

Harmonization of IEEE323 and IEC60780 standards For Environmental Qualification of Electric Equipments

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1. Introduction

IEEE323 standard has been widely used for the qualification of electric equipment in Asian Pacific area while IEC6070 has been mostly used in European area [1,2]. Since each plant uses different standards for environmental qualification, manufacturers have to perform the qualification test twice in accordance with each standard. Problems can also be encountered in the plant site when they are going to purchase equipments qualified by different qualification standards which are not used in his plant.

The need of harmonization of each standard has been raised several years and it is known that some studies are in progress by IEEE committee [3]. KEPRI has a plan of comparing EQ relative standards of IEEE, IEC and RCC in 2009. In this paper, brief comparing results between IEEE323 and IEC60780 and the proper harmonization method is introduced.

2. Methods and Results

2.1 Introduction of IEEE323 and IEC60780

2.1.1 IEEE323

IEEE323 is a standard published by the Institute of Electrical and Electronics Engineers Inc. IEEE323 describes the basic requirements for qualifying Class 1E equipment and interfaces that are to be used in nuclear power generating stations. The principles, methods, and procedures described are intended to be used for qualifying equipment, maintaining and extending qualification, and updating qualification, as required, if the equipment is modified. The qualification requirements in this standard, when met, demonstrate and document the ability of equipment to perform safety functions under applicable service conditions including design basis events, reducing the risk of common-cause equipment failure.

It had been passed 32 years for the fourth edition of IEEE323 in 2003 since the first edition of IEEE323 issued in 1971. Even 5 years have been passed since the IEEE323-2003 issued, IEEE323-1974 is still used for regulation of PWR nuclear power plant and IEEE323-1983 for PHWR nuclear power plant in Korea.

2.1.2 IEC60780

IEC60780 is a standard published by International Electrotechnical Commission. This international standard is applicable to electrical equipment of safety systems used in nuclear power plants, including components or equipment of any interface whose failure could adversely affect the performance of the safety system. It is also applicable to non-electric interfaces associated with a safety function.

The first edition of IEC60780 was issued in 1984 and it was revised to the second edition in 1998.

2.2 Comparison of IEEE323 and IEC60780

2.2.1 Scope and Object

Scope of IEEE323 is bounded for Class 1E equipment and interface used in nuclear power plant while IEC60780 is applicable to electrical equipment of safety system used in nuclear power plants. In the definition chapter of IEEE323 3.2 Class 1E, it is described that the terms of Class 1E equipment and safety-related electric equipment are synonymous. It is clear that IEEE323 and IEC60780 have same scope.

IEEE323 is intended to be used for qualifying equipment, maintaining and extending qualification, and updating qualification if the equipment is modified. The qualification requirements in this standard demonstrate and document the ability of equipment to perform safety function under applicable service conditions including design basis events, reducing the risk of common-cause equipment failure. IEC60780 describes the qualification procedures and methods to be used and the associated documentation. These qualification requirements provide adequate verification that the equipment of the safety systems is designed to perform its function. One of major differences of these two standards is applicable service condition for qualification. IEC60780 defines accident condition as earthquake of inside or outside of reactor building and postulated initiating event which leads to environment stresses such as irradiation, temperature, pressure, steam, chemical spraying in the inside of reactor building. IEEE323 specified the accident condition as high-energy line break, loss-of-coolant accident, main

steam line break, and/or safe shutdown seismic events regardless of inside or outside reactor building.

It is recognized that IEC60780 deal with the loss-of-coolant accident(LOCA) in the containment building while the IEEE323 cover DBA regardless of inside and outside containment. If there is an equipment located in MSLB condition of outside containment, careful comparison of initial peak temperature is required. Peak temperature of MSLB is generally higher than that of LOCA.

2.2.2 Qualification method

IEEE323 use the method of type testing, operating experience, analysis and combined method for initial qualification. IEC6078 use the method of type testing, operating experience, analysis, combined method and on-going qualification. There is no difference in the qualification method between two standards.

2.2.3 Test sequence

IEEE323 has test sequence of thermal aging - normal and accident radiation - non-seismic mechanical vibration - OBE and SSE seismic test - accident steam test. IEC60780 has test sequence of thermal aging - corrosion test - mechanical vibration test - prolonged operating test - seismic test - accident radiation - accident thermodynamic condition test. IEC60780 describe about corrosion test and prolonged operating test which is not shown on IEEE323. Corrosion test and prolonged operating test can be regarded as aging consideration described in IEEE323-2003 6.2.1.2 aging consideration. I think there is no significant difference in test sequence between IEEE323 and IEC60780

2.2.4 Margin

IEEE323 and IEC60780 suggest the margins of design basis event service conditions as shown on table 1. Comparison result of peak temperature with margin for pressure of 7.2 bar to 20 bar is shown on figure 1. Margin of IEEE323 is bigger than that of IEC60780 for all of the temperature ranges. Deviations of margin between IEEE323 and IEC60780 were changed from 2.68 °C to 5.53 °C depend on the temperature range. Since IEEE323 is more conservative than IEC60780, careful comparison should be taken based on actual test result if the equipment was qualified in accordance with IEC60780. For the margin of radiation, IEC60780 use integrated ageing & accident while IEEE323 use accident only. Since accident radiation is much higher than normal radiation, no severe problem is anticipated if it is not a special case.

Table 1. margin of design basis event service

Factor	IEEE323	IEC60780
Peak Temperature	+8 °C	Temp. of Sat. steam pressure+ 1×10 ⁵ Pa
Peak Pressure	+10% of gauge	+10% with max. 1×10 ⁵ Pa
Radiation	+10%(on accident dose)	+10%(Integrated ageing & accident)
Voltage	± 10%	± 10%
Operating time	+10%	+10%
Frequency	± 5%	± 5%

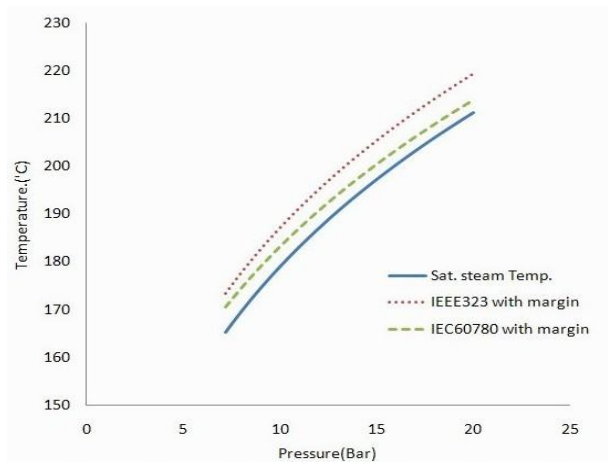


Fig. 1. Temperature margin of IEEE323 and IEC60780

3. Conclusions

Comparisons of scope, object, qualification method, test sequence and margin between IEEE323 and IEC60780 were implemented.

IEEE323 and IEC60780 have same purpose and object but the test sequence and margin application is slightly different. Equipment qualified by IEC60780 should add additional margin of accident temperature to satisfy the IEEE323 requirement. Some consideration such as corrosion and prolonged operating test need to be taken during the IEEE323 test

REFERENCES

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