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IEEE 693 SEISMIC QUALIFICATION OF COMPOSITES FOR SUBSTATION HIGH-VOLTAGE EQUIPMENT

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SUMMARY

This paper discusses research on the application of IEEE Standard 693 seismic qualification requirements for hollow-core composite insulators used on high-voltage instrument transformer substation equipment. The IEEE 693 qualification procedure of time history shake-table and static-pull tests as well as the acceptance criteria is evaluated. Failure modes for composite insulators are discussed. Experimental observations show that the acceptance criteria are invalid for qualifying hollow-core composites. The need for a static-pull test following vibration qualification tests is presented. The need for post-vibration-test measurement of damping is discussed. Changes to the IEEE standard and potential research are recommended.

INTRODUCTION

IEEE Standard 693-1997, "IEEE Recommended Practice for Seismic Design of Substations" [1], is a major improvement in the way the power industry seismically qualifies substation high-voltage equipment. The standard has established discrete qualification levels with associated controlling response spectra, and well-defined qualification procedures and acceptance criteria. In addition to general procedures for analysis and testing, special procedures and criteria are developed for individual classes of equipment that reflect their unique characteristics and earthquake performance.

The standard provides two seismic qualification performance levels that are defined by excitation response spectra. Acceptance criteria are established so that equipment shake table-tests qualification need only be subjected to an excitation half of those defined by the performance response spectra. While not explicitly stated in the standard, it is the view of the authors that testing to half of the performance level requires that the failure modes of the equipment are understood and that associated critical variables, such as a strain, can be measured. The acceptance

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