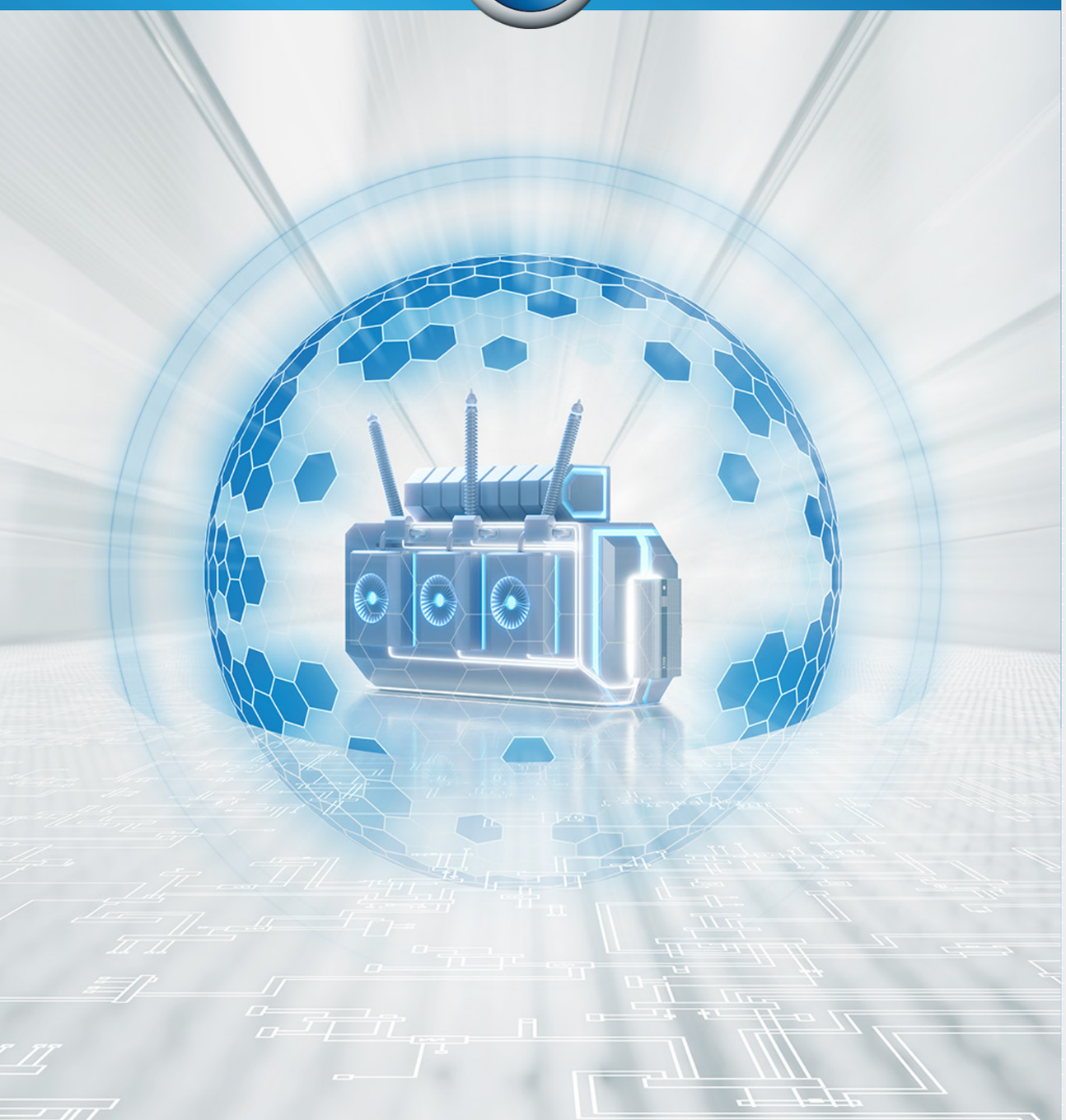
UNDERSTAND THE CONDITION OF POWER TRANSFORMERS & OPTIMIZE THE MAINTENANCE STRATEGY



An aging fleet of power transformer with increasing fault susceptibility and fluctuating transformer loads, due to the feed-in of renewable energy are just some of the challenges facing the electric power industry. In addition, the constant expansion of the grid leads to an increased demand for new transformers, which in turn leads to higher costs and long delivery times. The bottom line is that the installed old equipment is more loaded and new equipment takes time to acquire.

Therefore, monitoring and diagnosis of transformers becomes more important to understand the exact condition of the assets. Based on the accurate diagnosis, life-extending measures can be initiated on existing transformers to keep them on the grid for a longer time span, alleviating the supply shortage while maximizing the value of the assets. This ensures reliability for a safe operation.

MONITORING AND DIAGNOSIS OF TRANSFORMERS BECOMES MORE IMPORTANT TO UNDERSTAND THE EXACT CONDITION OF THE ASSETS. BASED ON THE ACCURATE DIAGNOSIS, LIFE-EXTENDING MEASURES CAN BE INITIATED ON EXISTING TRANSFORMERS TO KEEP THEM ON THE GRID FOR A LONGER TIME SPAN, ALLEVIATING THE SUPPLY SHORTAGE WHILE MAXIMIZING THE VALUE OF THE ASSETS.

Data is needed to know the condition! Understanding the condition of a transformer is very similar to the human health. A diagnosis is also based on symptoms. Measurements can help to categorize the symptoms and provide information about possible diseases. Like the human blood count, the analysis of the insulating medium oil provides information about the state of health and indicates thermal and electrical faults.

According to IEC 60599, the dissolved and free gas analysis (DGA) is one of the most widely used diagnostic tools for detecting and evaluating faults in oil-insulated transformers [1]. The key gases can be measured either by taking a sample and subsequently analyzing it in the laboratory, which is done at a certain time interval (e.g. yearly). To minimize the uncertainty between these intervals an additional option is to install a DGA sensor, which has been described as “the heart of on-line monitoring” [2]. Sensors that collect real-time data under real operating conditions enable continuous condition assessment, which facilitates the transition to condition-based maintenance. The gained transparency supports decision making and optimized planning of maintenance and repair measures.

Transformers generate a lot of data over their lifetime. But what does data mean for a transformer and its health?

For an accurate diagnosis, it is best to include and combine several pieces of information. The large amount of data produced by the transformer makes it possible to determine its failure more precisely and at an early stage. Just like humans, where the diagnosis of diseases is based on certain symptoms. In the case of symptoms such as a runny nose, loss of taste and fever, the doctor could suspect a corona infection. He can then confirm his assumption with specific tests, such as a PCR test, in order to treat the disease correctly.

The same approach can be applied to the energy sector. Based on the early warning system, targeted on-site testing can be initiated. Maintenance is carried out when it is needed and can be scheduled when the transformer is shut down anyway.

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DURING THE LIFE TIME OF A POWER TRANSFORMER, A WIDE VARIETY OF DATA CAN BE COLLECTED. MASTER DATA, MEASUREMENT DATA FROM PHYSICAL INSPECTIONS AND TESTS, AND CONTINUOUS TIME SERIES FROM AN INCREASING NUMBER OF INSTALLED SENSORS.

Lots of Data can be Overwhelming!

During the life time of a power transformer, a wide variety of data can be collected. Master data, measurement data from physical inspections and test, and continuous time series from an increasing number of installed sensors.

In practice, this data is often scattered across different systems and drives. This makes it difficult to maintain an overview and perform a holistic assessment. But it is not just the distributed data that is a challenge - interpreting it correctly is also a challenge. The ppm measurements from the laboratory report are usually incomprehensible to the layperson, as most of the people looking at the results have not studied chemistry. Digital solutions in the form of assistant and analytical tool make the process easier!

TESSA®
ASSET PERFORMANCE MANAGEMENT IS AN INTEGRATED PLATFORM FOR COLLECTING AND STORING ALL INSPECTION AND SENSOR DATA IN A CENTRAL DATABASE, COMBINED IN A USER-FRIENDLY INTERFACE PROVIDING CONCISE INFORMATION AND AVAILABLE ON ANY DEVICE.

Discover Data-Driven Asset Management

Maschinenfabrik Reinhausen offers a customized and modular automation solution for monitoring and diagnostics of power transformers.

With the MSENSE® sensor portfolio you can digitize the transformer components and receive all measured data in continuous time series. The connected sensor information is consolidated and hard time synchronized in ETOS®, which is a transformer manufacturer independent operating system for monitoring, controlling and regulating individual power transformers.

TESSA® Asset **P**erformance **M**anagement is an integrated platform for collecting and storing all inspection and sensor data in a central database, combined in a user-friendly interface providing concise information and available on any device.

Photo: Maschinenfabrik Reinhausen

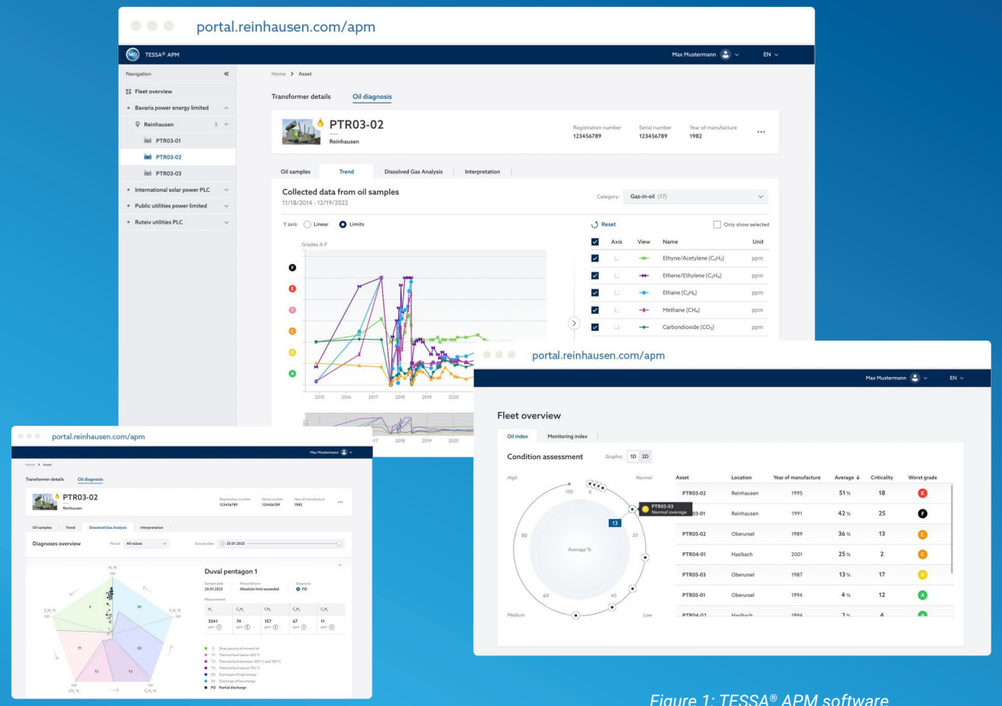

Figure 1: TESSA® APM software

This helps to identify and track the condition of power transformers. Gain an overview of the condition of your fleet and gain meaningful insights into the health of individual assets along with their individual components. Transform your inspection and sensor data into advanced analytics and identify irregularities at an early stage. Evaluations based on the latest standards and a unique algorithm that provides actionable recommendations.

TESSA® APM supports Asset- and Service Manager in the ISO 55000 process by simplifying the time-consuming, manual analysis process.

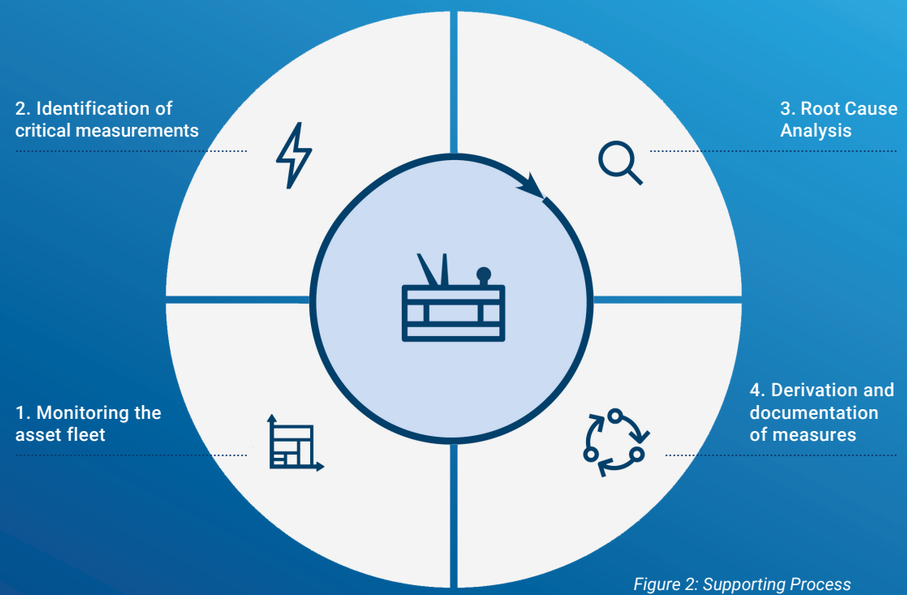

Figure 2: Supporting Process

Transformers Digitalization

Benefits

- Save time with process automation
- Save cost through life-time optimization
- Understandable assessments and analysis for further decision making
- Based on transformer expert knowledge

Organize all the master data (e.g. nameplate information) relevant to the assessment as each transformer is unique and must be analyzed according to its individual characteristics. Store all measurement data in a structured way, either time series from sensors such as MSENSE® DGA or point measurements from laboratory oil test!

Recognize increasing values with configurable alarms that provide information when thresholds are reached. Enable life-prolonging actions to be taken before it becomes an expensive repair or even a failure with a power outage.

Visualize data automatically in a graphical or tabular trend view. A custom selection of measured values, axes and time periods can be used for a detailed analysis of historical trends. Compare past data with current data and identify trends by assessing the deltas and the rate of increase over different time periods.

Assess transformers and their components based on health indices according to international standards such as CIGRE, IEC and IEEE. The condition of the fleet is displayed in a condition and risk matrix with a prioritized ranking. This helps to easily identify the critical units! A powerful visualization with an advanced grade system displays single measurements with their respective thresholds either in a table view or in graphical trend chart. Make comparisons of current and historical measurements and trends of health and conditions indices.

Analyze root-cause using common failure classification methods such as Duval Triangle and pentagon. Unique algorithms show the probability estimate for the most likely transformer problems with a fault description.

Define required actions with recommendations based on standards such as IEEE C57.104 from 2019 or unique algorithm. Support decision making process and optimize maintenance planning.

Document the findings and generate easy interpretation reports with a single click. Customize the report layout to match your corporate design. All relevant files of any type can be stored with the associated asset or component for quick access.

Leonhard Link studied Business Administration at the OTH Regensburg. During his studies, he completed an internship at Maschinenfabrik Reinhausen in the field of software and business model development, then stayed on as a student trainee and wrote his bachelor's thesis on the topic of requirements evaluation and documentation in agile software development. He has been a product manager of TESSA® APM for more than one and a half years.

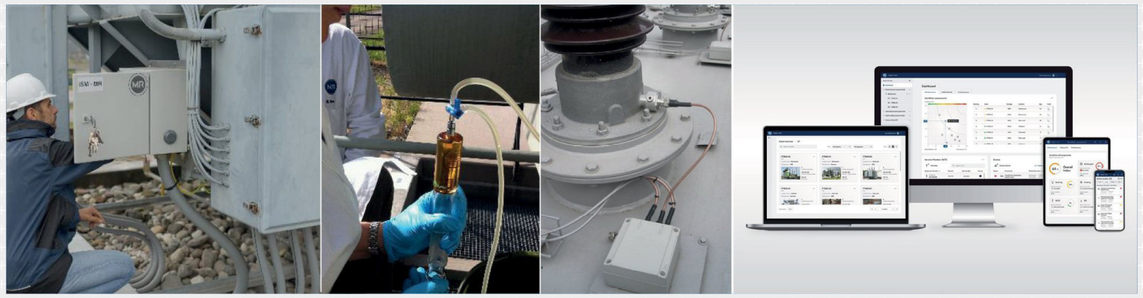

Photo: Maschinenfabrik Reinhausen

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[1] IEC 60599:2022 "Mineral oil-filled electrical equipment in service - Guidance on the interpretation of dissolved and free gases analysis" IEC, Geneva, Switzerland, 4 edn., 2022

[2] E. A. Mackenzie, J. Crossey, A. dePablo and W. Ferguson, "On-line monitoring and diagnostics for power transformers," 2010 IEEE International Symposium on Electrical Insulation, San Diego, CA, USA, 2010

Do you need more information?
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Register and get meaningful insight into the health of your power transformers!

Sign up **for free** and **get started!**