substations
- Asset management, maintenance, monitoring, reliability and sustainability issues
- Managing risk in design, installation and operation of substations
Brochures, Tutorials, Events

Obtaining Value from On-Line Substation Condition Monitoring

WG B3.12

June 2011

IT Strategies for Asset Management of Substations - General Principles

Working Group B3.06 TF05

April 2014

CIGRE SESSION

26th to 29th August
Du 26 au 29 août
2014

Paris - France / Palais des Congrès
Porte Maillot - 75017 Paris

Register as from mid-January 2014
With your National Committee or with CIGRE in Paris.
Open to CIGRE members and non-members.

Inscrivez-vous à partir de mi-janvier 2014
auprès de votre Comité National ou auprès du CIGRE à Paris.
Ouvet aux membres CIGRE et aux non-membres.

For on-line registration and general information:
Inscription en ligne et autres informations générales sur :
www.cigre.org
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Observed Trends in Substation design

1. Different approaches to design standardization to achieve faster delivery and lower costs
2. Smart Grids and even smarter substations
3. Higher use of IEC 61850 Station & Process (compatibility with OLCM technologies)
4. Non-Conventional Instrument Transformers
5. Improved high voltage plant design
Observed Trends in Substation design

6. Use of Gas Insulated systems (GIS, GIL)
7. Increasing stakeholder and customer awareness and influence in design
8. Ultra high voltage (1200kV in India)
9. Alternative materials: nano-composites, SF$_6$ replacement etc.
10. More awareness of severe weather conditions (climate change?)
Observed Trends in Substation design

11. The use of robotics in substations
12. More risk management – coupled with awareness of Asset Management
   – PAS 55 and ISO 55000.
   – On-line technologies continue to develop
On-Line Monitoring

- Reduces the risk of unplanned failures
- Provides information on condition when maintenance frequencies reduced
- Now a mature technology
- There are still non-believers!

April 2013…
Obtaining the Benefits of OLCM technology

• Be realistic and aim for highest risk reduction!
• Make sure you use proven technologies
• Deal with knowledgeable “partners” / suppliers
• Embed the monitoring into a risk based, asset management approach
• Invest in training for your people
• Consider your IT systems – non-vendor specific
• Forget the research projects!
So what's missing?

• Standards or Guides
  – Need better education for managers, training, guides for engineers
  – Research on information management for OLCM
  – Means more work for Universities, CIGRE and IEEE!

• Monitoring system features or sensors
  – Sensor range limited and some interface issues
What’s missing?

• Monitoring system data
  – Poor integration of information systems
  – Too much data and not enough information for decision making
  – Too much human intervention to interpret data – use the KISS principle.
The Future Substation

- Unmanned, fully automated, robotic patrols
- Primary plant is enclosed, maintenance free.
- Condition sensors built into primary side for continuous monitoring
- Non-conventional instrument transformers
- 61850 deployed - fibre optics
- Condition Data managed centrally and expert analysis systems deployed
Conclusions

• On line monitoring has come a long way
• But we still have work to do to learn to use the technology – not play with it!
• Substations will continue to evolve
• New technologies are available
• For condition data: focus on simplicity and making decision making easier
• Use the work of CIGRE and IEEE so we don’t need to reinvent the wheel