

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.

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.

Tutorials: Renewables

This two part tutorial will focus on everything you wanted to know about renewables.

Wednesday, 24 October 2018

Closed Session for Utility and Industrial Groups Only (Morning)

Share your experiences relating to site management and asset 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		
18:00 – 19:00	Welcome Reception and Industry Expo	
MONDAY, 22 OCTOBER 2018		
9:00 – 10:00	Opening Address and Keynote Speaker	
10:15 – 12:30	Colloquium Sessions on Primary and Secondary Asset Care including Life Management, Maintenance, Performance, Cost, and Risk	Renewables Tutorial: Wind and Solar Power
12:30 – 14:00	Lunch in the Industry Expo area	
14:00 – 16:00	Colloquium Sessions on Primary and Secondary Asset Care including Life Management, Maintenance, Performance, Cost, and Risk	Renewables Tutorial: Wind and Solar Power
16:00 – 17:30	Joint Protection, Automation, Communications & Controls and Asset Management Session: Substation Data to Asset Management Decisions	
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	Protection, Automation, Communications and Control Sessions
12:30 – 13:30	Lunch in the Industry Expo	
13:30 – 18:00	Colloquium Sessions on Primary and Secondary Asset Care including Life Management, Maintenance, Performance, Cost, and Risk	Protection, Automation, Communications and Control 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	

MONDAY, 22 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

Steve Cox, Engineering and Technical Director; Electricity North West, UK

TRACK ONE ASSET MANAGEMENT COLLOQUIUM SESSIONS

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 also 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

Zac 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 **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.
- 1.3 **Losses in Solar Farm Transformers**
Clarke Simmons; Neuville 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.
- 1.4 **Reverse Power Flows and Their Impact on Transformer Operation**
Joe Helms; Northern Power Grid, UK
Hamdi Shishtawi; 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.
- 1.5 **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.
- 1.6 **New Beverly Park Station, a \$35M Rebuild of an Existing Station**
Steve Larson, Snohomish County PUD, US
The American utility has recently installed fifteen 115kV breakers, one 230 kV breaker, and a 300 MVA transformer as part of a substation re-build.
- 1.7 **Security of Distribution Supply Standards in Middle East**
Joe 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.
- 1.8 **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.

1.9 **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 power and large distribution transformers and large industrial fans.

TRACK TWO TUTORIALS: RENEWABLES

10:30 – 12:30 **Wind and Solar Power – All You Wanted to Know Part 1**

Ed Khan, Doble Engineering Company, USA

The application of renewables is attracting a lot of attention since it impacts the electric grid in several different ways. There are both positive and negative impacts that need to be recognized with solutions that need to be implemented. It is important to understand the issues for different segments of the industry. Using renewables impacts utilities, companies designing renewable plants, manufacturers, testing companies and maintenance personnel.

With these factors in mind, this tutorial describes the operation and behavior of these plants, and explains the issues while laying out solutions. We will look at the technical aspects of proper integration and efficient operation of these plants.

This tutorial will cover the following topics:

1. Introduction of renewables in general
2. General comparison with conventional power plants
3. Different types of short circuit contributions from wind generation
4. Short circuit contributions from solar plants
5. Impact of renewables on electric grid
6. Protection applied at the plant and interfacing utility grid
7. Issues such as islanding, frequency regulation, reactive power requirements, power flow, voltage rise, reverse power and voltage unbalance will be discussed
8. Harmonic penetration and solutions such as harmonic filters
9. Maintenance of on-shore and off-shore wind farms and solar plants overview

14:00 – 15:30 **Wind and Solar Power – All You Wanted to Know Part 2**

Ed Khan, Doble Engineering Company, USA

JOINT PROTECTION, AUTOMATION, COMMUNICATIONS & CONTROLS AND ASSET MANAGEMENT SESSION

16:00 – 17:30 **Substation Data to Asset Management Decisions**

1. **Collecting Diagnostic Data at Asset Level** | The opening presentation will start at the asset. Different types of transformer monitoring are now available but the question is how to get the best value from the installation, including how to aggregate data to enhance value.
2. **Machine Learning Technologies** | These technologies are being developed for power system applications and this will allow data classification.
3. **Processing Data into Information for Asset Management Decisions** | A practical example with a utility describing how it is integrating a wide variety of data sources in order to optimise it and form decision-ready outputs.

TUESDAY, 23 OCTOBER 2018

TRACK ONE ASSET MANAGEMENT COLLOQUIUM SESSIONS

TOPIC 2 ASSET PERFORMANCE AND ENHANCED RELIABILITY

Rebuilding major assets has several attractions – it may be more cost effective than a new purchase; there may be physical constraints that prevent a new installation. However, like policies to examine any scrap units, it adds to the knowledge base regarding similar designs remaining, validating diagnostic assessment and providing a basis for asset health index development. 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. Varying aspects will be covered with a general discussion at the end of the session.

2.1 Learning from the Rebuilding of a 220kV Transformer

Tom O'Neill; ESB International, Ireland

2.2 Tap Changer Replacement as a Means to Manage an Aged Station Transformer Fleet

Jamie Beardsall; Drax Power Station, UK

This 3000MW power station has responded to changes in the power generation environment since its commissioning in the 1970s. The presentation will focus on the experiences with four station transformers. The on-load tap-changers are key components for reliable operation and replacing the old on-load tap-changers will achieve a reduction in maintenance costs, guarantee easy spare parts supply, and increase the reliability of the station transformers.

2.3 “Zero” Maintenance Oil Dryer Installation

Andrew Fieldsend-Roxborough; National Grid, UK

T. Chen; Manchester University, UK

National Grid has used oil dryers which required maintenance as the cartridges get saturated. Alongside EPRI, a trial is currently underway of an oil dryer that does not use cartridges and therefore requires little to no maintenance to ensure it continues to dry the oil.

2.4 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.

2.5 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.

2.6 Modified Life Scores and Monetised Risk

Andrew Fieldsend-Roxborough; National Grid, UK

National Grid has begun the process of moving towards a system of prioritizing both maintenance and replacement of assets using Monetised Risk. This has necessitated the move from a discrete Asset Health Index to a more continuous score termed an End of Life Modifier. This is then combined with the probability and impact of possible consequences to produce monetized risk which can be compared across asset types.

2.7 DISCUSSION ITEMS

1. Do you have any experiences of achieving a positive cost benefit rebuilding rather than replacing major assets?
2. Have you undertaken a forensic tear down during scrapping? What are the benefits?
3. Are you using or developing asset health indices? Has there been a value? What do you think of the presentations of this session?

a. **Asset Health Indices (AHC) – Experience Creating a Maintenance Index and Evolving It Into an AHC**

Laura McCartney; ESB International, Ireland

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 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.

3.2 Hydro-Processing of Mineral Oils and Additives

Ed Casserly; Ergon Refinings, Inc., USA

Hydro-processed mineral insulating oils (naphthenic and isoparaffinic) are highly oxidatively stable, efficient in heat transfer, and definitely non-corrosive. There are still misconceptions about corrosive sulfur, DBDS additives and misuse of inhibitors to mask unstable oils in order to meet IEC oxidation test requirements.

3.3 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.

3.4 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.

3.5 Improving Performance with Better Thermal Models

Zhongdong Wang, Qiang Liu, Xiang Zhang & M. Daghrach; 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.

3.6 Development and Validation of a Thermal Hydraulic Management Platform for Power Transformers

Márcio Quintel; EFACEC Energia, S.A., Portugal

Transformer thermal design is improving with better modelling tools. Once set up it will allow them to validate hot spot calculations and so give a better indicator of resilience and ageing rates. It will also allow assessing the consequences from variations such as changing oil for alternative fluids.

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 Cost Effective Condition Monitoring Strategies

Malcolm Seltzer-Grant; 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.

4.2 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.

4.3 Advances in EMI Interpretation and Analysis

Mike Hughes Narborough; Doble Engineering Company, UK

TRACK TWO PROTECTION, AUTOMATION, COMMUNICATIONS AND CONTROLS SESSIONS

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 **Impact of Dispersed Generation and Low Carbon Technologies on the Protection Applied to Radial Distribution Networks**

Peter Crossley; University of Manchester, UK

The presentation will describe the impact of low carbon technologies, non-synchronous generation, intermittent energy sources and changing demand behaviour on the protection applied to radial HV distribution networks. Future, and in some cases existing, concerns include: the mal-operation of conventional relays due to reductions in the fault level resulting from the replacement of conventional high-inertia synchronous generators with low-inertia power-electronic interfaced sources; challenges in applying loss of mains protection; and the unwanted operation of Directional Overcurrent [DOC] relays resulting from HV feeders that occasionally act as generators, rather than demand, and deliver reverse power flows into the MV:HV transformers.

5.2 **Time from the Sky - the Use of Precise Time from GNSS in the Power Industry**

Christian Farrow; Chronos, UK

This presentation will discuss time synchronisation for the power industry with emphasis on GPS and other GNSS systems and why they can be suitable as reference sources for precise time. IRIG timecodes and IEEE1588-2008/PTPv2 will be covered with detailed descriptions of the "Power Profile." The benefits and challenges of carrying precise time over the network when GNSS is not available will be discussed with references to "On Path Support" from Boundary & Transparent Clocks.

5.3 **Phasor Measurement Units and New Trends in Communications for Utilities**

Inder Sood, President; Valiant Communications, India

This presentation will cover various aspects of Phasor Measurement Units (PMU). The details covered will deal with the use of PMUs for monitoring the power grid in real time. Other topics will include differences between -104 RTU / SCADA Control and the PMU data. It shall also discuss the role of DPS and the importance of time stamp accuracy in ascertaining the reliability of the PMU data. Important aspects of IEEE C37.118 that covers PMU application will be addressed. The effect of increasing the IEEE C37.118 protocol message frame rates have on the quality of output will be elaborated. One of the frequently asked questions posed is the number of PMUs and their locations that are required to cover the grid adequately. This presentation will cover the principles that must be used to determine the number of PMUs required and their locations. Also common tools available for grid monitoring will be dealt with along with the application of Phasor Data Concentrator and the way which compliments the PMU.

5.4 **Investigation of Time Synchronization Performance using IEEE 1588 for IEC 61850-based Transmission Substations**

Mingyu Han; Manchester University, UK

Accurate timing with sub-microsecond accuracy is required by control and monitoring equipment in power system applications such as phase measurement units, travelling wave locator and more recently sample value process bus in IEC 61850 based substations. Conventional ways for disseminating high accurate time information in substations include using 1-PPS and IRIG-B time code via dedicated cables. However, they are difficult to change once installed and requires efforts to manually compensate the signal propagation delay. IEEE 1588 is a networked timing solution, which allows time synchronisation messages to transmit in Ethernet cables with propagation delay automatically compensated. It is a perfect fit for IEC 61850 substations as it

shares the same transmission medium with protection and control messages. This work focus on the investigation of synchronisation performance using IEEE 1588 on a testbed with commercially available devices with the aim to enhance the confidence of power industry to deploy such technology in present and future IEC 61850 substations.

5.5 **Testing of the Power Swing Blocking Function in Numerical Distance Relays**

Michael Murphy; ESB International, Ireland

Power swing blocking is a vital function for ensuring the stability of distance protection relays during abnormal systems events. This function can be difficult to test and often is omitted during protection commissioning. This presentation outlines a utility's approach in investigating the power swing blocking functionality on its distance relays, and provides an overview of the standardized approach adopted in testing this function.

5.6 **Impact of Subharmonics for Motor Differential Protection**

Eoin Cowhey; ESB International, Ireland

This presentation provides an overview of an investigation into blocking issues for motor differential protection caused by sub harmonic currents. These currents are induced by static converter connected to rotor circuit, which is a feature of these scheme types. The analysis methods are discussed in detail along with the simulation and testing process.

5.7 **Modeling Transformers in Real Time**

Dean Ouellette; RTDS, Canada

This presentation will deal with various aspects of modelling transformers in real time digital simulations. First, we will look at the basics of real time digital simulations and then get into detailed description of transformer models. One of the key subjects related to transformers is the occurrence of sympathetic inrush. This type of inrush is not understood in its totality. The presentation will explain what sympathetic inrush is and how this condition can be modelled in a real time simulation.

The second topic that has assumed critical importance in recent years is the occurrence of geomagnetically induced currents (GIC) in a power system during solar storms. This presentation will explain the phenomenon and then describe how GICs impact transformers along with modelling techniques adopted to study the response of transformers under such conditions. Transformer design plays a critical role in handling the negative impact of GICs. Shell and core type of transformer design react differently and this will be part of modelling techniques that are used in real time simulations. In short, the intent of this presentation is to provide a very clear understanding of these two complicated issues along with basic understanding of real time simulations and general transformer modelling techniques.

5.8 **Augmenting Asset Management of Transformers Using Advanced Protective Relaying Features**

Krishnakumar Venkataraman; GE, UK

The challenges faced by power industry due to aging asset fleets with many assets reaching end of design life in an environment of increased CAPEX constraints and the restrictions in OPEX spend leaves difficulties in preventive maintenance programs. Added to that, unexpected failures of primary electrical equipment leading to safety concerns, unplanned outage, and loss of production with growing shortage of expertise due to retiring work force puts pressure on the Industries to have an effective Asset Performance Management. A novel and unique integration of techniques in a protection relay helps APM of transformers and motors to meet these challenges.

- 5.9 **Evolution of Measurement Transformers and the Impact on Power System Simulation**
David Gueret; Doble Engineering Company, France
Optical current transformers are being applied selectively in power grid. One of the main advantage of such devices is that these do not saturate under heavy fault current. However, these devices are very expensive. There are many aspects of these devices that are being discussed in the industry both pros and cons. This presentation will highlight the reasons why these devices are so attractive to utilities, the technology behind these devices, standardization, modelling of these devices and new trends.
- 5.10 **New Data Protection and Cybersecurity Regime and Impact on System Operation**
Gowri Rajappan; Doble Engineering Company, US
A consequential new data protection regulation, GDPR, and a cybersecurity directive, NIS Directive, went into effect this year. These have significant effect on the electric power sector in Europe. GDPR is concerned with protecting personal information. NIS Directive is concerned with protecting critical infrastructure, which includes the power system. In terms of power system and industrial control system security, there were several pivotal incidents in the past year, including malware targeting cyber assets used in the sector and hacker incursion into several US power plant control rooms. We will discuss the impact of the new regulatory regime as well as the increased incidence of cyber threat events on European utilities.
- 5.11 **Renewables – Impact on Transformers and Protective Relaying**
Ed Khan; Doble Engineering Company, USA
Renewables, such as wind and solar power, have been applied extensively and their presence is increasing at a very fast pace. These clean power sources are becoming very popular but not without challenges. These generating devices use electronics and this creates harmonics that impact the connected equipment. One such equipment is the transformer. In addition, wind generators exhibit certain operating characteristics that are detrimental to transformers. This presentation will discuss the impact of harmonics and impact of loading pattern on transformers. These issues along with solutions will be presented.

WEDNESDAY, 24 OCTOBER 2018

SESSION 5 SITE MANAGEMENT AND ASSET PERFORMANCE, FAILURES, AND MALFUNCTIONS CLOSED SESSION FOR UTILITY & INDUSTRIAL GROUPS ONLY

This session typically is freer with more informal discussions than the previous two days.

TOPIC 1 SAFETY ON SITE

Recent discussions at CIGRE indicate that in most countries how work is carried out safely is decided by staff themselves without any direct company processes. In a few other countries, safety at site is controlled in a top down manner through legislation overseen by government health and safety departments and regulators. These are then managed through company policies and to site processes.

- What is your view on a safety culture – top-down or bottom up?
- Where should basic decisions be made – on-site or in the board rooms? Who is responsible for government legislation compliance?
- Are there benefits from having rigid processes such for work instructions, risk management assessments and risk mitigation?
- Are there safety incidents you wish to share?

TOPIC 2 LEARNING FROM REBUILDING – EITHER ASSETS ONLY OR COMPLETE SUBSTATIONS ON AN OLD SITE

Rebuilding on an earlier site presents challenges of its own, particularly when a node in a network.

- What are the issues when building on an earlier site?
- What are the issues when extending an existing site that remains operational during new work?
- Is safety control any different than replacing a major asset in a working substation?

TOPIC 3 PCB LEGISLATION

Recently an issue arose regarding the proposed wording change to the existing Regulation (EC) NO 850/2004 (the POPs Regulation). Initially this looks minor but has an unexpectedly significant effect. Is there a lack of understanding within legislators? If so, how can we input change? How many large volume assets with high levels of PCB contaminant exist? How are utilities identifying, labelling and dealing with hermetically sealed small oil volume assets?

The existing wording: “(iii) Endeavour to identify and remove from use equipment containing greater than 0.005 percent polychlorinated biphenyls and volumes greater than 0.05 litres;” is to be changed to “shall identify and remove” by 31st December 2025.

TOPIC 4 LEARNING FROM FAILURES

Everyone is invited, and encouraged, to discuss a recent failure or safety incident.

- **Transformers, Reactors and Tap Changers**
- **Bushings**
- **Instrument Transformers:** There has been recent re-occurrence of an old problem, failures driven by high temperatures. CIGRE TB 512 indicated that the largest cause of major and catastrophic failures was from an internal dielectric failure. Are there other examples?
- **Circuit Breakers**
- **Generators and Motors**