IRIS POWER
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Diagnostic News

July 2018

Inside this issue:

UPCOMING EVENTS 2018

CARILEC Engineering Conference & Exhibition
Port of Spain, T & T
July 22-26 , 2018

CIGRE 2018
Paris, France
August 26-31, 2018

65th Annual PCIC Conference
Cincinnati, OH
September 24-26, 2018

Hydro 2018
Gdansk, Poland
October 15-17, 2018

Correlative Analyses to Increase the Reliability of Transformer Health Assessment

By:
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Reliable transformers are essential for a reliable electrical network. Therefore, the knowledge of the condition of an asset is extremely important. Offline condition assessment methods are established and used for decades with success. However, they give a screenshot of the asset in the moment that the measurements are taken, and the development of incipient faults can be missed. Nowadays besides offline methods, more comprehensive online monitoring approaches for the transformer fleets combined with analytic models and severity analyses are used in order to capture changing conditions in real time and to predict critical situations and transformer condition.

In order to efficiently assess the condition of a transformer, the failure mechanisms, their associated monitoring parameter(s) and a dedicated analytic model must be known. Comparing different parameters is important in order to achieve a holistic view on a specific asset condition. Monitors can complement each other in in order to achieve a higher accuracy in assessing the health of an asset and to improve the coverage of developing faults with a different dynamic in its development. Transformer reliability can be improved by using severity checks, based on correlative analyses of different monitored input data, and analytic models (e.g. oil bubbling temperature or Dissolved Gas Analyses algorithms for transformers) giving operators more easy to understand information instead of providing an overwhelming amount of scattered data.

Introducing online monitoring in the past most often was limited to some independent parameters. Users struggled accessing the true overall condition of an asset. Typical statements were and still are "I got an alarm, but what that does it mean to my asset?" Confusion prevailed over clear decisions in lots of cases. "False Alarms" can lead to not trusting installed monitoring solutions. A common opinion was and still is that always the help of experts in that field is needed. Modern condition monitoring solutions require comprehensive online sensors and monitoring combined with analytic models and severity analyzes to capture changing conditions in real time.

Analytic Models - Creating information instead of data

The knowledge of failure statistics and the experience with a transformer fleet combined with the criticality of the asset are essential to choose the right parameters for an assessment and to build analytic models for Condition Based maintenance decisions. Presenting "only" data can lead to poor maintenance/ operational decisions and unnecessary interventions, which usually have the potential to introduce new risks. Fig. 1 shows this scattered data approach. Data in this case is often analyzed separately in disregards of the possible relationship to other parameters, or even legacy data.

Continued on page 2...

Iris Co-Author Receives Best Paper Award

Third best paper in Equipment and Technology was awarded to "Identification of Hydro Unit Stiffnesses, Critical Speed and Vibrating Masses Based on Vibration Measurements" at HydroVision 2018 in Charlotte, NC. Co-authored by Ozren Husnjak and Ozren Oreskovic, Veski Ltd.; Fabian Kaica, Fabian Kaica Consulting; John Letal, Iris Power and presented by Nicolas Dehlinger, Iris Power Congratulations!

Correlative Analyses to Increase the Reliability of Transformer Health Assessment

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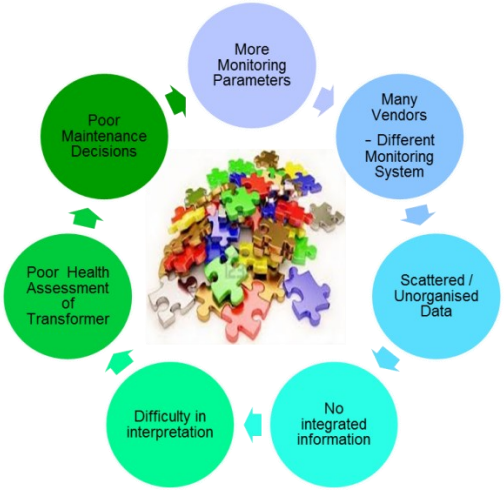

Scattered data approach

To access a certain alarm or warning condition, different parameters should be correlated to each other, including online and offline data, as well as data from different sources, e.g., SCADA systems, periodical visual checks, load data etc. Automated correlation of data can be done for online data. Offline available data needs to be reviewed manually or via an interface uploaded into an online tool which can marry online and offline data. All transformer incipient faults will somehow result in the creation of detectable signs of its presence. These signs could be chemical, electrical, optical or acoustical nature, but most of the time a combination of these.

Analytics and correlative analyses

Analytics can be applied to specific parameters whereas correlative analyses combines information from different parameters and from different sources. The aim is to extract information from disparate data sets. In the bubbling temperature model for example the hotspot temperature is used to determine the temperature at which the gas bubble generation starts. To enable this calculation, a set of different parameters need to be known, like the hot spot temperature itself, the moisture in oil, the gas content in oil, the pressure at the hot spot, the temperature of the oil at the moisture sensor and the ambient temperature which all for the analytic model.

An example of correlative analysis could be partial discharge (PD) measured on a transformer bushing tap. Partial discharges can be the overhead lines or the bushing surface, or the bushing internally, and it is necessary to determine which. PD appearance and disappearance for longer periods, mostly related to climatic conditions, will give an indication of external discharges (e.g., surface discharges on the surface of the bushings or corona discharges on the overhead lines).

Besides reliable capturing the data for the chosen parameters, relevant information needs to be extracted. Using a PD example again it would mean, that PD impulses must be related to its position in phase of the line voltage, which then allow to combine the single impulses to different pattern types (PRPD pattern – phase resolved partial discharge pattern; 3D pattern; point of wave etc.). Adding the time of occurrence will also give additional information for the analysis of the PD. Comparing for example the time of arrival or/and amplitudes of the same PD impulses at different sensors will give further useful information about the origin of the PD. Thus collected data must be analyzed through different abstraction levels (analyzed by simple logic or sophisticated artificial neuronal network approaches, fuzzy logic etc.) and further verified with the help of other correlated related data (e.g. PD and Dissolved Gas Analyses – DGA – for transformers).

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Correlative Analyses to Increase the Reliability of Transformer Health Assessment

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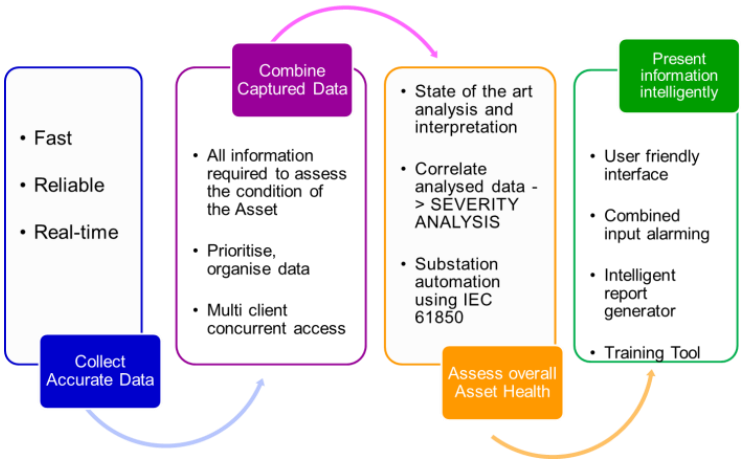


Information Extraction Approach

Correlative analyses makes use of one or several relevant parameters or even results out of the analytics to support or to contradict a certain assessment. That will increase the confidence in the result of the risk assessment drastically. Table 1 shows an example of correlative analytic models for failures in the magnetic circuit considering different parameters and its detection time.

Table 1: Magnetic circuit correlative analyses

	Component	Failure mechanisms	Analytical model	Measured signals/ parameters	Detection time
Magnetic Circuit	Core ground lead	Loss of core ground	DGA Model	Hydrogen or multi-gas	Hours
	Magnetic shield	Unintentional core and shield grounds create problems and discharges	Core Ground Current Model	Core ground current	Days
			Gas Accumulation Rate Model	Gas accumulation	Real time
			Thermal Model	Core hotspot (Fiber) Temperature	Hours
			PD Model	PD	Real Time

In the example shown in table 1 there are 5 different analytic models available, which can support or contradict a certain assessment. For each of the models different input parameters need to be gathered and each of the models/ parameters has its own detection time. It is useful to use more than only one analytic model for a certain failure mechanism. For the case above, most probably the DGA model, the core ground current model and the PD model would be the best fit. in that case the parameters to measure are dissolved gases, PD and the core ground current each which has its own detection time. To be effective, modern CBM systems require both sophisticated on-line monitors as well as analytic models and correlation of data from several sources. Although the examples here are from Transformers, such techniques have been applied to rotating machines and other electrical equipment.

Product Development News

Hazardous Location PDTracII™

A Hazardous location PDTracII (ATEX/IECEx, C-US, Inmetro) has undergone many enhancements and is scheduled to be released in July. This release will bring the older Hazardous Location PDTrac in-line with the current conventional PDTracII hardware and software. Users who currently are using the older Hazardous Location PDTracII, should note for future purchases, this new version has a larger mounting footprint than the current version.

GuardII 4208

The Iris Power GuardII 4208 is scheduled to be commercially available in November 2018. This is the natural evolution of the GuardII with major improvements including upgraded hardware to allow for 4 technologies in one instrument, and specific improvements to the endwinding vibration module.

The 4 technologies in one instrument continuously collecting data on one asset include:

- Shaft current and voltage
- Endwinding vibration
- Rotor flux
- Partial discharge

The endwinding vibration module will now be 32 channels of simultaneously collected data and other notable improvements include:

- Individually setup channels allowing for flexible sensor installation locations.
- Smart triggers to initiate data collection based on changes to the vibration levels or operating conditions of the asset (provided by Modbus through TCP/IP).
- Additional alerts for improved classification of vibration into moderate, high, and very high.
- Advanced diagnostics with operating deflection shape (ODS) analysis to determine the global vibration pattern of the endwinding with several measurement locations.
- Additional trend capabilities including acceleration, velocity, displacement, amplitude and phase (relative to shaft trigger) at specific frequencies.

This release of GuardII will also include an improved Iris Application Manager (IAM) software package.

2018 Training Courses

ELCID TRAINING
October 23-25, 2018
Iris Power Facility
Toronto, Canada

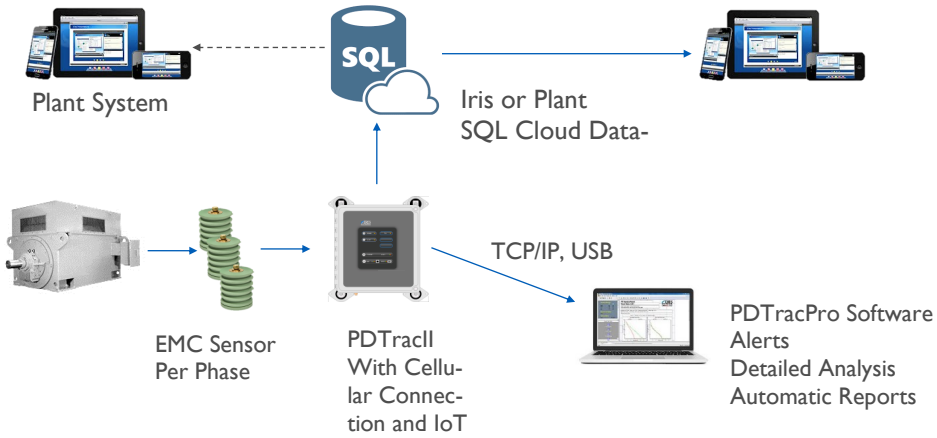
PARTIAL DISCHARGE COURSE
October 23-25, 2018
Minneapolis, MN

HYDROGENERATOR MONITORING COURSE
November 6-8, 2018
Portland, OR

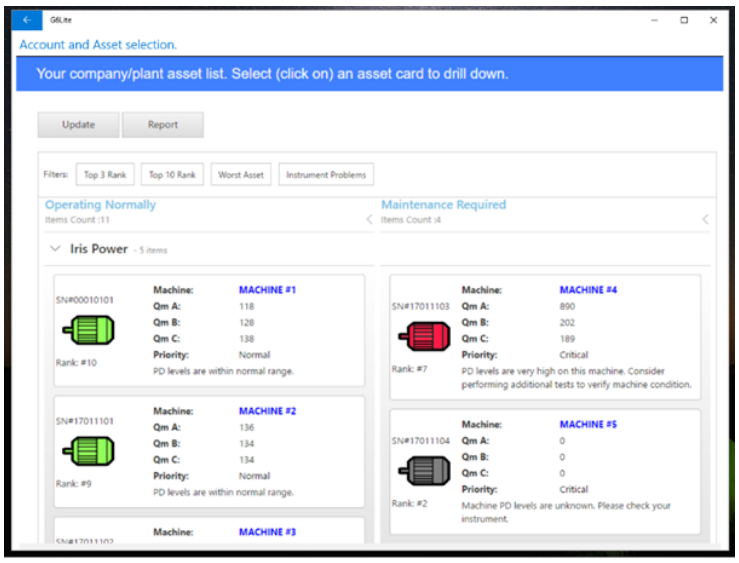
For more information, contact:
khoward@qualitrolcorp.com
or visit the Learning Center at
www.irispower.com

Cloud Enabled PDTracII Instruments

Iris Power is piloting 5 Cloud enabled PDTracII Instruments in North America and Europe to investigate the potential of incorporating this technology in condition monitoring of rotating machines. The pilot versions are using cellular connections to push PDTracII data to a SQL database in the Cloud. A Web based application suitable for computer or mobile phone use, provides data viewing from any location with Internet access. The PDTracII supports both the traditional local interfaces via TCP/IP or USB as well as Cloud connectivity.



Web Based Software Interfaces will provide an Asset Status display with summary condition information including location, motor names, warnings, alerts, partial discharge levels and trending



The main challenges to overcome are: 1) aligning the plant maintenance cycles that are relatively much larger, with the information technology required in an IT (software and hardware) environment that is often in flux; and 2) the major concern in data security which has led to monitoring systems purposefully being designed to not be capable of data transfer data outside of the plant network.

Iris Rotating Machine Conference - IRMC

The 21st IRMC was hosted in sunny Long Beach California in early May. About 100 attendees from all over the globe joined this technical conference. As usual, out of 4 days of conference, day 1 and 4 were training sessions which include Partial Discharge Theory & Interpretation by Howard Sedding, Stator Core Testing hosted by Mladen Sasic, Advance PD Interpretation by Greg Stone and Stator Endwinding Vibration by John Letal. Bill Thompson from EM diagnostic presented induction motors mechanical faults and the case for vibration monitoring.

Day 2 and 3 were full of technical sessions presented by industry experts to highlight their issues and experiences. Some highlights included a presentation by Sang Bin Lee from Korea University and Korea Electric Power Company on experience with insulation testing and failures. POSCO from Pohang Korea the failures they have encountered and showcased their rotating machine diagnostic methods. Gabor Csaba from Fortum discussed interesting details about Lifetime Assessment (LTA) using failure mode concepts. Steve Kilmartin's presentation was focused on generator condition monitoring with GCM-A. Howard Moudy brought his many years' experience with a case study about Turbine generator repair after Cycling Fatigue Failure. BC hydro reviewed corona discharge on a 275 MVA generator in their fleet. Attendees were very interactive with lots of questions after each session.

Bill Thompson Receives the C.V. Maughan Rotating Machines Award "For Dedicated and Innovative Research into the Condition Monitoring of Motors" from Iris GM Joseph Mbuyi

The full technical program for this years IRMC is at https://irispower.com/courses/iris-rotating-machine-conference/

Save the date
22nd Iris
Rotating Machine Conference
IRMC
May 6-9, 2019
New Orleans, LA