**MEETING NOTES**

**PUBLIC MEETING HELD ON APRIL 12, 2001**
**on**
**Environmental Qualification (EQ)**

The staff met with the representatives of NEI, EPRI, NUGEQ, consultants, nuclear utilities, NSSS vendors, and A/Es on April 12, 2001, at the NRC HQ in Rockville, MD. The purpose of this meeting was to discuss four technical issues concerning environmental qualification of safety-related low-voltage cables. The meeting was an informal meeting. It started with presentation by the staff on each technical issue and then discussed the possible "industry initiatives" to address the four technical issues.

The following is the summary of meeting:

Issues Discussed:

1. **Need for Monitoring Plant Environments & Condition Monitoring**

**ISSUE: For maintaining qualification throughout the qualified life of safety-related I&C cables, should the licensees provide information on how the environments are monitored to detect localized hot-spots and how to ensure that the original test conditions are not exceeded in operating nuclear power plants?**

**Is it prudent to perform some kind of condition monitoring of I&C cables, that may include walkdowns to look for any visible signs of anomalies attributable to cable aging?**

**What are the industry initiatives?**

Summary of the staff presentation: The overall EQ process provides reasonable assurance that, when qualified in accordance with the NRC regulations, cables will perform their intended safety function during their qualified life. Specifically, 10 CFR 50.49(e)(5) contains provisions for aging that require, in part, consideration of all significant types of aging degradation that can affect the component's functional capability. Compliance with 10 CFR 50.49 provides reasonable assurance that the cables will perform the intended function during accident conditions after exposure to the effects of service aging. Failures of Okonite, Rockbestos, and Samuel Moore cables in recent Wyle and Sandia tests, raise concerns about the performance of these cables.

The licensees were expected to provide assurance that safety-related equipment will perform its intended function throughout its installed life and operating environmental conditions will not exceed those assumed during original qualification. It is expected that the licensees will monitor environments (temperature and radiation) in operating plants, at least in certain areas, so that they know where the "hot-spots" are. The licensees were encouraged to consider surveillance, maintenance, and condition monitoring. The qualification of safety-related equipment must be maintained throughout the service-life. The staff noted that a "feed back mechanism" is missing.

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Inspection, surveillance, condition monitoring, and trending of selected parameters for any installed safety-related cable-system can potentially increase knowledge regarding aging effects and confidence in cable-system reliability and performance.

The staff noted that you can not simply walk away for 40 years after a successful test of a single prototype cable and do nothing during the 40 years to manage aging of cables. The staff discussed the potential need of (1) monitoring environments in operating nuclear power plants, and (2) implementing a condition monitoring program.

Summary of discussions with the Industry: The industry stated that the reported "failures" in the NRC recent tests were isolated incidents. The Samuel Moore cables passed in other tests. Further, the failures occurred during the post-LOCA voltage withstand test, which is too conservative and not realistic.

The service environments in the operating nuclear power plants are much lower than the preaging temperatures used in the accelerated aging portion of the tests.

The licensees know the hot spots in their plants and appropriate corrective actions are taken on a regular basis.

The nuclear industry indicated that they would consider a written response to the staff in the near future to document their response to this issue and the response will also include the aging management programs in the operating nuclear power plants.

2. **Testing of Single Prototype**

**ISSUE: Should the IEEE standards be revised to require testing of multiple specimens?**

Summary of the staff presentation: Based on IEEE standards, single prototype testing has been used for many applications and will almost certainly be used in future applications. However, based on recent research results, the staff believes that the use of single cable specimen for environmental qualification warrants further discussion with the nuclear industry.

The analysis of test failures into random and common-mode categories is significantly enhanced by testing multiple specimens. If one of these specimens fails but the others perform throughout the program, the justification that the failure was random becomes significantly more sound.

Summary of discussion with the industry: The cost of testing more than one prototype is prohibitive. The built-in conservatism and margins are technical justifications for testing a single prototype.

IEEE plans to provide a written response to this issue in the near future.

3. **Post-LOCA Submerged Voltage-withstand Test**

**ISSUE: What are the technical bases for this Post-LOCA test? Should this requirement be changed?**

Summary of staff presentation: IEEE standards require a submerged voltage-withstand test (80V/mil ac or 240V/mil dc) for 5 minutes. This is a post- LOCA test. For a 30 mil thickness, the test voltage is 2400 V. According to IEEE standard (IEEE Std. 383-1974), the post-LOCA simulation test demonstrates an adequate margin of safety. It should be noted that the several test specimens, which were preaged to 40 and 60 years of equivalent service life, in NRC tests failed submerged voltage- withstand test. It was noted that some cables failed voltage withstand test in NRC tests at a significantly lower than the voltage level of 2400 V.

Summary of the discussions with the industry: The history of this requirement was presented. The industry stated that this is an extremely severe test and I&C cables would never be exposed to this voltage.

IEEE plans to provide a written response to this issue in the near future.

4. **Testing of I&C cables for 60 years service life**

**ISSUE: Should the cable aging be addressed as part of an aging management program for detecting aging degradation of safety-related I&C cables for 60 years of service life?**

**How do we ensure that the service environmental conditions will not exceed the environmental conditions assumed in the analysis for demonstrating requalification to 60 years of service life?**

Summary of the staff presentation: If one uses the Arrhenius equation to calculate thermal aging conditions, the ratio of accelerated aging time to simulated service time remains constant as long as there is no change in activation energy, aging temperature, and service temperature. Therefore, one can clearly obtain the 60 -year aging time by multiplying the 40-year aging time by 1.5.

This was the technical basis for choosing 60-year accelerated aging time. Of the twelve cables preaged and tested, eight experienced failures during the post-LOCA submerged voltage withstand tests. The results indicate that some low-voltage I&C cables may not have sufficient margins beyond the 40 years of their qualified life. If the service environmental conditions are assumed to be those used in the original qualification, then these cables may not perform their intended functions at the end of the 60 year service life, and subjected to LOCA conditions. The staff is concerned that many I&C cables, at their existing ratings, may not have sufficient margins for 60 years of their service life.

If the service environmental conditions in operating nuclear power plants are lower than those assumed in the original qualification, then it is expected that the I&C cables would perform their intended safety functions. One of the options under the current license renewal rule permits extending qualified life based on the facts that the service environments are lower than those assumed in the original qualification of the I&C cables. However, the staff discussed the potential need for monitoring of service environments and implementing some kind of condition monitoring program for **all**

**safety-related I&C cables** for the license renewal term. It was noted that the condition monitoring program would not eliminate failures but it would provide useful information about the health of the cables and to predict future performance, and it would also lead to corrective actions, which are expected to prevent failures from occurring.

Summary of discussion with the industry:

This test was unrealistic. Multiplication by 1.5 for aging time is overly conservative. The current licence renewal rule provides several options.

The industry would consider submitting a written response to staff in the near future on this issue.

**Additional Observations:**

1. The failures of Okonite single conductor bonded cables in the NRC tests are being addressed by the staff separately. The generic implications of other single conductor bonded cables were discussed.

   The staff noted that the preaging parameters, which were used by Okonite in its original qualification tests, were much higher as compared to other manufacturers. If single conductor bonded I&C cables manufactured by Okonite or any other manufacturers are exposed to severe hot spots in the operating nuclear power plants, catastrophic failures can be expected.

2. The industry asked how the issues discussed at the meeting would be factored into the resolution of GSI-168.

   The staff stated that the industry's responses and "initiatives" to these issues would provide useful information in bringing a resolution and closure of GSI-168.

3. The industry pointed out that NRC Regulatory Issue Summary, dated December 26, 2000, stated the generic implications of similar Okonite cable of different wire gage, similar cable of other manufacturers, and similar multi-conductor cable of all manufacturers were being considered in the resolution of GSI-168. The staff noted that this issue is under consideration.