

ASSET MANAGEMENT IN PRACTICE: Learn from others & share your experiences!

THE 24TH EURODOBLE ASSET & MAINTENANCE MANAGEMENT COLLOQUIUM IN MANCHESTER

EuroDoble is a forum for sharing best practices for managing European power networks, power stations, and industrial sites with learning opportunities for power engineer involved with transmission and distribution, maintenance, protection or asset management. Join us for a week of learning and knowledge sharing in Manchester, UK.

CALL FOR EURODOBLE PRESENTATIONS - Be part of the conversation, join us in Manchester

Share your knowledge with the power community by presenting at EuroDoble 2018. If you make a formal presentation you can attend free of charge, full papers are not required. Email eventseurope@doble.com to submit your abstract.

SUNDAY, 21 OCTOBER 2018

On-line Monitoring Seminar and Workshop | 17:00 – 18:00

This seminar and workshop will include a discussion of the latest in monitoring technology and applications and work through real world examples.

Monday, 22 October & Tuesday, 23 October 2018

Colloquium Sessions on Primary and Secondary Asset Care including Life Management, Maintenance, Performance, Cost, and Risk

Learn from your colleagues and share your experiences! These colloquium sessions are divided into topic areas, each led with technical presentations followed by attendee discussion. These themes are related to assets including rotating machines, transformers, circuit breakers, GIS, cables, instrument transformers, bushing and insulators, arresters and capacitor, and protection systems.

Secondary Systems Tutorials and Asset & Maintenance Management for Light Current Assets

Protection testing and other related topics will be explored during these tutorials and sessions.

Wednesday, 24 October 2018

Closed Session for Utility and Industrial Groups Only (Morning)

Share your experiences relating to plant performance, failures, and malfunctions. Prepare a few PowerPoint slides to share your thoughts and ideas, describing asset failures and performance issues related to manufacture. What asset lives do you now ascribe to service life of each asset type?

SUNDAY, 21 OCTOBER 2018		
17:00 – 18:00	On-line Monitoring Seminar & Workshop	
18:00 – 19:00	Welcome Reception and Industry Expo	
MONDAY, 22 OCTOBER 2018		
9:00 – 10:00	Opening Address and Keynote Speaker	
10:15 – 12:00	Colloquium Sessions on Primary and Secondary Asset Care including Life Management, Maintenance, Performance, Cost, and Risk	Secondary Systems Sessions
12:30 – 14:00	Lunch in the Industry Expo area	
14:00 – 18:00	Colloquium Sessions on Primary and Secondary Asset Care including Life Management, Maintenance, Performance, Cost, and Risk	Secondary Systems Sessions
18:00	Colloquium Reception in Industry Expo Room <i>All are welcome</i>	
TUESDAY, 23 OCTOBER 2018		
8:30 – 12:30	Colloquium Sessions on Primary and Secondary Asset Care including Life Management, Maintenance, Performance, Cost, and Risk	Secondary Systems Sessions
12:30 – 14:00	Lunch in the Industry Expo	
14:00 – 18:00	Colloquium Sessions on Primary and Secondary Asset Care including Life Management, Maintenance, Performance, Cost, and Risk	Secondary Systems Sessions
18:00	<i>EuroDoble Client Committee Meeting and Dinner (Client Members Only)</i>	
WEDNESDAY, 24 OCTOBER 2018		
9:00 – 13:00	Utility Only Session Asset Failures	

SUNDAY, 21 OCTOBER 2018

ON-LINE MONITORING SEMINAR & WORKSHOP | 17:00 – 18:00

This seminar and workshop will include a discussion of the latest in monitoring technology and applications and work through real world examples.

MONDAY, 22 OCTOBER 2018 & TUESDAY, 23 OCTOBER 2018

OPENING ADDRESS

Bryan Sayler, President; Doble Engineering Company, USA

Bryan Sayler brings 28 years of experience developing and implementing highly engineered test solutions for wireless, EMC and microwave applications in the electronics, automotive and aerospace industries. Prior to joining Doble, Mr. Sayler was Sr. Vice President Solutions Development at ETS-Lindgren where he led global project management, hardware, software and strategic solutions development through active participation in global standards bodies including IEEE, CTIA, 3GPP and the WiFi Alliance. He has a Bachelor of Arts degree from Southeastern University and Masters in Business Administration from Baylor University.

KEYNOTE ADDRESS

TOPIC 1 FUTURE PROOFING THE EXISTING NETWORKS

The industry needs to adapt to change. These changes come from accommodating more long distance interconnections to remote wind and solar farms, generation fed from the distribution system, generation fed from semi-independent micro-grids with local renewables, energy storage and battery systems. Each of these means increased stresses and greater flexibility needed from ageing assets designed for a different environment. It means changes to design for new assets and understanding the risks for existing assets including more transients and harmonics, load and ratings management, difficulties for long term outage management and more.

1.1 The Important Role of Interconnectors in a Balanced Network

Z. Richardson; National Grid, UK

Greater decarbonisation of the industry will lead to more reliance upon less certain renewable generation at distribution voltages. One of the key roles for the transmission system will be to transfer power from areas with surplus renewable output and over longer distances, in some case linking AC and DC systems.

1.2 The Nemo Link

To Be Announced

This HVDC link is a joint venture between two utilities, National Grid (UK) and Elia (Belgium). Due to be commissioned in 2019 this link will use a world leading HVDC submarine power cable design and will be capable of transmitting up to 1,000 MW at 400 kV, i.e. an annual transmission capacity of 8.76 TWh.

1.3 Energy Storage - Comparing Technologies

Steven Larson; Snohomish County PUD # 1, USA

It is widely accepted that successful reliance upon renewable generation is usually associated with power storage. This presentation will be comparing various types of energy storage technologies including pumped hydro, flywheel, compressed air, and the different battery types. Included will be a progress report on the two competing battery systems installed at this US utility.

1.4 Losses in Solar Farm Transformers

C. Simmons; Neville Grid Data, UK

As with wind farms, this UK solar farm has had service problems with equipment that had been specified and selected. The presentation will cover reliability of 1MVA transformers.

1.5 Reverse Power Flows and Their Impact on Transformer Operation

J. Helms; Northern Power Grid, UK

R. Clayman; Fundamentals, UK

Tap changers and their protection are normally set to regulate for voltage variations on the high voltage winding. But increased renewable use will lead to variations on the LV and this can lead to over-fluxing.

1.6 Investigating Internal Resonant Over-voltage Flashovers in Distribution and Wind Turbine Transformers

John Lapworth; Doble Engineering Company, UK

Over the last year, Doble UK have been investigating the cause of several failures of 11kV distribution transformers and 33kV wind turbine transformers that appeared to be very similar: flashovers between off-circuit tap switches and associated collapses of tap windings. Some of these had occurred after several years of service but one was only days after entering service. Internal resonant over-voltages were suspected, initiated by switching transients. Special SFRA tests have confirmed this as the likely explanation, and it is suspected that the particular winding design and arrangement used, very common for such transformers, is a key factor. Recommendations are suggested for avoiding such failures, including enhanced factory acceptance tests.

1.7 Combustible Gas Generation in Wind Farm Transformers

G. Cooper; Balfour Beatty, UK

Hongzhi Ding; Doble Engineering Company, UK

The load pattern here is different to conventional units and there is no guide to DGA interpretation. The presentation aims to review the existing data/practices and put together recommendations and guidelines when a gassing wind-farm transformer should be removed from service and either repaired or replaced, and help towards development of industry standard for wind-farm transformers.

1.8 Security of Distribution Supply Standards in Middle East

J. MacEnri; MEPS, Ireland

The presentation will cover the use of distribution security of supply standards and regulatory oversight and management of them. Several Middle East countries have tried using a standard developed by UK DNOs. Experience suggests major changes are required.

1.9 Standards & Specification Changes for Medium Voltage Switchgear

Ian Naylor; Threepwood, UK

IEC standard 62271-200 is under revision, as is the UK ENA TS 41-36, which both prescribe MV switchgear requirements. The key changes that impact manufacturers and duty holders are to be presented.

1.10 Achieving Effective Market Surveillance for Power Transformers with the INTAS Project (Industrial and Tertiary Product Testing and Application of Standards)

A. Baggini, I. Weiss, N. Ruiz Fuente, T. Jezdinsky, R. Targosz, P. Waide, T. Hartikainen

The INTAS project is part of an initiative to improve performance by reduced losses through the use of products that are compliant with stated energy performance. Here the focus will be on transformer fans.

TOPIC 2 ASSET PERFORMANCE AND ENHANCED RELIABILITY

Asset condition assessment, asset health review, risk analyses, and failure analyses have become integral to the management of assets allowing for more focused expenditures and better network performance.

- 2.1 **Asset Health Indices - Building an International Consensus for Preferred Methodologies**
Alan Wilson; Doble Engineering Company, UK
The need to manage the risk of an in-service asset failure has led to greater interest in creating indicators of asset condition, and from that an index of risk mitigation plans. A CIGRE group is evaluating best practice when creating likelihood of failure indices for substation assets. Some of the key features are readily apparent.
- 2.2 **Asset Health Indices - Experience Creating a Maintenance Index and Evolving It into AHI**
L. McCartney; ESB International, Ireland
ESB International have created a maintenance indexing system for substation assets and this has been in use. The next step is to evolve into a more comprehensive AHI.
- 2.3 **Asset Health Indices – Starting with FEMCA and Linking Through Diagnostic Indicators to Create AHI**
Tony McGrail; Doble Engineering Company, USA
Starting at the right point is key to success. Following RCM methodology the first step is to define failure modes and their indicators. This can then lead to determining the features to be assessed to indicate condition and likelihood of failure.
- 2.4 **Modified Life Scores and Monetised Risk**
Andrew Fieldsend-Roxborough; National Grid, UK
- 2.5 **Failure Data Analysis of Low Voltage Vacuum Circuit Breakers in National Grid of Bahrain**
A. Alabbasi; Derasat Research Centre, Bahrain
M. Khalil; Doble Engineering Company, Poland
A two-year survey was conducted in Bahrain from October 2015 to September 2017 on 2000 circuit breakers of voltage level 11 kV. The results are to be presented here. The survey included details on the failure causes of circuit breakers mechanisms and the auxiliary equipment that contributes in the circuit breaker failure.
- 2.6 **Learning from the Rebuilding a 220kV Transformer**
Brendan Diggin; ESB International, Ireland
- 2.7 **New Beverly Park Station, a \$35M Rebuild of an Existing Station**
Steve Larson; Snohomish County PUD #1, USA
This USA utility have recently installed 15 - 115 kV breakers, 1 - 230 kV breaker, and a 300 MVA transformer as part of a substation re-build.

TOPIC 3 NEW MATERIALS AND DESIGNS

Utilities are responding to environmental challenges in many ways. For some, it involves improving the impact of materials being used. For others, it is to address carbon emission targets through greater use of renewable fuel sources embedded within a smart or micro grid.

3.1 **Trialling Alternatives to SF6 at Sellindge**

*Andrew Fieldsend-Roxborough; National Grid, UK
T. Chen; Manchester University, UK*

3.2 **Dielectric Performance of Insulating Liquids**

Carl Wolmarans; NYNAS AB, Sweden

Transformer oil specifications are based strongly on product characterization. There are very few performance-related parameters. This makes sense since compatibility between new and in-service oils is important, but precisely because of this, it is very difficult to assess the performance expected for an insulating oil only based on the requirements of the specifications. This presentation brings some important aspects related to the dielectric performance of in-service oils and that are not covered by current specifications of insulating oils.

3.3 **Improving Performance with Better Thermal Models**

Z. Wang, Qiang Liu, Xiang Zhang & M. Daghrah; Manchester University, UK

Understanding the thermal profiles including the hotspot temperature is essential for managing transformer thermal rating and life expectancy. Traditionally, mineral oil is used as a dielectric coolant for transformers. With increasing applications of alternative liquids in transformers such as esters and gas-to-liquids, the thermal behaviour of different liquids is of great interest to transformer industry. In this presentation, both experimental tests and computational fluid dynamics (CFD) simulations of the thermal behaviour of three liquids, a mineral oil, a gas-to-liquid and a synthetic ester, are conducted for a disc-type transformer winding model. The thermal performances are compared and dimensional analyses are implemented to produce generally applicable results.

3.4 **Application of Aramid Enhanced Cellulose Paper and Practical Verification in Power Transformers for Extended Life or Optimized Size**

R.P. Marek, W. Calil, L. Galhardo, A. Souza, R. Szewczyk; ABB Brazil & DuPont

This contribution presents a practical verification of aramid enhanced cellulose paper for applications in power transformers. Currently, the aramid enhanced cellulose paper is used in construction of transformers for hot climate installations rated up to 500 kV. A joint study by ABB and DuPont compared the gas production of two 165 MVA, 230kV/34.5kV power transformers during temperature rise testing. The project tested the hypothesis that if the new insulation system is really suitable for higher temperature operation, then reduced gas production, especially CO and CO₂, would verify this higher temperature capability.

3.5 **Design and Use of Ester-Filled Transformers**

*Anastasia E. O'Malley; Consolidated Edison Co. of NY, Inc., US
G. J. Pukel Siemens; AG Austria, Transformers Weiz, Austria*

This presentation will describe the development and early use of a hybrid insulation system to provide a compact, multi-ratio transformer design that maximized operational flexibility and minimized installation time. The application involved by-passing a 328MVA 345/138 kV Three-Phase Unit with three Multi-Ratio and Lightweight Single-Phase Resiliency Transformers. The implementation of these newer alternatives allows for improved fire safety characteristics, the reduced environmental impact of biodegradable liquids offer advantages that help to reduce operational risks. In addition, the higher thermal capability of ester liquids together with high temperature solid insulation materials offer increased design flexibility to create innovative solutions to prior existing constraints. The differences from traditional mineral oil/cellulose

insulation systems offer challenges that need to be incorporated in the transformer design, construction, processing and placing in service. The implementation of these newer alternatives allows for innovative solutions to meet today's power system safety, sustainability and resiliency needs.

TOPIC 4 DEVELOPING DIAGNOSTICS, CONDITION MONITORING, & DATA MANAGEMENT TECHNIQUES

It is becoming more important to utilize diagnostics to detect maintenance or renewal needs condition indications are important triggers in both time based and reliability centred maintenance. There is a greater reliance on routing non-invasive surveys and in some cases installed systems with remote monitoring.

4.1 Transformer Monitoring Systems

Tony McGrail; Doble Engineering Company, USA

This presentation will describe different types of transformer monitoring now available with a special focus on how to get best value from the installation and what to do with the results. This presentation will also describe how to aggregate data from transformer monitoring and other sources to assess transformer condition.

4.2 Cost Effective Condition Monitoring Strategies

Marc Foxall; HVPD, UK

This presentation will demonstrate using a case study of a cost effective, condition monitoring (CM) strategy which identifies, locates and monitors partial discharge (PD) activity network wide using a range of Partial Discharge (PD) instruments, from simple handheld units to 24/7 monitors. The case study helped to prevent the costly failure of critical 11 kV air insulated switchgear (AIS) within Australia's mining industry.

4.3 Life Cycle Costing Analysis for On-line DGA Monitors Using Photo-acoustic and Chromatography

Simon Sutton; Doble Engineering Company, UK

The capital cost of dissolved gas analysers varies between manufacturers. A simple life cycle cost tool has been built which allows factors such as upfront costs, consumables, repairs and life expectancy to be considered to generate a total cost of ownership. Results will be presented for a comparison between two analysers, one requiring consumables and one that does not.

4.4 Advances in EMI Interpretation and Analysis

Mike Hughes Narborough; Doble Engineering Company, UK

TOPIC 5 IMPROVED CAPABILITY FROM SECONDARY SYSTEMS

There has been a rapid development of Protection, Automation, Controls and Communications (PACC) technology and this appears to have significantly improved efficiency, security and flexibility of the secondary systems within power networks. The risks include a shorter life span and increased complexity of devices.

5.1 Maintenance and Testing Challenges for Modern IEDs – Hardware, Software and Data Management

5.2 Case Studies Implementing and Integrating IEC 61850

5.3 Data Management and Security

5.4 Novel Applications of PMU Applications in Power Systems

5.5 Interfacing with Monitoring Systems

WEDNESDAY, 24 OCTOBER 2018

SESSION 5 PLANT PERFORMANCE, FAILURES, AND MALFUNCTIONS

CLOSED SESSION FOR UTILITY & INDUSTRIAL GROUPS ONLY

SAFETY

Have there been any incidents with safety issues that you wish to discuss to the wider group?

FAILURE AND ASSET PERFORMANCE ISSUES

Describe asset failures and performance issues relating to manufacture. What asset lives do you now ascribe to service life of each asset type?

ENHANCING PERFORMANCE

Machines On-line Monitoring of rotating machines has been widely used for some decades, share your experiences with data interpretation and how this relates to machine design/manufacture

Cables and Accessories Lessons learned from issues arising in operation – what are the issues and how do they need to be resolved by design, manufacture, or diagnostics? What is your experience of proportion of failures at accessories and in-length ageing?

Gas Insulated Substations Do you have experience with on-line partial discharge diagnostics versus routine measurements performed by a specialist? Have you had many failures that could have been detected by these techniques?

Reactive Equipment On-line diagnostics, condition assessment relating to oil, paper and other major constituents. Failure statistics, impact of switching transients and power quality. What is the experience with re-builds and adding water exclusion systems?

Switching Equipment What are the newer techniques for maintenance timing, diagnostics and gas management? Have you found mid-life refurbishment to be cost effective?