



Life of a Transformer™ Seminar

Get Empowered with Doble
25-28 October 2016 | Dublin IRELAND



AGENDA

* Indicates Advanced Session

Tuesday, 25 October 2016

HALF-DAY OPTIONAL LABORATORY SEMINAR

8:00 – 17:30 *Registration & Information Desk Open*

14:00 – 17:30 **Transformer Condition Assessment Using Laboratory Diagnostics**
Paul Griffin, Vice President Consulting & Testing Services
Doble Engineering Company

A thorough understanding of how to assess the condition of electrical insulating materials and transformers will be presented in this all-day session.

Dissolved gas-in-oil analysis – This is the single most important diagnostic test for transformers. This presentation reviews how the test is performed, how to distinguish between normal gassing behavior and problems, and how to evaluate trends. Practical case studies and examples are used to illustrate theoretical concepts. Seminar participants will be quizzed (with class participation) on their understanding in diagnosing 12 cases.

Water in Transformer Oil – Assessing how dry a transformer is requires more than a water in oil test. Learn how to assess the wetness of the transformer insulation system and why you need to know the operating temperature at the time of sampling. This session discusses water migration in transformers and how water affects the ability to overload them. Examples are provided.

Condition assessment of cellulosic insulation – The analysis of the condition of the paper insulation has changed quite a bit in the past 10 years. Learn how the solid insulation ages and how to assess the condition of the paper and pressboard insulation and its remaining life. Case studies are given to illustrate the distribution of paper aging in transformers and how operation and maintenance can influence it.

Metals in oil – This presentation provides an understanding of the importance of metal-in-oil tests as a diagnostic. To be able to use the information, the correct test must be specified – learn the difference between dissolved and particulate metals and when to choose each test. Case studies are given.



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Quality of new and service aged oils – Background information is provided on the properties of transformer oil. The presentation includes how to specify and evaluate new oils, what tests to perform and how to evaluate in-service oils. Aging characteristics of insulating materials – Aging is discussed in sections on oil and paper which provides information on how to increase the life of transformers. There are a number of factors that accelerate the aging of the insulation system that can be controlled. This session provides information on when to reclaim or replace oil and gives specifications for reclaimed oil.

Load tap changer and oil circuit breaker diagnostics – This presentation gives the latest information on diagnostics for load tap changers (LTCs) and bulk oil breakers. Case studies are provided.

Sampling – The presentation discusses how to save money on your sampling program through proper training and what common pitfalls to avoid. Proper sampling preparation, practices, and equipment are given.

17:30 – 19:00 *Industry Expo & Reception*

Wednesday, 26 October 2016

8:00 – 17:00 *Registration & Information Desk Open*

8:00 – 8:30 *Early Morning Coffee*

8:30 – 8:45 **Welcome Remarks and Introduction**
Bryan Sayler, President
Doble Engineering Company

8:45 – 9:15 **Keynote Address**
Zhongdong Wang
University of Manchester

9:15 - 10:00 **Transformer Specifications**
Robert Le Roux, Primary Plant Specialist
ESB International

As transformers are utilized internationally and not only in Europe, written specifications can be interpreted in many ways, leading to total confusion or in quotations that are sorely lacking in completeness and required detail. This can be expensive and a waste of time to both the Tenderer and the



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Purchaser. The goal of this presentation is to provide a plan for writing a specification that is concise, clear and irrespective of the country where utilized, by Purchaser or Tenderer, will result in the desired outcome.

***Robert le Roux** is an Electrical Engineer with a range of engineering skills and practical experience obtained internationally. He joined ESBI as a Resident Engineer in 2010 and is presently an Electrical Engineer and Consultant with the ESBI High Voltage Power Plant team. Mr. le Roux has a track record working on large-scale Power Plant and Civil Engineering projects. His experience spans all aspects of the project life cycle from design through to construction and operation. He has worked on projects for ESBI in Ireland and Bahrain. As part of his role, Mr. le Roux is responsible for specification writing for Primary Plant equipment, Technical Tender evaluation and also to assist ESB Networks with problem solving on HV equipment related problems.*

9:15 – 10:00

Oil Manufacturing

Edward Casserly, Director Refinery Research & Development

Ergon

Naphthenic mineral transformer oils are refined from naphthenic crude oils. This presentation will describe how crude oils are selected and refined to produce base stocks which are then formulated into transformer oils. The pros and cons of various processing schemes will be discussed. Specific additives are used to formulate products to ensure a long life. Manufacturers produce oils to specific international specifications (ASTM D3487 and IEC 60296). Also discussed will be how manufacturers ensure that the oils meet the ever changing specifications and testing requirements.

***Ed Casserly** received his B.A. in Chemistry from the University of St. Thomas and his Ph.D. in Organic Chemistry from Rice University, Houston, Texas. Ed began his career as a research chemist with Pennzoil and Penreco, a specialty hydrocarbon producer. He has been involved with R&D and technical support for specialty petroleum products for over 30 years. He is a co-inventor on 7 US patents on synthetic hydrocarbon fluids and has published many technical papers. Ed is currently Director of Refinery Research and Development for Ergon Refining, Jackson, Mississippi. He is a member of IEEE, Cigre, ASTM D27 (Secretary).*

10:00 – 10:30

Morning Break

10:30 – 11:15

Supplier Selection

Patrice Hurlet, Chief of Group Electrical Equipment

EDF



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***10:30 – 12:00**

dc Magnetisation

Gerald Leber, Head of Research STW
Siemens

Modern power transformer cores are made of highly efficient grain-oriented electrical core steel. The cores are manufactured using the most advanced core stacking techniques. Transformers specified for extra low no-load losses and noise-levels are also usually operated at low core flux densities and low excitation currents. However, parasitic DC from the grid can flow through grounded high-voltage windings, having a negative influence on transformer performance. Even a small superimposed DC current in the range of a few hundred milliamps can increase the noise levels of a transformer dramatically. This presentation identifies the effects of parasitic DC on transformer performance and presents counter measures. A new technology called DC Compensation is presented in detail. This new technology eliminates the negative effects of DC without adversely affecting the transmission grid.

Gerald Leber is R&D Manager of the Siemens Global Technology Center Research in Weiz, Austria. After graduation at the Technical University of Graz/Austria he started to work as an electrical design engineer for shunt reactors and large power transformers at ELIN Transformers Weiz in 1994. In 1999 he changed to research and was responsible for several R&D projects such as "Short Circuit Withstand Capability", "Winding Processing" and "GIC/DC Magnetisation Capability" of power transformers. Since 2011 he is leader and key expert of the global Siemens working group "Short Circuit Strength" and is responsible for the short circuit design rules.

11:15 – 12:00

Design Review – The Best Way to Anticipate Future Problems

Bert Wouters, Transformer Expert
Elia

The design review is an exercise between buyer and manufacturer to see whether the ordered transformer meets customer specifications and the imposed standards. It is a means for the buyer to better understand the technical capabilities of the manufacturer, and for the manufacturer, to better understand what the needs of its customers are. During the design review the design can be adjusted by both parties, in order to anticipate any future problems during FAT, commissioning or during operational functioning of the transformer. Electrical, mechanical, thermal ... margins are carefully evaluated and adjusted if necessary. Practical examples are given in order to demonstrate the effectiveness of a design review.

Bert Wouters is transformer expert for Elia, the Belgium national TSO since 201. He began his career in 1990 as an electrical design engineer at Pauwels TrafoBelguim where he focused on special transformers. In 2001 he joined Elia as Project Leader responsible for expanding, and refurbishment of existing High



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Voltage substations from 36 kV up to 380 kV and then as Quality Engineer for testing and approving protection cubicles for TV substations. Mr. Wouters holds a Master of Engineering, Business Management & Project Management degree.

12:00 – 13:30 *Industry Expo & Lunch*

13:30 – 15:00 **Design and Construction**
Ronny Mertens
CG Global

The design process of power transformers follows different steps and starts with the design of the active part i.e. core and windings. This design step is being demonstrated by a detailed case study i.e. a simplified but worked out design step as part of the complete optimization process. At the same time construction details will be shown as these are directly related to the used design rules and design criteria. In the next parts the design methodology for the insulation and mechanical design incl. cooling design will be demonstrated and clarified by pictures showing the different elements in the construction of power transformers.

Ronny Mertens received in 1999 his PhD degree in electrical engineering. He initially focused on demonstrating the short-circuit behaviour of power transformers using the finite element method at Pauwels Transformers (currently CG Power Systems). After several functions in R&D incl. managing a team in India, he is now the Engineering Manager for the Power Transformers division. After having been the Belgian representative within Cigré for Study Committee A2 on Transformers, he is still active within Cigré as the convener of JWG A2-D1.46 on ageing markers and shifted his focus towards standardization work within Cenelec and IEC.

***13:30 - 15:00** **High Temperature Solid Insulation**
Radoslaw Szewczyk, Application Development – Transformers EMEA
DuPont Protection Solutions

This session will focus on properties and applications of high temperature aramid insulation for liquid-immersed power transformers. Various transformer design aspects related to the use of insulation materials other than cellulose and mineral oil will be addressed. Different concepts for hybrid insulation systems will be explained. Emphasis on some material properties will be made, in order to help designers to understand the materials better and make the right material selections.



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The session will also introduce a recently developed insulation paper with a 130°C thermal class. This paper is an aramid enhanced cellulose paper – a paper based on cellulose pulp and combined with aramid. The solution has been engineered to fill the gap of insulating materials in thermal class higher than cellulose but lower than aramid. Application of this new paper, Nomex® 910, could allow improvement of insulation system performance beyond what is now offered now by the thermally upgraded paper, without the cost typically related to high temperature aramid insulation. Basic material properties will be presented and possible application benefits will be discussed.

Radoslaw Szewczyk has been employed at DuPont since 2006, and works as an Application Development Specialist for Nomex® insulation in power transformers in EMEA region. Previously, he worked as a Transformer Design Engineer at ABB in Poland (distribution transformers) and at Pauwels Canada (power transformers). He received his Master of Science in Electrical Engineering from the Technical University of Lodz, Poland, in 1998. He is an active member of various IEC working groups developing international standards in the area of transformers and insulating materials. He is a convener of IEC TC10 – Project Team 63012 for modified or blended ester liquids. He is also a chairman of Polish National Committee for standardization in power transformers.

15:00 – 15:30 *Afternoon Break*

15:30 – 17:00 **Works Test**
Emanuel D’Ostilio
Matteo Tironi
Tironi

*15:30 - 17:00 **Special Transformers for Industrial Applications**
Fabio Marton
Tamini TES

17:00 – 18:30 *Industry Expo & Reception*

Thursday, 27 October 2016

8:00 – 17:00 *Registration & Information Desk Open*

8:00 – 8:30 *Early Morning Coffee*

8:30 – 9:15 **Transformer Losses and Efficiency**



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Kai Pollari, Global Marketing Manager

ABB

Transformer losses and efficiency has been a focal subject for the transformer industry and the markets during the last years. Emerging efficiency regulations and supporting standards are pushing the transformer markets towards better sustainability through improved product energy performance in several countries and regions including Europe. The presentation focuses on the key points of the current European standards and regulation on transformer efficiency and talks also about the ongoing process and what is foreseen for the future.

Kai Pollari is a manager within the Global Marketing Unit of ABB Business Unit Transformers. Currently he is focusing on the energy efficiency of transformers as a global subject. He obtained his master's degree on electrical engineering from the Technical University of Tampere, Finland in 1993. He has been working in ABB's transformer business in various positions from testing to sales and marketing since the year 1992. He is a member of the IEC transformers technical committee as well as of the T&D Europe association.

***8:30 - 10:00**

Short Circuit Withstand

Dario Rogora

Tamini

Dario Rogora holds a Master of Science degree in Electrical Engineering and graduated from the "Politecnico di Milano" in 2008. Since then he is working in Tamini Trasformatori (Milan, Italy) as Electrical Design Engineer mainly focused on large power transformer and phase-shifting transformer.

9:15 – 10:00

Transformer Noise

Mario Scala

Siemens

Outdoor noise is a serious and increasing problem in our society in general and transformers in the vicinity of residential areas are an important part of the problem. In order to fulfill increasingly demanding limits on noise from transformer installations, it is necessary to understand the total process of sound generation, transmission and radiation. This presentation will describe the mechanisms involved when transformer noise under different loading conditions is generated. Important differences between the factory acceptance test and actual noise emission in operation will be discussed.

10:00 - 10:30

Morning Break



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10:30 – 11:00

Shunt Reactors

Claes Bengtsson, Global Product Manager

ABB

Shunt reactors are used in high voltage transmission systems to stabilize the voltage during load variations. Another important application is for compensation of high voltage cables where shunt reactors often is a prerequisite for transmission of any energy. A traditional shunt reactor has a fixed rating and is either connected to the power line all the time or switched in and out depending on the load. Also reactors with variable rating are today available and are growing in use. Shunt reactors are subjective to large magnetic forces during normal operation which sets special technical challenges in designing these products. The purpose of the presentation is to give an introduction to shunt reactors and to their applications, design principles, special requirements and testing.

Dr. Bengtsson is global product manager for reactors within the ABB Group. He joined ABB in 1984 and has a long experience in transformers and reactors. He has held several management positions including responsible for strategy and head of R&D, both for large power transformer. He is member of Cigré SC A2 and IEC TC14. He holds a PhD in physics from Uppsala University.

*10:30 – 12:00

Heavy Duty Test Systems for Use in the Field

Kay Leiteritz, Area Sales Manager

High Volt

In state-of the art transmission and distribution systems power electronics play an important role. Improvements in semi-conductor technology combined with advanced control systems allow generation of voltages that fulfill the requirements of international standards on transformer testing. Consequently, test systems based on static frequency converters become more and more relevant for tests on power transformers. The installed base of power transformers is aging. This situation needs special attention, because undetected insulation defects cause failures which can lead to severe blackouts in complete transmission systems. Diagnostic tests during maintenance or after on-site repair, especially sensitive PD measurement and localization, are indispensable measures for condition assessment during lifetime of a power transformer. In combination with converter-based HV transformer test systems as mobile power source a wide range of on-site tests is covered.

Kay Leiteritz studied Electrical Engineering at the Technical University of Dresden, Saxony, Germany from 2006 to 2012. He received his master's degree in 2012. His thesis was titled "Requirements on HVDC circuit breakers". He joined HIGHVOLT Prueftechnik Dresden GmbH in 2013 and is currently working as an Area Sales Manager.



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11:00 – 11:30

Phase-Shifting Transformers

Andrea Rossini, Technical Solutions Developer & Sales Manager
Tamini TES

The use of phase shifting transformer is becoming more frequent in power grids. The deregulation of the energy sector and the growth of electric consumption require the high voltage grid of different countries to be interconnected to strengthen the reliability of the power supply. Energy is no longer produced and consumed in the same area, but is traded on a large scale between different countries over long distances. It is therefore necessary to optimize the load flow and the power factor so to allow the grid to achieve a high level of efficiency and reliability, avoiding congestion on lines not directly interested by the load flow. The PST through the regulation of the voltage angle displacement between input and output voltage, fulfills this scope. It is now regarded as a precious and reliable component in complex high and medium voltage interconnecting grids. Both the magnitude and the direction of the power flow can be controlled by varying the angle phase shift. Similar considerations can be made about the reactive power flow, but based on the in-phase regulation of the voltages.

Andrea Rossini is Technical Solutions Developer and Sales Manager at Tamini Trasformatori in Milano, Italy. An Italian native, Mr. Rossini has been with Tamini since 2003, with a previous experience in the dry type special transformer and reactors at Sirten(Gruppo Trafomec) as Engineering manager. Mr. Rossini holds a Master of Science degree in Electrical Engineering and graduated at Politecnico di Milano in year 1992.

11:30 – 12:00

Shell-Form Construction

Emanuel Almeida, Transformer Business Unit / Shell Engineering
Efacec

Shell form technology is one way to construct a power transformer. Such a construction will inherently have some differentiating characteristics. Being that the core form technology is more widespread than shell form, it is not uncommon for comparisons to be set up between core and shell form transformers. This paper presents some shell design and technical aspects that lead to some differentiating characteristics for these machines. The importance of these characteristics is then shown by way of example, by presenting transformer applications where such characteristics were pivotal for the client's requirements to be met.

Emanuel Almeida is a Mechanical engineer with a Masters' degree in Design from Stanford University and a PhD in Reconfigurable Manufacturing from the University of Michigan, Ann Arbor. He joined EFACEC Power Transformers R&D in 2006. Since 2012 he is in the Shell Transformer Division with focus on design and technology of power transformers and reactors. Mr. Almeida is currently serving as secretary for Cigré Working Group A2.54 Power Transformer Audible Sound Requirements.



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12:00 - 13:30

Lunch

13:30 – 14:00

Evaluating the Reliability of Resin Impregnated Paper (RIP) Bushings

Bernhard Heil, Head of Technical Support

HSP

For any reasonable evaluation of the reliability of Resin Impregnated Paper (RIP) Bushings a founded understanding of the physical aspects is essential. The parameters for any evaluation are different compared with oil impregnated paper (OIP) bushings. In this paper the physical background for RIP bushings is presented. Case studies are discussed to demonstrate the influence of different parameters on the condition of the bushing as well as on the measurement results.

Bernhard Heil has been employed at HSP Hochspannungsgeräte GmbH since 2008, and currently works as Head of the Technical Support. He received his diploma and his PhD at RWTH Aachen University in 2001 and 2006, respectively. From 2006 to 2008 he worked as Chief Engineer and Group Leader of the research group Insulating Systems and Diagnostics at RWTH Aachen University.

***13:30 – 15:00**

Introduction to M5000 / SFRA Testing

Steve Harpham, Technical Application Engineer

Rafal Zaleski, Senior Test Engineer

Doble Engineering Company

14:00 – 14:30

How to Select Transformer Oil

Rob Holmes, Shell UK Lubricant Technical Advisor

Dr. Peter Smith, Global Technology Manager

Shell

Modern transformers and operators demand more stringent performance requirements from transformer oils, to ensure higher system reliability and efficiency. Historically such oils have often been based on conventional hydrocarbons. Although many of these oils have a long and proven track record in the Industry, they are not without their limitations, such as lack of global availability, and variable consistency/composition and performance. This presentation outlines some of the points to consider when selecting a hydrocarbon transformer oil to ensure optimised performance in service.

Rob Holmes is the Technical Manager for the UK Power Sector with responsibility for supporting commercial sales for Electrical Oils, Gas Engine Oils and Turbine Oils. Mr. Holmes studied Chemistry at Liverpool Polytechnic and has been involved in the Chemical Industry for 28 years. He started his career with ICI and



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worked for 17 years in R&D, Technical Service & Production Chemistry roles. He joined Shell in 2006 and has been involved in technical roles managing the Transport Sector and latterly Shell's network of UK lubricant distributors. He has held responsibilities for lubricants in the Power Sector since early 2013.

Dr. Peter Smith is the Global Technology Manager within Shell Global Solutions responsible for designing, developing and commercialising Shell Speciality Lubricants (which includes transformer oils and turbine oils) globally. He has a degree and PhD in Chemistry (University of East Anglia, Norwich, UK), and has been involved in the research and development of lubricants for International Oil and Lubricant Companies for the last 28 years. He has written and presented publications on the design and development of lubricants at various International Conferences and for various journals.

14:30 – 15:00 **Tap-Changers for Power Transformers – Operating Principles and Design Features**
Sebastian Rehkopf, Technical Product Manager
Reinhausen

On-load tap-changers (OLTC) are indispensable equipment for regulation of power transformers which are used in energy supply networks. By means of OLTCs it is possible to change the transformer's turn ratio whilst it is energized and on load. Thus a flexible voltage regulation is possible which is necessary to ensure a reliable and cost-efficient grid operation. The latest major innovation concerning OLTCs is the introduction of the vacuum switching technology which replaces the traditional oil switching technology. After showing the switching principle of OLTCs, the different basic arrangements of tap windings will be discussed. Then the use of these basic arrangements in different transformer winding schemes will be shown. Finally the different styles of tap-changers will be introduced, as well as the two above mentioned switching technologies.

Sebastian Rehkopf has been employed at Maschinenfabrik Reinhausen GmbH since 2008. Currently he works as a technical product manager. Before that he has worked as a development engineer in the engineering department for on-load tap-changer and the basic development. Mr. Rehkopf studied Industrial Engineering and Management at the Technical University of Dortmund, Germany.

15:00 – 15:30 *Afternoon Break*

15:30 – 16:00 **Transformer Transport, Installation and Commissioning**
Chris Hodgson, Managing Director
Power System Partners

Whilst the design and manufacture of a transformer is complex and specific to system needs the active part of the transformer is never seen by many. Generally, the majority of the customer interface to the



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transformer occurs during the transportation, installation and commissioning of the transformer and therefore the customer's perception of what constitutes a 'good' transformer can be heavily biased towards what occurs during this phase of the overall project. There is also real potential during the transformer transportation for the transformer to suffer significant damage. Similarly, mistakes made during installation can result in immediate and catastrophic failure of a transformer if not undertaken with care and diligence. The successful delivery and installation of a transformer relies on careful planning, which must be undertaken long before the transformer is even built. The commissioning phase provides the final confirmation that the transformer, erected in its final position, is electrically equivalent to the transformer which has been fully proven during factory testing prior to shipment. If successfully achieved, then the transformer can be brought into service and the operating life of the transformer commenced.

Chris Hodgson's entire career has been spent working in the electricity supply industry. He began his working life as a graduate apprentice with GEC Measurements in 1990 where he learnt about the development, production and application of electrical protection relays. With this knowledge he joined the Relay Applications Department, where he provided direct customer support as well as advising internally with respect to protection offers and developments of new products and lecturing on the many protection courses provided by GEC Measurements. With this bedrock of electrical system knowledge Chris's career then spread into a commercial role where he was Sales Manager for GEC Alstom Protection and Control before moving to similar roles within Acrastyle, a Protection and Control Panel Manufacturing Company, and VA TECH Transmission and Distribution. Currently he is Managing Director of Power System Partners, a Company providing representation for a number of electrical plant Original Equipment Manufacturers. This includes the SGB Smit Group of Transformer Manufacturers, who he has represented for over 12 years. Part of his responsibilities for SGB Smit Transformers includes arranging for the transportation, installation and commissioning of transformers that can range in size from 1000kVA 11/0.415kV to 1000MVA 400/275kV.

***15:30 – 17:00**

Introduction to M7000 / Transformer Testing at Site
Steve Harpham, Technical Application Engineer
Rafal Zaleski, Senior Test Engineer
Doble Engineering Company

16:00 – 16:30

Oil Management
Andy Bartram, Sales Manager
Electrical Oil Services Ltd.



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With today's focus on transformer life extension there has never been a better time to look again at your transformer insulation system. Having a working knowledge of insulation degradation and options for site treatment can help today's hard pressed site engineer manage his or her transformers with confidence. Drawing on this long history of close involvement with the UK electricity supply industry this presentation seeks to review insulating oil degradation (from a practical site engineers perspective) with reference to BSEN60422:2013 and consider the latest in-situ oil regeneration techniques for "deep cleaning" insulation systems and extending the potential life of transformers.

***Andy Bartram** has worked in the electrical oil industry for 26 years and has been employed at EOS since its formation in 1999. Prior to joining the electrical oil business Mr. Bartram was with the CEGB as a 400kV SAP in the transmission division which became National Grid shortly before he left to join Carless. As Sales Manager for the UK's leading insulating oil and services provider he leads a team of three Electrical Engineers offering guidance on all aspects of insulating oil management, testing and treatment. Mr. Bartram lives in the Cambridgeshire Fenlands is married with two grown up children.*

16:30 – 17:00

Maintenance, Refurbishment and Repair
Elizabeth MacKenzie, Technical Director
Winder Power

This presentation considers reasons why operators may opt for refurbishing transformers in the short term, thus delaying replacement. It goes on to reflect upon which transformers should or may be refurbished, and those that should not. Different aspects of on-site refurbishment are also presented. The presentation is illustrated with examples of refurbishments that have been carried out in the UK for various network operators.

***Elizabeth MacKenzie**, a Chartered Engineer, European Engineer and Fellow of the Institution of Engineering and Technology, leads the design team at Winder Power. She joined Winder Power in August 2011 having previously been a Product Manager for Transformer Monitoring Systems at GE. Elizabeth brings a wealth of experience from the transformer industry, having formerly worked in ABB where she was Engineering Manager of their transformer plant in Scotland, and at HSPT, where she was Transformer Development Manager. She has also worked as a transformer consultant. Elizabeth holds BSc and MSc degrees in Electrical and Electronic Engineering from The Queen's University of Belfast.*



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Friday, 28 October 2016

8:00 – 15:00 *Registration and Information Desk Open*

8:00 – 8:30 *Early Morning Coffee*

8:30 – 10:00 **Troubleshooting in the Field**
Kamendren Govender, Principal Engineer
Rafal Zaleski, Senior Test Engineer
Doble Engineering Company

Kamendren Govender is currently employed with Doble Engineering Africa as a Principal Engineer. He is predominately involved in transformer condition assessment for clients in Africa. He has a BSc in Electrical Engineering and is a registered professional engineer.

Rafal Zaleski was born in Poland in 1977. He received the M.Sc. degree in Automation and Robotics from Silesian University of Technology in 2002. From 2002 to 2009 he was involved in power transformer diagnostics in Poland. He was leading group of people, carrying out condition assessments and supporting R&D team. Since 2009 until now he holds Senior Test Engineer with Doble Powertest UK continuing his involvement in transformer field but also doing other substation apparatus assessments.

*8:30 – 10:00 **Introduction to DobleARMS**
G. Matthew Kennedy, Solution Director, Enterprise & Data Technology
Doble Engineering Company

G. Matthew Kennedy is Doble Engineering Company's Solutions Director: Enterprise and Data Technology, overseeing the complete software and cloud product vision of the company. During his time at Doble, Mr. Kennedy has had leading roles in the innovation and development of products such as the M-Series (M4, M5, M7), DTA, dobleARMS™ and dobleDATABASE™. With a keen interest in diagnostic technology, Mr. Kennedy has authored diagnostic analysis sections for international standards in addition to numerous papers, journal and magazine articles for the power industry. He holds a BS in Electrical Engineering from the University of California, Santa Barbara where he studied signal and digital signal processing. His post graduate studies continued with the US Navy: Nuclear Power School, University of Idaho in Electrical Power Engineering and Cornell University in Product Design and Development. He is a member of IEEE, IEC, USNC, and ISO.

10:00 – 10:30 *Morning Break*



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10:30 – 11:15

Partial Discharge in Transformers

Rafal Zaleski, Senior Test Engineer

Tony McGrail, Solutions Manager, On-Line Diagnostics

Doble Engineering Company

Rafal Zaleski was born in Poland in 1977. He received the M.Sc. degree in Automation and Robotics from Silesian University of Technology in 2002. From 2002 to 2009 he was involved in power transformer diagnostics in Poland. He was leading group of people, carrying out condition assessments and supporting R&D team. Since 2009 until now he holds Senior Test Engineer with Doble Powertest UK continuing his involvement in transformer field but also doing other substation apparatus assessments.

Tony McGrail is Doble Engineering Company's Solutions Director for Asset Management & Monitoring Technology, providing condition, criticality and risk analysis for utility companies. Previously Dr. McGrail has spent over 10 years with National Grid in the UK and the US; he has been both a substation equipment specialist, with a focus on power transformers, circuit breakers and integrated condition monitoring, and has also taken on the role of substation asset manager and distribution asset manager, identifying risks and opportunities for investment in an ageing infrastructure. Dr. McGrail is a Fellow of the IET, Chairman of the IET Council, a member of the IEEE, ASTM, CIGRE and the IAM, is currently on the executive committee of the Doble Client Committee on Asset and Maintenance Management, and a contributor to SFRA and other standards. His initial degree was in Physics, supplemented by an MS and a PhD in EE and an MBA. Dr. McGrail has a commitment to lifelong learning and is an Adjunct Professor at Worcester Polytechnic Institute, MA, leading courses in power systems analysis and distribution fundamentals.

*10:30 – 12:00

Use of Alternative Insulation Liquids

Mark Lashbrook, Senior Applications Engineer

M&I Materials

The predominant liquid used for electrical insulation and cooling in transformers is mineral oil. However, it has some limitations, specifically in terms of fire safety and environmental impact. In answer to this, the use of ester-based alternative liquids has been increasing and today they are not just used in special-application transformers (such as traction or windpower units), but are being specified into mainstream distribution and larger power units. This session will provide a brief history of insulation liquids and cover the different types of fluids available. It will also include detailed information on the various properties of these liquids, including fire behaviour, environmental impact and moisture interaction. Reference will be made to how these properties impact the design, installation and operation of modern transformer systems.



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Mark Lashbrook received a BEng(Hons) degree in electrical and electronic engineering from Loughborough University in 1995. Following graduation he has worked in a number of engineering roles within the semiconductor, manufacturing and power industries. He joined M&I Materials Ltd as a Development Engineer in 2007 and he is currently employed with the company as a Senior Applications Engineer for the MIDEL range of Dielectric Fluids. Mr. Lashbrook is a member of the IET.

11:15 – 12:00

Disposal and Forensics

Simon Ryder, Principal Engineer

Doble Engineering Company

Ian Kerr, Depot Manager

Celtic Recycling

Transformers are known as being amongst the reliable items of equipment used in electricity generation, transmission, and distribution. When failures occur, they provide an opportunity to learn both the root cause of the particular failure and how similar failures can be prevented in future. The most effective means of doing so is a forensic examination of the failed transformer. However failures are not the only opportunities to learn and much can be learned from forensic examinations on transformers which have not failed. This paper will consider how best to conduct a forensic examination. This session will also give an extended case study, showing how much can be learned from a forensic examination following a failure and how this learning can be applied to managing sister or similar transformers.

Simon Ryder obtained an M. Eng. degree in Engineering Science from St John's College, Oxford University in 1996. Later that same year, he joined Alstom working in transformer design, development, and eventually research. Mr. Ryder is particularly noted for his work on frequency response analysis and thermal characteristics of transformers. He joined Doble Engineering Company in 2003 where he specialises in procurement of new transformers, transformer asset health review and transformer forensics. He is a member of IEEE-PES, a fellow of IET, and a chartered engineer. Mr. Ryder was a member of CIGRE working group A2.36 on transformer procurement and is a member of new CIGRE working group A2.48 on shunt reactors.

Iain Kerr is Depot Manager at Celtic Recycling's state of the art processing facility in Newport, United Kingdom. Mr. Kerr joined the company in 2009, taking responsibility for the setup and management of the companies waste management contract with RWE npower before moving on to assist with overseeing the £5 million development at Newport. Following completion of the development, Mr. Kerr is responsible for the day to day management of the facility ensuring that all processing and recycling activity is undertaken in accordance with current health, safety and environmental legislation. Prior to his appointment at Celtic Recycling, he spent ten years at EDF Energy as a Risk Manager with responsibility for various cost saving



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Lunch

13:30 – 15:00

Getting the Best Out of your Transformer

Richard Heywood, UK Manager

Tony McGrail, Solutions Manager, On-Line Diagnostics

Doble Engineering Company

Richard Heywood obtained a PhD degree from the University of Surrey specialising in solid insulation ageing in power transformers. Dr. Heywood worked with National Grid on transformer diagnostics and population management. He joined Doble in 2002 as manager of operations in Great Britain. He specialises in interpretation of transformer oil test results and transformer asset health review. Dr. Heywood has been a member of various CIGRE working groups, including D1.01.13 on use of furanic compounds for diagnostics.

Tony McGrail is Doble Engineering Company's Solutions Director for Asset Management & Monitoring Technology, providing condition, criticality and risk analysis for utility companies. Previously Dr. McGrail has spent over 10 years with National Grid in the UK and the US; he has been both a substation equipment specialist, with a focus on power transformers, circuit breakers and integrated condition monitoring, and has also taken on the role of substation asset manager and distribution asset manager, identifying risks and opportunities for investment in an ageing infrastructure. Dr. McGrail is a Fellow of the IET, Chairman of the IET Council, a member of the IEEE, ASTM, CIGRE and the IAM, is currently on the executive committee of the Doble Client Committee on Asset and Maintenance Management, and a contributor to SFRA and other standards. His initial degree was in Physics, supplemented by an MS and a PhD in EE and an MBA. Dr. McGrail has a commitment to lifelong learning and is an Adjunct Professor at Worcester Polytechnic Institute, MA, leading courses in power systems analysis and distribution fundamentals.