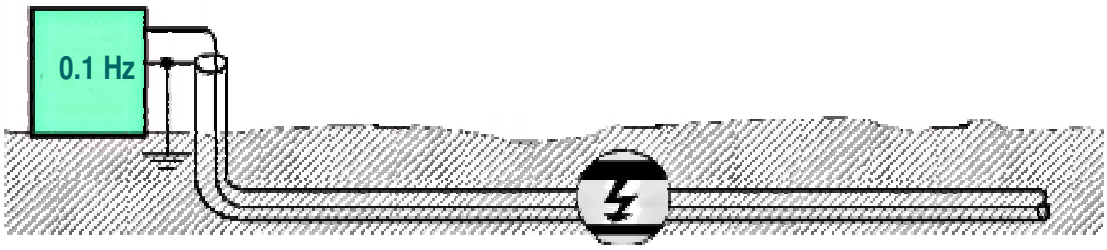
WHY WE MUST PERFORM A VLF INSULATION TEST

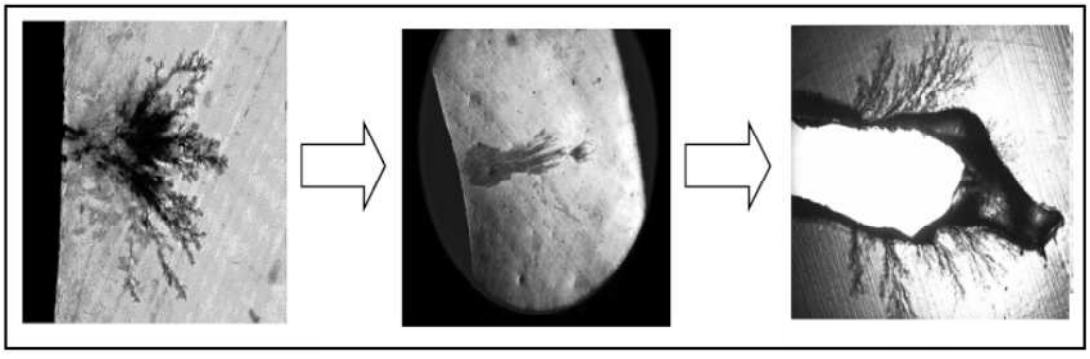
High voltage withstand tests are used within manufacturing plants to ensure the quality of completed cable system components from MV to EHV. Thus, it is quite natural for utilities to also use withstand tests as commissioning and maintenance tests for cable systems in the field.

The goal of these tests is the same as in the factory test, namely to have any weak components of the cable system fail in a controlled manner, such that the minimum number of customers are affected. In fact a recent study (Cable Diagnostic Focused Initiative Project by NEETRAC-Georgia Tech) has shown that withstand tests are among the most routinely employed diagnostic tests in the USA; this study has also shown that the most preferred withstand tests use Very Low Frequency (VLF: 0.01 to 0.1 Hz) AC methods.



The benefits of VLF testing (*Paul Brooker TR Corporation*)

- When testing with VLF and unlike DC Hipot, partial discharge will iniate at the existing defects insight cables insulation. Since these dicharges begin, will lead to cable failure while testing and prior to energization.
- Water trees, which are the main cause of failure in solid dielectric cables, will start forming electrical trees during the test and thus a cable failure will be concluded within test duration. Below is a progression of a water tree to an electrical tree and finally to an isulation breakdown



- Regular routine testing of aged cables has been demostrated to reduce the chance of unscheduled failure to approximately 10% of the failure rate that might be encountered without such testing. Approx. 12% of cables fail during the test and cable repair can then be done in a planned manner.
- Fault location (pin point location) will involve considerable less stress of DC thumber if preconditioning using a VLF tester to ioning and carbonising the insulation at the fault location

Some observations for the VLF withstand test are (based on CDFI results):

- VLF tests are very practical for a utility to perform and do not require specialized services
- The Survivor rates are high for these tests with expected values, based on 1,000 ft (305 m) cable system segment lengths, in the range of 0.2 to 4% for 30 min tests performed at the IEEE Std. 400.2 voltage levels
- IEEE Std. 400.2 provides appropriate time and voltage test levels (determining optimal times and voltages was outside the scope of the work reported here)
- VLF tests at IEEE Std. 400.2 test levels do not significantly damage cable systems as would be manifested by cascading (or multiple) failures on test or shortened times to failure in service
- Data have been collected using both of the commonly used VLF waveforms, there is little evidence of a significant difference in outcomes that can be ascribed to the voltage waveform
- A number of areas for further technically useful work have been identified

International standards and guides

- **DIN VDE 0276 (after laying tests on new cables)**
- **IEC 60502-2:2014 Cables for rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV) (after laying tests on new cables)**
- **IEEE 400-2012 Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems**
- **IEEE 400.2-2013 Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)**
- **CENELEC HD620 S1 (after laying tests on new cables**