ABB OVR-3 Recloser Passes Severe Environment Testing

Environmental effects can drastically reduce the lifespan of any outdoor product. For this reason, tests such as IEC 61109 have been developed to predict the lifespan of products exposed to UV radiation, frequent wetting and drying cycles, variant wind conditions, pollutants, and other environmental conditions.

IEC 61109, Annex C provides a method for comparing and selecting the "best performing" insulators based on one fixed environment. Unfortunately, the tests referenced in IEC 61109, ANSI C29.11, and other similar standards are not able to adequately reproduce aging in multi-variant environments such as Florida (USA), South Africa, and other high contamination areas.

As a result, many utilities perform natural aging tests in severe environments located within their service territories. These tests provide accurate results which demonstrate the true capability of a product to withstand aging from multiple environmental factors.

OVR-3 at KIPTS

One such test site is the Koeberg Insulator Pollution Test Station (KIPTS), which is run by the ESKOM Electric Utility. KIPTS is located 17 miles (27 km) north of Cape Town, South Africa and is characterized as having:

- **Dry summers**
- **High winds**
- **High exposure to UV radiation**
- **Seasonal rainfall**
- **Extremely heavy levels of marine & industrial pollution (salt, etc.)**

This makes KIPTS an ideal location for environmental testing, and as such, is recognized worldwide as the premier natural aging test site.

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1VAL264002-DTR Rev. A April 2007

Pollution Levels

On average, the pollution index (contamination conductivity) at KIPTS averages 2000 µS/cm (500 Ω-cm). This constitutes a "Very Heavy" pollution level as per IEC 60815. In fact, the pollution index at KIPTS is roughly six times higher than the amount required to be classified as having a "Very Heavy" pollution level.

Comparison of Common Pollution Indices

Pollution Level (IEC 60815)	Pollution Index (µS/cm)	ESDD (mg/cm^2)	Minimum Required Specific Creep (mm/kV^1)
Light	0 – 75	< 0.06	16
Medium	76 – 200	0.06 – 0.12	20
Heavy	201 – 350	0.12 – 0.24	25
Very Heavy	> 350	> 0.24	31 ABB OVR = 36 @ 27 kV

Product Aging (Combined Environmental Effects)

Product aging occurs at twice the rate[2] of the 5000 hour IEC 61109 test at KIPTS. Furthermore, all environmental testing is conducted at one of the following system voltages: 11 kV, 24 kV, 33 kV, 66 kV, and 132 kV.

Visual Examination

The following visual examinations are conducted every three months:

- **Hydrophobicity - in accordance with the STRI method.**
- **Material degradation - crazing, alligatoring, discoloration, chalking, peeling, and flaking**
- **Electrical erosion - material loss, cracking, exposure of core, and surface changes**
- **Tracking - carbonized (blackened), conductive pathways formed along an insulator as a result of exposure to electrical field stress, contamination, and inadequate dielectric selection**
- **Puncture – a hole created in an insulating material, after long term erosion**

[1] **Ratio of insulation leakage distance (phase to ground) divided by the maximum voltage (phase to phase) applied to the equipment of interest.**

[2] **As per ESKOM specification SCSPVAC13 – Rev 1A (page 2).**

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Electrical Examination

Leakage currents are monitored to detect any electrical degradation that a test material (insulation system) may have experienced. If the resistive leakage current of a sample exceeds even a few milliamps, it may be damaged. Leakage currents are sampled at 2 kHz, and data logging begins when leakage currents increase above 1 mA. Samples can be energized at one of the following system voltages: 11 kV, 24 kV, 33 kV, 66 kV, and 132 kV (Actual test voltage was 13.9 kV (24 kV/√3) phase to ground for the 27 kV, OVR-3 recloser).

KIPTS has observed that samples which continuously conduct more than 600 mA of leakage current often flashover and may fail. Therefore, any samples that conduct a leakage current greater than 750 mA are removed from the energized circuit by a fuse. If the sample blows three fuses, it fails the evaluation at KIPTS.

Electrical charge is also monitored. Sudden increases in electrical charge may predict the occurrence of undesirable electrical activity such as corona discharges or flashover of a sample.

Environmental Test Parameters

The KIPTS test is conducted as follows for 27 kV Reclosers:

- **For heavy-to-very heavy pollution environments (one year cycle)**
- **For marine and industrial environments**
- **For light-to-medium pollution environments (winter cycle)**
- **For inland non-coastal environments**
- **As per ESKOM specifications SCSPVAC13 and SCSPVAC19**
- **Energized at 13.9 kV phase to ground (24 kV phase to phase)**

The environmental parameters for the OVR-3 test were as follows:

- **Temperature range: 32°F - 100°F (0°C - 38°C)**
- **Natural UV radiation (UVB monitored - Typically 100-350 µW/cm^2)**
- **Rainfall: 0.2 - 1 in (5 - 26 mm) per day; Max = 3.5 in (90 mm) per day**
- **Humidity range: 15 – 95 %**
- **Pollution index: 2000 µS/cm (See above)**
- **Varying wind conditions: 0 - 25 mph (0 - 11 m/s)**

Given the above information, ABB decided that KIPTS provided the harshest real-world environment for testing the OVR Recloser. The 27 kV OVR-3 was tested at KIPTS for one year from May 2004 to April 2005.

KIPTS test site

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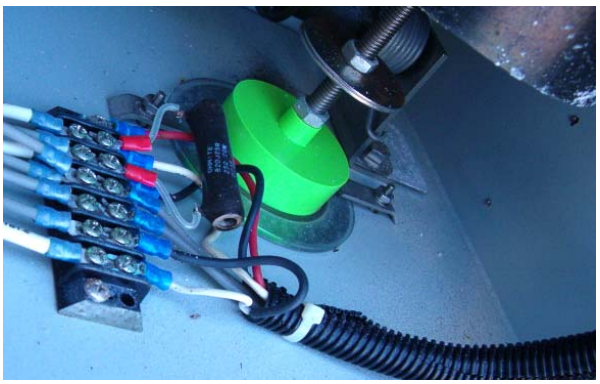
ABB OVR-3 KIPTS Test Results:

- **PASSED** - Testing for use in marine and industrial environments
- **PASSED** - No signs of material erosion, tracking, cracks, or punctures reported
- **PASSED** - No more than one instance of insulation leakage current exceeding 750 mA (only three instances allowed)
- **PASSED** – Heavy-to-very heavy pollution test

No damage to magnetic actuator assembly

- ✓ **APPROVED** - For marine & industrial environments
- ✓ **APPROVED** – For inland non-coastal environments
- ✓ Stainless steel high voltage cabinet and internal components did not corrode even with heater off during entire test



No damage to terminal blocks or indicators

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