

Application: Wind & Solar Farm Cable Testing

Application Description

Testing the cables of a wind or solar farm has become routine. It usually involves **testing 35 kV cable systems** with a **Very Low Frequency (VLF) AC** hipot to perform **AC Withstand testing** and sometimes diagnostic testing, like **Tangent Delta** measurement and/or **Partial Discharge** detection. (If the reader is unfamiliar with VLF technology, read the **Cable Testing – AC Withstand** and **Cable Testing – Diagnostic Methods** Applications.) These tests usually using a 0.1 Hz VLF AC hipot, not 50/60 Hz, as the voltage source to overcome the high capacitance of the long cable runs, sometimes up to 10 uF. Even using VLF technology at **0.1 Hz or 0.05 Hz** rather than 50/60 Hz is sometimes problematic as the cable lengths are often too long to test due to their high capacitance.

Comments: This application is straightforward, but for one frequent problem. Often the cable runs are very long without accessible splice boxes or other access points. The design of the cable systems is often done with little consideration for the testing and fault locating that will be necessary. Also, it is common that the people who design the system with cable lengths of 5 or 10 miles specify Partial Discharge or Tan Delta testing. These tests cannot be effectively done on cable lengths in excess of ~ 2 miles. Further complicating the testing and fault locating is that the neutrals are cross bonded to minimize voltage drop and the related thermal problems, but with no access to the buried linkage boxes. This method of design, driven in large part to keep costs down, needs to change.

The most common test is the **VLF AC Withstand test**. This is a **pass/fail over voltage stress test** performed to insure that the cable insulation, attached accessories, and the terminations are all sound with no damage from installation errors or factory material defects. Since the whole system is new, it can be assumed that all components are healthy except for those that were not installed correctly or damaged during installation. If there is a defective splice or cut in the cable, the test voltage level and the test duration are designed to cause the defect to fail during the test, while not adversely affecting the rest of the healthy cable installation.

Usually the **IEEE 400.2-2012 Standard** for VLF and Tan Delta Cable testing is referenced. This standard dictates that for **Acceptance testing cable rated for 35 kVac, a peak sinusoidal VLF voltage of 62 kVac be applied for 30 – 60 minutes**. Based on the known electrical tree growth rate under these VLF voltage conditions, any defect severe enough to be driven into a partial discharge condition will have enough time to grow and penetrate through the insulation, causing a failure. Find the fault, fix it, and retest.

Diagnostic testing is often performed, especially on older installations, to learn of the cables insulation health but without the risk of a possible failure that a Withstand test poses. The two commonly performed tests are slight overvoltage tests of short duration that are useful in their own ways but provide very different data sets. A **Tan δ (Delta) test measures the degree of insulation deterioration** over the entire cable length. This offers an excellent way of comparing many cables to help prioritize injection/rejuvenation, replacement, or other testing methods that may be beneficial. A **Partial Discharge** test attempts to locate specific places of troublesome electrical discharges and their severity. Both of these tests are limited to perhaps 2 miles or 3 - 4 km.

HVI Product Solutions

HVI produces products for **VLF Withstand, Tan Delta, and Partial Discharge** testing. HVI also offers **high voltage, high energy thumpers** needed for efficient fault finding. HVI can supply these devices separately or designed as a custom package ready to mount.

SKD Series Custom Packages
Cable Testing & Fault Locating

CDS Series Thumpers/Surge Generators/Radar
0 - 5/10/20 kV @ 1000 J & 0 - 9/18/36 kV @ 3200 J

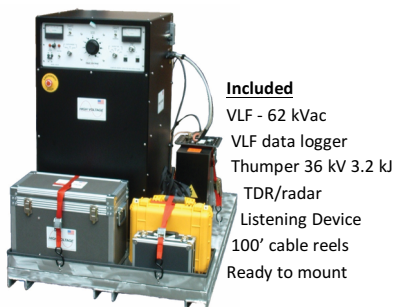
VLF E Series & TD Series

0 - 34 & 65 kVac @ 0.1 Hz.
VLF Withstand & Tan Delta

VLF Series model VLF-65CMF

0 - 65 kVac, 2.2 uF - 22 uF

VLF Series model VLF-6022CMF
0 - 62 kVac, 1.1 uF - 5.5 uF



Included
VLF - 62 kVac
VLF data logger
Thumper 36 kV 3.2 kJ
TDR/radar
Listening Device
100' cable reels
Ready to mount



Cable system is new. Needs **VLF AC Withstand test** to find workmanship errors on splices and terminations and possible cable installation damage. VLF it! Tan Delta and Partial Discharge testing are not really needed now.