



# 2011 LIFE OF A TRANSFORMER SEMINAR

February 6-11, 2011 Lake Buena Vista, FL



## AGENDA

### Monday, February 7, 2011

6:00 Registration & Information Desk Open

6:30 – 7:30 Breakfast

**7:30 – 8:00 Welcome Introduction & Opening Remarks**  
Liisa Colby, Director of Corporate Communications  
Richard K. Ladroga, P.E., VP Global Strategic Development  
Dave Zabetakis, President  
**Doble Engineering**

**8:00 – 8:45 VIDEO – “The Making of a Transformer”**  
Professionally filmed and produced at the Waukesha transformer manufacturing facilities, this video presentation and narrative will provide each attendee with a unique, up close and personal tour of the inner workings of a transformer manufacturing plant. Come and see this detailed presentation which will cover all aspects of transformer manufacturing and construction – ONLY AVAILABLE AT THE “LIFE OF A TRANSFORMER” SEMINAR!

Introduction of video by Trent Spear, VP of Business Development  
**Waukesha Electric Systems**

*Registration Desk open  
Saturday & Sunday -  
Come beat the crowd  
and register early!*

### Core Training

**8:45 – 9:30 Transformer Principles & Fundamentals**  
As we move forward into the 21st Century, the use of electricity by mankind has evolved into a necessary staple of everyday life. But it wasn't always this way. The advent of power transformers in today's world is a function of necessity, a product of ingenuity, and a marvel of technology. Power transformers are the key element in the present system of electrical power distribution, and this system could not function without transformers. Let's take a look at why and how they were developed.

### Advanced Training

**8:45 – 9:30 New Transformers I**  
Purchase of a power transformer can easily account for the majority of investment into a new transmission or distribution substation. As users strive for the most effective investment they should consider life-cycle owning costs, rather than only the purchase price. It is important to understand the actual loss cost and physical design impacts when conducting a loss evaluation. Although transformers are highly efficient, the cost of losses amounts to a significant portion of owning cost.

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## AGENDA

### Core Training

Richard K. Ladroga, P.E.  
VP Global Strategic Development  
**Doble Engineering**

9:30 – 9:45 *Break*

**9:45 – 10:45 Transformer Specifications**  
Specifications are written by purchasers to insure all vendors are providing a responsive quotation of a transformer fulfilling the intent of the customer specification. However, interpretation of the written word is subjective, and this presentation will discuss some key elements of the transformer specification that are critical to providing a responsive complete quotation that results in satisfying the customer's wants and requirements. This presentation will present a comprehensive look at the specification interpretation processes followed by most manufacturers of Power Transformers as they design a transformer in response to a customer's specification. The goal is to provide a clear, well-defined specification that eliminates variances of interpretation by vendors and results in a proposal and product that meets the customers' intentions and specifications. Many specifications refer to IEEE Standards for definition, it is critical to know what the current revision of these standards require.

David Harris, P.E.  
Customer Technical Executive

### Advanced Training

Bill Griesacker  
Transformer Engineer  
**Doble Engineering**

Kirk Robbins  
Senior Staff Engineer  
**Exelon Nuclear**

Jim McIver, P.E.  
Principal Application Engineer  
**Siemens Energy, Inc.**

9:30 – 9:45 *Break*

**9:45 – 12:00 New Transformers II**  
*Continued from previous presentation.*

Bill Griesacker  
Transformer Engineer  
**Doble Engineering**

Kirk Robbins  
Senior Staff Engineer  
**Exelon Nuclear**

Jim McIver, P.E.  
Principal Application Engineer  
**Siemens Energy, Inc.**

12:00 – 13:00 *Lunch*

**13:00 – 15:00 Transformer Cooling I**  
Includes discussion of pumps, coolers, fans, unit uprating, US and International standards, ancillary and auxiliary systems, thermal constraints, ambient conditions, loading, dynamic modeling, design limitations, leak repairs, and maintenance.



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## AGENDA

### Core Training

#### Waukesha Electric Systems

**10:45 – 12:00 Transformer Design & Manufacturing I**

A very in-depth, step-by-step look at the construction of a transformer, from raw materials to finished product. A large number of photos and illustrations will be used to graphically display each step in the process. Design principles and calculations will be also presented, including mechanical, electrical, and material design considerations.

Note: This presentation will be highly enhanced by the earlier VIDEO tour of the Waukesha, Wisconsin transformer manufacturing facility – a full length professionally filmed video presentation of the entire design, manufacturing, and testing process that goes along with this presentation. Don't miss this in-depth learning opportunity.

H. Jin Sim, P.E.  
VP & Chief Technology Officer  
**Waukesha Electric Systems**

12:00 – 13:00 *Lunch*

**13:00 – 14:00 Transformer Design & Manufacturing II**  
*Continued from morning presentation.*

H. Jin Sim, P.E.  
VP & Chief Technology Officer  
**Waukesha Electric Systems**

### Advanced Training

Craig L. Stiegemeier  
Technology Director Transformer Services  
**ABB**

Richard (Dick) L. Amos  
Region Manager  
Cardinal Pumps & Exchangers  
**Unifin International LP**

15:00 – 15:15 *Break*

**15:15 – 16:00 Transformer Cooling II**  
*Continued from previous presentation.*

Craig L. Stiegemeier  
Technology Director Transformer Services  
**ABB**

Richard (Dick) L. Amos  
Region Manager  
Cardinal Pumps & Exchangers  
**Unifin International LP**

**16:00 – 16:30 Q&A Session – “Ask the Experts”**  
Pre-submitted and new questions from the floor will be presented and answered by a panel of experts. Also – “ASK DOBLE” questions and answers will be presented.

**16:00 – 18:30 Manufacturers Expo & Reception**  
The industry's top manufacturers and service providers will be on hand to provide answers to your questions, increase your knowledge with demonstrations, present you with promotional materials and product catalogs, and help you develop new contacts.



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### Core Training

**14:00 – 14:30 Insulating Materials**  
The insulation system is a critical component of a power transformer. The life of a transformer is defined by the life of the insulation. This presentation will review the basic functions of the insulation system must perform in a power transformer. The presentation will include insulation system design and manufacturing practices which will maximize the integrity of the insulation system over the life of the transformer. In addition, insulation aging mechanisms will be discussed to assist in the development of operation and maintenance practices in order to maximize transformer life.

Michael Franchek  
VP Innovation and Technology  
**Weidmann Electrical Technology**

**14:30 – 15:00 Factory Testing I**  
Learn about the various tests specified and performed to ensure a quality product. Learn why you need to attend and witness factory testing, and learn what you should be looking for. ANSI/IEEE C57.12.00, C57.12.90 standards will be presented.

Raj Ahuja  
VP Engineering  
**Waukesha Electric Systems**

15:00 – 15:15 *Break*

### Advanced Training



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#### Core Training

**15:15 – 16:00 Factory Testing II**

*Continued from previous presentation.*

Raj Ahuja  
VP Engineering  
**Waukesha Electric Systems**

**16:00 – 16:30 Q&A Session – “Ask the Experts”**

Pre-submitted and new questions from the floor will be presented and answered by a panel of experts. Also – “ASK DOBLE” questions and answers will be presented.

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#### Advanced Training



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## AGENDA

### Tuesday, February 8, 2011

6:00 Registration & Information Desk Open

6:30 – 7:30 Breakfast

#### Core Training

**7:30 – 8:15 Special Design Generator Step-Up**  
Besides the standard designs for GSU transformers, there are a number of cases where detailed investigations are necessary to adjust the design to meet specific application requirements. This topic will cover those application "nuances". Specifically, a review of the maximum operating voltage (overexcitation implications when attempting maintain output voltage during high load periods) and local overheating of the tank and other structures due to the high currents seen in the LV isophase bus input.

Bertrand F. Poulin  
Senior Principal Engineer  
**ABB**

**8:15 – 9:00 Review of Geomagnetic Disturbances & the Impact on Power Transformers**  
Continued from previous presentation. In addition, a review of Geomagnetic Disturbance impact on power transformers will also be presented during this session as this topic is of keen interest with the expected increase of GMD activity

#### Advanced Training

**7:30 – 9:30 Explosions & Failures I**  
Fire prevention, blast suppression, fault dynamics, blast walls, transformer failures, emergency response, contingency plans.

Topics discussed include transformer fault dynamics, explosion phenomena, materials expansions, pressure rise analysis, transformer tank failure, blast containment, fire containment, physical construction, and overall critical asset protection.

Dr. Clem Hiel  
President

#### Composite Support

Ryan Brady, MSc.  
Research Engineer  
**Transformer Protector Corp.**

H. Jin Sim, P.E.  
VP & CTO  
**Waukesha Electric Systems**

9:30 – 9:45 Break

**9:45 – 10:30 Explosions & Failures II**  
*Continued from previous presentation.*

Dr. Clem Hiel  
President

#### Composite Support

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## AGENDA

### Core Training

during the upcoming solar storm peak.

Bertrand F. Poulin  
Senior Principal Engineer  
Craig L. Stiegemeier  
Technology Director Transformer Services  
**ABB**

**9:00 – 9:30 Transformer Bushing Field Issues and Replacement Considerations I**  
This presentation addresses some of the most common transformer bushing issues encountered in the field. A brief review of the history, design and manufacturing of bushings will educate the user of different types of transformer bushings. A detailed review of the history of the GE Type U bushing will be presented, along with both strong and weak points of the design and failure modes of service aged Type U bushings. The presentation will conclude with a review of the considerations to be examined when replacing bushings, along with specific case studies of actual bushing replacement projects. The transformer owner will come away from this presentation with a thorough understanding of the details needing covered when planning a bushing replacement project.

Randy Williams  
Utility Bushing Applications Mgr  
Craig L. Stiegemeier  
Technology Director Transformer

### Advanced Training

Ryan Brady, MSc.  
Research Engineer  
**Transformer Protection Corp.**

H. Jin Sim, P.E.  
VP & CTO  
**Waukesha Electric Systems**

**10:30 – 13:30 Lunch & Manufacturers Exposition**  
The industry's top manufacturers and service providers will be on hand to provide answers to your questions, increase your knowledge with demonstrations, present you with promotional materials and product catalogs, and help you develop new contacts. Lunch will be served inside the Expo Hall.

**13:30 – 15:00 Transformer Fluids I**  
This presentation will include topics such as insulating paper, press-board, and transformer insulating fluids, including mineral oils and natural esters. Napthenic mineral oil history, production, refining processes, hydrotreating, national and international standards, uninhibited and inhibited oils, and applications, moisture ingress, total moisture content, oil quality, dissolved gas, metals-in-oil, contamination, and corrosive sulfur shall be presented and discussed. Case studies and real-world applications will be presented for discussion.

Donald B. Cherry  
Principal Consulting Scientist  
- Dielectric Fluids

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## AGENDA

### Core Training

Services  
**ABB**

9:30 – 9:45 *Break*

**9:45 – 10:30 Transformer Bushing Field Issues and Replacement Considerations II**  
*Continued from previous presentation.*

Randy Williams  
Utility Bushing Applications Mgr  
Craig L. Stiegemeier  
Technology Director Transformer Services  
**ABB**

**10:30 – 13:30 Lunch & Manufacturers Exposition**  
The industry's top manufacturers and service providers will be on hand to provide answers to your questions, increase your knowledge with demonstrations, present you with promotional materials and product catalogs, and help you develop new contacts. Lunch will be served inside the Expo Hall.

**13:30 – 14:30 Transportation & Rigging – Sea, Rail, Truck**  
Today's large units typically come from overseas or across US borders. Learn about oceanic, rail, barge, and flatbed shipment and handling. Topics also include safe rigging methods, permitting, US rail issues and restrictions. Learn about transportation method selection, reliability, impact to delivery cycle, monitoring, inspection, testing, dimension constraints, dimension measur-

### Advanced Training

**ABB**

Paul Griffin  
VP Consulting & Testing Services  
**Doble Engineering**

Jimmy Rasco  
VP Global Base Oil Technology  
**Ergon**

15:00 – 15:15 *Break*

**15:15 – 16:45 Transformer Fluids II**  
*Continued from previous presentation.*

Donald B. Cherry  
Principal Consulting Scientist  
- Dielectric Fluids  
**ABB**

Paul Griffin  
VP Consulting & Testing Services  
**Doble Engineering**

Jimmy Rasco  
VP Global Base Oil Technology  
**Ergon**

**16:45 – 17:15 Q&A Session – “Ask the Experts”**  
Pre-submitted and new questions from the floor will be presented and answered by a panel of experts. Also – “ASK DOBLE” questions and answers will be presented.



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ing techniques including lasers, shipment preparation, travel concerns, receipt, impact recorders, commissioning, damage, and much more.

Danny Cain  
Safety & Risk Manager  
**Edwards Moving & Rigging**

**14:30 – 15:00 Site Design I**  
Site selection, soil mechanics, grading, bearing and jacking loads, transformer foundation and containment design, SPCC guidelines, 40CFR112, deluge systems, blast walls, cooling considerations. New code guidelines will be presented!

Curtis Smith, P.E.  
Regional Office Manager  
Mark Juneau  
Civil/Structural Engineer  
**Black & Veatch**

*15:00 – 15:15 Break*

**15:15 – 15:45 Site Design II**  
*Continued from previous presentation.*

Curtis Smith, P.E.  
Regional Office Manager  
Mark Juneau  
Civil/Structural Engineer  
**Black & Veatch**

**15:45 – 16:45 Transformer Operations & Loading – A User's View**  
This practical presentation discusses the actual operation and loading of power transformers. Topics include

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operations/loading/overloading, thermal concerns, stray flux heating, core and coil heating, transformer degradation and loss of life, asset management, IEEE and IEC Standards, maintenance issues, economics, types of transformers and their loading capabilities, emergency ratings, and much more.

Donald W. Platts  
Senior Staff Engineer  
**PPL Electric Utilities**

- 16:45 – 17:15 Q&A Session – “Ask the Experts”**  
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## AGENDA

### Wednesday, February 9, 2011

6:00 Registration & Information Desk Open

6:30 – 7:30 Breakfast

#### Core Training

**7:30 - 9:30 Transformer Acceptance, Commissioning, Installation, Oil Processing, Start Up**  
Shipment receipt, impact recorders, acceptance testing, internal inspections, field dressing – pumps, radiators, coolers, gauges, controls, equipment requirements, oil filling, hold times, energization – includes presentation of oil processing techniques, core and coil heating, vacuum requirements, moisture limits, water removal, cold traps, filtration, field processing rigs, site requirements.

Bill Herron  
Director of Field Service  
**Delta Star**

9:30 – 9:45 Break

**9:45 - 11:30 Transformer Maintenance**  
Rick Youngblood  
Principal Engineer  
**Doble Engineering**

11:30 – 12:30 Lunch

**12:30 – 13:30 SPECIAL KEYNOTE ADDRESS**  
**by Gene Kranz, NASA flight director, mission commander - Apollo 13**  
(sponsored by Waukesha Electric Systems)

Don't miss this!

#### Advanced Training

**7:30 – 9:30 Load Tap Changers I**  
Energized Load Tap Changers (LTCs), De-Energized (DETC), Transmission Class, Distribution Class, Resistive, Reactive, and so very much more. This is by far one of the most impressive presentations of the week, and it is jam-packed with information about history, usage, various designs, operations, maintenance, gas analysis, repairs, failures and components. Representatives of ABB and Reinhausen will be on hand to make presentations and then open the floor for discussion, and most importantly, to field your questions. This extremely practical presentation will allow the attendees to ask about all types of subjects related to the everyday operations, loading, and maintenance of transformer tap changers.

Craig L. Stiegemeier  
Technology Director Transformer Services  
Mike Brake  
Senior LTC Engineer  
**ABB**

Bernhard Kurth  
General Manager  
**Reinhausen Manufacturing**

# 2011 LIFE OF A TRANSFORMER SEMINAR

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## AGENDA

### Core Training

Of the great many men and women involved in the history of our excursions into outer space, NASA flight director Gene Kranz time and again distinguished himself as a remarkable leader. His oversight of the dramatic Apollo 13 mission is perhaps his most well known achievement, but it was under his watch that NASA rededicated itself after the tragedy of Apollo 1, achieved its aim of a lunar landing on Apollo 11, and took some of the first steps towards a long term human presence in space with Skylab. There is much to be learned about personal integrity and leadership by studying the conduct and attributes of this great man.

Meet him at the 2011 "Life of a Transformer" Seminar!

**13:30 – 14:15 Transformer Field Repair**  
Oil leaks, bushings, arresters, oil.

Jim Hackett  
Power Services Division Manager  
**Colt Atlantic Services, Inc.**

**14:15 – 15:00 Transformer Monitoring**  
David Scaquetti  
Transformer Monitoring Supervisor  
**Siemens Energy, Inc.**

15:00 – 15:15 *Break*

**15:15 – 16:15 Mobile Substation sTransformer Monitoring**  
Marion Jaroszewski  
Senior Consultant

### Advanced Training

9:30 – 9:45 *Break*

**9:45 – 11:30 Load Tap Changers II**  
*Continued from previous presentation.*

Craig L. Stiegemeier  
Technology Director Transformer Services  
Mike Brake  
Senior LTC Engineer  
**ABB**

Bernhard Kurth  
General Manager  
**Reinhausen Manufacturing**

11:30 – 12:30 *Lunch*

**12:30 – 13:30 SPECIAL KEYNOTE ADDRESS by Gene Kranz, NASA flight director, mission commander - Apollo 13**  
(sponsored by Waukesha Electric Systems)

*Don't miss this!*

Of the great many men and women involved in the history of our excursions into outer space, NASA flight director Gene Kranz time and again distinguished himself as a remarkable leader. His oversight of the dramatic Apollo 13 mission is perhaps his most well known achievement, but it was under his watch that NASA rededicated itself after the tragedy of Apollo 1, achieved its aim of a lunar landing on Apollo 11, and took some of the first steps towards a long term human presence in space with Skylab. There is much to be learned about personal integrity and leadership by studying



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### Core Training

**Delta Star, Inc**

- 16:15 – 16:45 Q&A Session – “Ask the Experts”**  
Pre-submitted and new questions from the floor will be presented and answered by a panel of experts. Also – “ASK DOBLE” questions and answers will be presented.

### Advanced Training

the conduct and attributes of this great man.

Meet him at the 2011 “Life of a Transformer” Seminar!

- 13:30 – 15:00 Field Test & Repair I**  
Static frequency converter, field induced voltage, large field repairs

Craig L. Stiegemeier  
Technology Director Transformer Services

**ABB**

John Herron  
Sales Engineering Consultant  
**Highvolt**

Jan-Rainer Sicham  
On Site Repairs Manager  
**Siemens Energy, Inc.**

Troy Kabrich  
General Manager - Service Division  
**Waukesha Electric Systems**

*15:00 – 15:15 Break*

- 15:15 – 16:15 Field Test & Repair II**  
*Continued from previous presentation.*

Craig L. Stiegemeier  
Technology Director Transformer Services

**ABB**

John Herron  
Sales Engineering Consultant  
**Highvolt**



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#### Core Training

#### Advanced Training

Jan-Rainer Sicham  
On Site Repairs Manager  
**Siemens Energy, Inc.**

Troy Kabrich  
General Manager - Service Division  
**Waukesha Electric Systems**

**16:15 – 16:45 Q&A Session – “Ask the Experts”**  
Pre-submitted and new questions from the floor will be presented and answered by a panel of experts. Also – “ASK DOBLE” questions and answers will be presented.

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## AGENDA

### Thursday, February 10, 2011

6:00 Registration & Information Desk Open

6:30 – 7:30 Breakfast

#### Focus - Transformer Field Diagnostics

The entire morning will focus on Transformer Field Diagnostics. With a strong demand for even more information on these crucial topics we have expanded this section of the seminar. Presentations are delivered by top experts in the field, including information on Thermal Imaging, Acoustic Discharge, Electromagnetic Interference Testing, Transformer Turns Ratio, Megger, Power Factor, Capacitance, Leakage Reactance, Winding Resistance, Excitation Current, Sweep Frequency Response Analysis, and Partial Discharge. ANSI/IEEE standards will be presented. Diagnostic case studies, condition assessment, and actual data will be discussed in detail.

#### Core Training

**7:30 – 9:30 Transformer Field Testing & Diagnostics**  
Thermal imaging, offline tests, online tests. Transformer Turns Ratio, Megger, Power Factor, Capacitance, Leakage Reactance, Winding Resistance, Excitation Current, Sweep Frequency Response Analysis, Electromagnetic Interference.  
  
Robert Brusetti, P.E.  
Director Client Service Engineering  
**Doble Engineering**

9:30 – 9:45 Break

**9:45 – 12:00 Acoustic Emission, EMI & Partial Discharge**  
The use of technology to monitor and interpret acoustic emissions from transformers is presented, using real-world applications and case studies.  
  
Karl Haubner  
Client Service Engineer

#### Advanced Training

**7:30 – 9:30 Controls & Instrumentation I**  
Protective relays, transformer paralleling, LTC controls, gauges, control cabinets, online monitoring, communications, data collection and storage, automation.  
  
E. Tom Jauch  
BECO Application Consultant  
Steve Turner  
Senior Applications Engineer  
**Beckwith Electric Co. Inc.**

Bill Griesacker  
Transformer Engineer  
Peter Longo  
EMI Engineer  
**Doble Engineering**

9:30 – 9:45 Break

**9:45 – 12:00 Controls & Instrumentation II**  
*Continued from previous presentation.*  
  
E. Tom Jauch  
BECO Application Consultant

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### Core Training

Peter Longo, P.E.  
EMI Field Engineer  
**Doble Engineering**

Gary Couvas  
Area Sales Manager  
**LumaSense Technologies, Inc.**

12:00 – 13:00 *Lunch*

**13:00 – 14:00 Ultra High Voltage Transformer Design & Operations**  
Zhong Juntao  
**TBEA**

**14:00 – 15:00 Factory Repair**  
This presentation will address the reasons for performing repair at a qualified repair facility as opposed to in the field. Economics will also be discussed, including the logic to repair versus replacement.

Bruce Forsyth, P.E.  
VP/GM Commercial Transformer Operations  
**Southwest Electric Company**

15:00 – 15:15 *Break*

**15:15 – 16:15 Transformer Failure**  
A presentation filled with all types of transformer failures, including bushings, windings, arresters, tap-changers, insulators, isophase bus, and more! Come and learn all about methods of investigation, Foreign Material Exclusion Zones (FMEZ), materials inspection and collection, laboratory analysis, methods of elimination, and methods of deter-

### Advanced Training

Steve Turner  
Senior Applications Engineer  
**Beckwith Electric Co. Inc.**

Bill Griesacker  
Transformer Engineer  
Peter Longo  
EMI Engineer  
**Doble Engineering**

12:00 – 13:00 *Lunch*

**13:00 – 15:00 Anything Transformer Related I**  
Discuss anything that is transformer related and get your answers from a group of experts!

**Expert panel**

15:00 – 15:15 *Break*

**15:15 – 16:15 Anything Transformer Related II**  
*Continued from previous presentation.*

**Expert panel**

**16:15 – 16:45 Q&A Session – “Ask the Experts”**  
Pre-submitted and new questions from the floor will be presented and answered by a panel of experts. Also – “ASK DOBLE” questions and answers will be presented.



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### Core Training

mination. Common mode failure types are presented.

Troy Kabrich  
General Manager - Service Division  
**Waukesha Electric Systems**

- 16:15 – 16:45 Q&A Session – “Ask the Experts”**  
Pre-submitted and new questions from the floor will be presented and answered by a panel of experts. Also – “ASK DOBLE” questions and answers will be presented.

### Advanced Training



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## AGENDA

### Friday, February 11, 2011

6:00 Registration & Information Desk Open

6:30 – 7:30 Breakfast

#### 7:30 – 12:00 Transformer Condition Assessment Using Laboratory Diagnostics I

Provides a thorough understanding of how to assess the condition of electrical insulating materials and transformers. This section is divided into three topics:

*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* - This part of the session 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.

*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.

Paul Griffin, VP Consulting & Testing Services  
Lance Lewand, Director of Laboratory Services  
**Doble Engineering**

9:30 – 9:45 Break

#### 9:45 – 12:00 Transformer Condition Assessment Using Laboratory Diagnostics II

Continued from previous presentation.

Paul Griffin, VP Consulting & Testing Services  
Lance Lewand, Director of Laboratory Services  
**Doble Engineering**

12:00 – 13:00 Lunch

#### 13:00 – 15:15 Transformer Condition Assessment Using Laboratory Diagnostics III

Provides a thorough understanding of how to assess the condition of electrical insulating materials and transformers. This section is divided into seven topics:

### “Electrical Apparatus Condition Assessment Using Laboratory Diagnostics”

OPTIONAL  
FIFTH DAY!  
Lab Seminar

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*Dissolved gas in oil analysis, continued* – Dissolved combustible gases in oil do not typically cause problems but can form flammable mixtures. This session discusses how to determine the flammability of combustible gasses and precautions to take.

*Load tap changer diagnostics* – This presentation gives the latest information on diagnostics for LTCs, how to diagnose DGA results for LTCs and some of the pitfalls to avoid. Case studies are provided.

*Oil circuit breaker diagnostics* – This session is about diagnostics for bulk oil breakers which are used to take transformers out of service. Diagnostic test includes dissolved gas in oil analysis. Case study examples are included.

*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.

*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.

*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.

*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.

Paul Griffin, VP Consulting & Testing Services  
**Doble Engineering**

15:00 – 15:15 *Break*

**15:15 – 16:30 Transformer Condition Assessment Using Laboratory Diagnostics IV**  
Continued from previous presentation.

Paul Griffin, VP Consulting & Testing Services  
**Doble Engineering**