

# 2009 EuroDoble Colloquium

Berlin, Germany

19 – 21 October 2009

This year's EuroDoble Colloquium will focus on some of the major issues concerning the purchase and care of utility assets. Politicians talk of Smart Grids, intercontinental interconnection or networks at one extreme to the interconnection of small and unpredictable local power supplies at the other. All these create problems for those who have to manage the assets.

So what are the issues? One must be the ability to accept power flowing up and down the voltage networks with minimal impact produced by voltage swings, harmonics, transients and short-term overloading. All require confidence in the reliability from both the primary and secondary equipment. These factors impact the 2009 EuroDoble Colloquium as follows:

## *Assessment of Assets*

Much of the asset base has been in service for more than 40 years. The best equipment may give many more decades of reliable service at their current utilisation. However we need to know which equipment will last and how to manage the poorer quality remainder with condition based maintenance and risk based asset replacement strategies. Much of our meeting will include technologies to solve these questions. We will also be entering the debate on how to develop dissolved gas methods as an indicator of developing faults, thereby managing the risk of failure rather than how to be wise after the event.

## *Ageing and Contamination*

The contamination that has concerned substation engineers for decades has been the effects of ingress of moisture. Presentations will describe the science and experiences with simple and direct methods to measure moisture. The presentations will explore the current interest by some of using over-hyped indirect methods relying on laboratory models and statistical curve fitting. The second important accelerator is from the use of oils that become corrosive. Extensive studies by Doble and the manufacturers have investigated all the issues in depth and these results will be covered. Confusions in the science by some recent experts, and the worry that oil treatment may make the oil more likely to become corrosive in the future will also be covered.

## *Asset Replacement*

Eventually the primary assets will need replacing together with robust assets for new connections. With greater technical demand and the use of remote factories, greater care is needed. Issues involved with this transition will be a major part of the first day.

## *Discussion Groups*

Two days of discussion groups will be held. This year will see the first Asset Managers discussion group as well as another day focusing on failures. Both will allow for round-table sharing of experience.

## *Protection*

There will be three days devoted to protection issues. Presentation sessions will include automated testing of IEC61850 based systems, protection for wind-farms and maintenance criterion for microprocessor relays. The first tutorial session will cover the basics of relay protection. The second tutorial will focus on the use of Doble test set/software to test various protection relays and schemes. In addition, IEC61850 related capabilities of Doble test sets will be demonstrated.

## REGISTRATION HOURS

Sunday 18 October from 18:00 – 19:30 in the Foyer on the 1<sup>st</sup> floor

Monday 19 October at 8:30 in the Foyer on the 1<sup>st</sup> floor

## RECEPTIONS

*All attendees and companions are welcome, and encouraged, to attend.*

Sunday 18 October from 18:00 – 19:30 in the Foyer on the 1<sup>st</sup> floor

Monday 19 October from 17:30 – 19:30 in the Foyer on the 1<sup>st</sup> floor

## OPENING CEREMONY

Monday 19 October at 8:30 AM

### WELCOME

*Vegard Larsen, President, DobleEurope*

### FORMAL OPENING

*Jiří Velek, CEPS, Czech Republic*

*Vice-Chairman of EuroDoble Committee*

### OPENING ADDRESS

*Benedikt Schmitz, Siemens Energy Sector, Germany*

9:10 – 9:30

**COFFEE BREAK**

Conference Sessions – Monday 19 October from 9:30 – 17:00

Tuesday 20 October from 8:30 – 17:00

## MONDAY 19 OCTOBER

## CONFERENCE SESSION

9:30 – 12:00

**SESSION 1 – SALON UNTER DEN LINDEN, 2<sup>ND</sup> FLOOR**

### 1.1 INSPECTION OF FACTORIES PRODUCING PRIMARY ASSETS

**Simon Ryder, Doble PowerTest, UK**

#### 1. Factory Assessments

A key aspect when purchasing any new primary asset is to ensure that the specification matches the operational environment. This provides the negotiation with the supplier discussing how the requirements are met within the design and construction. Equally important is to ensure that the product delivered matches the purchase specification. Mr. Ryder will describe this topic within his experience in preparing the tender documents and assessing factories around the world. These, together with an assessment of the design and management of the build and test, are particularly important when dealing with remote factories

#### 2. Factory Tests and Their Role

Factory tests are most important when judging if the design and build have met the promises made. The basic dielectric and thermal performance tests are to be described, particularly focusing on the need to be able to interpret the data presented.

**1.2 TRANSFORMER SPECIFICATION AND THE DESIGNER RESPONSE**

**Simon Ryder, Doble PowerTest, UK**

This will cover the design elements and how they are covered by the purchaser when specifying a new transformer. The response of the designer will then be described, how essential components such as the winding and core are designed to meet the specified requirements.

**1.3 LIFESPAN EXTENSION OF SF<sub>6</sub> LIVE TANK HIGH VOLTAGE CIRCUIT BREAKERS**

**Erik Backstrom, After Sales and Service ABB AB, High Voltage Products, Sweden**

This presentation will address how the lifespan of an SF<sub>6</sub> live tank high voltage circuit breaker is affected by a wide range of different factors. It will include how the condition of circuit breaker is determined and how a range of different solutions are created to extend its lifespan.

**1.4 TRANSFORMING KNOWLEDGE INTO AVAILABILITY**

**Gerhard Buchgraber, Siemens, Germany**

This presentation will describe the range of Siemens on-line monitoring systems for power transformers.

**12:00 – 13:30 LUNCH BREAK ON YOUR OWN**

**13:30 – 17:00 SESSION 2 – SALON UNTER DEN LINDEN, 2<sup>ND</sup> FLOOR  
COFFEE BREAK AT 15:00**

**OIL IMPREGNATED PAPER APPARATUS AND ITS PROBLEMS**

**2.2 CORROSIVE SULPHUR AND OUR UNDERSTANDING OF THE PROCESSES**

**Paul Griffin, VP Laboratory Services, Doble Engineering, USA**

Corrosive sulphur problems are still occurring today. But now a better understanding of the physical chemistry processes involved and the effects of corrosive oil are available today, quite unlike when problems were first seen with modern oils in the 1990's. This presentation provides a description of our understandings achieved after extensive research in laboratories of OEMs, oil producers and independents such as Doble.

**2.1A DISCUSSION ITEM – BUT IS OIL REMEDIATION THE PANACEA ACCLAIMED?**

**David Woodcock, National Grid, UK**

A number of European Utilities have recently reported cases of oil becoming more corrosive following regeneration than before the treatment. All known cases where the corrosion has caused problems in a transformer have resulted from corrosion of the silver rather than copper, but there are also some cases where the oil has a stronger tendency to form copper sulfide after the treatment than before.

**2.2 MOISTURE IN OIL-PAPER SYSTEMS**

**Paul Griffin, VP Laboratory Services, Doble Engineering, USA**

Moisture ingress is one of the major causes of premature failure and ageing in apparatus such as power transformers, bushings and instrument transformers. This presentation will describe the physical processes associated with the interaction of water with oil-paper systems, together with direct means of measuring the extent of any ingress.

**2.3 HOW TO ASSESS MOISTURE IN OIL PAPER HV APPARATUS**

**John A. Lapworth & Simon Ryder, Principal Engineers, Doble PowerTest, UK**

The traditional methods for assessing dryness have used either a moisture determination in an oil sample or implied from power factor measurements at 50 or 60Hz. More recently both approaches have seen new developments. On-line relative saturation measurements are now available allowing estimation of the relative amounts of moisture in the oil and paper. It is also possible to measure dielectric relaxation characteristics and calculate, or estimate, the degree of wetness. The latter, however, remains dependent upon laboratory modeling and extrapolations. Despite heavy lobbying to get these indirect approaches to become accepted science, CIGRE has considered the approaches and concludes that the former, a direct measurement of moisture content, is more reliable. Experimental evidence for this conclusion comes from use of a variety of these indirect measurements on UK transformers over a number of years.

**2.4 ENVIRONMENTALLY SAFE EMPTYING OF TRANSFORMER PITS**

**Karl-Inge Walldén, Vattenfall Services Nordic AB, Sweden**

Transformer pits not only gather leaking oil but they also collect rainwater. When the pits are emptied there is a risk of oil entering into the environment. Vattenfall has pioneered a technique to check the efficiency of oil containment and treat any polluted water prior to release. This case study presentation will describe their development of this environmentally safe method of emptying of bunds.

**2.5 EVALUATION OF OVERHEATING CONDITIONS IN TRANSFORMERS**

**Paul Griffin, VP Laboratory Services, Doble Engineering, USA**

It is important to know when there is high temperature heating of oil if the problem involves paper insulation. If there is not that much paper involved it can be difficult to assess this based only on carbon oxides and furanic compounds. Research at the Doble Oil Laboratories has shown that the ethylene to ethane ratio can be useful indicator for such situations.

**2.6 DISCUSSION ITEM – EVALUATION OF OVERHEATING CONDITIONS IN TRANSFORMERS**

**Richard Heywood & John Lapworth, Doble PowerTest, UK**

The EuroDoble group has looked at the gas signatures using the IEEE Key Gas method for this situation, and with it the development of the Lapworth algorithm and its use. This discussion will contribute case examples of ‘bare metal’ v. covered conductor thermal faults and could compare, as used by the scoring system.

**TUESDAY 20 OCTOBER**

**CONFERENCE SESSION ON DIAGNOSTICS**

**8:30 – 12:00**

**SESSION 3 – SALON UNTER DEN LINDEN, 2<sup>ND</sup> FLOOR**

*COFFEE BREAK AT 10:00*

**3.1 FURAN ANALYSES AS A MEASURE OF PAPER AGEING**

**Richard Heywood, Doble PowerTest, UK**

An additional indicator of the thermal ageing of paper is the measurement of furanic compounds in the oil. This presentation will describe the experience obtained in the UK and USA as well as the extent to which it can be relied upon to indicate polymer chain length.

### **3.2 ON-SITE EXPERIENCES WITH MULTI-TERMINAL IEC PARTIAL DISCHARGE (PD) MEASUREMENTS, UHF PD MEASUREMENTS AND MIXED UHF AND ACOUSTIC PD LOCALIZATION**

**S. Coenen, A. Pfeffer, M Heindl & S. Tenbohlen, Institute of Power Transmission and High Voltage Technology (IEH), Universität Stuttgart, Germany**  
**S. Markalous, Doble Lemke, Germany**

There is increasing interest on the use of UHF probes to detect partial discharges in transformers, but it is difficult to understand how this method compares with the traditional factory tests where detection is made at the bushing taps and at frequencies less than 1MHz. To compare the two different measurement methods three offline measurements were made on-site at two different power transformers. Secondly, the important question is to obtain knowledge about the geometric position of the PD within power transformers. For many years, PD localization has been based on run time differences of acoustic sensors triggered by more sensitive measurable signals like UHF signals. The current work presents an example of PD localization on a third transformer with the additionally use of runtime differences measured in UHF range with 3 UHF sensors combined with run time information of three acoustic sensors.

### **3.3 ON-LINE PARTIAL DISCHARGE (PD) MONITORING AND DIAGNOSIS AT POWER CABLES**

**Matthias Boltze, Doble Lemke, Germany**

Most cables installed in recent years have been triple extruded polymeric cable. Whilst the cable itself is made and tested extensively in the factory, joints and terminations are made on-site and this is where the risk of early failure is highest. The most effective strategy to address this problem is commissioning and in-service testing combining AC testing and sensitive PD measurements. A new system applying UHF sensors and acquisition unit has been developed, suitable for any kinds of HV XLPE cable terminations including transformer sealing ends, together with terminations for metal-clad substations. This presentation reports on successful experiences with PD measurements during installation tests of high voltage XLPE insulated single core underground cable systems tested with AC voltages.

### **3.4 CASE STUDY: INVESTIGATING A CT FAILURE IN FINGRID USING THE PDS100 SURVEY TOOL**

**Daniel Kuosa, Fingrid, Finland**  
**Ståle Kråkenes, Doble Europe, Europe**

Radio frequency interference (RFI) survey scans were used to locate a suspected PD fault in a 110 kV CT in Fingrid's Inkoo substation. The investigation was undertaken from Fingrid's side as a first step to evaluate both the PDS100 tool and RFI as a screening method to detect partial discharge in oil-insulated equipment such as instrument transformers and transformer bushings. The survey methodology is defined, together with the findings of the survey.

### **3.5 ASSESSMENT CONDITION OF CAPACITIVE VOLTAGE TRANSFORMER USING TANGENT DELTA MEASUREMENT**

**Dimas Bangun Fiddiansyah, PT PLN (Persero), Indonesia**

One of the critical parts of the maintenance strategy is to determine insulation condition through tangent delta and capacitances measurement. Tangent delta is effective way to predict the level of acidity, drying, wet or deteriorated in its insulation. It is able to detect if the CVT insulation condition is either normal or abnormal from the results, referring values to Doble standards and based on nameplate. From these results, an action plan is made if it detected abnormal condition on the CVT and intended to prevent a worsening situation.

**3.6 FIELD EXPERIENCE IN SFRA MEASUREMENT ON GENERATOR TRANSFORMERS**

**A. Saravanakumar, M. Boltze & S. Markalous, Doble LDIC, Germany**

Sweep frequency response measurement (SFRA) is a low voltage, non-invasive, sensitive diagnostic tool, popularly employed in ascertaining mechanical integrity of transformer winding/core assembly. An optimal solution to such technologies is for extensive sharing of knowledge in this field. In this paper, we contribute our field experience and interpretation of SFRA measurements performed on nine generator transformers.

**12:00 – 13:30**      ***LUNCH BREAK ON YOUR OWN***

**13:30 – 17:00**      **SESSION 4: PARTIAL DISCHARGES TUTORIALS –  
SALON UNTER DEN LINDEN, 2<sup>ND</sup> FLOOR  
*COFFEE BREAK AT 15:00***

**4.1 PARTIAL DISCHARGES (PD) AND INSULATION FAILURE**

**Alan Wilson, Doble Lemke, Germany**

This presentation will describe the causes of partial discharge and provide practical examples of where PD have caused premature failure in HV apparatus.

**4.2 AN INTRODUCTION TO PARTIAL DISCHARGE MEASUREMENTS**

**Sacha Markalous, Doble Lemke, Germany**

This second presentation will describe the basic measurement techniques described in international standards.

**4.3 CASE STUDIES USING PARTIAL DISCHARGE MEASUREMENTS IN THE FIELD**

**Alan Wilson, Doble Lemke, Germany**

The third presentation will describe experiences using these measurements in the field.

**Asset Management Round Table****Monday 20 October from 9:00 – 17:00 in the Drachenhau**

<i>10:00</i>	<i>Coffee Break</i>
<i>12:00 – 13:30</i>	<i>Lunch on your own</i>
<i>15:00</i>	<i>Coffee Break</i>

This is a session for a smaller group of active asset managers to share experiences. Each attendee is expected to contribute with statements as to their practice, experience or opinion. This may include a PowerPoint, but the aim is to provide an informal setting for an easy flow of information between participants.

**Discussion Themes****1. Use of Remote Factories**

Are better processes needed for the selection of remote factories for the supply of major assets? What about ethical issues and energy impact for remote factories? Factory visits and post delivery of support: is more effort needed for more visits, inspections and witnessing than in local factories? What are the absolutely crucial factors in obtaining a successful delivery?

**2. Special Requirements in Purchasing Specifications**

General requirements are covered in international specifications and best debated at CIGRE, IEC and IEEE. There are always requirements specific to the utility or the individual installation. These may relate to the design, additional performance in acceptance tests or the use of special tests. The latter might relate to proving manufacturer claims such as the SF<sub>6</sub> leak rate, or tests intended to provide fingerprint evidence for in service assessment such as SFRA tests for transformers. Discussion contributions should focus their ability to introduce requirements within the context of compliance with legislation and the willingness of manufacturers to respond. One outcome of the discussion may be a combined approach to achieve acceptance of specific proposals.

**3. How Do You Determine Critical Circuits?**

Is this done from a load shedding/restoration list, regulatory fines, extent of system impact, likelihood to cause an outage that is reportable (to the regulator) or another way? How do you use a criticality ranking?

**4. How Do You Monitor and Record Equipment or System Reliability?**

Perhaps you use IEEE definitions such as SAIDI, CAIDI, etc. How do you collect and use this information? What are the requirements on the company to undertake this activity and is it audited for retention of the licence, price review and noting the massive bureaucracy introduced in North America by FERC and NERC?

**TRACK TWO: PROTECTION**

Conference Session – Monday 19 October from 9:30 – 17:00

Basic Protective Relaying Course – Tuesday 20 October from 8:30 – 16:30

Tutorial Session – Wednesday 21 October from 8:30 – 17:00

**MONDAY 19 OCTOBER**

**TECHNICAL PRESENTATIONS –  
WINTERGARTEN, 2<sup>ND</sup> FLOOR**

- 9:30 – 10:00**            **Opening Remarks and Welcome**  
*Ed Khan, Chairman of the Session, Doble Engineering, US*
- 10:00 – 10:45**        **Automated Testing of IEC 61850 Based Automation Systems**  
*Richard Schimmel, KEMA, Arnhem Netherlands*
- 10:45 – 11:30**        **Challenges in the Design of New IEC 61850 Compliant Protection Relays**  
*Rui Jorge, EFACEC, Portugal*
- 11:30 – 12:15**        **Fault Analysis as a Complement to Maintenance of IEDS**  
*Ingrid Widell, EON, Sweden*
- 12:15 – 13:30**        *Lunch on your own*
- 13:30 – 14:15**        **Grid Connection Requirements for Wind Farms**  
*Eduardo Gonzalez Franco, EDP Renováveis, Spain*  
*Ana Morales, DigSilent, Germany*
- 14:15 – 15:00**        **Generation of COMTRADE Files for Testing Relays**  
*Ana Morales, DigSilent, Germany*
- 15:00 – 15:30**        **Break**
- 15:30 – 16:15**        **Fundamentals of Generator Protection – A Design Philosophy**  
*John-Amoo-Oto, Excelon Corporation*
- 16:15 – 17:00**        **Experience in the Maintenance of the Microprocessor Relays of the Spanish Transmission Grid**  
*Julio Muñoz, Red Eléctrica de España SAU, Spain*

**TUESDAY 20 OCTOBER**

**TUTORIAL SESSION –  
WINTERGARTEN, 2<sup>ND</sup> FLOOR**

- 8:30 – 12:00**        **Basic Protective Relaying**  
*Ed Khan, Doble Engineering, USA*
- 12:00 – 13:30**        *Lunch on your own*
- 13:30 – 16:30**        **Basic Protective Relaying (continued)**  
*Ed Khan, Doble Engineering, USA*

## WEDNESDAY 21 OCTOBER TUTORIAL SESSION – DRACHENHAUS

**8:30 – 12:00**      **Relay Testing Using Doble’s F6150 Power System Simulator**  
*Mauro Borrelli, Doble Engineering, Europe*

**12:00 – 13:30**      *Lunch on your own*

**13:30 – 17:00**      **Demonstration of Doble Test Set/Software IEC61850 Testing Capabilities**  
*Doble Engineering, Europe*

<p>UTILITY-ONLY HIGH VOLTAGE SESSION Wednesday 21 October from 8:30 – 16:00</p>
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*THIS SESSION IS ONLY OPEN TO UTILITIES AND TESTING COMPANIES.*

### **SESSION 1 A FOCUS ON RISK MANAGEMENT ZONES**

The attendees are encouraged to discuss the extent they have used risk management zones (one-time called “exclusion zones”). Discussion should include the types of events that led to their development, how they determined the size of the zone, how they managed the risks and how they determined that a zone use could be terminated.

*Led by David Woodcock, National Grid, UK*

### **SESSION 2 A FOCUS ON CABLE TERMINATIONS**

Several utilities have reported problems leading to explosive failures of sealing ends at transmission voltages. Some have been design related, others associated with deterioration of the fluid. Invitations to the discussion are invited.

### **SESSION 3 OIL PURCHASING AND ACCEPTANCE TESTING**

We have discussed corrosive sulphur earlier, but this gives an opportunity for private discussion on how utilities are dealing with the issue in the oil supply caused by these failures. It is also an opportunity to learn about Doble’s annual oil survey.

*Led by Paul Griffin, Doble Engineering, USA*

### **SESSION 4 GENERAL EQUIPMENT EXPERIENCE**

This is the opportunity for each attendee to share some experience, either good or bad, where there was a learning experience that can be shared. Perhaps a failure or a failure avoided by intervention. This could include:

- Failure in factory test
- Failure in transport or commissioning
- In service failure
- Experience with asset disposal- are companies testing bushings and small oil volume equipment for PCB prior to scrapping?

*Led by John Stead, AltaLink, Canada*

*We regret that manufacturers and insurers may not attend this meeting due to the non-commercial nature of the proceedings.*

**FACTORY TOUR: SIEMENS CIRCUIT BREAKER & GAS INSULATOR  
SWITCHGEAR**  
Thursday 22 October

Attendees have the special opportunity to tour a local factory for a first hand look at how circuit breakers and gas insulator switchgears are made!

The bus will depart from the Westin Grand Berlin at 9:15 from the main lobby. The Siemens tour will begin at 10:00 and last until 11:30. The bus will return to the hotel via the Berlin Tegel Airport for attendees who are flying out Thursday afternoon.

*This factory tour is open to utility attendees only.*

**EURODOBLE 2009**