

# Using Factory Grade® Technology to Identify Damaging Commissioning Test

## VLF Test vs. the IMCORP Factory Grade® Technology

### HIGHLIGHTS

#### OVERVIEW

0.1 Hz VLF test and IMCORP's Factory Grade® technology are compared side-by-side at utility solar site.

#### CHALLENGE

VLF test passes cables but termination were still failing.

#### RESULTS

Based on distribution system experience, utility uses IMCORP's Factory Grade® technology to identify workmanship defects and VLF test induced damage.

A utility client requested IMCORP to commission cable systems at a new generation facility after experiencing several in-service termination failures. The installation contractor had already tested the cable systems with a very low frequency (VLF) test. Many uninformed installers subscribe to the common myth that 'proper' VLF testing will detect serious cable defects while not harming healthy insulation. This case once again provides evidence to the contrary to the myth. Fortunately the utility client had extensive experience with the our Factory Grade® technology on thousands of their distribution cable systems and recommended the site be thoroughly reassessed. Our Factory Grade® technology pinpointed dozens of terminations that did not meet the accessory manufacturer's minimum performance standards (table bottom left). An example of one such termination is depicted below. When the termination was dissected the technicians found workmanship issues, including insufficient void filling mastic and insufficient shrinkage of heat shrink layers. The technicians also found clear evidence of damage (telltale long narrow carbon tree track) caused by the VLF test which passed the terminations only a short time before. This termination most likely would have failed within a short time in service causing significant down time, collateral damage, and losses in generation revenue.

This case illustrates a great example of IMCORP partnering with utility clients to:

- eliminate failure producing defects and provide feedback
- educate installers on the deficiencies of poor installation practices
- educate specify engineers on the false sense of security and material damage yielding from legacy commissioning tests



The Manufacturers' Standards



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

\* No partial discharge should be observable above the sensitivity threshold up to the voltage threshold  
<sup>A</sup>200 V/mil

Table I: Manufacturers' Standards<sup>1</sup>



Outside: Terminations look okay



Inside: Installation defects & VLF test damage

[1] IEEE standards are classified as:

- **Standards:** documents with mandatory requirements.
- **Recommended Practices:** documents in which procedures and positions preferred by the IEEE are presented.
- **Standard Guides:** documents in which alternative approaches to good practice are suggested but no clear-cut recommendations are made.