IRIS POWER ENGINEERING

Diagnostic News

Iris Power Engineering

WINTER 2004

Your Source For Monitoring the Reliability of Electrical Equipment

IN THIS ISSUE:

WHAT IS AN INVERTER DUTY MOTOR?

Greg Stone, Iris Power Engineering

Surprisingly, almost any motor can now be called an inverter duty motor - that is there are few agreed-upon requirements for a motor that is connected to a modern inverter. Soon, at least as far as the motor's electrical insulation system is concerned, a new IEC standard may define the capabilities of an inverter duty motor. Once approved, this new standard may have an enormous commercial significance both for motor manufacturers and inverter motor users

For the past 3 years, an IEC working group (IEC Technical Committee 2 (rotating machines), WG27) has been determining what insulation tests an 'inverter duty motor' must be able to withstand. Although IEC 60034 -18 Part 41 (as it will eventually be called) is still in a state that changes may occur, the main features of this new document are becoming clear.

There will be two main types of motors covered:

- Type I motors where the stator windings are not expected to encounter partial discharges (PD) either when new, or for any time during its exected life. Type I insulation systems are usually 'random wound' machines, typically rated less than <690 V. The expectation here is that once PD begins, the insulation will degrade due to erosion caused by the PD, resulting in premature failure. Thus the designer has to make sure that PD will never occur during the useful life of the motor.

- Type II motors, where PD is expected during normal operation, and the motor manufacturer has designed the insulation to resist failure due to the PD. Normally, Type II motors will have form wound coils in the stator.

For each insulation type there will be two kinds of tests:

- Tests done for each motor design (design tests) to show that the insulation system design and manufacturing method can be expected to yield a satisfactory life. For Type I insulation systems, this is using the standard test procedure of thermal plus environmental aging used to determine the thermal classification of an insulation system (i.e. Class B, F, H, etc.) augmented with a PD diagnostic test during the aging to ensure that the PD inception voltage (PDIV) stays above a specified voltage. For Type II stators, the aging test is done on the turn, ground and stress control components separately. The idea is to make sure that heating and/or PD caused by the repetitive voltage surges from the inverter do not significantly shorten the insulation life.

- There will also be an acceptance test that will be done on a percentage of production motors or coils, to ensure a sufficient consistency of quality. For Type I motors, this will involve the measurement of the PDIV on production machines, such as that already being done by at least one motor manufacturer, as described in a recent paper to the September 2004 IEEE Petroleum and Chemical Industry Conference. For Type II stators, this will be an endurance test at high voltage and temperature on a few coils to ensure that the insulation life is sufficient.

Many details of the new standard remain to be established, including test methods to measure the PDIV. Thus it is expected that it may still be 1-2 years before the new standard is published. In the meantime, those interested in studying the latest draft standard should contact their national member of the IEC rotating machines committee, to obtain a copy of the draft.

Plan to attend next years IRMC

JUNE 13-16, 2005

SCOTTSDALE, ARIZONA

For more information, please contact KIM ZARB at kzarb@irispower.com or 416-620-5600 extension 240.

OUR UK OFFICE HAS MOVED TO:

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Please be sure to update your contact information.

NEW MANAGEMENT APPOINTMENTS

BLAKE LLOYD MOVES TO SALES DEPARTMENT, PAUL MAGDER TAKES ON NEW ROLE IN DEVELOPMENT

Iris Power Engineering is pleased to announce the appointment of Blake Lloyd as the Vice President of Sales. Blake is an Electrical Engineer with extensive experience in instrumentation and product development.

Blake worked in software development and then in the Electrical Research Department at Ontario Hydro, where he was responsible for conducting research into advanced measurement, testing, and diagnostic monitoring techniques for rotating machines and insulation systems.

Since co-founding Iris in 1990, Blake has been the principle architect of Iris' line of partial discharge related instrumentation and analysis software. He has written over 30 papers, has 2 US patents, and is a Registered Professional Engineer in the Province of Ontario, Canada.

Paul Magder will now be moving from the sales department to direct the activities of Iris' Product Engineering and Development group. Paul has spent the last two years as the VP of sales and previous to that was the manager of production. Paul has been with Iris for 10 years. He is a certified electronics technologist and before coming to Iris worked in a variety of industries overseeing manufacturing operations.

These changes will enable Iris to continue to provide our customers the resources and the products that have established Iris as the industry leader in monitoring services of large motors and generators. Blake can be reached at blloyd@irispower.com, and Paul at pmagder@irispower.com.

IRIS GUARD SYSTEMS

The 'Guard' line of continuous monitors was first introduced in 1994, and was then the world's first commercial system that continuously monitored the partial discharge (PD) activity on motors and generators. Since its introduction, specialized versions of the Guard monitors have been introduced:

- TurboGuard for use with SSC PD sensors
- BusGuard for use with 80 pF couplers on the output bus of a motor or generator
- HydroGuard for use with 80 pF couplers installed within hydrogenerator stators.

The Guard line is a premium continuous PD monitor which can tag each PD measurement with motor or generator operating conditions such as kV, MW, temperature, etc., to enable the most reliable trending of PD and the most sensitive detection of developing insulation system problems. The Guard instrumentation can acquire the operating conditions directly from analog sensors. It also acquires the PD as a function of the AC phase position to enable determination of the cause of any stator winding problems.

Many systems have been installed all over the world in the past 10 years. To maximize the benefits of the Guard hardware, Iris has been completely rewriting and upgrading the control software. The new software, which will be released in early 2005, operates on Windows 2000 and above, and has much greater flexibility for triggering and storing PD results. In addition, users can easily see at a glance the PD activity levels for all monitored machines, and determine system status.

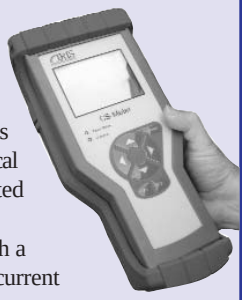
Please contact Iris for more information on the features of this new control software.

BECOME A CSMETER REPRESENTATIVE

Iris Power Engineering is currently seeking product representatives, for the CSMeter product line.

Features of the CSMeter:

- Online testing: no need for shut down or interruption.
- On-the-spot diagnosis
- Designed toguard against false alarms if gearboxes and other mechanical drives are connected to the motor.
- Captures data with a single clamp-on current probe
- Portable, easy and safe to use



Please contact **CSMeter@irispower.com** for further details.

CASE STUDY

CSMETER FINDS BROKEN ROTOR BARS

BACKGROUND

A CSMeter test was performed on a 4160V, 4000hp motor with a rated speed of 1792rpm at a gas separation plant in Texas in September 2004. The test was performed blind, i.e., the tester was not told about any problem with this motor and tested only knowing the necessary motor nameplate parameters.

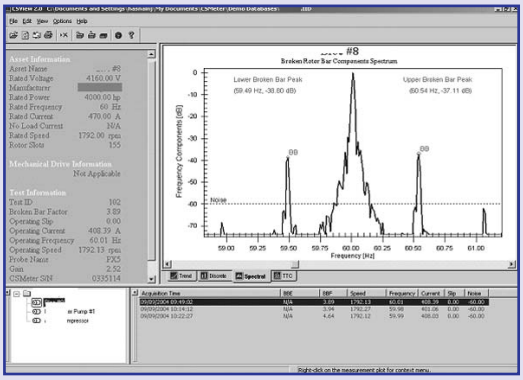


Figure 1: Frequency Spectrum and Motor Data

TEST RESULTS

The motor name-plate data such as the rated hp, rated current, rated speed and also the main phase CT ratio was uploaded to the CSMeter in approximately 2 minutes. The test was taken by clamping around the secondary side of a main CT with a 5A/1V current probe. Also keyed in was the number of rotor bars in the motor: in this case the motor had 155 rotor bars.

CSMeter returned a diagnosis of 3.89 broken bars and displayed a frequency spectrum showing broken rotor bar sidebands on the LCD screen after acquiring and processing the data for approximately 3 minutes.

The data was later downloaded to a PC and the graph from the analysis software is displayed in Figure 1. The CSMeter had shown the running speed to be 1792.13 rpm and the load current at 408.4A (87% full load current) as reflected in Figure 1.

Note that the sidebands due to broken rotor bars have been marked "BB" (short for broken bars) in red. The frequency positions of the two symmetrical sidebands due to broken rotor bars are indicated at 59.49Hz and 60.54Hz. Also note the slight skirting effect at the base of the supply frequency spike due to minor load fluctuations.

The dB difference between the fundamental frequency and each sideband is marked at 38.80dB and 37.11dB. The diagnosis of 3.89 broken bars (see Figure 1, BBF or the Broken Bar Factor) is a direct estimate of the number of bars broken. Had the total number of rotor bars not been known CSMeter would have returned an estimate (BBE, or the Broken Bar Estimator) indicating the severity of the problem.

Two other tests were performed subsequently and CSMeter returned BBFs of 3.94 and 4.64 respectively. The customer was informed that this motor had approximately 4-5 rotor bars broken out of a total of 155. (Note: Some information in the graph has been hidden to preserve the identity of the manufacturer and plant).

CORROBORATION

The customer disclosed right after the test that an earlier visual inspection had confirmed that this motor had 4 broken rotor bars and the CSMeter diagnosis was indeed spot-on.

HYDRO 2004

A SUCCESS!

Pauline Reade is pictured above representing Iris at Hydro 2004 in Porto, Portugal. Iris shared a booth with Unifin International, a leading designer and manufacturer of specialized industrial heat transfer equipment.

UPCOMING EVENTS

Dec 5-8 IMC 2004 Fort Myers, FL

Jan 17-20 EPRI International Conference on Electric Generator Predictive Maintenance and Refurbishment St. Petersburg, FL

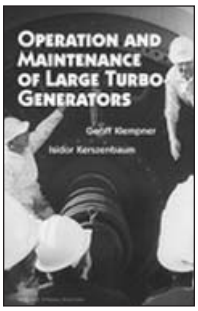
Jan 20-21 INSULEC Mumbai, India

Jan 24-27 EPRI LEMUG Orlando, FL

Jan 25-27 EGC Bizmark, ND

Feb 8-10 EXFOR 2005 Montreal, PQ

IRIS BOOKSHELF



Geoff Klempner, Isidor Kerszenbaum

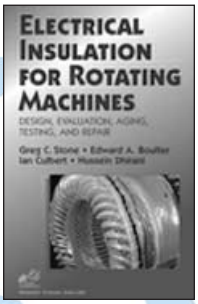
Operation and Maintenance of Large Turbo-Generators is the ultimate resource for operators and inspectors of large utility and industrial generating facilities who deal with multiple units of disparate size, origin, and vintage. It offers the complete scope of information regarding operation and maintenance of all types of turbine-driven generators built in the world.

Based on the authors' combined sixty years of generating station and design work experience, the information presented in the book is designed to inform the reader about actual machine operational problems and failure modes that occur in generating stations and other types of facilities.

Readers will find very detailed coverage of:

- Design and construction of generators and auxiliary systems
- Generator operation, including interaction with the grid
- Monitoring, diagnostics, and protection of turbo-generators
- Inspection practices, including stator, rotor, and auxiliary systems
- Ideas for improving plant reliability and reducing costs and electrical failures
- Maintenance testing, including electrical and nondestructive examination

Operation and Maintenance of Large Turbo-Generators comes filled with photos and graphs, commonly used inspection forms, and extensive references for each topic. It is an indispensable resource for anyone involved in the design, construction, protection, operation, maintenance, and troubleshooting of large generators in generating stations and industrial power facilities. The book is also an excellent learning tool for students, consultants, and design engineers.



Greg Stone, Edward A. Boulter, Ian Culbert, Hussein Dhirani

Electrical Insulation for Rotating Machines: Design, Evaluation, Aging, Testing, and Repair is a single comprehensive resource for the design, application, testing, and maintenance of rotating machines.

Filling a long-standing gap in the field, *Electrical Insulation for Rotating Machines* covers, in one useful volume, all aspects of the design, deterioration, testing, and repair of the electrical insulation used in motors and generators. Lucidly written by leading experts, this authoritative reference provides both historical background important to understanding machine insulation design and the most up-to-date information on new machines and how to select insulation systems for them.

Coverage includes such key topics as:

- Types of rotating machines, windings, and rotor and stator winding construction
- Evaluating insulation materials and systems
- Stator winding and rotor winding insulation systems in current use
- Failure mechanisms and repair
- Testing and monitoring
- Maintenance strategies

Detailing over 30 different rotor and stator winding failure processes and reviewing almost 25 different tests and monitors used to assess winding insulation condition, *Electrical Insulation for Rotating Machines* will help machine users avoid unnecessary machine failures, reduce maintenance costs, and inspire greater confidence in the design of future machines.

For more information on these books and how to order, please visit www.wiley.com