## TIC 2 Day CPD Advanced Course – Program 11-12th Feb 2019

### Power Transformer Mineral and Ester Oils – Analysis and Management

**Venue:** UQ, St Lucia Campus, Sir Llew Edwards Bldg. 14, Room 217 Brisbane  
**Day 1, 11th Feb 2019**

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<td>8.30-9.00</td>
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<td>9.00-9.15</td>
<td>Welcome</td>
<td>Prof Tapan Saha UQ</td>
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| 9.15-10.00    | **Mineral oils**  
What are mineral oils– Basic chemistry, influence of balanced aromatic molecule, methods and classification of paraffinic, naphthenic characteristic mineral insulating oil, special fluids for specific purposes and applications | Chian Yaw Nynas Singapore  
Philippe Reboul Nynas Australia |
| 10.00-10.30   | Morning Tea                                                              |                                                |
| 11.00-12.00   | **Mineral oils**  
Standards & Specifications -International Standards, guides and specifications of new, unused insulating oil (IEC 60296 Ed4. 2012), corrosive sulphur tests, DBDS  
Differences between DGA, Gassing Tendency and Stray Gassing  
Unique technical trends of naphthenic oils, important roles/functions of insulating oil on cooling, electrical insulation, information carrier | Chian Yaw Nynas Singapore  
Philippe Reboul Nynas Australia |
| 12.30-1.00    | Lunch                                                                    |                                                |
| 1.00-1.55     | **Implementing Life cycle Oriented Maintenance of transformer oils-leading distribution company shares their experiences** – Re-use of recovered oil, importance of oil sampling, DGA review process: EQL perspective, typical actions from oil results review, understanding of various DGA and oil quality parameters, DGA interpretation techniques for various assets (Transformers, OLTCs, Instrument transformers), is your asset going to fail or is it just stray gassing, management of wet transformers, estimation of remaining life of transformers by oil results, case studies of fault finding from oil analysis | Jayaram Baniya EnergyQ |
| 1.55-2.45     | **Getting the most from your oil laboratory provider**-Communicating effectively with your laboratory team, what to do if things go wrong?  
Quality aspects including proficiency testing, differences between laboratories and standards. Common oversights and suggestions on how to improve turnaround times. Transportation / logistics, use of the correct containers, time taken for analysis. | Tony Tuong Ngo  
Powerlink Queensland |
| 2.45-3.00     | Afternoon tea                                                            |                                                |
| 3.00-4.30     | **Mineral oils**  
Total Cost of Ownership (asset management) - choosing the right type of insulating oil, cost perspective and comparison (Power transformer), what insulating oil to choose for your transformer?  
**Case Study – Properties of ageing mineral insulating oils in service**  
Scope of evaluation insights into oxidation process, uninhibited and inhibited oils, findings and learnings | Chian Yaw Nynas Singapore  
Philippe Reboul Nynas Australia |
| 4.30          | Close                                                                    | Prof Tapan Saha UQ                              |
| 4.30-5.00     | Update on TIC Research Projects and CPD courses  
Pizzas/refreshments at St Lucy Caffè e Cucina, St Lucia Campus (5min walk) | Ray Holzheimer UQ |
| 5.00-6.00     |                                                                         |                                                |

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# Power Transformer Mineral and Ester Oils – Analysis and Management

## Day 2, 12th Feb 2019

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<td>8.00-8.15</td>
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<td>Ray Holzheimer UQ</td>
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| 8.15 -10:00| **Natural and Synthetic Esters**  
Introduction and experience of esters worldwide  
Ester applications  
**Chemical structure** of natural and synthetic esters. How ester behave differently to mineral oil  
**Fire safety** of esters concept of self-extinguishing, Insurance ramifications, designing transformer installations, cost saving in substations  
**Environmental behaviour overview** Biodegradability test implications  
Environmental protection implications for designing transformer installations  
**Moisture tolerance**. How esters interact with water, how behaviour of esters differs from other fluids  
**Oxidation stability** How chemical structure of esters influences oxidation stability. Comparison of the stability of esters vs other fluids  
**Electrical differences** Creep strength, Large gap breakdown, Impulse behaviour  
Designing power transformer for ester – considerations  
**Cellulose Paper Pressboard** how paper is preserved  
Running hotter or longer  
Paper aging markers – furans and alcohols  
The use of cellulose/TUK/Aramid papers  
Paper/pressboard impregnation with esters and implications  
Importance of ensuring proper impregnation | Dr Russell Martin  
M&I Materials, UK |
| 10.00 -10.30| Morning Tea                                                                                 |                     |
| 10.30 -12.15| **Retrofilling with esters**  
Why retrofilling is done Miscibility of esters Conditions for candidate transformers for retrofilling, voltage class, materials compatibility, non-silicone liquid transformers  
Retrofilling procedure. Free breathing or sealed considerations.  
**Maintenance and laboratory testing** Important test consideration  
Tan delta (DDF) Interfacial tension  
Dissolved gas analysis  
Similarities and differences with the gassing of mineral oil  
Correct sampling technique  
Gas analysis methods.  
**International standards** for esters IEC/IEEE/ASTM documents  
New standard development | Dr Russell Martin  
M&I Materials, UK |
| 12.15 -12.45| Lunch                                                                                       |                     |
| 12.45 -2.45| **Sampling/testing oils in the field, laboratory testing, interpreting the results**  
Chemistry of oil and paper in transformers (including how gases are produced, how oil and paper degrade)  
Description of diagnostic oil tests available including Dissolved Gas Analysis (DGA), Oil Quality Tests, Furans and Particle Analysis.  
Interpreting results: applying laboratory test results to condition of equipment. Detailed Case Studies will be shown.  
Taking appropriate action based on results. Oil Sampling – outline of best equipment and method for gaining a representative sample.  
Diagnostic testing of other oil-filled equipment namely Tap Changers, Circuit Breakers, Ring Main Units SF6 testing. | Antony Giacomin  
TJ/H2b |
| 2.45-3.15| Afternoon tea                                                                               |                     |
| 3.15 – 4.00| **Group sharing Experiences**  
• Case studies and questions | Ray Holzheimer UQ   |
| 4.00 - 4.15| Closing of Course                                                                           | Ray Holzheimer UQ   |