HV CABLE QUALIFICATIONS TO IEC 62067-2006 AND ICEA S-108-720-2004

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ABSTRACT

Manufacturers and users in the North American environment are faced with the dilemma of selecting the most appropriate qualification procedure for their cable or cable system: the cable system approach of IEC or the high temperature cable only method of ICEA. Parties are increasingly interested in performing a single test program which encompasses the most critical elements of each thereby providing a route to qualify a cable design to both IEC and ICEA requirements. This paper will review the differing test factors, considerations for laboratories when implementing serial or combined test programs, and issues for manufacturers and users when determining their test approach.

KEYWORDS

Cable qualifications, cable systems.

INTRODUCTION

As the use of XLPE cable systems increases in America, manufacturers and users are faced with the dilemma of selecting the most appropriate qualification procedure for their cable or cable system: the cable system approach of IEC or the high temperature cable only route of ICEA. Thus laboratories are increasingly being requested to perform a single test program which encompasses the most critical elements thereby providing a route to qualify a cable design to both IEC 62067 and ICEA S-108-720 requirements. NEETRAC has completed several combined tests on HV & EHV cable designs and these will be discussed in the paper.

Each of these two standards includes different test sequences as well as differing requirements for test voltages, conductor temperature range and setup, and impulse testing procedures. Users and manufacturers must determine if the test programs are to be combined or performed on a single sample in series with the cable dissection phase delayed. The differences in temperature and cable setup requirements are the main motivating factors for considering this approach. Figure 1 describes the required electrical type test programs and the NEETRAC combined approach utilized to meet the most onerous requirements of each standard on a single test sample.

This paper will review the differing test factors, considerations for laboratories when implementing either a combined or serial test program, and issues for manufacturers and users when determining their test approach.

COMPARISON OF TEST FACTORS

Sample requirements

IEC adopts a cable system test approach and requires a minimum of 10 m of cable and one sample of each accessory type to be included in the test. ICEA is a cable only test, but requires that the sample be installed within a pipe. Both qualification programs require that the cable portion of the sample be formed into a U bend with a diameter defined by the cable dimensions and materials.

Test Order

The most significant differences between the two qualification programs occur in the test order and the tests required. Figure 1 depicts the two programs (IEC and ICEA) from the bending procedure forward and the NEETRAC combined test program (right most). In the figure, dashed lines indicate equivalent tests. Bold lines show the source of the test in the combined test series (original clause numbers are retained).

IEC 62067 also requires an initial insulation thickness check (not listed in Fig. 1) to verify that the insulation thickness of the tested cable sample is not excessive compared with the nominal value. This check can be performed on the sample after the bending test, but should be completed prior to any voltage application.

Once the sample is installed, IEC requires an initial partial discharge test under ambient conditions and a hot dissipation factor measurement. At this point (identified as A in Fig.1), the manufacturer/end user must determine if a combined or a serial test program is to be performed. If a combined test program is selected, voltage and temperature levels can be set to the more stringent ICEA values.

Twenty thermal cycles with applied voltage are the next required test for both programs. As before, the more stringent ICEA voltage and temperature values should be applied if a combined test program is selected. IEC permits the two hour “at temperature” period to be anytime in the 8 hour current-on window for each thermal cycle. ICEA requires that the sample be in the “at temperature” period in the final two hours of the current-on window.

Once thermal cycling is complete, the test programs diverge into two paths. ICEA specifies that all tests can be performed on a single sample and in that situation the hot impulse test is moved to after the hot dissipation factor test. IEC permits the post thermal cycling ac tests to be moved to after the hot impulse tests completely. Another difference is in the impulse test procedures discussed in a later section of this article. The NEETRAC test program harmonizes the two standards by performing the ICEA ambient partial discharge and hot dissipation factor tests prior to performing the IEC required hot switching impulse test (if $U_m \geq 300$ kV) and the hot impulse test required by both standards. This test order also assumes that the manufacturer/end user does not wish to impulse the sample to failure.

Both standards require an ac withstand test after completing the impulse withstand test. The applied voltage and time length of the withstand test are dependent on the test approach selected. IEC also