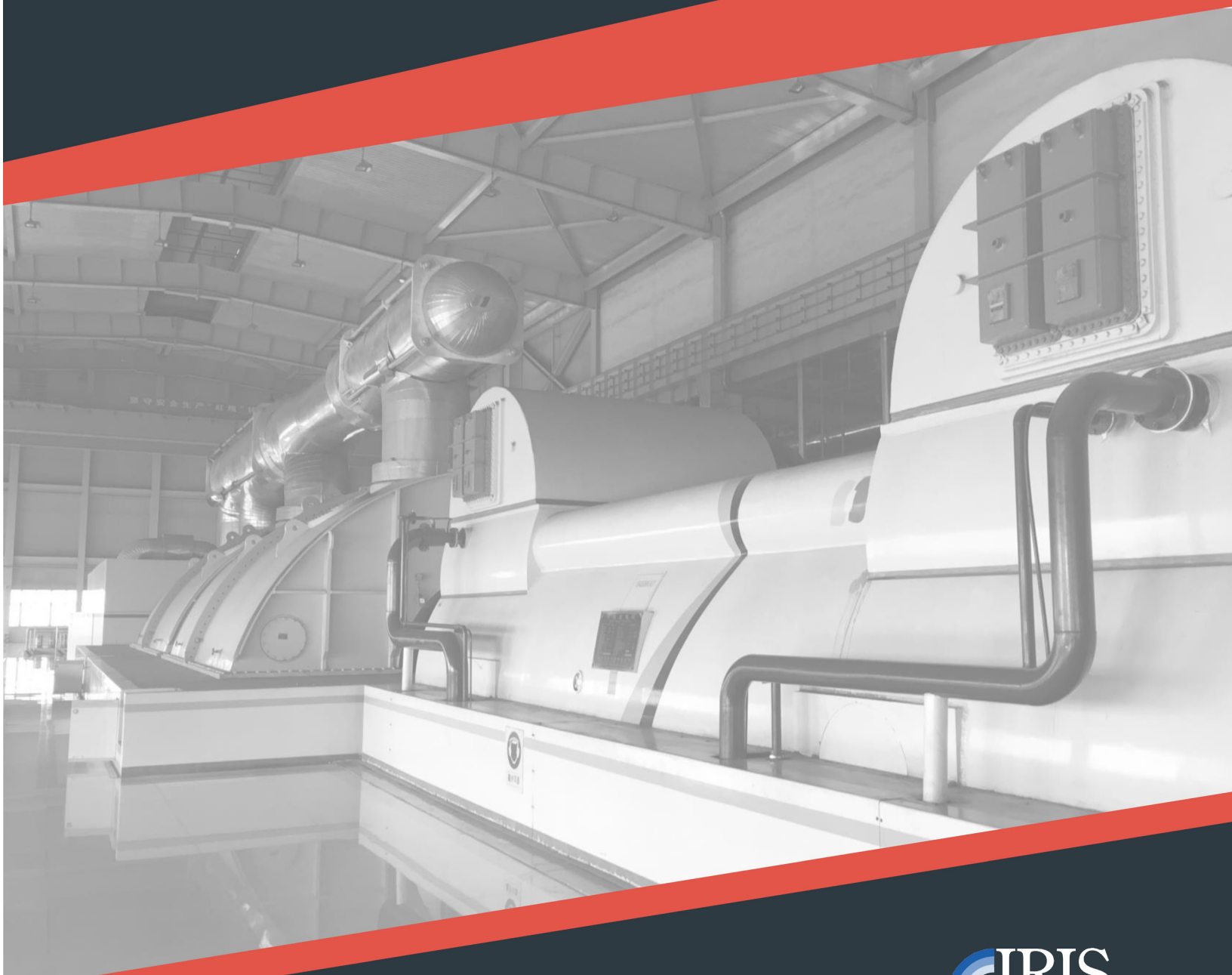
IRIS POWER

OFF-LINE TESTING SOLUTIONS

QUALITROL®
Defining Reliability



IRIS POWER
A QUALITROL Company

MANAGE YOUR RISK

Qualitrol-Iris Power is the world's largest provider of asset monitoring and diagnostics solutions for high voltage motor and generator windings.

CUSTOMER VALUE

>80k
Global sensor installs on rotating machines

#1
Online monitoring provider for motor and generator windings database

>700k
Test results in Iris Power's Partial Discharge Database

OFF-LINE TEST EQUIPMENT FOR MOTORS AND GENERATORS

In addition to periodic and continuous on-line monitoring of rotating machine rotor and stator windings, Qualitrol-Iris Power is the only company that offers a complete selection of tools for motor and generator stator core, wedges and winding insulation condition assessment, including:

EL CID™
Stator core test

RIV™
Robotic tool for EL CID, wedge tightness and visual inspections with rotor removed or insitue

SWA™
Stator wedge analyzer

DCR60™
DC Ramp hipot test

PPM-97™
RF corona probe to locate PD sites

PowerMaxx™
AC test transformer and associated diagnostic instruments

DeltaMaxx™
Off-line PD tester and dielectric loss instrument

DRA3™
DC polarization/ depolarization instrument

All these tools complement the on-line rotor and stator winding instruments and monitors and help plant maintenance personnel better assess the machine condition prior to repairs or rewinds as well as after repairs.

EL CID STATOR CORE TEST

The invention in 1978 of the EL CID test by John Sutton and his colleagues at the British utility – the CEGB – revolutionized the assessment of stator cores in motors, turbine generators and hydrogenerators. For the first time, machine owners could easily and safely detect and locate core lamination problems without performing a "full flux" or "ring flux" test that involve high currents and voltages.

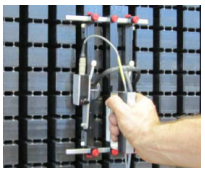
Stator cores, as well as salient pole rotor poles and squirrel cage induction rotors, are fabricated from thin laminations of magnetic steel. The laminations are insulated from one another to prevent the flow of axial currents in the core from the main magnetic field, thus improving the efficiency of the motor or generator. If the thin insulation between laminations becomes shorted, an axial current flows which increases the temperature of the core at the shorted locations. Even if the shorted laminations are not near the winding, eventually the temperature may climb so high that the steel laminations start melting, which rapidly escalates the problem, and could lead to a stator winding ground fault.

EL CID INSTRUMENT

Prior to the development of the EL CID test, the only way to ensure that no shorted laminations of any significance were present was to induce, in the core, a magnetic flux that was almost the same as would occur in operation. For stator core testing, this requires the removal of the rotor, the temporary installation of large, high voltage conductors routed through the stator bore and around the outside of the machine.

For large generators, this coil has to be fed from a high power AC source, often requiring many hundreds of amps and several kV. Once the coil is energized, an infrared thermovision camera is used to monitor the core for hot spots that are caused by lamination shorts. Often this test takes days to perform and is very labor intensive. In addition, the excitation of the core creates certain safety risks. Also, the high flux that is present can lead to dangerous overheating of the core (since no flowing air or hydrogen is cooling the core) that has itself damaged the core. EL CID overcomes all these problems.

The key advantage of the EL CID test is that it is performed with a low magnetic flux – typically only 4% of the normal operating flux in the core. Rather than depending on core heating to detect the shorted laminations, the shorts are directly detected by a magnetic flux sensor (a Chattock coil) that is manually or robotically scanned over the inside bore of a stator core, or the outside surface of a rotor. Directly detecting the axial currents (and their associated magnetic field) is much more sensitive to both surface and deep-seated lamination shorts than waiting for the temperature to rise in a full flux test.



EL CID TEST ON HYDROGENERATOR STATOR CORE

The EL CID test is easy to perform, requires only a small excitation winding, and most machines can be tested in just one day by one person. Electrical technicians can be trained and certified to perform and interpret the EL CID test in just 3 days with the Iris Power ACE course. See IEEE 56 and P1719 for more information.

SWA™ – STATOR WEDGE ANALYZER

One of the most common stator winding aging mechanisms is when loose stator bars or coils develop due to the loosening of the stator wedges. Loose coils or bars in the stator slots will eventually abrade the insulation as they rub against the stator core under the influence of the magnetic forces. Thus, it is essential to keep the wedges tight to ensure a non-vibrating winding. Coil or bar looseness can be detected by the on-line PD test.

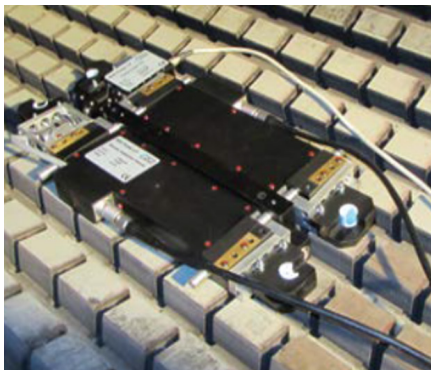
Historically, the wedge tap test has been performed to subjectively determine if the wedges are loose. This requires the rotor to be removed and an expert taps each wedge to determine if the wedge is loose, medium or tight, based on sound and vibration through the fingers.

A map is then manually made of slot number vs. axial position based on this subjective indication.

The IRIS SWA is the world's best selling objective wedge mapping device. The SWA probe is positioned on a wedge test point, magnetically attached to the stator core and a calibrated "hammer" taps the wedge. A built in accelerometer detects the vibration in the wedge due to the tap and proprietary algorithms convert the vibration into a Relative Tightness Indicator scale and software automatically creates a wedge tightness map. Furthermore, like the EL CID sensor, the SWA sensor can be mounted on the Iris Power RIV 800 robotic vehicle so that wedge tightness maps can often be produced without removing the rotor – a huge reduction in the cost of performing this test. See IEEE 56 for more information.

RIV 800™ – FOR ROTOR-IN and ROTOR-OUT EL CID, SWA AND VISUAL ASSESSMENT

Historically, finding loose wedges or stator core lamination problems has required that the rotor be removed. With the RIV 800 robotic device, which can crawl along stator core teeth with or without rotor in place, it is often possible to find loose wedges and core problems without removing the rotor of a turbogenerator. With the video camera mounted on the RIV, it is also possible to visually examine the stator core, vent ducts and even the rotor surface. Not having to remove the rotor results in a significant reduction in time and cost in completing these tasks. Even more important, rotor removal and insertion is a high risk endeavor where significant damage can occur to the rotor or stator.



Thus the RIV reduces the risk of problems associated with rotor removal and insertion.

Most of the world's major generator manufacturers use the RIV and associated SWA and EL CID devices to perform rotor-in inspections for their customers.

DCR-60™ – DC RAMP HIPOT TESTER

The DCR-60 is an instrument that slowly and smoothly increases the DC voltage on coils or windings up to a maximum of 60 kV dc, while measuring the current. DCR-60 can be used in automatic ramp mode or manual mode, as a conventional hipot instrument, as described in IEEE 95.

The tester has several advantages over conventional DC high potential (hipot) tests:

- Often the DCR-60 tester will show an abrupt increase in current as the voltage increases. This sudden increase is an indication that groundwall insulation failure is imminent, and the test should be aborted to avoid a complete stator insulation failure. Thus the DCR-60 tester enables a hipot test with a lower risk of a test failure. For companies that are wary of a failure due to a conventional hipot test, this provides some comfort.
- A built-in discharge circuit for safe discharge of energy stored in the winding during the test.
- A record of the current vs. voltage/time is automatically recorded and can be used in comparison to future tests to determine if the leakage currents are significantly higher.
- It is much less likely for test operators to accidentally apply a higher voltage than anticipated to the winding, avoiding unnecessary winding failures.

PPM-97™– RF CORONA PROBE TO LOCATE PARTIAL DISCHARGE (PD) SITES

The on-line PDA and TGA tests identify which stator windings have high PD, and consequently most at risk of stator winding insulation failure. However, these on-line tests do not enable users to find exactly which coils or bars have the highest PD. In the late 1940s, Westinghouse developed the first corona probe to help locate the parts of the winding with the highest PD. In the 1960s, the US utility, TVA, published a circuit for a generic corona probe based on a "near-field" antenna and radio circuit tuned to 5 MHz. The PPM-97 probe is the latest embodiment of the corona probe, based on the original TVA probe, with more advanced RF circuitry.

When PD occurs, it generates radio frequency signals. As the signals propagate away from the PD source, they lose signal intensity. The PPM- 97 probe works by detecting these RF signals. The closer the probe's antenna is to the site, the higher is the detected signal, which is measured in mA. By scanning the PPM-97 antenna over the entire stator winding while it is energized to rated voltage, the PD sites can often be located to within a few centimeters.

Furthermore, many years of experience has shown that if the PD magnitude for epoxy mica exceeds 20 mA, then serious PD is occurring. This pass-fail criterion is stated in IEEE Standard 1434 and is used by many companies as a Quality Control criteria in acceptance of new bars and coils.

PPM-97 WITH CARRYING CASE

PDTECH DELTAMAXX™ LOSS FACTOR AND OFF-LINE PD TESTER

The PDTech DeltaMaxx digital system determines with high precision the dielectric loss factor (power factor or dissipation factor), capacitance, and partial discharge activity in generator and motor windings, transformers, and cables and capacitors. Different models are available, rated up to 50 kV AC. Part of the kit is a PD calibrator used for measurement result normalization. The DeltaMaxx software automatically generates a test report in nanocoulombs in MS Excel, with all measured parameters and graphical representation of results.

LOSS FACTOR/CAPACITANCE TEST:

The system measures the high voltage applied to a test object via a reference capacitor. The current is measured by the voltage drop across an external shunt resistor. Both are processed by a 16-bit A/D converter. The phase angle between the high voltage and the current is determined by novel algorithm, which allows the calculation of the loss angle and automatic elimination of several potential error sources. This instrument is compliant with IEC 60034-27-3 and IEEE 286**.**

PARTIAL DISCHARGE TEST:

The DeltaMaxx measurement unit contains the necessary coupling capacitor, pre-amplifier and signal processing within one enclosure. Digitising takes place in the measuring unit to measure PD. This technique allows the unit to be placed in the direct vicinity of the test object and long signal cables, which could pick-up interference, are no longer necessary. The DeltaMaxx measures PD in the low frequency range and is compliant with IEC 60270, 60034-27-1and ASTM D1868.

PDTECH DELTAMAXX™

PDTECH DRA-3™ DC DIELECTRIC RESPONSE ANALYZER

The dielectric response analyzer is used for insulation diagnosis for generators, motors and transformers, using the polarization-depolarization current (PDC) method. It measures the DC charging and discharging currents of stator or rotor winding insulation, including testing between the phase and ground and between different phases, and provides more diagnostic information than the more common IR/IP test.

The PDTech DRA-3 System allows you to connect all three phases and the ground at one time. The phases are measured sequentially step by step, without any interaction from test personnel. The measurement steps are automatically controlled and results stored by a computer connected to the instrument. The DRA-3 can also provide Insulation Resistance Profiling (IRP) chart as described in IEEE 43.

PDTECH POWERMAXX™ 50/60 HIGH VOLTAGE SUPPLY

The PDTech PowerMaxx is a flexible PD-free 50/60 Hz AC power supply for energizing stator bars and windings up to 15 kV rms. The transformer can supply up to 0.85A, and when used with additional compensating reactors, the system can supply loads up to 1 µF. The system is fed from a 400 to 480 V, 40 A single phase power outlet and suitable for air-freight, since the dry type transformer and reactors are packaged in convenient size modules.

The PowerMaxx facilitates off-line stator winding tests such as PD, dissipation factor, tipup with a built-in DeltaMaxx device. The PowerMaxx can be used as a power source for other high-voltage tests such as the Corona Probe test, etc.

PRODUCT COMMISSIONING AND TESTING SERVICES

Iris Power's philosophy is that machine owners should be given the tools that enable them to install, on their own, the various types of sensors and monitoring instrumentation that we produce. Also, machine owners should be able to perform data interpretation, if they choose. We can do this since we have deliberately tried to design products that can be used by plant staff with usually just a few days of training. Iris Power has short training seminars for the installation, commissioning and use of its sensors, monitors and portable instruments.

However, if customers choose a third party to help them within installation, commissioning and interpretation of any of our off-line tests or on-line monitors, Qualitrol-Iris Power has a large team of specialist technologists and engineers to facilitate this.

OFF-LINE TESTING SERVICES

Advice, supervision and training on the installation of all its products on machines:

- Testing services using all the instrumentation that Iris Power produces for stator and rotor windings, as well as training of customers who wish to do their own testing and interpretation
- World-class courses on the maintenance of different types of motors and generators
- Consulting services for winding condition assessment, failure investigations, as well as new machine and rewind specifications

The specific services and testing Qualitro-Iris Power performs via its Field Service Group include:

- PD sensor location selection, installation advice, and sensor commissioning for optimum performance
- Flux probe location and installation advice
- Fiber-optic endwinding vibration sensor location and installation
- Continuous PD, flux, endwinding vibration (using bump testing) and air gap monitor installation advice and commissioning
- On-line PD testing services and interpretation.
- On-line rotor winding shorted turns testing and interpretation.
- On-line endwinding vibration testing services and interpretation.
- On-line induction motor rotor broken bar detection testing and interpretation.
- Seminars and training on any of these subjects

Iris Power manufactures a range of off-line test instruments to help machine owners and operators assess the condition of rotor and stator windings. Iris Power offers short training seminars on how to use the test equipment and how to interpret results for all the off-line testing equipment it manufactures, including:

- EL CID stator core test
- SWA wedge analyzer
- Endwinding bump (natural frequency) testing
- DCR ramp test hipot unit
- Off-line PD and dissipation factor tip-up

In addition to training, Iris Power can provide testing services and interpretation reports for all of these off-line test tools.

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