

Downtown Power Grid Reliability Assured



Factory Grade® Technology pinpoints severe defects tangent delta tests missed

HIGHLIGHTS

OVERVIEW

Factory Grade® technology pinpoints severe defects missed by misleading VLF tan delta reports and insights into the capabilities of the tests are gained.

CHALLENGE

VLF TD and IMCORP's Factory Grade® technology yield vastly different results.

RESULTS

Once again, IMCORP's Factory Grade® technology proven 100% effective in identifying substandard issues in cable systems and provides Precision Reliability™ feedback to clients while TD results are demonstrated to be inadequate.

A utility client requested IMCORP to proactively assess their cables in a downtown area feeding a convention center. A nationally televised event was coming to town so naturally the reliability of the downtown power grid and avoiding an image-damaging power outage was of utmost importance.

The IMCORP Factory Grade® technology provided a meter-by-meter profile and pinpointed many issues with the cable systems feeding the convention center. The utility was surprised with how many components did not meet the cable and accessory manufacturers' minimum performance standards. While the utility was greatly concerned and intended to make repairs prior to the upcoming event, they decided to get a second opinion with a different type of test called a VLF tan delta (tangent delta, TD) test. To the utility's surprise, the VLF TD test reported everything was okay with the cable systems. Not completely understanding the difference between the TD and Factory Grade® test results, the utility extracted some substandard components pinpointed by the Factory Grade® technology and sent them to two independent laboratories.

The pictures below are a sampling of the issues found during the laboratory dissection and root cause analysis. Many severe issues were found in various states of deterioration with most originating from installation errors. The dissections provided evidence including insulation surface erosion, contaminating fluids, jagged/non-radial semicon cutbacks, and electrical (carbon) treeing more than half way through the insulation. All of these issues were associated with substandard partial discharge (PD) activity! Through this experience, the utility learned 5 lessons. Unlike a Factory Grade® PD test, VLF TD tests: (1) cannot locate defects, (2) only detect issues associated with conduction and losses which, may be more common in legacy paper insulated (PILC) cable systems but are rare in modern solid dielectric (plastic and rubber) systems, (3) are not effective at finding installation issues and are likely to provide a false sense of security to installers, (4) can only provide an average measurement for the whole cable system and even gross aging defects such as the electrical tree (carbon path) in the right most picture below cannot be detected, and (5) cannot be calibrated in the field so the results are inherently unreliable.

Not only were there significant educational benefits to this study, the utility's experience with the power grid is a positive story too. The utility made numerous repairs, placed the system back in service, and the nationally televised event took place without incident. In fact, the utility claims they have had no outages 6 years after the event.



The Manufacturers' Standards



Component Standard	Testing Frequency	Thresholds* Sensitivity	Voltage
Terminations IEEE 48	50/60 Hz	5pC	≤ 1.5 Uo
Joints IEEE 404	50/60 Hz	5pC	≤ 1.5 Uo
Separable Connectors IEEE 386	50/60 Hz	5pC	≤ 1.3 Uo
MV Extruded Cable ICEA S-97/94-682/649	50/60 Hz	5pC	≤ 4.0 Uo ^A
HV / EHV Extruded Cable ICEA S-108-720	50/60 Hz	5pC	≤ 2.0 Uo

* No partial discharge should be observable above the sensitivity threshold up to the voltage threshold
^A200 V/mil



Contaminating fluid inside joint/cable interface



Jagged/ non-radial semicon cutback with evidence of insulation surface erosion



Electrical tree (carbon path) 50% through cable insulation