

DIAGNOSTIC NEWS

The Newsletter on Monitoring the Reliability of Electrical Equipment

Iris Power Engineering

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What is the Meaning of Class F Insulation Systems

By: Greg Stone

One of the most common questions that occur in the seminars we hold on winding maintenance is: "Can a Class F winding operate indefinitely at 155C?" The short answer is no, but first a little background is needed.

The nameplate of a motor or generator is required by NEMA or IEC standards to specify the thermal classification of the insulation used in the stator and (if appropriate) rotor windings. This thermal classification is meant to be an indicator of the maximum temperature that the windings can safely operate at. The machine designers would have ensured that the copper cross-section, the amount of steel and the cooling system would all have been sufficient to keep the insulation below this temperature during normal operation. In older machines, the thermal class was referred to by a letter grade: A, B, F or H. Present-day machines may have a numerical index: 105, 130, 155 or 180, corresponding to the respective letter grades.

Thermal classification is needed because one of the most common reasons for a machine to be rewound is the gradual degradation of electrical insulation in the presence of heat. In general, operation at high temperature causes the chemical bonds in the organic parts of the insulation (epoxy, polyester, etc) to break, leading to the loss of mechanical and electrical strength, as well as the debonding of tape layers. This process is a chemical reaction (oxidation in air-cooled machines), and is characterised by a more rapid chemical reaction at higher temperatures. For over 50 years, machine designers have known that for approximately every 10C increase in operating temperature, the chemical reaction rate will double, and the 'thermal' life

will be reduced by 50%. In addition, different insulation materials have different abilities, and can operate at higher or lower temperatures. Thus both machine designers and users need to know the capabilities (classification) of the materials used. For example, asphaltic mica groundwall insulation will degrade at a much lower temperature than a modern epoxy mica or polyester mica insulation system.

The present system of assigning a thermal class (B, F, 130, 155, etc) involves measuring the absolute capability of each material, and determining the relative capability of an insulation system consisting of several materials.

The absolute capability of various materials is determined according to procedures outlined in IEEE 1 and 101 or IEC 60085. Insulating material specimens are exposed to different temperatures, and the aging time for a, say, 50% drop in tensile strength or electrical strength is determined. Using statistical methods, the aging temperature that produces a 'life' of 20,000 hours (about 3 years) is called the thermal class. That is, a Class F (155) material will have been demonstrated to endure about 3 years at 155C. Similarly, Class A, B, and H materials will endure 3 years at 105, 130 and 180C respectively.

The ability of complete insulation systems (for example turn insulation, ground insulation, side-packing and wedges) is measured on a relative, rather than absolute basis. Using 'formettes' or 'motorettes' which are models of the insulation system, the systems are exposed to various aging temperatures to determine their life (see for example IEEE 275 or IEC 60034-18). The

~ Continued on pg. 2 ~



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Our Deepest Condolences...

It is with deep regret that we announce the recent passing of Ron Hoffman, our Field Services Specialist in Reno, Nevada. Ron succumbed to extensive injuries suffered in a car accident. He was one of those special individuals that few of us have had the good fortune of knowing - but for those of us who did, it was a great privilege working with him. He will be greatly missed.



IRMC 2001...

By: Marta Blocki

Just around the corner



Iris's 4th Annual IRMC (Iris Rotating Machine Conference) is well on its way. We are expecting a promising turn-out this year, at the Hilton Alexandria Mark Center in Alexandria, Virginia, commencing June 25-28, 2001. In addition to our preliminary program, we are currently in the process of releasing our final program, which will specify the final details regarding paper presentations and tutorials.

The IRMC is one of the few non-commercial conferences dealing exclusively with practical problems in operating and maintaining motors and generators.

Apart from our technical program, we will also be offering several tutorials, designed to educate plant maintenance personnel on predictive maintenance and test methods. Some of these tutorials will include: Condition-Based Maintenance for Stator Windings, Partial Discharge Theory, Introduction to Current Signature Analysis, Introductory/Advanced Partial Discharge Interpretation, and much more.

To download more information pertaining to this event, including conference and tutorial registration forms, visit our website at: www.irispower.com (events section) or contact Kim Zarb at (416) 620-5600 X 240 or e-mail: kzarb@irispower.com

We anticipate your participation.

"I enjoy the IRMC, and I think it is the best value international conference on large rotating machines around. It deals with just the issues I need to hear, has all the people I need to meet ..."

Rotek Engineering,
South Africa

What is the Meaning of Class F Insulation Systems (Continued from pg 1)

life of the insulation system under this test is then compared to a 'service proven' system tested in the same manner to determine the thermal classification of the new system. Thus, if a new system had about the same life under the test as a service proven system, the new system would be assigned the same thermal class as the proven system. If the new system could achieve the same life expectancy under a test, while being exposed to temperatures of 25C or more higher than the service proven system, then it would be assigned a thermal classification one step higher. For example, if an epoxy mica system could achieve the same life at test temperatures 25C higher than that obtained by an asphaltic mica system that had already been classed as Class B (130), the epoxy mica system is classed as Class F (155).

Note that insulation systems (and thus the nameplate rating) are rated based on a relative system capability, not an absolute capability. The key here is the service experience of the 'service proven' system. This comes from the historical thermal classification. Class F systems were rated in comparison to class B sys-

tems. The Class B systems were rated compared to Class A systems. Class A systems were rated based on experience in the 1950's. Unfortunately, the older insulation systems were never operated at temperatures anything near their material rating. The vast majority of machines rated Class B never operated above 80C or so (far below the material rating of 130C). Thus, it is not surprising that Class B systems easily achieved a satisfactory 30-year winding life without thermal failure.

Today, many motors and generators are being designed to operate at increasingly higher operating temperatures using the same Class F insulation materials. It is not reasonable to expect the same winding life from such machines, unless superior materials (Class H) are used. It is my belief that a Class F stator winding which operates at 145C will not survive for more than 5 to 10 years without a rewind. If we wish to operate machines at higher temperatures, we will need better materials that have Class H materials.

Did you Know...

Iris Power Engineering offers at least three annual maintenance courses alternating throughout Canada and the United States?

That's right! You can embark upon an incredible journey into the fascinating world of **Partial Discharge, Hydrogenerator Maintenance** and/or **Motor and Generator Maintenance**, specially designed to help you monitor the condition of your windings while helping you plan maintenance, based on that condition.

Each course takes place at a fully equipped 4-star hotel, and the package includes a copy of course notes, lunches, snacks and refreshments - all at a price that can't be beat. Our courses are instructed by highly trained Iris personnel with over 20 years' experience in the application and testing of large motor and generator windings.

Alternately, we also cater courses based on your own personal preferences and needs. Simply select the course(s) which appeals to you most, and we will bring our course to *you*. For a

By: Marta Blocki

complete course selection list and flyer downloads please refer to our website: www.irispower.com. Simply fill out the registration form and fax it back to Marta Blocki at (416) 620-1995 for quick and easy registration. Alternately, Marta can be reached by phone at: (416) 620-5600 X 241 or by e-mail at: mblocki@irispower.com

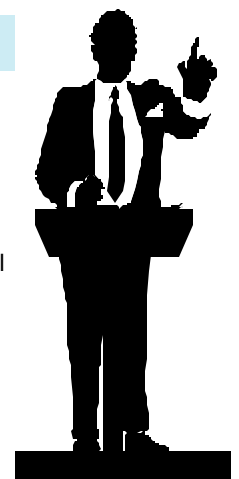
We have just completed a very successful Partial Discharge course in San Clemente, CA, with over 30 participants. It is not too late to register for our upcoming events.

Upcoming courses:

August 14-17, 2001 - Motor and Turbogenerator Maintenance Course, Long Beach, CA

November 27-30, 2001- Hydrogenerator Course, Orlando, FL

We look forward to seeing you there!

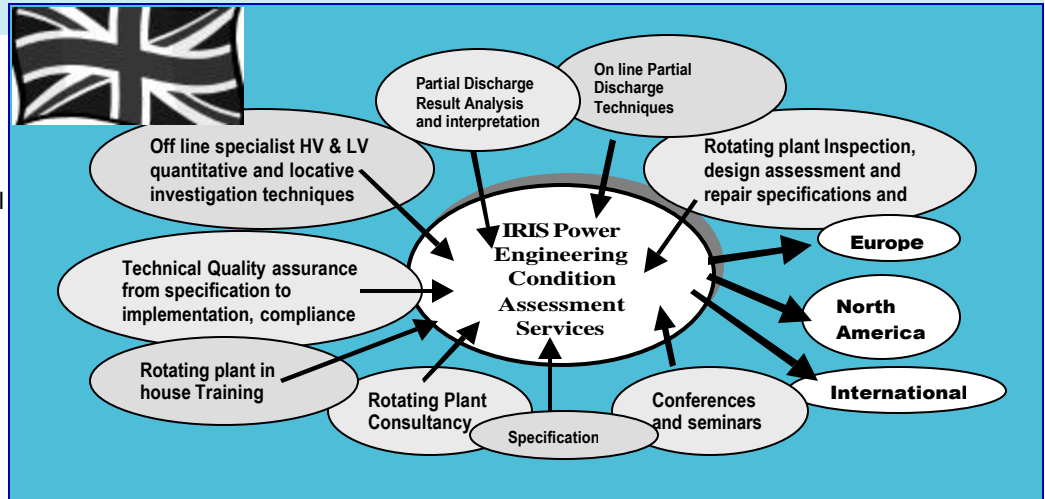


Rotating Plant Total Condition Assessment - an Exciting New Era for IRIS!

By: Andy Brown

The opening of the Iris European Office based in Nantwich, UK, represents an exciting new era for Iris. The expansion into total condition assessment headed by our Technical Director, incorporates the traditional Iris on-line condition monitoring with the added enhancement of services into diagnostic monitoring and consultancy of rotating plants involving:

- *Off-line specialist low and high voltage quantitative and locative investigation techniques and assessment
- *Rotating plant inspection, design assessment and repair specifications and techniques
- *Technical quality assurance from specification to implementation, compliance and conformance



This exciting expansion is centered initially in the UK, but the remit of the Technical Director is to offer the full experience of total condition monitoring services to our clients in Europe and North America. For more details on total condition monitoring assessment services, please contact Andy Brown (UK) (0)1270-615020 Fax 615001, abrown@irispower.com OR Earl Goodeve (Canada), (416) 620-5600 Fax (416) 620-1995, egoodeve@irispower.com.

The European Operation formed on 1st November 2000, operating from the KOCH Glitsch Ltd. offices in the UK, consists of leading technical authorities and engineers, i.e. CEBG and Nuclear Electric / Scottish Hydro, with a combined experience in excess of 100 man years of rotating plant experience. This office has both the specialist low and high voltage equipment, including HV test transformers (rated up to 46kVA, 30kV) and experience to offer total condition assessment to European clients. The European team is complimented by the wealth of experience of Iris engineers in Canada and the US.



Left to Right: Dick Smith, Trevor Thomas, Andy Brown, Kevin Handford, David Brown

Iris Launches "Trac" line of Products

By: Blake Lloyd

Iris is currently rolling out a line of cost effective products for continuous PD monitoring of motors and generators. These include *HydroTrac* (for Hydraulic generators with differential couplers), *BusTrac* (for motors and small turbine generators with bus couplers), and *TurboTrac* (for large turbine generators with Stator Slot Couplers). In addition, we now offer a continuous air gap flux monitor for turbo generators. All of these products can be networked for remote monitoring and acquisition. For more information visit our website: www.irispower.com



FluxTrac installation at Florida Power & Light, Riviera Plant by Iris's Supervisor of Product Development Mark Susnik

Field Service Expands

By: Marta Blocki

Byron Mazariegos

has recently left the Technical Manufacturing Team to join our Field Service Specialists. Byron's new responsibilities include coupler installations, calibrations, and, of course, partial discharge testing.

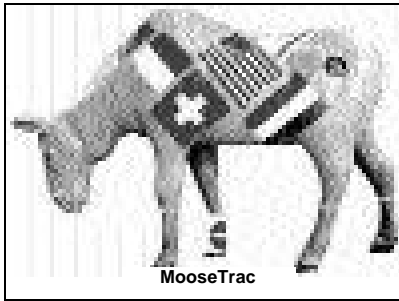
Recreationally, Byron enjoys reading and swimming (hopefully not simultaneously). He can be reached at (416) 620-5600 or at: bmazariegos@irispower.com



Moose from the City is New Iris Mascot

By: Marta Blocki

One of the 326 life-sized moose sculptures which have formerly grazed our Toronto streets has found a new home at Iris after being auctioned for a charity bid recently. "World Trotter," a brightly adorned moose with flags from around the world has been moved into our front lobby from its previous abode at Pearson International airport. The moose is a truly Canadian symbol as it represents Iris's world presence and international market.



The moose has been renamed by Peter Kantardziski, our Senior Manager of International Projects to "MooseTrac," a clever pun on our new line of TRAC instruments and the "moose track" itself. Our sales and field service staff are encouraged to bring back travel souvenirs to decorate MooseTrac, truly making it a very special Iris mascot.

Courses

- *August 14-17: **Motor & Generator Maintenance Course**, Long Beach, CA
- *November 27-30: **Hydrogenerator Course**, Orlando, FL

Conferences

- *April 29-May 1, 2001: **IEEE Cement Industry Conference**, Vancouver, B.C.
- *May 1-2: **VibroSystem Conference**, Orlando, FL
- *May 7-13: **Generator Care Conference**, Australia
- *June 11-13: **Nordic Insulation Conference**, Stockholm, Sweden
- *June 25-28: **IRMC Conference**, Alexandria, VA
- *August 15-18: **EPRI Maintenance Conference**, *Houston, TX

Tradeshows

- *June 24-27: **EASA**, Chicago, IL
- *July 8-11: **Waterpower XII**, Salt Lake City, UT

~ NEW DOMESTIC SALES TERRITORIES ~

Clinton Roache	Derek Mitchell	Jay Hamilton		Rob Lobo	Rajiv Sharma
Arkansas (AR) Illinois (IL) Missouri (MO) Nebraska (NE)	CANADA Alberta (AB) British Columbia (BC) Manitoba (MB) NWT (NT) Ontario (ON) Saskatchewan (SK) Yukon (YT) USA Alaska (AK) Arizona (AZ) California (CA) Colorado (CO) Nevada (NV) Wyoming (WY)	CANADA New Brunswick (NB) Newfoundland (NF) Nova Scotia (NS) PEI (PE) INTERNATIONAL Antigua Aruba Bahamas Barbados English Caribbean Trinidad & Tobago Virgin Islands	USA Alabama (AL) Delaware (DE) Florida (FL) Georgia (GA) Mississippi (MS) New Jersey (NJ) N. Carolina (NC) S. Carolina (SC) Tennessee (TN) Virginia (VA)	Connecticut (CT) Louisiana (LA) Massachusetts (MA) Ohio (OH) Pennsylvania (PA) Rhode Island (RI) Texas (TX) Vermont (VT) West Virginia (WV)	Indiana (IN) Iowa (IA) Kentucky (KY) Michigan (MI) N. Dakota (ND) S. Dakota (SD) Wisconsin (WI) Randy Wallman Idaho (ID) Oregon (OR) Montana (MT) Utah (UT)

~ NEW INTERNATIONAL SALES TERRITORIES ~

Peter Kantardziski		Joseph Mbuyi	Brian Stevenson	Eugene Kazlou	
Bosnia	Macedonia	Austria	Australia	Quebec (PQ)	Korea
Brazil	Poland	Belgium	Burma	Algeria	Latvia
Bulgaria	Portugal	Germany	India	Belarus	Lithuania
China	Romania	Great Britain	Latin America (except Brazil)	Denmark	Malaysia
Croatia	Slovakia	Ireland	New Zealand	Egypt	Morocco
Czech Republic	Slovenia	Italy	Pakistan	Estonia	Norway
Greece	Spain	Netherlands	Spanish Caribbean	Finland	Philippines
HongKong	Taiwan	South Africa	Thailand	France	Russia
Hungary	Turkey	Switzerland		French Speaking Africa	Singapore
Japan	Yugoslavia			Indonesia	Sweden
Middle East (except Egypt)				Israel	Ukraine

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