Acceptance criteria in nuclear power plant cable qualification

Vít PLAČEK, Jan KABRT, Vladimir HNÁT, Pavel ŽÁK; ÚJV Řež, a. s., Czech Republic, vit.placek@ujv.cz, jan.kabrt@ujv.cz, vladimir.hnati@ujv.cz, pavel.zak@ujv.cz

ABSTRACT
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, 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.

KEYWORDS
qualification, cable, acceptance criteria, nuclear power plants.

INTRODUCTION
It is fundamental for the safe operation of commercial NPPs and for the protection of public health and safety through regulation to ensure that safety systems and equipment are able to perform their intended functions during normal operation, earthquakes, and postulated accidents (DBE – design basis events) which may e.g. include the loss-of-coolant-accident (LOCA). Such an accident results from the loss of reactor coolant from breaks in the reactor coolant pressure boundary including a break equivalent in size to the double-ended rupture of largest pipe of reactor core system. The conditions of DBE are characterized by high level of radiation, rapid increase of temperature and temperature a spray solution on a specific cable application in each respective NPP. The criteria are easily derived from standards and/or recommendations [1,2,4,5]. However, it is more complicated to identify the appropriate functional properties to be tested and their acceptance criteria. This means to select the properties and their values that will confirm the functionality of the tested cable in the real service, as well as during accident(s) and post-accident period.

FUNCTIONAL PROPERTIES
During the qualification the cables are subjected to a diagnostic measurement procedure. The extent of the measured properties may vary and, generally, the procedure is based on a specific cable application in the respective NPP. The most important are electrical and mechanical properties of polymeric insulation materials. In general, the functional properties to be measured are those that demonstrate the basic properties and behavior of the cable during its service life and during postulated accidents. Moreover, the extent of the testing shall not be uselessly excessive. Usually, an engineering analysis should be used to justify the critical characteristics for specific NPP applications.

ACCEPTANCE CRITERIA
Setting the appropriate acceptance criteria is often one of the most difficult parts of the qualification. The criteria are usually the limit values of properties beyond which the degree of deterioration is considered to reduce the ability of the cable to withstand stress encountered in normal service and during accidents. The acceptance criteria shall be, on the one hand, conservative enough to...