IEEE 383 Standard for Qualifying Electric Cables and Splices for Nuclear Facilities Preview

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IEEE 383 Background

- This standard provides guidance for developing a program to type test cables and field splices
- It implements IEEE 323 which describes basic requirements for equipment qualification
- Initial issue of IEEE 383 was in 1974
- Originally used for qualifying connections
  - IEEE 572 (first issued in 1985) now used for qualifying connection assemblies
- Present Version of IEEE 383 is 2003
- Differences To IEEE 383-2003 Will Be Discussed

Title

- Title changes: Delete Class 1E, Delete “Field” before splices, and change nuclear power generating stations to nuclear facilities
  - Deleting Class 1E is to be consistent with changes being proposed in IEEE P60780-323
  - Field splices changed to splices throughout document
    - Similar to how cable is handled: There is a caveat on qualification of cables and splices within equipment to be qualified with equipment
  - Change from nuclear power generating stations to nuclear facilities consistent with IEEE 627 “IEEE Standard for Qualification of Equipment Used in Nuclear Facilities”.
- Standard for Qualifying Electric Cables and Splices for Nuclear Facilities

Scope

- Scope was simplified. This includes changes to be consistent with title, simplifying what is included and adding a note on qualification of fiber optic cable being to IEEE 1682.
  - This standard provides general requirements and methods for qualifying electric cables, and splices for nuclear facilities. Cable, wire, and splices within or integral to other devices (e.g., instruments, panels, motors, etc.) should be qualified using the requirements in the applicable device standard or IEEE Std 323. However, this standard's requirements may be applied to the cable, wire and splices within these devices. For qualification of fiber optic cable refer to IEEE Std 1682

Purpose

- Purpose was Modified by Changing “specific direction” to “standardized methodology” and “field splices” to “splices”
  - The purpose of this standard is to provide standard methodology for the implementation of IEEE Std 323 as it pertains to the qualification of electrical cables and splices

Normative References

- References changed to normative references
- Therefore documents limited to:
  - IEEE 323 which is the mother document
  - IEEE 1202 which is the referenced flame test
  - and IEEE 1, 98 and 101 on Arrhenius
- IEEE 627 is not listed as a normative reference since this is an upper tier to IEEE 323
  - This is referenced in the bibliography

Definitions

- Definition of nuclear facilities added
- Definition of representative cable revised to change “same or higher service rating” to “the voltage class”
  - Also “same or higher volts per mil operating level” changed to “same or higher operating electrical stress”
- Same changes made to representative splice
- Added a definition of wire

General Change

- Changed “Class 1E” to “safety related” and “field splices” to “splices”

Thermoplastic

- In 6.1.1 the following was added: “The insulation and jacket is assumed to be thermoset. If the materials are thermoplastic or radiation can improve the performance of the materials additional samples that have not been thermally aged or irradiated shall also be included in DBE testing.”
- Similar Changes Made in 6.4.3

Colors

- In 6.1.1 the following was added: “Reasoning for choice of colors tested shall be documented.”

Power Cable

- In 6.1.1 the following was added: “Separate power cable sample (s) may be needed as this cable shall be at rated voltage and rated current. Determination of rated current should consider the cable test configuration and design ambient temperature.”

Test Sample

- In 6.1.1 the following was modified: “Qualification of a type test sample cable shall qualify cable with the same insulation thickness and with heavier thickness without regard to voltage rating, within the same voltage class (e.g., 5 kV qualifies 15 kV, and 600 V wall thickness qualifies 1000 V walls) if and only if the **same or higher operating voltage stress level is maintained. For low voltage cables the same or higher volts per mil operating level is required. For medium voltage cables and coaxial cables, the** applied peak voltage stress in V/mil during the test shall be equal to or greater than the peak voltage stress that a test sample of the higher voltage rating would require.”

Splice Samples

- In 6.1.3: **To qualify a** multiconductor splice (i.e., electrically interconnecting three or more conductors) similar design characteristics **including representative number of conductors, functional configurations and components shall be used.**

Documentation

- In 6.2.1.1 the following was added: "and the stranding configuration (i.e., round, compressed or compact)."
- In 6.2.1.2 semiconducting was changed to "stress control layers/".
- In 6.2.1.4 "percent overlap and lay of tape shields, and information on other shields such as insulation or overall static shield" was added.
- In 6.2.1.8,"the date of applicable manufacturing standards and the date of manufacture" was added.
- In 6.2.2.6, "the date of applicable manufacturing standards and the date of manufacture" was added.
- In 9.1, "Documentation should also include manufacturer's inspection and maintenance requirements" was added.

Aging

- In 6.3, Arrhenius method was changed to just method and guidance on IEEE 1 with 98 and 101 required.
- In 6.4.1, “The lowest exposure temperature shall give a life of more than 5000 hours.” was added.
- In 6.4.1, “Sample form, size and shape shall be considered. The sample thickness shall be representative of what will be used in service.” was added.
- In 6.4.2, if orientation of compound, crystallinity, and thickness is representative of what will be used in service” was added.

Inert Atmosphere

- In 6.4.2 Deleted: There may be cases of the specific application testing involving the qualification of cable or splices for application in an inert atmosphere such as used in some Boiling Water Reactor applications. The impact of the inert environment can be credited as a basis for use of aging techniques other than Arrhenius; however, justification shall be provided for the alternative technique.

Data/Communication

- In 6.4.4 “The qualification type tests for coaxial, triaxial, twinaxial and data/communication cables should include sufficient testing of cable’s critical electrical performance characteristics to permit an adequate analysis of the compatibility of the cables for the specific application, as appropriate.” was added.

Section 7

- In section 7 added, “and section 6.4.2.”
- In section 7 added, “Qualification of low voltages cables shall include long term water immersion testing to ICEA T-22-294 at 90°C with both ac and dc voltage at the cables rated voltage for at least one year without failure of the sample and with insulation resistance meeting the requirements of ICEA T-27-581 section 2.15.”
- In section 7 added, Qualification for submergence of medium voltage cables shall be ICEA S-94-649 for at least one year in the accelerated water treeing test”

Flame Test

- Section 8 was rewritten as follows: “All cables shall not propagate flame and shall be rated as such by passing the vertical tray flame propagation test requirements of IEEE Std 1202 and UL VW-1 as noted below. In addition the testing shall include samples which have been aged and irradiated to the normal thermal and radiation levels of the plant environment per 6.4.2. Note, change in jacket color is considered a new design and shall be tested. Switchboard cables, coaxial, twinaxial, and triaxial cables not installed in tray may only be required to pass the UL VW-1 flame test. Single conductors going into multiconductor cables rated 2000 volts or less shall pass the UL VW-1 test. UL VW-1flame test shall be per UL 2556 with the criteria in UL 44 except that for coaxial, triaxial and twinaxial cables the size tested shall be the actual cable size.”

Circuit Integrity

- In section 8 added, “For cables that need a fire rating IEEE P1844 Standard Test Procedure for Determining Circuit Integrity Performance of Fire Resistive Cables in Nuclear Facilities may be used.”

Modifications

- In Section 10 added, “Generally a change in a large portion of compound such as the base resin will require new qualification, but also small changes such as those of an antioxidant (which may only be 1% of the formulation) may also require new Arrhenius aging as well as DBE testing. Ingredient name changes will require a review, but may or may not require new testing depending upon the circumstance. Changes should always be documented, but effect on qualification is sometimes hard to judge. In this case it is conservative to re-qualify.”

Bibliography & Annex B

- References were moved to the bibliography.
- Annex B on modifications was added.

Questions