Response to Public Comments for Draft Regulatory Guide DG-1132, "Qualification of Safety-Related Cables and Field Splices for Nuclear Power Plants" Proposed New Regulatory Guide (RG) 1.211

A notice that Draft Regulatory Guide DG-1132 (proposed new Regulatory Guide 1.211) was available for public comment was published in the *Federal Register* (72 FR 38845) on Monday, July 16, 2007. The public comment period was closed on September 16, 2007. Comments were received from the five organizations identified below. The NRC has combined the comments and NRC staff disposition in the following table.

Comments were received from:

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Comments		Resolution of Public Comments	
Originator	**Section of DG-1132**	**Specific Comment**	**NRC Resolution**
Westinghouse	Section B, Page 2, fourth paragraph	DG-1132, Section B, Page 2, fourth paragraph states that power and instrumentation and control (I&C) 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. A condition monitoring program does not demonstrate that the cables can perform their safety related function; that is the purpose of qualification testing. Condition monitoring programs are used to assess the physical and operating condition of the cabling. The qualification program demonstrates that the cables will perform their required safety-related function at the end of qualified life under design basis accident (DBA) conditions.	Regulatory Position was clarified. Suitable techniques for condition monitoring for cables should be incorporated in a maintenance program in a nuclear power plant to maintain and demonstrate qualification throughout its qualified life.

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		Conditioning monitoring can be used to support aging assessments in conjunction with monitoring temperature and radiation. Condition monitoring can be used to determine if qualified equipment is suitable for further service based on its installed conditions. Usually when condition monitoring is applied one or more condition indicators are monitored to determine whether equipment remains in a qualified condition. As the qualified equipment approaches the end of its demonstrated qualified life, condition monitoring results may be used to determine if an extension of qualified life is possible. When condition monitoring technologies become proven and commercially available then they can become part of the plant maintenance/ surveillance program implemented by the utility. Conditioning monitoring should not be required as part of the EQ program, rather it should be part of the plant maintenance/surveillance program. Westinghouse recommends deleting the last sentence of the fourth paragraph or revising it to clarify the purpose of a condition monitoring program. Also, Regulatory Position C(2)(c) should be deleted or clarified.	
Westinghouse	Regulatory Positions C(2)(a) and C(2)(b)	Regulatory Positions C(2)(a) and C(2)(b) request supplements to Clause 4 of IEEE Std 383-2003. These positions are already included in IEEEE Std 383-2003, Clause 4. These exceptions should be deleted.	Regulatory Positions 2(a) and 2(b) in Section C were deleted.
Westinghouse	Regulatory Position C(10)	Regulatory Position C(10) should be deleted. Condition monitoring does not demonstrate that the cables can perform their safety-related function. See Item I above.	It is not the intent that a condition-monitoring program will replace qualification testing. The word "demonstrate" was replaced with the word "ensure." A condition-monitoring program is useful to confirm basic assumptions of the qualification program concerning normal environment. Cable aging for the normal operating conditions is usually performed

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			by subjecting new cable to artificial thermal aging in an oven for a time period determined by an Arrhenius extrapolation. Radiation also is applied as appropriate. Additional stressors such as manufacturing impurities, installation errors, unanticipated environment, or operating conditions are not considered in the qualification program. See the additional discussion on condition monitoring under Regulatory Position 10.
IEEE – PES	Section B - Discussion	"*In addition, power and Instrumentation and control cables for which failures could disable risk - significant equipment should have condition monitoring programs to determine that the cables can perform their function when needed.*" IEEE Comment: IEEE 383-2003 asserts that type testing is adequate to ensure that cable and field splices will perform their intended functions during and after a design basis event. The requirement to impose condition monitoring on a subset of Class I E electrical cables implies that qualifications by type testing is no longer adequate. This is inconsistent with the qualification philosophy contained within IEEE 323-2003 and its daughter standards. The requirement for CM is also being imposed without any condition monitoring techniques being endorsed by IEEE 383-2003. The introduction of cable CM establishes a requirement for testing with no defined test methodology or acceptance criteria, The recommended use of such cable CM programs is also inconsistent with prior NRC conclusions regarding cable condition monitoring. The technical assessment of Generic Safety Issue 168, determined that "typical I&C cable qualification test programs include numerous conservative	Revision 1 of Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants" dated June 1984 states the following: "....'qualification' is a verification of design limited to demonstrating that the electric equipment is capable of performing its safety function under significant environmental stresses resulting from design basis accidents in order to avoid common-cause failures." This is consistent with IEEE Std 323-2003 (and its previous versions). Regulatory Guide 1.89 further states, "...state-of-the-art preconditioning techniques are not capable of simulating all significant types of degradation, and natural pre-aging is difficult and costly. .... Experience suggests that consideration should be given, for example, to a

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		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 of Electrical Equipment Important to Safety for Nuclear Power Plants". IEEE Recommendation: The requirement for condition monitoring of Class 1 E cables should be omitted from the "Discussion" Regulatory Positions 2(c) and 10.	combination of (1) preconditioning of test samples employing the Arrhenius theory and (2) surveillance, testing, and maintenance of selected equipment specifically directed toward detecting those degradation processes that, based on experience, are not amenable to preconditioning and that could result in common-cause functional failure of the equipment during design basis accidents." The industry data received in response to GL 2007-01 indicated over 400 power cable failures. Some of the cables were environmentally qualified. The NRC staff believes these failures can be significantly reduced through a condition-monitoring program. Therefore, an appropriate condition-monitoring program for cables must be incorporated in a maintenance program in a nuclear power plant. Testing of one prototype in a laboratory and then conducting little or no surveillance for 40 years (or longer) does not provide a reasonable level of confidence in cable performance. Monitoring of environmental conditions and radiation levels and adopting suitable technique(s) for condition monitoring are the necessary steps to provide a reasonable level of confidence. Power cables that are routed underground

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			should be capable of performing their function when subjected to anticipated environmental conditions such as moisture or flooding. This is consistent with Generic Letter GL 2007-1. Note that Regulatory Position 10 was revised.
IEEE – PES	Regulatory Position 1 Clause 3.3	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. IEEE Comment, The IEEE is not aware of any research, qualification test, or experience information suggesting that conductor material, strand, and strand type can affect qualification results of the cable's performance during DBE testing. Since this change is being recommended to the definition of "representative cable" this could lead to the interpretation that any change in the conductor material, strand, and strand type would have to be qualified. The requirement to include additional test samples for a change that does not impact qualification is not warranted and will add an unnecessary complexity to the qualification process. IEEE Recommendation: Delete regulatory position 1.	Regulatory Position 1 was modified to better reflect staff intent. Documenting the details of the sample tested is essential to determine if any future analysis is needed.
IEEE – PES	Regulatory Position 2 Clause 4	Clause 4, "Principal 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. IEEE Comment: The information required with items (a) and (b) is	Regulatory Position 2(a) and 2(b) were deleted. Regulatory Position 2(c) on condition monitoring was deleted because this concept was covered in Regulatory Position 10 in DG-1132.

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		currently required. Clause 4 currently requires that the documentation used to demonstrate qualification includes: • The cable or field splice's specification or qualification plan. • Inspection and maintenance requirements. • Summaries and conclusions. See previous comments on cable condition monitoring. IEEE Recommendation: Delete Regulatory Position 2.	
IEEE – PES	Regulatory Position 3 Clause 6.1.2	Clause 6.1.2, "Coaxial, triaxiel, and twinaxial," should also include specimens of identical materials and construction, and configuration should include connections. IEEE comments: Clause 6.1.2 currently requires that test specimens use identical materials and unique construction features, including braid angle and shield filler materials. The test specimens must also meet the requirements of a "Representative Cable". To add identical constructions could be implied to mean that every coaxial cable (RG 6, 58, etc.) is tested. This will require test specimens for each and every cable variation offered by a manufacturer. Such a requirement is an unnecessary burden, inhibits the use of minor cable design changes, and is inconsistent with the qualification of other cable types. IEEE 383-2003 and current practice rely on testing of representative cables with identical materials and specific characteristics but do not require identical constructions. IEEE also disagrees that the coaxial, triaxial, and twinaxial test specimens include connections. IEEE 383-2003 specifically removed connections from its scope. Connectors are now addressed in IEEE Std. 572. The requirement to test cable and connectors could also be Interpreted as qualifying a "matched set". This could further lead to the Interpretation that every variation of cable and connector must be type tested. It should also be noted that IEEE 383-2003 now requires that coaxial, triaxial, and twinaxial cable be tested with their jacket to ensure that Jacket integrity Is maintained. This is intended to ensure that jacket integrity is maintained	Regulatory Position 3 was deleted

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		for qualified connectors and splices that rely on said performance. IEEE recommendation: Delete Regulatory Position 3.	
IEEE – PES	Regulatory Position 7 Clause 6.3	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. IEEE comment: It Is believed that the requirement to combine In a new cable splice with an aged cable is intended to demonstrate that the aged cable will not adversely affect the splice. This test configuration is not considered relevant to future qualification tests performed in accordance with IEEE 383-2003. IEEE 383-2003 requires that a 20 X diameter mandrel bend test be performed after normal environment thermal and radiation aging. This test demonstrates the cable jacketing material will retain some flexibility at the end of its qualified life. This effectively precludes Installing splices onto embrittled cables within their specified qualified life. IEEE 383-1974 did not require this test if a similar 40 X diameter mandrel bend test was performed after the accident exposure. The requirement for the mandrel bend test after thermal and radiation aging is an enhancement to the qualification type test defined in IEEE 383-2003. IEEE Recommendation: Delete Regulatory Position 7.	Regulatory Position 7 was deleted.
IEEE – PES	Regulatory Position 8 Clause 8.4.5	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". IEEE Comment: The mandrel bend tests are intended to test the Integrity of the cable not establish a suitable level of electrical performance for specific instruments. The acceptable performance of an Instrument cable during a OBE Is an installation specific evaluation which is dependent on device type and cannot be determined by the cable manufacturer or the test lab.	Regulatory Position 8 was deleted. See revised Regulatory Position 5.

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		IEEE Recommendation: Delete Regulatory Position 8.	
NUGEQ	Regulatory Position 1 Clause 3.3	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	Regulatory Position 1 was modified. The supplemental information is for descriptive purposes and should be documented for any future analysis if needed.

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		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 RPI. 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.	
NUGEQ	Regulatory Position 2 Clause 4.	Regulatory Position (2) - Clause 4, *"Principal 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"	Regulatory Positions 2(a) and 2(b) were deleted. Regulatory Position 2(c) on condition monitoring also was deleted because Regulatory Position 10 covers this concept. See revised Regulatory Position 6.

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		See NUGEQ Comment 10 regarding condition monitoring and RP2(c). NUGEQ Recommendation: Delete RP 2. Delete RP 2(a) and 2(b) since they are redundant to existing Clause 4 language. See NUGEQ Comment 10 regarding condition monitoring and delete RP 2(c).	
NUGEQ	Regulatory Position 3 Clause 6.1.2	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 meet 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	Regulatory Position 3 was deleted.

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		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 RP 3	
NUGEQ	Regulatory Position 4 Clause 6.2.1.1	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)."	Regulatory Position 4 was modified as suggested. (See new Regulatory Position 2).
NUGEQ	Regulatory Position 6 Clause 6.2.2.6	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	Regulatory Position 6 has been clarified as suggested. (See new Regulatory Position 3). The NRC staff is concerned about traceability of cable and field splices back to the original type tests, potentially years after the original manufacturer performed

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		available along with other manufacturing records for specimens fabricated under appropriate QA controls (10 CFR 50 Appendix B). NUGEQ Recommendation: Delete RP 6 or for consistency identify both Clause 6.2.1.8 (for cables) and 6.2.2.6 (for field splices).	the type tests. Additionally, many of the cables or field splices may only be available as commercial products not fabricated in accordance with Appendix B of 10 CFR 50.
NUGEQ	Regulatory Position 7 Clause 6.3	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[1], 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.	Regulatory Position 7 was deleted. However, a cautionary note was added as suggested in the "Discussion Section." The cautionary note reads: "NRC research suggests the potential for cracking of age-embrittled cable materials during subsequent installation of field splices."

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		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. _____ 1 See NUGEQ letter to Satish Aggarwal, Comments on EQ Task Action Plan Research: Invitation to NUGEQ Meeting, (July 8, 1999)	
NUGEQ	Regulatory Position 8 Clause 6.4.5	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.	Regulatory Position 8 was modified as suggested and is included in new Regulatory Position 4. "The qualification type tests for coaxial, triaxial, and twinaxial cables should include sufficient testing of the cable's critical electrical performance characteristics to permit an adequate analysis of the compatibility of the coaxial, triaxial, and twinaxial cables for the specific application, as appropriate."

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		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."	
NUGEQ	Regulatory Position 9 Clause 9.1	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.	Regulatory Position 9 was modified as suggested. See new Regulatory Position 3.
NUGEQ	Regulatory Position 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 functions 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 [sic] also believes that such activities are most appropriate when selectively applied	Regulatory Position 10 was revised (See new Regulatory Position 6): Programs for monitoring of environmental conditions (such as temperature, radiation levels), and condition monitoring should be implemented for power, instrumentation, and control cables (the condition monitoring of safety-related

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		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 RP1 0 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 /&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-	cables may be limited to those cables covered by 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants."). Condition monitoring programs may include any appropriate technique(s), supplemented with walkdowns to look for visible signs of anomalies attributable to aging with particular emphasis on the identification of localized adverse environments or "hot spots." For safety-related power cables that are inaccessible or installed underground, appropriate inspection, testing and monitoring programs should be implemented to detect degradation. The condition monitoring and its frequency may be adjusted based on the cable performance. The NRC staff has found installed cables that were operating outside their assumed environmental operating parameters and may not have performed their safety-related function(s). The number of failures recorded in response to GL-2007-01 further supports the need for a cable-monitoring program.

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		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:	

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		(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.	
Duke Energy	Section B Discussion Page 2	The last paragraph does not specifically address IEEE 383-2003 like the rest of that section. Instead, it introduces concerns specific to underground power cables similar to the scope of GL 2007-01. How does this information relate to IEEE 383-2003? Since "recent underground power cable failures" are cited (and not splices), what is the basis for "field splices for medium voltage cables in inaccessible locations should not be permitted"? If this paragraph must remain and still with the "should" recommendation terminology, the "should not be permitted" could be better worded as "should be avoided."	The last paragraph is included because it is a recent concern as discussed in NRC Generic Letter 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," dated February 7, 2007. The words "should not be permitted" have been replaced with "should be avoided," as suggested.
uke Energy	Section C Regulatory Position 1	Item (1) on the definition of "Representative Cable": The qualification and thus representative cable specimen should not be specific to a particular stranding of conductor. If the concern is one of fully describing the	Regulatory Position 1 modified.

Comments		Resolution of Public Comments	
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		representative cable, clause 6.2.1.1 Conductor within IEEE-383-2003 already requires "Material type, identification, size, stranding, and coating." This comment also addresses Page 3 item (4) of DG-1132.	
Duke Energy	Regulatory Position 2(c) and 10.	Items (2)(c) and (10): The operational scope of the added "condition monitoring program" implementation recommendation is broader than the qualification scope of IEEE-383-2003. If these clauses must remain, then (2)(c) should be worded consistently by adding "... be implemented for cables whose failures could disable risk-significant equipment."	Regulatory Position 2(c) was deleted. The concept for condition monitoring is included in Regulatory Position 10.
Duke Energy	Regulatory Position 3	Item (3): Was the recommendation to include "connections" intended to be "field splices" per the scope of IEEE-383-2003? Page 4 of DG-1 132, REGULATORY ANALYSIS, Section 1. Background, last sentence already acknowledges the word "connections" being removed from the title and scope of the standard because IEEE 572-1985 covers qualification of connections.	Regulatory Position 3 was deleted.
Duke Energy	References	Item 1, the "1994" may be a typographical error as it appears inconsistent with the other listed references. It should match up with the "2003" IEEE 383 reference or its 2004 copyright and publish year.	The commenter is correct and the reference has been corrected.
Exelon AmerGen	Section B Discussion Last Paragraph	On page 2, in the last paragraph in Section B, "Discussion," the NRC makes reference to "*field splices for medium-voltage cables in inaccessible locations should not be permitted*" Exelon/AmerGen request that the NRC provide clarification concerning the intent of this statement. Specifically, is it the NRC's intent to preclude pulling splices into inaccessible locations?	The wording was revised to read: "...the staff has concluded that the field splices for medium-voltage cables in inaccessible locations should be avoided."
Exelon AmerGen	Regulatory Position 10	On page 3, Section C, "Regulatory Position, Item 10 states: "*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*." Exelon/AmerGen believe that this issue warrants further discussion and request that additional clarification be provided in the following areas: A. The scope of DG-1132 is primarily for Class 1 E cables located in harsh environments. "Risk-significant" equipment is not necessarily defined in scope of DG-1 132, and therefore, Exelon/AmerGen	Regulatory Position 10 was revised. **In response to comment "A." –** The words, "Risk-significant" were deleted.

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		recommend clearly defining the scope of the guidance provided in DG-1132.	
		B. Generic Letter (GL) 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," recommends that licensees should have power cable condition monitoring programs for Maintenance Rule systems. The GL does not specifically mandate cable condition monitoring programs, and the regulatory basis for requiring a cable condition monitoring program is not established or clearly defined in any NRC documentation. Therefore, Exelon/AmerGen request further clarification concerning the basis for requiring a cable condition monitoring program.	**In response to comment "B." –** The bases for an establishment of condition monitoring program are 10 CFR Appendix A, criterion 18; 10 CFR 50.65 and 10 CFR 50.49; and lessons learned from operating experience over the past 30 years.
		C. DG-1132 discusses that the need for equipment qualification is to prevent common mode failure due to harsh environments resulting from a Design Basis Earthquake (DBE). As such, any cable condition monitoring program would be limited to those cables whose qualification aging conditions were not consistent with actual installed plant conditions. Exelon/AmerGen would not expect to find too many Class 1 E cables, which would be subject to a post DBE environment, to be in any environment not enveloped by the qualification plan. One possible exception would be if a Class l-E harsh environment cable was continuously immersed in water; this probably would not be considered a qualification aging technique. Therefore, Exelon/AmerGen request further clarification concerning this issue.	**In response to comment "C." –** The scope for condition monitoring of cables is limited to those covered by the "Maintenance Rule."
		D. DG-1 132 explains that the need for equipment qualification is to prevent common mode failure due to harsh environments resulting from a DBE. Section C, "Regulatory Position," Item 10 does not limit the scope of cable condition monitoring to cables in harsh environments. There is no identified common cause, other than the harsh environment, that would cause multiple cables to fail. Therefore, Exelon/AmerGen request further clarification concerning this issue.	**In response to comment "D." –** An inspection of the entire length of the cable and verification that the total length has been enveloped within design assumptions (due to changing environmental conditions or misapplication) may not be practical. A monitoring program at suitable intervals

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		E. DG-1 132 does not appear to include a discussion about Regulatory Position Item 10 in the Regulatory Analysis section of the draft Regulatory Guide. The Conclusion section indicates that the proposed action will reduce unnecessary burden. Imposing cable condition monitoring programs could have a significant impact on licensees with no clear benefit. Therefore, Exelon/AmerGen request further explanation and clarification regarding the perceived benefit. F. Exelon/AmerGen does not believe that there is an assured means of monitoring cables to determine if they can perform their intended safety function. Comments were provided to the NRC on the draft GL 2007-01 relative to this specific issue. The industry attempted to portray that cable condition monitoring technology is not capable of determining the remaining life in a cable. HiPot testing will fault cables that have pre-existing conditions; however, many view this destructive testing methodology as overly stressful on cables. This testing can potentially cause failures in cables that have considerable life remaining. Other non-destructive testing methodologies, such as Partial Discharge (PD) and Polarization Index (Tan-Delta), can provide advance indications of changes in the cable's characteristics, but there is not enough library information on these tests to provide acceptance criteria. IEEE 400, "*Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems*," does provide criteria for PD tests on XLPE insulated cables; however, EPR insulated cables are predominant in the nuclear industry. EPR cables do not trend linearly to failure; they tend to test well, and then cascade to failure over a period of a few months. Therefore, Exelon/AmerGen request that the NRC provide additional explanation and clarification concerning the basis for cable condition monitoring.	ensures functional integrity of the cable. **In response to comment "E."** – The reduction in burden was addressing the overall benefit of the regulatory guide. **In response to comment "F."** – In certain cases, use of more than one technique may be needed to assess the degradation of the cable insulation. In addition to the techniques mentioned in the comment, the use of Line Resonance Analysis based on frequency domain reflectometry for monitoring the insulation is gaining wider acceptance for a variety of cable types. The purpose of the monitoring program is to observe the rate of insulation degradation and to reduce the cable failures during the performance of a safety function.