TESTS OF OUTER PROTECTION FOR BURIED JOINTS, EXPERIENCE AND RECOMMENDATION

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ABSTRACT

Annex H of IEC 60840 and annex D of IEC 62067 describe the tests of outer protection for buried joints. As the requirements for the heating/cooling cycles leave much room for various interpretations, the reproducibility is limited. KEMA's interpretation on the duration of a complete cycle is outlined. The new editions to be published of these standards now require a minimum cycle time. Also, the examination leaves room for interpretation and hence testing at different test houses may lead to different results. To overcome this lack in reproducibility, suggestions are given to improve the standards.

KEYWORDS

Joint; Outer Protection; Test Set-up; Examination; Improvement.

INTRODUCTION

This paper addresses KEMA's experience of more than 10 years with type testing cable accessories related to tests of outer protection for buried joints as described in IEC 60840, annex H and IEC 62067, annex D. At the introduction of this test, we developed a system of hot and cold water tanks that allow a smooth transition from low temperature to high temperature and vice versa for the required heat cycles. The standards require heat cycles but do not fix the transition time from one temperature to the other. This paper describes the developed system for this test and the choices made in view of the procedure given in the standards.

This test seems to be very demanding for the joint when looking at the high failure rate of roughly 50%. This paper discusses the kind of defects that may be found during examination after completion of all electrical tests. These defects are compared with the requirements given in the standards and some deficiencies are discussed.

Finally, this paper compares the tests of outer protection given with actual operational conditions. Differences between these standards and the actual operational conditions will lead to some suggestions for improvement.

OBJECTIVE AND TEST DESCRIPTION

The aim of this test is to check the watertightness of a joint when it is subjected to temperature cycling. A buried joint is seldomly surrounded by a dry environment and even can be at a depth lower than the water table. To simulate this last situation, the joint must be immersed in water. Heating of the joint assembly by conductor current is not quite practicable as the volume of water represents a large heat sink. Different types of joint assemblies would then reach different surface temperatures. Although the natural situation is heating from the inside, one has chosen to heat the joint from the outside, i.e. by hot water, in order to improve reproducibility. Taking in consideration the thermal soil insulation in service, the temperature should cycle between 10 K above ambient and 15 K to 20 K below the maximum conductor temperature of the cable. In practice, this means that the limits are roughly 30 °C and 70 - 75 °C. The duration of a cycle is not given, but the test object must remain at the maximum temperature for at least 5 hours.

CYCLE TIME: STANDARD VS PRACTICE

At present, both IEC 60840 and IEC 62067 do not explicitly require a minimum cycle time. These standards require the water temperature to be raised to the required maximum temperature and maintained at that temperature for at least 5 hours. This is followed by cooling down to within 10 K of ambient. No minimum time for cooling down is given and this may result in quite some difference in cycle time between the various test facilities (manufacturers or independent test houses). KEMA has decided to perform these tests using a 12 or 24 hours cycle, depending on the size of the joint (tank size). We assume this cycle allows the whole test object to cool down sufficiently before starting the next cycle.

The new editions to be published of the above mentioned standards, currently under vote within IEC, require a minimum cycle duration of 12 hours and it is advised to keep the time necessary to heat the water equal to the time to cool the water. For the minimum cycle time, this requires a transition time from cold to hot and vice versa of approximately 3½ hours.

TEST FACILITY

The existing test facility to test the outer protection for buried joints consists of a cylindrical vessel to accommodate the joint, a hot water basin, a cold water basin and a control system. Two different sizes of vessels are available in order to accommodate the various sizes of joints. The test object is slided into the vessel from one end while resting on a trolley. After the test object is in position, the vessel is sealed off and filled with water. With pumps a steady flow of water is maintained through the vessel, in order to obtain a homogeneous water temperature in the vessel. The pressure above the test object is kept at least at 0,1 bar. The temperature is controlled using two large basins, one containing hot water and one containing cold water. The temperature in the hot basin is normally kept at around 90 °C while the cold water basin is normally kept at approximately 20 °C. During the heating phase, the water flow is led through the hot basin. Initially, the vessel containing the test object is heated as hot water is mixed with the cold water in the vessel. At the same time, the temperature set point for the