

Acceptance criteria in nuclear power plant cable qualification

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Nuclear power plant (NPP) equipment qualification is a fundamental process to test whether safety systems and equipment can perform their intended functions during normal operation, as well as during postulated accidents (DBE). In the process of qualification all samples are subjected to diagnostic measurements to test whether the equipment fulfills all previously defined acceptance criteria. The criteria are usually limit values of certain properties beyond which the degree of deterioration is considered to reduce the material's ability to withstand stress encountered in the course of the regular service and/or DBE. The extent of measured properties and the acceptance criteria may vary and, generally, they depend on a specific cable application in each respective NPP. The most commonly tested parameters are insulation resistance, voltage withstand and mechanical properties of polymeric insulations. The acceptance (failure) criteria shall be, on the one hand, conservative enough to sufficiently cover margins and uncertainties and, on the other hand, they shall not be too demanding to give needlessly negative results. In this paper some acceptance criteria are explained and proposed.

The qualification tests include a number of measurements at the beginning, in the course of and at the end of the testing procedure, and results of such tests determine whether the cable passes the type test or not. However, standards and regulations do not always contain a sufficiently accurate specification of the parameters to be measured or the limit values which shall not be exceeded. Based on many years of experience with the qualification of NPP equipment we have proposed to use the following functional properties and limit values:

- The properties of the cable shall meet the design requirements throughout the entire time of operation, as long as such requirements are accurately specified.

If the design requirements are not detailed enough we have proposed that at least the following properties should be demonstrated:

- Properties of a new cable shall always meet the manufacturer's technical specifications.
- For pre-aged cables, before DBE simulation, the elongation at break of the sheath and core insulation shall be greater than 50% absolute.
- Volume resistivity shall be always, i.e. also in the course of DBE simulation, greater than 10^{10} Ωcm .
- The polarization index shall not drop below 1.
- In the course of DBE simulation the cable shall be supplied by the operating voltage and shall remain functional.
- Further, the cable shall meet the voltage withstand test, for which the test conditions - voltage, test time, medium - are relatively well defined by the current national standards.
- No fluid from the surrounding environment (water, steam) shall be detected inside the cable

For some cables, e.g. coaxial or communication cables, it is advisable to measure also other properties decisive for keeping of the function, such as capacity, signal attenuation etc. Throughout the test the values shall not differ from those in the manufacturer's technical specifications and/or values predictable based on known physical laws (e.g. growth of attenuation as a result of growing resistivity of metals with the increasing temperature, etc.).

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