

Moisture & Oxygen Management, **Online** Monitoring and Diagnostics of Power Transformers

New perspective on transformer life management by monitoring and controlling moisture and oxygen of its insulation system.

7th – 9th October 2019 | Kuala Lumpur, Malaysia



Moisture & Oxygen Management, Online Monitoring and Diagnostics of Power Transformers (3 Days)

The primary focus of the 3-day masterclass will be on the sources, causes and effects of moisture & oxygen on transformer insulation life and incipient failure modes. It will be demonstrated that laboratory periodic oil analysis is limited and not always adequate, while continuous online monitoring has increasing potential and many significant advantages.

Moisture & Oxygen Management:

From sources of moisture and oxygen ingress to methods of their removal this masterclass explores various aspects of transformers life cycle management. There will be focus on the area of detrimental effects of moisture and oxygen on transformer insulation, methods of water and oxygen measurement and assessment. Substantial time will be dedicated to various parameters used to describe moisture in oil/paper insulation. The trainer will take the audience through a number of transformer failure cases caused by the presence of water. He also will provide an in-depth overview of online as well as off-line water and oxygen measurement techniques used by leading electric utilities and analytical laboratories. Variety of water removal methods and associated equipment will be discussed and studied in detail and on practical examples. The audience will learn about many innovative solutions brought in the field of predictive condition monitoring of power transformers.

Online monitoring & diagnostic:

With the increasing demand for uninterrupted electric supply, expansion of existing transmission & distribution infrastructure and continuous pressure to reduce operation and maintenance costs, online transformer monitoring solutions market is expected to experience a substantial growth during the next decade.

Transition to digital utility (smart grid, industry 4.0, etc) is immanent and it is hard to imagine that in the very near future engineers will not be exposed to online monitoring of their essential assets, such as transformers, power lines and substation switchgear. As technology keeps evolving with new features (communication protocols, sensors, advanced analytics, etc) on a daily basis, the trainer will be discussing new ways of data management and delivery, complementing traditional SCADA with Industrial Internet of Things (IIoT) with the emphasis on architecture, reliability and security. Successful implementation of online monitoring, fault identification and isolation, transformer life extension will also be covered by the trainer.

Participants will have the opportunity to experience real time monitoring as the trainer will demonstrate the IIoT based transformer monitoring system - the first in the world, which uses non-conventional innovative methods for temperature, moisture and oil quality monitoring.

The course is filled with numerous case studies, practical industry examples and real time monitoring demonstrations. Participants will be able to expand on the knowledge gained elsewhere and will develop new perspective on the whole subject of transformer life cycle management.

Advance your knowledge and learn about:

- Various sources of moisture and oxygen found in transformers.
- New parameters used for moisture assessment.
- Seven myths of moisture assessment are still believed to be a reality.
- New methods of transformer dehydration and gas removal.
- A connection of moisture parameters and oil quality.
- What needs to be monitored.
- Health indices and their most relevant use.
- New diagnostic methods which cannot be found in any other course, standards or guidelines.
- Transformer's enemies are in check.
- Smart sensors for Internet of Transformer Things.
- Machine learning for transformer monitoring and diagnostics.

This program is intended for:

This 3-day program is intended for those working in the asset management of electrical plant, project management and design of high voltage substations and will provide an in-depth knowledge and understanding of moisture phenomenon in large power transformers as well as advances in online transformer condition monitoring:

- Electrical asset engineer/manager who wants a broader and more in-depth understanding of maintenance needs and failure modes.
- Anyone who are interested in understanding problems and solutions associated with managing key assets of electric utility.
- Anyone who is involved in developing and implementing life maintenance strategies of transformers.
- Utility engineers, managers, technical officers and technicians, business & strategy staff, regulatory compliance staff, IT and OT staff and all those involved in day-to-day asset management.
- All levels who have interest in intelligent transformer monitoring and diagnostics.
- Utilities R&D involved in developing of new technologies for condition-based maintenance and operation of electric plant.
- Maintenance Managers/ Supervisors/ Engineers, Facilities Managers/ Supervisors/ Engineers, Utility Managers/ Supervisors/ Engineers, Plant Maintenance Head, Plant Supervisors/ Managers/ Engineers, Electrical Maintenance Managers/ Engineers, Electrical and Test Managers/ Engineers, Head of Engineering, Manufacturing and Production Managers/Supervisors/Engineers, Operations Managers/ Supervisors/ Engineers.

Moisture & Oxygen Management, Online Monitoring and Diagnostics of Power Transformers (3 Days)

DAY 1

Moisture Management in Transformers

Water in Transformers - So What?

- Accelerated paper aging
- Vapor bubbles evolution
- Corrosion of core and tank
- Progressive consumption of oil additives
- Decrease of insulation breakdown strength
- Reduction of transformer life

Many Faces of Water in transformers

- "Water" vs "moisture"
- Free, bound, dissolved and active
- Water content of oil
- Water content of paper
- Relative humidity and relative saturation
- Dew point
- Water activity and water potential
- Water-in-oil solubility

Sources of water contamination

- Residual after factory processing
- Atmospheric water vapor
- Leaking gaskets and valves
- Faulty dehydration system (silica gel breathers, air cells)
- Chemical decomposition of water and oil

Moisture equilibrium in paper/oil system

- Development of moisture equilibrium diagrams
- Equilibrium diagrams for mineral oil
- Equilibrium diagrams for natural and synthetic esters
- Use and misuse of moisture equilibrium theory

Off-line laboratory moisture assessment

- Karl Fisher titration method
- FTIR spectroscopy
- Oil sampling for water assessment
- Lab instrumentation for water measurement
- Reporting water content
- IEEE and IEC Guidelines on water in transformers

Dielectric Frequency Response of Power Transformers

- Dielectric Response methods:
 - Recovery Voltage Measurements (RVM)
 - Polarization and Depolarization Current (PDC) measurement
 - ("IR measurements as function of time")
 - (C & PF measurement as function of frequency)
- Test records and report
- Measurement analysis and interpretation
 - Theory and validation
 - Non-moisture related factors influencing the DFR measurements
 - Examples of typical measurement challenges

Off-line drying of power transformers

- Methods and instrumentation
 - Vapor phase drying
 - Drying by Low frequency heating

Oxygen in Power Transformers

- Sources of oxygen ingress
- Detrimental effects of oxygen in transformers
- Oil oxidation and mechanism of sludge formation
- Accelerated paper aging
- Oil preservation system
- Degassing of transformer oil
- Combined impact of oxygen, water and temperature on transformer insulation life

Field experience with moisture assessment: Case studies

DAY 2

Online Transformer Monitoring and Diagnostics 1

What is online continuous monitoring?

- On-load vs online continuous

Why online monitoring (OM)?

- Prevention of incipient faults
- Identification of manufacturer's defects
- Determination of utilization factor and overloading capacity
- Life extension and management of transformer life cycle
- Improvement of grid reliability
- Assistance in ranking and health indexing of transformer fleet
- Assistance in replace/repair/refurbish decisions
 - Challenges and barriers to Online Monitoring

What transformer components to monitor?

- Core
- Windings
- Liquid insulation
- Solid insulation
- LTC
- Bushings
- Cooling system

Which parameters could and should be monitored?

- Load
- Voltage
- Temperatures
- Moisture
- Dissolved gases
- Dielectric dissipation factor
- Oil flow rate and oil level
- Partial discharge
- Environment and weather

Sensors, transducers and intelligent monitoring devises: How to select?

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DAY 3

Online Transformer Monitoring and Diagnostics 2

Diagnostic methods and algorithms for Online Monitoring

- Thermal models
- DGA - Dissolved Gas Analysis
 - Fault severity and fault type classification methods
 - Duval triangles and pentagons
 - IEEE and IEC guidelines for DGA
 - Energy weighted approach to DGA (R-DGA)
 - Online vs off-line DGA diagnostics
 - Single gas and multi gas online monitors
- Moisture models
- LTC tap position and motor current models
- Bushings leakage current, capacitance and DDF models
- Cooling efficiency diagnosis
- Electrical and acoustic PD models
- Identification of sensor's drift and malfunction

Big data, Machine Learning and AI for Online Monitoring.

Business case for online monitoring: Costs and benefits of online monitoring.

Information communication for Online Monitoring – past, present and future.

Online monitoring (OM) and Smart Grid – Does OM make transformer smarter?

Online monitoring and Industrial Internet of Things (IIoT) Online monitoring equipment markets and trends

On-line moisture monitoring

- Moisture sensors: how to select
- Pitfalls of using equilibrium diagrams for online moisture monitoring
- Moisture Cloud Algorithm

On-line drying of oil filled transformers

- Industrial absorbent materials and their use for moisture dehydration
- Self-dehydrating breathers
- Mobile dry-out systems
- Permanently connected dryers

Field experience with online transformer monitoring:

Case studies

During the 3-day masterclass the trainer will be sharing: Photographic and video evidence, graphs, charts and diagrams, as well as wealth of knowledge related to:

- Transformer failure investigation at one of the largest Australian power stations;
- Bubble evolution insight a transformer insulation system;
- Installation of various sensors and oil reclamation plants;
- Moisture assessment of scrapped and onload transformers;
- Collecting and processing oil and paper samples for moisture analysis;
- Design and implementation of online monitoring solutions.

Industrial Internet of Things (IIoT) monitoring system:

The trainer will demonstrate an IIoT based monitoring system - the first system on the market which uses minimum hardware (low cost) and allows a user to perform:

- Continuous monitoring of oil/paper insulation quality/degradation,
- Accurate monitoring of absolute water content (ppm), relative saturation, water in oil solubility and dielectric breakdown voltage,
- Detection of pump and fans failure,
- Oil level and leak detection,
- Thermal performance and cooling efficiency,
- Enhanced loading and aging estimations,
- Sensor failure and drift detection,
- Prediction of remaining life,
- More accurate load forecasting and
- Drying efficiency monitoring.



Moisture & Oxygen Management, Online Monitoring and Diagnostics of Power Transformers (3 Days) Registration Form

Moisture & Oxygen Management, Online Monitoring and Diagnostics for Power Transformers	3 or more participants	Per Participant	PROGRAM DETAILS Venue: Kuala Lumpur, Malaysia Date: 7 th – 9 th October 2019
Full 3 Days	SGD 2599 ()	SGD 2999 ()	REGISTER NOW! CONTACT: Kelvin MAIN: +603 7727 3952 FAX: +603 7727 5278 Email: registration@petro1.com.my
REGISTER 3 AND SENT THE 4TH FREE <ul style="list-style-type: none"> Please note that all registrations must be made at the same time to qualify. The above investment fee are inclusive of course material, tea breaks and lunch. The above investment fee is exclude of SST 6%. 			
<input type="checkbox"/> I would like to organize this training on-site and save at least 25% on the total course Fees! Please call +603 7727 3952 for more about our in-house training or email intraining@petro1.com.my (Terms & Conditions apply)			

Delegates Details

1. Name: _____ Mr Mrs Ms Dr

Job Title: _____

Email : _____

Contact No: _____

Department: _____

2. Name: _____ Mr Mrs Ms Dr

Job Title: _____

Email : _____

Contact No: _____

Department: _____

3. Name: _____ Mr Mrs Ms Dr

Job Title: _____

Email : _____

Contact No: _____

Department: _____

Head of Department: _____

Invoice Details

Invoice Attention to: _____

Company: _____

Industry: _____

Address: _____

Postcode: _____ Country: _____

Telephone: _____ Fax: _____

Email: _____

Authorized Signature : _____

Credit card Payment

Please Debit my credit card:

VISA MASTERCARD

Card Number: _____ - _____ - _____ - _____

Security Code: Expiry Date:

Named printed on card: _____

Signature: _____

Payment Method
By Direct Transfer: Please quote invoice numbers on remittance advice.

ACCOUNT NAME : PETRO1 SDN BHD
BANK : United Overseas Bank (Malaysia) BHD
ACCOUNT NO : 202 900 3191 (SGD)
All bank charges to be borne by payers. Please ensure that PETRO1 SDN BHD received the full invoice amount.
**** Credit card payment will include a charges 2.8%**

Payment Policy: Upon receipt of a completed registration form, it confirms that the organization is registering for the seat(s) of the participant(s) to attend the conference or training workshop. Payment is required with registration and must be received prior to the event to guarantee the seat. Payment has to be received 7 working days prior to the event date to confirm registration.

Sales and service Tax (SST):
The above investment fee is exclude of SST 6%. The SST charges of 6% will be include during issuance of the invoices.

Venue: All of our training courses are held in 4 – 5 star venues. The course fee does not include accommodation or travel cost. It's recommended to book the hotel room early as there are only limited room available at the discounted corporate rate.

DATA PROTECTION
The information you provide will be safeguarded by Petro1 that may be used to keep you informed of relevant products and services. We take it seriously when it come s to protection of our client data.

Cancellation & Substitutions:
Upon receipt of a completed registration form, it confirms that the organization is registering for the seat(s) of the participant(s) to attend the conference or training workshop. Should you be unable to attend, substitutes are always welcome at no additional cost. Please inform us as early as possible. Payment is non-refundable if cancellation occurs 7 working days prior to event commencement. However a substitute is welcome at no additional charges. If cancellation occurs 5 working days prior to the registration date and there is no substitute, the organizer reserves the right to charge 50% of the total investment from your organization.

PETRO1 SDN BHD is not responsible for any loss or damage as a result of a substitution, alteration or cancellation/postponement of an event. PETRO1 SDN BHD shall assume no liability whatsoever in the event this training course is cancelled, rescheduled or postponed due to a fortuitous event, Act of God, war, fire, labor strike, extreme weather or other emergency.

Walk in Registration:
Walk-in participants with payment will only be admitted on the basis of seat availability at the event and with immediate full payment.

Program Change policy:
The organizer reserves the right to make any amendments and/or changes to the workshop, venue, facilitator replacements and/or modules if warranted by circumstances beyond its control.