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SUBJ: Comments on Draft Regulatory Guide DG-1132, "Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants," (72 Fed. Reg. 38,845 (July 16, 2007))

Ladies and Gentlemen:

In the referenced *Federal Register* Notice, the U.S. Nuclear Regulatory Commission ("NRC") Staff requested comments concerning proposed revisions to its regulatory guidance on qualification of safety related cables and field splices. The comments provided herein are submitted on behalf of the Nuclear Utility Group on Equipment Qualification ("NUGEQ" or the "Group").[1]

The enclosed comments and recommended DG-1132 changes are intended to help clarify the NRC guidance and make it consistent with accepted industry practice; cable-related research, including research sponsored by the NRC; the qualification guidance in IEEE 383-2003; and related NRC information, including the resolution of Generic Safety Issue (GSI) 168, "Environmental Qualification of Low-Voltage Instrumentation and Control Cables." The NUGEQ is particularly concerned with the recommendations in DG-1132 Regulatory Position (RP) 7 and 10. The RP7 guidance regarding field splices is a significant departure from current practice and accepted splice qualification programs. The RP10 guidance regarding condition monitoring is inconsistent with available research, industry experience, and prior NRC conclusions regarding the use of cable condition monitoring.

[1] The NUGEQ is comprised of member electric utilities in the United States and Canada, including NRC licensees authorized to operate over 80 nuclear power reactors in the United States. The NUGEQ was formed in 1981 to address and monitor topics and issues related to equipment qualification, particularly with respect to the environmental qualification of electrical equipment pursuant to 10 C.F.R. § 50.49.

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E-RIDS = ADM-03
Add = S. Aggarwal (SKA)

We appreciate the opportunity to comment on DG-1142. Please feel free to contact the NUGEQ if the NRC Staff would like further information on clarification on any of these comments.

Sincerely,

William A. Horin
Counsel to the Nuclear Utility Group
on Equipment Qualification

Enclosure: DG-1132 – NUGEQ Comments

DG-1132 - NUGEQ Comments (9/14/2007)

(Applicable DG-1132 text precedes NUGEQ Comment and NUGEQ Recommendation)

1. DG-1132 Discussion Section: *In addition, power and instrumentation and control cables for which failures could disable risk-significant equipment should have condition monitoring programs to demonstrate that the cables can perform their safety function when needed.*

NUGEQ Comment: The NUGEQ disagrees. Detailed comment and recommended revision to wording are provided as part of NUGEQ Comment 10.

2. Regulatory Position (1) - *Clause 3.3, "Representative Cable," of IEEE Std 383-2003 should be supplemented with a description of conductor type (material, strand, and strand type) and also differentiate between conductor shield, insulation shield, and overall static shield.*

NUGEQ Comment: Regulatory Position 1 (RP1) is unclear since it does not indicate if the recommended supplemental information is simply for descriptive purposes or if the NRC expects the Representative Cables to contain the same conductor and shield materials and configurations that are being qualified. Clause 3.3 currently specifies the characteristics of qualified cable styles than must be included in the qualification test program's Representative Cables. Among other characteristics it currently requires that the Representative Cables contain (a) the same shield materials as the cable styles being qualified and (b) construction/configuration features that conservatively represent the cable style features. It does not require the same conductor materials or types.

If the additional information specified by RP1 is intended to more fully describe the cable test specimens (i.e., representative cables) then RP1, instead of referencing Clause 3.3 should reference Clause 6.2 "Description of cables and field splices", particularly 6.2.1.1 "Conductor" and 6.2.1.4 "Shielding." In this case RP1 may not be necessary since 6.2.1.1 currently specifies "Material type identification, size, stranding, and coating", and 6.2.1.4 specifies, "Material identification, thickness, and form, including the braid angle for braided shields."

If instead the NRC expects that the Representative Cables contain the same conductor materials and configurations being qualified then the NUGEQ disagrees with RP1. The regulatory position is unnecessarily restrictive and could be interpreted to require qualification testing of each and every conductor/shield configuration. The standard correctly requires that Representative Cables contain the same materials and correctly permits conductor and shield configuration variations (e.g., type of stranding) when justified. The NUGEQ is not aware of any research, qualification test, or experience information suggesting that conductor material, strand, and strand type can affect qualification results for the cable's insulation system. Regarding medium voltage conductor and insulation shields (i.e., semicon layers), Clause 3.3 requires the same shield materials and construction/configuration features to

be included in the Representative Cable. The Clause 3.3 language similarly requires that the Representative Cables must include the same overall shield materials (e.g., aluminum-mylar, braided, or copper tape). These provisions are both sufficient and permit needed flexibility.

NUGEQ Recommendation: Delete RP1. RP1 is unnecessary if the requested information is for descriptive purposes since Clause 6.2 requires such information. Instead, if RP1 specifies needed characteristics of Representative Cable then it erroneously identifies conductor characteristics and appears redundant to existing Clause 3.3 language regarding shields.

3. Regulatory Position (2) - *Clause 4, "Principle qualification criteria," should be supplemented as follows:*

(a) The documentation should include the cable or field splice's specification and qualification plan.

(b) The documentation should include manufacturer's inspection and maintenance requirements to maintain and demonstrate continued qualification throughout its qualified life.

(c) A condition monitoring program should also be implemented.

NUGEQ Comment: RP2 (a) and (b) appear unnecessary because Clause 4 (paragraph 4) currently requires that the documentation used to demonstrate qualification includes:

- *The cable or field splice's specification or qualification plan*
- *The documents that demonstrate compliance with the qualification plan*
- *Inspection and maintenance requirements*
- *Summaries and conclusions"*

See NUGEQ Comment 10 regarding condition monitoring and RP2(c).

NUGEQ Recommendation: Delete RP2. Delete RP2(a) and (b) since they are redundant to existing Clause 4 language. See NUGEQ Comment 10 regarding condition monitoring and delete RP2(c).

4. Regulatory Position (3) - *Clause 6.1.2, "Coaxial, triaxial, and twinaxial," should also include specimens of identical materials and construction, and the configuration should include connections.*

NUGEQ Comment: Clause 6.1.2 current requires coaxial, triaxial, and twinaxial test specimens to use identical materials and unique construction features, including braid angle and shield filler materials. The test specimens must also meeting the requirements of Clause 3.3 "Representative Cable". However, these provisions do not require "identical construction" or use of connections for cable test specimens.

The NUGEQ disagrees that the coaxial, triaxial, and twinaxial test specimens must be identical in construction to qualified cable types since this requires test specimens for each and every cable variation offered by a manufacturer. Such a requirement is an unnecessary cost burden, inhibits the use of minor cable design changes to meet application unique considerations, and is inconsistent with the qualification of other cable types (e.g., power and multiconductor cables). IEEE 383 2003 and current practice rely on testing of representative cables with identical materials and specific characteristics but do not require identical constructions. For example, a 3 or 5 conductor multiconductor test specimen is considered, with appropriate justification, to be representative of other multiconductor cables with a different number of conductors.

The NUGEQ disagrees that the coaxial, triaxial, and twinaxial test specimens must include connections. As noted in the IEEE 383 2003 Introduction, connections were removed from the title and scope because IEEE Std 572 is specific to the qualification of connections. Importantly, IEEE 383-2003 Clause 6.1.2 requires that coaxial, triaxial, and twinaxial cable to be tested with their jackets to establish, among other things, that the jacket maintains "*integrity for connector and splice applications requiring such integrity.*" This is a new provision not contained in the previous version of IEEE 383. Since there can be a wide variety of qualified connector designs used on a particular cable, it is not meaningful to include one style with the cable test specimen. Further, inclusion of a connector as part of the cable test specimen confuses the test data since electrical measurements reflect the electrical characteristics of both the cable and connector.

NUGEQ Recommendation: Delete RP3

5. Regulatory Position (4) - *Clause 6.2.1.1, "Conductor," should include the stranding configuration.*

NUGEQ Comment: Clause 6.2.1.1, "Conductor," currently requires "Material type identification, size, stranding, and coating." Stranding is typically defined as the number of strands, the wire size of each strand (i.e., a 7/20 12 awg conductor consists of 7 strands of #20 awg wire), and, in some cases, if the stranding is round, compressed, or compact. It is unclear what additional information the NRC is requesting by use of the term "stranding configuration" but the NUGEQ suspects it refers to - round, compressed, or compact.

NUGEQ Recommendation: Delete RP4 or clarify "stranding configuration" as follows – "stranding configuration (round, compressed, or compact)."

6. Regulatory Position (6) - *Clause 6.2.2.6, "Identification," should include the date of applicable manufacturing standards and the date of manufacture.*

NUGEQ Comment: Both 6.2.1.8 (for cables) and 6.2.2.6 (for field splices) require test specimen identification by manufacturer's trade name or catalog number. Additional test specimen information, such as the manufacturer's applicable fabrication and material specifications and date of manufacture, could aid in test specimen traceability but would be available along with other manufacturing records for specimens fabricated under appropriate QA controls (10 CFR 50 Appendix B).

NUGEQ Recommendation: Delete RP6 or for consistency identify both Clause 6.2.1.8 (for cables) and 6.2.2.6 (for field splices).

7. Regulatory Position (7) - *Clause 6.3, "Age conditioning," should be supplemented to include aged cable specimen and new splice kits; and a new splice kit combining an aged cable with a new cable.*

NUGEQ Comment: The NUGEQ disagrees with RP7. For cable and field splice qualification for harsh DBE conditions, IEEE 383-2003 (Clauses 6.2.3 and 6.2.4) require at least two test specimens – one unaged and one aged (thermal and radiation). This is consistent with current practice and accepted cable and field splice qualification programs. In contrast, RP7 specifies the use of two additional specimens, (*new splice / aged cable* and *new splice / aged & new cable*), for qualification of field splices.

We assume the NRC may be basing this position on certain testing described in NUREG/CR-6704. Except for that testing the NUGEQ is unaware of any research, qualification, or experience suggesting the need for such "mixed age" field splice specimens. In prior correspondence with the NRC[2], the NUGEQ observed that the NUREG problems, which occurred on certain test splices made onto previously aged and accident irradiated cable specimens, were largely due to handling damage to the severely embrittled insulation/jacket materials during splice application. This test artifact is not relevant to future qualification tests performed in accordance with IEEE 323-2003, in part, because IEEE 323-2003 Clause 6.4.2d requires a 20D mandrel bend after thermal and radiation aging. This test demonstrates that the cable insulation materials retain some flexibility at the end of their qualified life. This effectively precludes installing splices onto embrittled insulating materials if the cables are within their specified qualified life. The prior (but not the current version) of IEEE 323 did not require this test if a similar 40D mandrel bend test was performed after the accident exposure.

NUGEQ Recommendation: Delete RP7. Alternatively, revise RP7 to caution licensees that NRC research suggests the potential for cracking of age-embrittled cable materials during subsequent installation of field splices.

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[2] See NUGEQ letter to Satish Aggarwal, Comments on EQ Task Action Plan Research; Invitation to NUGEQ Meeting, (July 8, 1999)

8. Regulatory Position (8) - *Clause 6.4.5, "Retained flexibility," should be supplemented to include the following:*

"The acceptance criteria for instrument cables should specify the minimum acceptable insulation resistance and signal attenuation limits."

NUGEQ Comment: Clause 6.4.5 currently identifies tests that are used to demonstrate that the cable test samples retain some degree of flexibility after the harsh DBE simulation. This is accomplished by immersion high potential testing of the specimen after a specified mandrel bend. The test establishes physical integrity and dielectric capability and is not directly related to electrical performance criteria such as insulation resistance and signal attenuation limits. These performance criteria have no meaning within the context of this mandrel bend testing.

Clause 6.4.4, "Design basis event simulation," currently requires that the acceptance criteria for applications shall be specified. This clause also states that "*Performance criteria, such as current, insulation resistance, and impedance, shall be pertinent to the sample construction and application and will differ from power, control, and instrumentation applications, such as the functional role of the jacket in protecting shields in concentric constructions.*" It also specifies that "*Any specialized applications using these cables for their high-frequency capability, for example, must be specifically evaluated to define performance criteria.*"

Finally, the NUGEQ notes that acceptance criteria for instrument cables will vary based on cable type and application. For example, signal attenuation criteria would not apply to all types of instrument cables.

NUGEQ Recommendation: Delete RP8 because the guidance is not applicable to Clause 6.4.5 and equivalent guidance already exists in Clause 6.4.4. Alternatively, reference Clause 6.4.4 and not Clause 6.4.5 and add the words "as appropriate" after "signal attenuation limits."

9. Regulatory Position (9) - *Clause 9.1, "General," should be supplemented to include the following:*

"Identification of the applicable date of manufacturing standards used in specification, manufacture, and selection of the factory acceptance criteria for test specimens. Documentation should also include manufacturer's inspection and maintenance requirements."

NUGEQ Comment: The first part of RP9 refers to the date of manufacturer standards associated with test specimen specification, manufacture, and factory acceptance. This position appears to be redundant to RP6 which requests similar information under Clause 6.2.2.6.

The second part of RP9 requests documentation of manufacturer inspection and maintenance requirements. The NUGEQ notes that Clause 4 currently requires that qualification documentation include *"Inspection and maintenance requirements*" but this requirement was not restated in the general documentation guidance in Clause 9.1.

NUGEQ Recommendation: Consolidate the RP6 and RP9 guidance on test specimen information into RP6 and limit RP9 guidance to Inspection and Maintenance Requirements.

10. Regulatory Position (10) - *Power and instrumentation and control cables for which failures could disable risk-significant equipment should have condition monitoring programs to demonstrate that the cables can perform their safety function when needed.*

NUGEQ Comment: The NUGEQ agrees that ongoing licensee activities related to maintaining cable qualification should focus on cables whose failures could disable risk-significant equipment. The NUREG also believes that such activities are most appropriate when selectively applied to risk-significant cables with the least margin due to qualification levels, service conditions, or other application considerations. However, the NUGEQ disagrees that cable condition monitoring (CM) programs should be implemented for these cables. As described below, the RP10 recommended use of such cable CM programs is inconsistent with prior NRC conclusions regarding cable CM. We also believe that the IEEE considered and rejected incorporating guidance on such condition monitoring during the development of IEEE 383-2004.

An August 14, 2003 NRC memorandum Subject: *Closeout of Generic Safety Issue (GSI) 168, "Environmental Qualification of Low-Voltage Instrumentation and Control Cables"* documented the resolution of Generic Safety Issue 168, *"Environmental Qualification of Low-Voltage Instrumentation and Control (I&C) Cables."* The memorandum states: "*The issue was resolved with no new requirements for licensees.*" The memorandum makes no recommendations regarding the use of cable CM including the specific CM methods evaluated as part of the GSI-168 efforts.

The memorandum states, based on the GSI technical assessment, that "*typical I&C cable qualification test programs include numerous conservative practices that collectively provide a high level of confidence that the installed I&C cables will perform their intended functions during and following design-basis events, as required by Title 10, Section 50.49, (10 CFR 50.49), of the Code of Federal*

Regulations "Environmental Qualification (EQ) of Electric Equipment Important to Safety for Nuclear Power Plants." The memorandum also concludes that in order to maintain qualification margin and conservatism, "*licensee walkdowns to look for any visible signs of anomalies attributable to aging with particular emphasis on the identification of localized adverse environments or "hot spots", coupled with the knowledge of the operating service environments, have proven to be effective and useful in ensuring that qualification is maintained.*"

The staff also issued RIS 2003-09 "*Environmental Qualification of Low-Voltage Instrumentation and Control Cables*,"(May 2, 2003) to disseminate results from the GSI-168 efforts. The RIS observations are more detailed but consistent with the GSI-168 closeout memorandum.

- Regarding cable CM the RIS states: "*The staff has concluded that, although a single reliable condition-monitoring technique does not currently exist, walkdowns to look for any visible signs of anomalies attributable to cable aging, coupled with monitoring of operating environments, have proven to be effective and useful.*"
- Regarding typical licensee activities the RIS notes: "*When unexpected localized adverse conditions are identified, the condition of the affected cables is evaluated and appropriate corrective action is taken. Monitoring or inspection of environmental conditions or component parameters was generally conducted to ensure that the component is within the bounds of its qualification basis.*"
- Regarding risk assessments and cable aging the RIS states: "*One of the key assumptions of the risk assessment is that operating environments are less severe than or the same as those assumed during qualification testing. These assumptions can be relied upon provided licensees have ongoing knowledge of environmental operating conditions at the nuclear power plants.*"

IEEE 383-2003 specifies cable qualification methods (test, operating experience, and analysis) with an emphasis on qualification by test. The standard does not identify the need for ongoing licensee activities (e.g., condition monitoring) in order to maintain the qualified status of cables qualified by these methods. Of course, this assumes that the cables are operated within the service limits (i.e., environmental and operational limits) established by that qualification. We understand that condition monitoring was considered by the IEEE during development of IEEE 383-2002 and was not incorporated into the standard.

NUGEQ Recommendation: Revise RP10 to read as follows:

> (10) Knowledge of environmental conditions and cable inspections should be considered for power, instrumentation and control cables whose failures could disable risk-significant equipment to ensure that the cables are within the bounds of their qualification basis. Licensee walkdowns to look for visible signs of anomalies attributable to aging with particular emphasis on the identification of localized adverse environments or "hot

spots", coupled with the knowledge of the operating service environments, have proven to be effective and useful in ensuring that qualification is maintained. Such activities are most appropriate when applied to such cables with the least margin due to qualification levels, service conditions, or other application considerations.

Replace Discussion sentence beginning "In addition, power and instrumentation and control cables for which failures could disable . . ." with the following:

In addition, knowledge of environmental conditions and cable inspections should be considered for power and instrumentation and control cables whose failures could disable risk-significant equipment to ensure that the cables are within the bounds of their qualification basis.