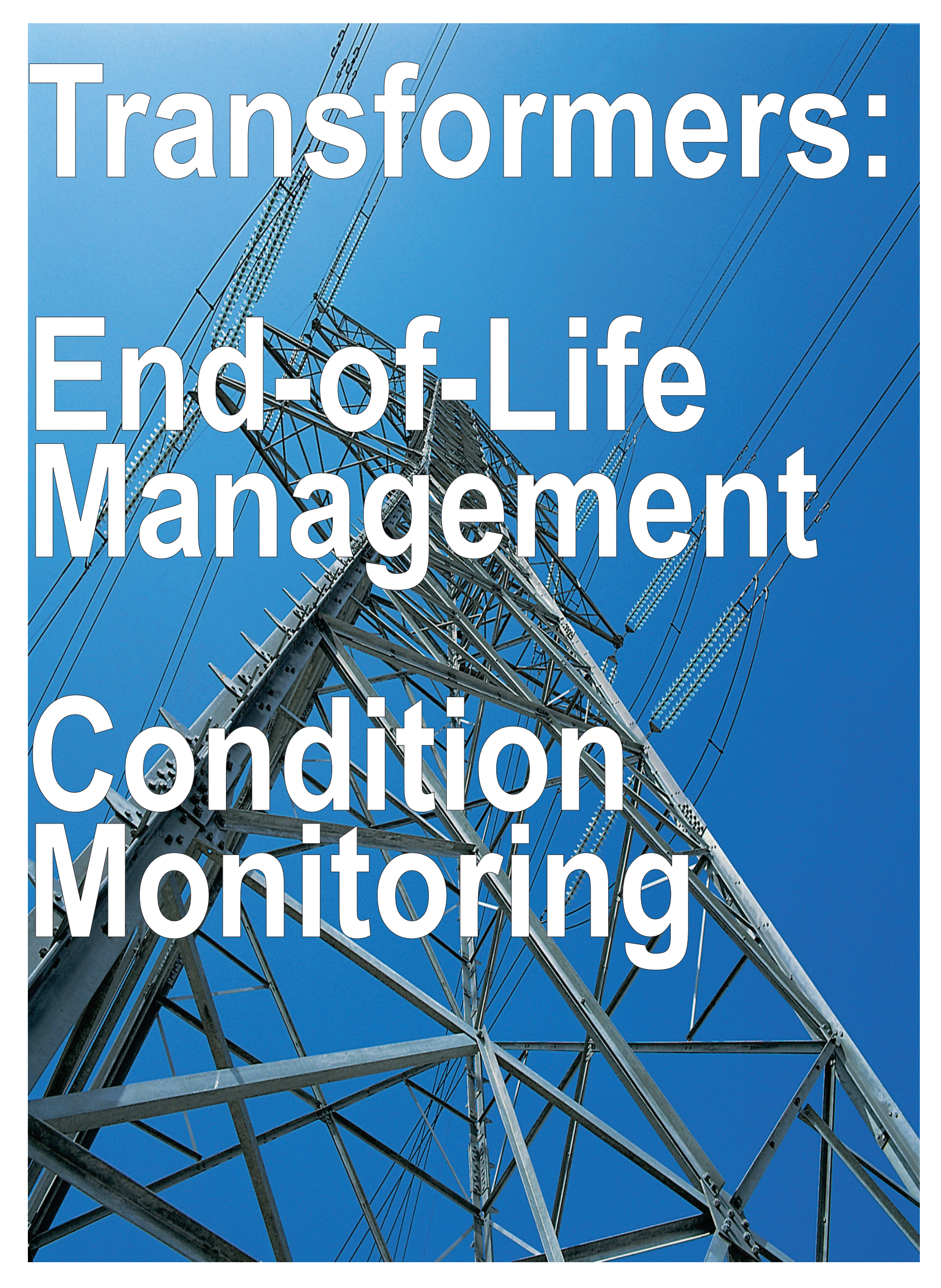




Transformers: End-of-Life Management Condition Monitoring

On-Site Workshop on Transformer End-of-Life

Venue-Your Plant Site

Duration: Two Days

Course Instructor:

Er. Georg P. Daemisch-Germany

Transformer ageing is profoundly perceived as thermal ageing of conductor insulating paper. Although paper ageing is predominantly controlled by thermal reaction as well as chemical reactions, dielectric strength of aged paper is reduced little but mechanical strength is severely weakened. Transformer thermal life is thus expressed as the age at which the mechanical strength of paper is reduced to below a certain threshold.

Retiring transformers with known defects or developing faults is one of the proactive ways for utilities to manage failure risk. These retired transformers normally go through forensic examinations and this provides an opportunity to directly measure paper insulation ageing status by the degree of polymerization [DP] of paper. DP is then used to predict the thermal life of a transformer.

When a transformer fails in service, its lifetime is the difference in years between the failure year and the installation year. On the other hand, end-of-life is a lifetime at which the asset does not meet the operation requirement anymore and therefore it is the end of transformer useful life.

Transformer Retirement is a proactive action made by utilities based on individual unit's poor condition and high risk of 'fail-in-service'. By taking actions to retire these units, the failure risk is reduced and the system reliability increased.

The age of a retired transformer should be emphasized as the retirement age, which is deduced from the year of retirement minus its installation year. Whether the retirement age should be used in the statistical analysis is still debatable. Overall, the active management of transformer retirement artificially distorts the failure hazard function which is effectively being lowered down.

During normal operation years of a transformer, paper's withstand strength is high so the transformer does not fail under a through fault event, i.e. short-circuit. Only extremely rare events will cause a transformer to fail, which are called random failure events. As paper ages, its mechanical strength is reduced and the decreased withstand strength may not sustain the high radial and compressive forces caused by a through fault, therefore the transformer fails.

It should be borne in mind that thermal life differs from one transformer to another greatly, due to the differences of their loading condition, local ambient temperature and design & hotspot factor. It is also believed that not only temperature but also oxygen, acidity and moisture play important roles in thermal ageing.

Asset managers predict the number of failure at each age in order to ensure the network reliability. The failure number, rather the failure mechanism is therefore critical for network secured operation.

Power Transformers are components that operate in a high voltage, high current and consequently high power environment. Although transformers are extremely energy efficient, the dissipated heat is a limiting factor for the maximum loading of power transformers. The insulating medium must be capable of dealing with large electric stresses, strong electro-mechanical forces and high temperatures.

The life of a power transformer mainly depends on the condition of the paper-oil insulation system. According to present statistics, tap-changers and bushings can also contribute to transformer failure. However, they can be more easily repaired or replaced than transformer windings and their insulation. In this presentation, the transformer life and the remaining life-time prediction is focused mainly on thermal degradation of its paper insulation. The oil-impregnated paper provides electrical insulation between windings and serves as a mechanical barrier between the individual windings and between winding layers. Thus, the paper is a critical factor in paper-oil insulation. A bad paper quality leads to premature insulation degradation, which in turn can lead to transformer failure after, for example, a winding short circuit.

In particular, it is known that thermal degradation of insulating paper does occur and will eventually limit transformer lifetimes. Individual lifetime simulation using the transformer thermal model suggested in the IEEE and IEC loading guides has been carried out as an alternative approach to predicting transformer end-of-life.

A transformer is designed and tested to have sufficient dielectric and mechanical strength, with some spare margin, to withstand the maximum operational stresses. The normal ageing process, represented as the reduction of oil quality and paper mechanical strength, will degrade the spare margin until it no longer sustains the stress caused by external events and thus the transformer is prone to fail. However, it is noticeable from the past operation experience that transformers do not fail due to normal ageing only. A transformer may develop a fault, in addition to normal ageing, which results in a faster than normal ageing/degradation process, with a higher consequent probability of failure at a particular age. Statistically, these are treated as random events (often triggered by a system event e.g. system short circuit, lightning, or/and switching transients) together with other events such as maintenance induced failures.

Overall, transformer failure is a probabilistic phenomenon with three main controlling parameters:

- Design
 - Ageing
 - External Triggering Events.
- Since a quantitative relation between the ageing conditions and

transformer intrinsic dielectric strength is lacking, transformer thermal life, expressed as the operating years to lose the mechanical strength of conductor paper under particular conditions, is used as the basis.

- Predominantly, these are the questions for which you seek answers:
- What are the risk factors when it comes to transformer life or the lack thereof?
 - What do you do with the tests?
 - What conditions do oil tests uncover?
 - To this day, “Do Nothing” is the biggest competitor for most testing and maintenance companies. Is this option acceptable?
 - Will an Impact Assessment be useful?
 - Why tests?
 - What tests should be standard?
 - Where to house all this data and trending analysis?
 - Finally, what are some of the common misconceptions about transformer failures?
 - ☐A new replacement transformer is rated the same as the unit it is replacing; therefore, it should be treated the same.
 - ☐All testing companies are alike.
 - ☐Hot oil processing on a transformer is standard in the industry.
 - ☐My power supplier has adequate transformer back-up in case of failure.
 - ☐Insurance coverage will cover my losses.
 - ☐Our plant operations people have the risk covered.

Georg will be the right person to answer these questions for you. If your transformers are at the threshold of impending failure, you can look forward to him to give them a fresh lease of life.

On-Site Workshop on Transformer Condition Monitoring

Venue: Your Plant Site

Duration: 2 Days

Default Scope of Workshop

This scope can be modified to suit your plant equipments and level of those attending.

Module-I:

Introduction to Dielectric Materials

Module Objective

- To develop a general understanding of:
- Dielectric materials and their characteristics
 - Dielectric polarization phenomenon and its significance
 - Liquid and solid dielectric materials used in electrical power equipment

Module Description

- This module will discuss about the physical processes that define the characteristics of dielectric materials.
- Participants will get to know the role of dielectric polarization in determining the properties of dielectric materials, basic tests and the related standards to assess the quality of dielectric materials.
- Special emphasis will be given on liquid mineral-oil insulation and on solid paper insulation with a focus on their ageing characteristics

Basics of Dielectric Materials

- Organic and inorganic dielectric materials
- Dielectric polarization mechanisms
- Properties of Mineral-Oil and Paper Insulation
- Thermal and electrical properties of mineral-oil and paper insulation with a focus on application in electrical power equipment
- Ageing processes involved in mineral-oil and paper insulation

Tests and Standards related to Determination of Properties

- Tests to be performed for the determination of properties of mineral-oil and paper insulation
- Standards relevant to such tests

Module-II

Determination of Functional Life of Transformers from Thermal Considerations

Module Objective

- To develop a general understanding of thermal effects in determining the functional life of mineral-oil filled transformers.
- To study the various factors those affect the elapsed life of a transformer under different types of loading conditions

Module Description

- This module will discuss important considerations for operation of mineral-oil filled transformers at higher temperatures
- Thermal effects that contribute to failures of such transformers
- Cumulative effect of temperature over time in causing deterioration of transformer insulation
- Methodologies to predict the useful life of the insulation in a transformer

Types of Loading of Transformers

- Normal loading
- Planned loading beyond nameplate rating
- Long-time emergency loading and Short-time emergency loading
- Ambient temperature and its influence on loading

Effect of Loading

- Calculation of hot-spot temperature considering the non-linear temperature distribution within a transformer

Module-III

Condition Monitoring of Oil-Paper Insulation System of Transformers

Module Objective

- To develop a comprehensive understanding of conventional methodologies employed for condition monitoring of oil-paper insulation system of transformers
- To understand the significance of dielectric response based methods in non-invasive condition monitoring
- To impart knowledge of strengths and weaknesses of different dielectric response based methods

Module Description

- This module will discuss the conventional methods for condition monitoring of transformers particularly the chemical techniques
- Special emphasis will be given on moisture dynamics in transformers.
- Participants will get detailed knowledge of the methods of dielectric response measurement in both time and frequency domain.
- Relevant analyses will also be discussed focusing on merits and demerits of different methods

Conventional Techniques of Transformer Insulation Assessment

- Why Condition Monitoring?
- Conventional electrical measurements
- Conventional Chemical Measurements
 - ☐Dissolved Gas Analysis
 - ☐Furan Analysis
 - ☐Degree of Polymerization

Moisture in Transformer Insulation

- Moisture Distribution
- Moisture Dynamics
- Effects of Moisture
- Moisture Detection – Karl Fischer Titration
- Moisture Equilibrium Curves
- Moisture Content in Paper
- Moisture Management

Dielectric Response Measurement in Time Domain

- Dielectric polarization phenomenon and its significance
- Polarization and Depolarization Current (PDC) Measurement
- PDC Measurement–Test Set Up
- Typical PDC Measurement Results
- Determination of Insulation Level
- Recovery Voltage Measurement (RVM)
- RVM Fundamentals, Polarization Spectrum
- Typical RVM Results
- Moisture estimation through PDC and RVM

Dielectric Response Measurement in Frequency Domain

- Frequency Domain Spectroscopy (FDS)
- FDS equipment and analysis
- Relating time and frequency domain results
- Various Factors affecting Dielectric Response Measurements in Field Conditions,
- Moisture estimation through FDS
- Advantages and Disadvantages of Dielectric Response Measurements in Time-Domain and Frequency Domain.

Frequency Response Analysis (FRA)

- Impulse Frequency Response Analysis
- Swept Frequency Response Analysis (SFRA)
- SFRA Measurement Set-Up
- Typical SFRA Response
- Peaks and Valleys in FRA Response
- SFRA Connection Methods
- Comparison of FRA Response
 - ☐Time-Based,
 - ☐Design-Based and
 - ☐Type-Based.
- Assessment of Mechanical Integrity of Transformer Winding
- Key Factors affecting Frequency Response Measurements

Module-IV:

Partial Discharge Phenomenon in Transformers

Module Objective

- To develop an insight into the partial discharge phenomenon occurring in high voltage transformers
- To study the various techniques of partial discharge detection vis-à-vis their application in the case of high voltage transformers

Module Description

- This module will discuss the physical processes involved in partial discharge phenomenon
- Participants will get detailed information on electrical method of partial discharge detection and the relevant standard
- Ultra-high frequency as well as acoustic measurement of partial discharge in transformers will also be discussed
- The issue of installation of partial discharge sensors in transformers will also be taken up

Basics of Partial Discharge

- Partial Discharge–how and where?
- Generation of PD pulses,
- Stress mechanisms activated by PD

Electrical Method of PD Detection

- Goals of PD measurement
- PD detection methods
- Electrical method of PD detection and the relevant standard
- Quantities related to PD measurement
- External interference and noise elimination

UHF and Acoustic Methods of PD Detection

- UHF sensors
- Detection of PD in transformers by UHF sensors
- On-line UHF PD measurement
- Detection of PD in transformers by acoustic sensors
- Non-removable and removable installation of sensors in transformers



Module-IV:

Partial Discharge Phenomenon in Transformers

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UHF and Acoustic Methods of PD Detection

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Module-V:

Remaining Life Analysis (RLA) of Transformers

Module Objective

- To develop a general understanding of remaining life of high voltage transformers
- To discuss the factors affecting the elapsed life of transformer

Module Description

- This module will discuss various factors affecting the remaining life of high voltage transformers
- Participants will get detailed information on remaining life analysis of transformers
- Techniques based on thermal considerations and cellulose degradation kinetics will be explained

Elapsed Life of Transformer from Thermal

Considerations

- Ageing equations
- Elapsed life calculation
- Elapsed Life of Transformer based on Solid Insulation Properties
- Life Estimation based on Cellulose Degradation Kinetics
- Probabilistic Approach towards Life Estimation

Module-VI

Gas Insulated System

Module Objective

- To develop a broad understanding of gas insulated system including gas insulated substations and gas insulated transmission lines. To get an insight into the gas insulation used in such system.

Module Description

- This module will discuss the historical development of gas insulated system outlining the goal of GIS.
- Participants will be made aware of the basics of GIS technology with special emphasis on key design features
- Reduction of SF₆ volume will be taken up with a focus on gas mixture.
- Developments in the field of gas insulated transmission lines with their special features will be discussed.
- Issues of reliability of such system and the quality assurance tests will also be covered.

Gas Insulated Substation

- Evolution of GIS
- Basics of GIS technology
- Key design features
- SF₆ volume reduction
- Reliability of GIS
- Design tests, Gas tightness and monitoring.
- Gas Insulated Transmission Line

Why GIL

- Historical development of GIL
- Applications of GIL
- Basic units of GIL

- Basic insulation level and current carrying capacity of GIL
 - Gas mixture as insulation
 - Installation of GIL,
 - Comparison of GIL with cables and overhead lines.
- THE END

PowerConsultancy has the Expertize, Products and Human Resources to provide the following services:

Transformers Inspection & Testing

- How will you ensure a new transformer has been built to specification?
- Do you understand the benefits of testing small transformers?

Problems:

For all new transformers, independent inspection and testing is recommended to ensure the finished product meets the specification. Poor manufacture can shorten the transformer's life or lead to catastrophic failure with significant consequences, particularly for large transformers.

Large Transformers:

For a transformer to be usable or optimized for its intended use, numerous parameters must be correct. These include the MVA, impedance, vector shift, Problems voltage, tapping steps and losses. In addition, there are often client specific requirements that must be complied with due to existing SCADA interfaces, auxiliary supplies or spares inventory.

Distribution Transformers:

These transformers are generally considered disposable items, so they're seldom inspected and tested. In reality, however, the return from inspecting and testing small transformers is typically greater than for large transformers.

Large Transformers:

To ensure large transformers are manufactured to the correct specification, PowerConsultancy can provide onsite inspection services either directly or via respected experts in the industry. During construction, the design method and quality of work are observed. Type and routine tests are also carried out to determine whether the transformer meets the specification.

Distribution Transformers:

Standardized designs ensure the compatibility of transformers across a network. The cost of 20 distribution transformers can be the same as one larger transformer. Making sure the first transformer is correct pays dividends for all the other transformers manufactured to the same design. After confirming the first transformer is correct to the specification and drawings, only random testing should be required for subsequent transformers. PowerConsultancy offers a practical distribution transformer review service.. The drawings are checked against the actual transformers to confirm the design. After following the transformers through the test bay, PowerConsultancy uses the witnessed results to perform independent calculations and confirm the test certificate. Technical schedules containing the witnessed results and a pass/fail are provided. Any discrepancies are highlighted and recommendations are made about whether the difference is critical.

Transformer Protection

PowerConsultancy is equipped with adequate highly competent manpower to provide adequate protection to your entire fleet of transformers irrespective of their age and size at economical costs. Please read below the range of services we offer in this regard:

What type of protection your transformer will need?

The type of protection will vary depending upon the application and the importance of the transformer. The most common protection is against faults and overloads. These protection devices should minimize the time of disconnect and reduce the risk of catastrophic failure. Any extended operation as faults or overloads will compromise the life of the transformer quite adversely. Protection devices provide quicker isolation of these problems and helps to protect and extend the life of the transformer.

Transformer failures broadly can be classified as following:

Winding failures which are due to Short Circuits including:

- Turn-Turn Faults
- Phase-Phase faults
- Phase-Ground
- Open Winding
- Core Faults which includes Core Insulation Failure and Shorted Laminations.
- On-Load Tap Changer Failures are usually caused by Mechanical, Electrical, Short Circuit, Overheating.
- Terminal failures such as loose connections, open leads, and short circuits.

- Abnormal Operating Conditions such as Overloading, Over-Voltage, and Over Fluxing.
- External Faults.

Choosing Transformer Protection For Your Application.

You have to balance the expense of a particular protection scheme or sacrifice the transformer. There are no rules or regulations determining what the appropriate protection scheme is for a transformer application. Call one of our transformer protection specialists for assistance in reviewing the transformer protection options and selecting the one that meets your need and budget. There is a tendency to tie protection to the MVA and primary kV of a transformer. Some of these issues to consider are the severity of personnel safety concerns, and the danger to nearby structures if the transformer tank ruptures due to an oil fire.

Transformer Protection Equipment Will Save Cost By Reducing Downtime.

You also need to consider the economic impact if the transformer failed and how downtime for repairing or replacing the transformer will impact the organization. The impact of production time loss, and the different costs related to repair time vs. complete replacement time. Does your organization have the availability of backup power or emergency replacement transformers, and the cost of each of these options. A transformer protection scheme can reduce or change a replacement into a repair.

Call Our Transformer Protection Specialists Today!

Our Transformer Protection Specialists can help you decide how much protection you might need for your transformers and your application. There are too many different types of protection devices on the market and each is designed for a specific task. It'll need an expert to identify the right protection system for you. To ensure that your transformers will have a long life, the transformer protection should be chosen with as much care as you did while choosing your parents!

Transformer Oil Leak Management

Oil Leakages are a frequent issue in Transformers which if not properly addressed can result in serious accidents such as fire or explosions. Oil can also cause accidents due to slipping. Besides, Transformer oil is an environmental pollutant. Spillage of Transformer oil can result in severe penalty for environmental violations.

Oil Leakages can be detected visually most of the times. However, some minor leakages are not always detectable by the naked eye. Special techniques such as the application of special fluids which indicate oil leakage by changing color. Once an oil leakage is detected, it needs to be arrested and the point of leakage should be plugged. Welding the leakage would require switching off the transformer and draining the oil.

Transformer oil leaks can be rectified by the application of special polymeric compounds and putties which cure and seal off the leakage.

Leakages can be prevented by ensuring that the elastomeric components of the transformer such as the gaskets, O rings, etc are replaced at the scheduled replacement intervals. The Transformer should be properly painted and any damage to the painting should be properly rectified. In addition to oil leakages, in transformers filled with Nitrogen the leakage above the oil surface can result in the leakage of nitrogen. The leakage of the inert gas can be confirmed by applying a soapy solution and observing the bubbles.

Transformers are susceptible to oil leakage which can be caused by corrosion or faulty welds. This leads to breakdown of fins, flanges, valves, seals, and pipework. If leaks are not stemmed and repaired, further deterioration will occur resulting in:

- Loss of oil.
- Environmental damage.
- Downtime.
- Ongoing maintenance costs.
- Potential high replacement costs.

These costly implications can be quickly and simply prevented using state-of-the-art transformer leak sealing solutions imported from the USA. Utilizing these products, even live leaks can be stemmed and sealed permanently in-situ, reducing downtime and costly replacement of parts. We can provide the answers to transformer oil leaks which will:

- Avoid expensive drain down procedures.
- Reduce expensive replacement costs.
- Prevent environmental damage.
- Minimize downtime.
- Eliminate the dangers of repairs involving hot work.

Through a network of highly trained technical consultants, we can provide a full 24-hour, on-site service with guidance and technical advice on transformer leak sealing irrespective of the size, type or make of your asset. Backed by a specialized engineering team, PowerConsultancy will diagnose the problem, recommend the solution and supervise the application in totality with training for on-site maintenance personnel if required.

Our sealing work will carry an unconditional warranty of five years

Transformer Residual Life Assessment.

RLA Study of Switch-Yard Equipment

Today the concept has changed and efforts are being directed to explore new approaches and techniques of Monitoring, Diagnosis, Life Assessment and Condition Evaluation, and possibility of extending the life of assets such as Power Transformer, Circuit Breakers, Current Transformers, Cables, Generator, Motors and the like.

PowerConsultancy can undertake exhaustive Residual Life Assessment [RLA] and Residual Life Extension [RLE] studies for entire Sub-Station and MV Switch-Gears. We can carry out testing of various types of test objects such as transformers, circuit breakers, isolators, CT/CVT and motors using state-of-the-art testing and measuring instruments.

The RLA & Condition Assessment process ranges from assessing Equipment Design specifications, Factory Test Data, Operating and Maintenance History Information and On-Site Test Data during the service life of the equipment. Our RLA & Condition Assessment process is a three stage approach as briefly explained hereunder with the example of power transformer:

Stage-I:

On-Line Tests & Operational, Design & Historic information:

This would be a review of all engineering design and operational documents and past test data including regular scans with on-line test methods. New oil tests would be undertaken wherever necessary. This would help us to identify the common problems and prioritize which off-line tests are more important in the second phase for detail review activities:

- External Inspection
- IR/UHF Surveys
- Oil Tests for Main Tank and LTC including DGA and FURAN
- Checking of Pump Operation and Fans.

Stage-II:

Off-Line Test on All Units

Focus on those that indicate risk from Stage-I; we'll undertake a range of outage tests to investigate issues, and correlate with assessment from stage-I activities:

- PF/Cap
- Winding and Insulation Resistance
- SFRA
- Turns Ratio
- Leakage Reactance
- Bushing
- Surge Arrester Testing
- OLTC Operation and Dynamic Contact Resistance Measurement
- Moisture Analysis of Paper Insulation by Dielectric Method (PDC+ FDS)

Stage-III:

Classification of Transformer and Recommendation for Future Test: All units will be assessed in terms of design groups with problems, overall condition, thermal, mechanical and dielectric condition. Assessment will be based on:

- Operational Problems and Design Group History.
- Oil Condition of Main Tank & Selectors.
- Thermal Ageing and Hot Spots in Winding and Connection.
- Dielectric condition.
- Mechanical condition.

The Test Frequency and Recommended Test will be modified after each cycle of measurement depending upon the condition of the transformer.

Transformer Diagnostic Tests

PowerConsultancy is fully equipped to perform following diagnostic tests and use its accumulated expertise for evaluating the condition of your transformers and accessories to arrive at Residual Life Assessment / Enhancement interpretations.

- Frequency Response Analysis-FRA
- Capacitance and Dissipation Factor Measurement.
- Impedance Measurements by FRSL Method.
- Analysis of Winding Damages with FRA method.
- Partial Discharge Measurements.
- Analysis of Insulation by Dielectric Method [PDC + FDS]
- OLTC Dynamic Contact Resistance Measurements [DCRM]
- Thermography, Noise, Vibration Measurement.
- DGA, Furan DP Test of Paper Insulation.
- Excitation Characteristics according to IEC 60044-1, IEC 60044-6 [TPS, TPX, TPY] and IEEE C57.13 for Knee-Joint voltages and Remanence Measurement.
- Leakage Resistive Current/3rd Harmonic Resistive Component Monitoring of LA.
- Motor Current Signature Analysis.
- Current Breaker Operation Time, like C, O, C-O, O-C-O
- Travel Characteristic of Breaker Contact/Mechanism.
- Dynamic Contact Resistance [DCRM]

On-Load Tap Changer Maintenance

Why maintenance is required for OLTC?

- Arcing of main and Contacts in diverter switch during switching operation causing carbonization

of oil and contact wear

- Diverter switch operation in milliseconds create stress on mechanical parts such as springs, braided coated leads etc
- Influence of climate conditions and on maintenance of silica gel breather affecting the oil quality and require timely replacement
- Updating the performance of On-Load Tap Changers
- Regular maintenance will increase the OLTC life and reduce the operational risk.

PowerConsultancy has the expertise to undertake routine as well as preventive maintenance of all kinds and makes of on-load tap changers.



Transformer Oil Data Interpretation

PowerConsultancy is an industry leader in oil diagnostics. Our diagnostic system provides a reliable snapshot of the overall internal health of the transformer, and identifies any remedial action required to prevent a predictable failure. Its benefit is that it allows you to intervene at key benchmarks to substantially extend the reliable life of your units up to several times.

Our diagnostic assessment system is available in several report options. Depending on the option you select, the report will:

- Identify any urgent issues requiring immediate attention.
- Provide you with a detailed action plan outlining steps to be taken to maintain and extend the life of your transformer.
- Include proactive maintenance recommendations intended to reduce downtime and increase longevity and reliability.
- Identify the reliability of your unit by assessing the oil and gas in the oil data.
- Help you develop long-range maintenance plans and budgetary forecasts.
- Reduce or eliminate predictable premature equipment repairs and replacements.
- Simple interpretations of results.
- Explicit maintenance recommendations intended to maximize return on maintenance costs and asset procurement.

We are an industry leader in providing oil services for transformers. We use our extensive experience and knowledge to help clients better understand their equipment maintenance requirements and give clear advice on the best course of action to ensure reliability and extend the useful life of their assets.

Interpreting transformer oil data is more an art than a science. Our experts based in Germany and Sweden have several decades of hands-on exposure in this domain. Backed with adequate hardware and software tools and knowledge-base, we'll be able to provide a very precise interpretation of what your data tells about the condition of your equipment. We'll also recommend appropriate treatments based on our analysis of your data.

Partial List of Customers General Workshops Conducted by Power Consultancy Limited

ABB | Andhra Pradesh State Electricity Board | Andhra Pradesh Power Transmission Corp | AREVA T&D | Atomic Power Station-Kalpakkam | Aluminum Bahrain | Badarpur Thermal Power Station

Bahrain Petroleum Refinery | Balasore Alloys Limited | Bhakra Beas Management Board | Bhutan Ferro Alloys | Bhutan Power Corporation | Birla Cement Factory | Carborandum Universal | Chennai Petroleum Corporation | Chukkah Power Station | Dubai Electricity & Water Authority | Durgapur Steel Plant | ElectroSteel Castings | EMCO Transformers | Essar Power Limited | Essar Steel Limited | GMR Ferro Alloys | GMR Power Plant | Government Bank Note Press | Gujarat Electricity Board | Himachal Pradesh State Electricity Board | Hindalco Industries Limited | Hirakud Power Station | Hospet Steels | Indian Institute of Technology | Indian Metals and Ferro Alloys | Karnataka Power Transmission Corp | KHRIBHCO Fertilizer | Madukkarai Cement Factory | Monnet Ispat Limited | National Hydroelectric Corporation | National Thermal Power Corp | Neyveli Thermal Power Station | Nsaria-Iran | Nuclear Power Corp | Orient Paper Mills | Power Grid Corp of India | Punjab State Electricity Board | Rayalaseema Thermal Power Project | Reliance Energy | Reliance Industries | Renukoot Power Station Renuagar Power Station | Saudi Electric Co | Saurashtra Cement | Sirpur Paper Mills | Spectrum Power | Tata Power | Tata Steel | Tenga Nasional BHD | Vardhaman Steel | Vijayawada Thermal Power Station | West Bengal Power Transmission Corp | Crompton Greaves Limited | Eberle | Gujarat Electricity Transmission | Company | Maharashtra State Electricity Transmission Company Kayamkulam Thermal Power Station Kaiga Atomic Power Station | Bharat Bijlee Limited | Calcutta Electricity Supply Company | Kothagudem Thermal Power Station Konaseema Thermal Power Station | Prai Power Station-Malaysia Bharat Bijlee Limited | Central Power Research Institute | Hindustan Aeronautics Limited | Calcutta Electricity Supply Company Limited

Dedicated On-Site Workshops

National Aluminum Company Limited | Durgapur Steel Plant | Madras Aluminum Company Limited | Shuweiha Thermal Power Station-Saudi Arabia | Dubai Electricity & Water Authority | Bahrain Aluminum Company | Bahrain Petroleum Company | Saudi Electric Company-Saudi Arabia

Extract from Bapco News

A training workshop was held for 50 employees from Electrical Maintenance and P&U Engineering last month. The workshop sessions, held from October 18 to 22 and organized by Plant Maintenance Department's Electrical Maintenance Section, covered the topic of Transformer Residual Life Enhancement, and was provided by U.K. based Power Consultancy, led by Chief Consultant Georg P. Daemisch, an internationally acclaimed expert on Transformer Residual Life Management, plus two other recognized experts in the respective fields of Transformer Measurements and Transformer Cooling.

Manager-Plant maintenance Mahmood Mirza spoke at the start of the workshop, which was facilitated by Superintendent-Electrical maintenance Andy Doherty along with Thaslim Kaja and K.N.Abdul Jabbar from Power Consultancy U.K. The sessions consisted of two two day workshops held at the training center

and a one-day on-site training session at the LSFO Substation.

Bapco Refinery has a fleet of over 300 oil-filled transformers. The continuous availability of these transformers is crucial to the safe and reliable operation of the Refinery's Power Plant, Oil processing Units, Oil Storage and Export facilities, and ancillary services such as Refinery Clinic, Security Building, Finance & Admin, Maintenance Workshops, Engineering Building, Training Center, Cafeteria and Awali. Many of these essential assets have reached or passed their manufacturer's stated life expectancy, however such transformers are often still in good condition physically and can often last for decades more.

Paramount to maintaining transformer long life is a managed program of condition assessment. An essential factor in the condition assessment process is the ability of Maintenance staff to understand the tell-tale signs of aging and degradation of the transformers. Of equal importance is their ability to distinguish the fundamental aspects of corrective, preventive and condition-based maintenance as well as understand the concepts of reliability-centred maintenance when applied to power transformers.

This training workshop was a first for BAPCO in this subject field, and the consultants expressed their appreciation of BAPCO's world-class preventive maintenance programs for all its high voltage assets.

END

Transformer Experts available for Short-Term / Long-Term assignments.

PowerConsultancy has a pool of highly experienced engineers and technicians who possess considerable hands-on experience of transformers of all types, sizes and makes. Most of them have worked in major utilities, both government and private, in various countries of the world.

PowerConsultancy can make their services available to you for both short and long term. You'll find them highly competent and most economical. Please contact us if we can be of service to you.

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