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Evaluation of the Fretting Resistance of the High Voltage Insulation on the ITER Magnet Feeder Busbars

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The high voltage (HV) insulation on the ITER magnet feeder superconducting busbars and current leads will be prepared from R-glass fabric, pre-impregnated with an epoxy resin, which is interleaved with polyimide film and wrapped onto the components and cured during feeder manufacture. The insulation architecture consists of 7 half-lapped layers of glass/Kapton, which is then enveloped in a ground-screen, and two further half-lapped layers of glass pre-preg for mechanical protection. The integrity of the HV insulation is critical in order to inhibit electrical arcs within the feeders. The insulation over the entire length of the HV components (bus bar, current leads and joints) must provide a level of voltage isolation of 30 kV.

After installation, the insulated bus bars will be supported by a series of sliding supports (steel clamps) and during machine cool-down the approximately 30m long bus bars will slide within these clamps by up to 30mm; the machine design is for 100 cool-downs.
During operation of the ITER device, there will be large (up to 15kN per clamp) Lorentz forces on the bus bars that are reacted through the clamps. Many of the ITER magnets are pulsed and during machine operation the bus bars will slide up to 5mm during each of the 30,000 lifetime pulses.

This worked was aimed at assessing the wear on, and the changes in, the electrical properties of the insulation when cycled through ±5mm for twice the ITER lifetime cycles at a constant load of 15kN. A total of 4 specimens were tested, and the average radial wear (underneath the clamps) after 60'000 cycles was 0.75 mm. This is less than the radial build of the pre-preg layers which cover the ground-screen. High voltage tests demonstrated that the electrical isolation of the insulation was intact after the fretting test.

Disclaimer

The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.

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