NRC Staff Resolution of Public Comments Received on the Proposed Generic Letter on Inaccessible or Underground Cable Failures That Disable Accident Mitigation Systems

Table 1: Key for Resolution of Comments		
Source of Comments (ADAMS Accession No.)	**Comment Designator**	**Remarks**
AmerGen/Exelon (ML052860144)	A	
Imcorptech (ML052310353 and ML052780381)	I	Operating experience in cable testing
Progress Energy (ML052780425)	P	
Strategic Teaming and Resource Sharing (STARS) (ML052860244)	S	
Tennessee Valley Authority (TVA) (ML052780374)	T	Endorsement of NEI comments
Nuclear Energy Institute (NEI) (ML052780354)	N	

Table 2: Key for Classifying Comments	
Bin #	**Description**
1	Comments related to cable testing/industry standards.
2	Comments related to the scope of the generic letter - voltage, inaccessibility, and environment.
3	Comments related to industry experience/data.
4	Comments related to general design criteria (GDC), licensing bases, and legal issues.
5	Miscellaneous comments.

ENCLOSURE 2

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	A-1 (Attachment, page 2)	1. The *Applicable Regulatory Requirements* section, last paragraph, third sentence, states: *"The cable failures that could disable risk-significant equipment are expected to have monitoring programs to demonstrate that the cables can perform their safety function when called on."* Cables associated with risk significant systems are functionally tested during the surveillance tests of the risk significant systems. The cable functional testing is no different from functional testing of motors during the corresponding surveillance test. The capability of cables to perform their intended safety function is demonstrated during surveillance testing of the system.	A-1 Not Incorporated. The surveillance procedures that involve energization of the cable for short periods may be sufficient to demonstrate a single component operation for a short period. The capability for design bases functions for extended duration cannot be confirmed through brief cycles of operation. Additionally, the cable failure that could impact multiple components or a train would need a suitable condition monitoring to avoid unanticipated failures.
1	N-A7 (Enclosure, page 29)	Cables associated with risk significant system are functionally tested during the surveillance tests of the risk significant systems. The cable functional testing is no different than functional testing of motors during the corresponding surveillance test. The capability of cables to perform their intended safety function is demonstrated during surveillance testing of the system.	Not Incorporated. The capability for design bases functions for extended duration cannot be confirmed through brief cycles of operation. See staff response to comment A-1 (page 2) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-G3 (Enclosure, page 1)	The nuclear power industry is adhering to the requirements of Regulatory Guide 1.118 and IEEE Std. 338-1987 in regard to testing of medium and low voltage cables. Medium and low voltage cables are functionally tested every time a connected load is functionally tested. The extent and frequency of the functional testing of medium and low voltage cables is probably in excess of that calculated commensurate with plant safety concerns and the failure history of medium and low voltage cables. Failure rates of cables can be determined from the results of functional tests. Functional tests cause effects on the cables that are identical to those required under actual operating and accident conditions. Accordingly, given that the industry has not experienced multiple simultaneous failures during functional tests, there is a very low likelihood that such a condition will occur under an actual loss of off-site power.	Not Incorporated. The capability for design bases functions for extended duration cannot be confirmed through brief cycles of functional testing. The information available at this time indicate a high rate of failure for inaccessible and underground cables. See staff response to comment A-1 (page 2) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-D1 (Enclosure, pages 33-34)	With respect to the need for testing, there is nothing that says it has to be diagnostic. Functional testing is adequate until the site experiences a failure, or there is indication of issues with a specific lot of cables. At that time, diagnostic testing, if feasible, can be performed to prioritize replacements of the cables. I believe the NEI 2005 Medium Voltage Underground Cable Survey data would support that this is exactly what the industry has been doing and that it has been effective in driving down the failure rate.	Not Incorporated. In the Discussion section of the GL, the staff identified diagnostic testing as an option adopted by some licensees. Diagnostic testing is necessary to evaluate cable degradation which could result in failure of multiple equipment. See staff response to comment A-1 (page 2) of Bin 1.
1	A-2 (Attachment, page 2)	2. The *Discussion* section, first example, second sentence, states: *"The incipient failures of these cables can go undetected because these cables generally remain de-energized when the plant is generating power. "* This paragraph is discussing power cables that connect the offsite power to the safety buses. Power cables used for offsite power, or in-plant distribution, are continuously energized and any failure would be immediately detected. Cables that are normally de-energized are feeds to Emergency Core Cooling System (ECCS) pumps. These cables are functionally tested during the surveillance testing of the connected loads.	A-2 Partially Incorporated. GL revised to indicate "The incipient failures of these cables can go undetected because in some plants these cables generally remain deenergized during power generation." There are two primary types of power source line up when the full spectrum safety bus power line up is considered. Certain plants power the safety buses through an auxiliary transformer, other plants directly connect to the offsite power. The GL reference was only to those plants that have power source line up through the auxiliary transformer. Also, see staff response to comment A-1 (page 2) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-D9 (Enclosure, page 37	If incipient failures go undetected because cables are generally de-energized, does continuous energization constitute an acceptable test? In general, power cables used for offsite power or in-plant distribution are continuously energized; any failure would be immediately detected. Cables that are normally de-energized are feeds to ECCS pumps; these cables are functionally tested along with the surveillance test of the connected loads.	Partially Incorporated. The GL reference was only to those plants that have power source line up through the auxiliary transformer. See staff response to comment A-2 (page 4) of Bin 1.
1	A-3 (Attachment, page 2)	3. The *Discussion* section, second example, states: *"The failure of the power cables from an emergency diesel generator (EDG) to the respective safety bus (where the EDGs are located in separate buildings) would prevent recovery of standby power from the respective EDG and result in the unavailability of a full train of accident mitigation systems during a loss-of-offsite-power event (LOOP).* " Power cables from the Emergency Diesel Generators (EDGs) are functionally tested, typically once per month, during the EDG surveillance runs.	A-3 Not Incorporated. The staff stated two risk-significant cables failures: failure of (1) the EDG cable and (2) the emergency service water pump cable when these components are located in different buildings. These are single failures, but the effect of the failure extends to the whole train and the risk significance would vary depending on plant unique capabilities for cross connecting safety systems. Also see staff response to comment A-1 (page 2) of Bin 1.
1	N-D10 (Enclosure, page 37)	Power cables from the EDGs are functionally tested, typically once per month during the EDG monthly surveillance runs.	Not Incorporated. The effect of the failure extends to the whole train and the risk significance would vary depending on plant unique capabilities for cross connecting safety systems. See staff response to comment A-3 (page 5) of Bin 1 and A-1 (page 2) of Bin 1.

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Bin #	**Comment #**	**Comment**	**Resolution**
1	A-4 (Attachment, page 2)	4. The <u>*Discussion*</u> section, third example, states: *"The failure of the power cables to an emergency service water (ESW) or component cooling water pump can disable one train of emergency core cooling systems for long-term service unless the headers can be cross-connected and the redundant pump(s) can be lined up to supply sufficient cooling for both trains. If the EDGs are cooled from ESW or service water, the cable failure could disable the EDG and lose one train of standby power."* Power cables supplying Emergency Service Water (ESW) pumps are functionally tested during surveillance testing of the ESW pumps. It is not uncommon for all ESW pumps to run coincident with the start of an EDG. Some plants perform this evolution weekly, but no less frequent than monthly.	Not Incorporated. The effect of the failure extends to the whole train and the risk significance would vary depending on plant unique capabilities for cross connecting safety systems. See staff response to comment A-3 (page 5) and A-1 (page 2) of Bin 1.
1	N-D11 (Enclosure, page 37)	Power cables supplying ESW pumps are functionally tested along with the surveillance testing of the ESW pumps. It is not uncommon for all ESW pumps to run coincident with the start of an EDG. In the case of some plants, this could be weekly, but is no less frequent than monthly.	Not Incorporated. The effect of the failure extends to the whole train and the risk significance would vary depending on plant unique capabilities for cross connecting safety systems. See staff response to comment A-3 (page 5) of Bin 1.

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Bin #	**Comment #**	**Comment**	**Resolution**
1	A-9 (Attachment, page)	9. The *Summary* section of the proposed GL states: *"Adequate monitoring will ensure that cables will not fail abruptly and cause plant transients or disable accident mitigation systems when they are needed."* This same assertion also appears in the *Purpose* section. IEEE-400-2001, *"Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems,"* Association of Edison Illuminating Companies (AEIC) G7-90, states: *"There are no field tests available that will provide an exact measurement of remaining service life in an operating cable system."* There is no "adequate monitoring" that will ensure cables will not fail abruptly. The best that presently can be achieved by monitoring is consistent with that achieved by other system surveillances (i.e., demonstration that the system was functional over the past surveillance interval along with reasonable assurance that it will perform its function in the future).	A-9 Partially Incorporated. The staff recognizes that adequate monitoring can only ensure that abrupt failures can be detected early and corrected in a timely manner. The GL was revised as follows: "Some licenses have detected cable degradations prior to failures through techniques for measuring and trending the condition of the cable insulation". See Bin 3 on industry experience/data and comment I-1 (page 35) of Bin 1 for an example of testing techniques. In the Discussion section of the GL, the staff identified diagnostic testing as an option adopted by some licensees. Diagnostic testing is necessary to evaluate cable degradation which could result in common mode failure of redundant equipment. See staff response to comment A-1 (page 2) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-SM1 (Enclosure, pages 44-45)	From IEEE-400-2001, "Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems", AEIC G7-90 states that "There are no field tests available that will provide an exact measurement of remaining service life in an operating cable system." There is no "adequate monitoring" that will ensure cables will not fail abruptly. The best that presently can be achieved by monitoring is consistent with that achieved by other system surveillances: demonstration that the system was functional over the past surveillance interval along with reasonable assurance that it will perform its function in the future.	Partially Incorporated. The staff recognizes that adequate monitoring can only ensure that abrupt failures can be detected early and corrected in a timely manner. See staff response to comment A-9 (page 7) of Bin 1.
1	A-10 (Attachment, page 5)	10. The *Discussion* section of the proposed GL states: *"Potential cable failures can be detected through state-of-the-art techniques for measuring and trending the condition of cable insulation."* Potential cable failures cannot be detected. Changes in the insulation properties of MV shielded cables can be tested and trended; however, the results of these tests are subject to many variables such that an accurate correlation cannot be made for just-in-time cable replacements. Time Domain Reflectometry is a troubleshooting tool that can be used to determine the approximate location of a failure; it is not a diagnostic cable test. IEEE-400 does not include a discussion on Broadband Impedance Spectroscopy (BBIS). The only	A-10 Partially Incorporated. The staff is requesting information on "inspection, testing and monitoring programs, to detect degradation…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. Use of labs or other suitable vendors or methods are options available to the licensees. Broadband

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		references found regarding BBIS are in the NRC Nuclear Reactor Regulations (NRR) Weekly Information Report, dated September 10, 2004, an abstract prepared by Boeing/Rockwell Scientific on BBIS research on aircraft wiring, and a presentation by the same authors at an American Nuclear Society (ANS) Meeting dated November 16, 2004, entitled "*Application of the Broadband Impedance Diagnostic/Prognostic Technique to Nuclear Power Plant Cables.*" The Weekly Information Report indicates that the research was being performed on LV instrumentation and control cables used in aircraft. The abstract indicates that the testing can identify differences in characteristics between new and stressed cables; however, it appears that significant work needs to be done to gather data indicating life remaining in the cables. The abstract indicates that knowledge of specific properties of the cable materials is required to interpret the results. The testing was also performed in laboratories, but the technology needs to be demonstrated in the field. Additionally, experience has to be gained in the field with any of these emerging technologies such that test data can be correlated precisely to the condition of the cables. The paper on nuclear plant cables presented at the ANS meeting is not readily	impedance spectroscopy may be used when its capability is suitably developed. It was deleted from the GL as an available technique at this time. See Bin 3 on industry experience/data.

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		available and it is doubtful that answers to the concerns raised have been addressed in the few months between the abstract and the presentation.	
1	N-D7 (Enclosure, pages 35-36)	Potential cable failures cannot be detected. Changes in the insulation properties of medium voltage shielded cables can be tested and trended, however the results of these tests are subject to many variables such that an accurate correlation can not be made for just in time cable replacements. Time Domain Reflectometry can be used to determine the approximate location of a failure, but it is not a diagnostic cable test. IEEE 400 does not include a discussion on Broadband Impendence Spectroscopy; until the industry consensus group on cable testing recognizes the validity of a test methodology, its use can be viewed as suspect.	Partially Incorporated. Use of labs or other suitable vendors or methods are options available to the licensees. Broadband impedance spectroscopy may be used when its capability is suitably developed. It was deleted from the GL as an available technique at this time. See staff response to comment A-10 (page 8) of Bin 1.

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Bin #	**Comment #**	**Comment**	**Resolution**
1	N-S18 (Enclosure, page 17)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: There is no indication that time domain reflectometry (TDR) is useful for evaluating degradation of either high or low voltage cable. Time domain reflectometry (TDR) is a useful tool for troubleshooting certain types of cable failures, but is unable to distinguish local cable degradation from sound insulation. The industry is unaware of any in-plant usage of broadband impedance spectroscopy. Partial Discharge (PD) tests have been used to a limited extent and dissipation factor (tan delta) testing has been used. Low-frequency test sets have been used successfully to perform these tests. Other tests currently are under development.	Partially incorporated. Use of labs or other suitable vendors or methods are options available to the licensees. Broadband impedance spectroscopy may be used when its capability is suitably developed. It was deleted from the GL as an available technique at this time. See staff response to comment A-10 (page 8) of Bin 1.
1	P-13 Discussion (Letter, page 3)	13. Proven diagnostic test methods for MV cables include partial discharge characterization, dissipation factor with VLF sinusoidal waveform, and VLF withstand as described in IEEE 400. There is no known industry standard for using time domain reflectometry and broadband impedance spectroscopy as diagnostic tools for MV cable condition monitoring.	Partially incorporated. Use of labs or other suitable vendors or methods are options available to the licensees. Broadband impedance spectroscopy may be used when its capability is suitably developed. It was deleted from the GL as an available technique at this time. See staff response to comment A-10 (page 8) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	S-16 (Attachment, page 5)	16. Diagnostic techniques that are currently available have limited applicability and may be controversial in that some engineers believe they should be used and other believe they deteriorate the cable to the point of premature failure. Some of the newer techniques (low frequency AC, PD, etc.) have not been used long enough to validate their effectiveness at early detection of potential failures or to validate that the tests do not cause premature failure. There is no consensus among the various industry experts on what tests to do for the various voltage classes and insulation types of cables in use and what acceptance criteria to use. Trending of megger readings, TDR or other types of tests may work in a laboratory under tightly controlled environmental conditions but is not effective in a real operating power plant. Additionally there is a lack of baseline data for installed cables to compare to.	Not incorporated. Use of labs or other suitable vendors or methods are options available to the licensees. See staff response to comment A-10 (page 8) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-B7 (Enclosure, pages 23-24)	Diagnostic techniques that are currently available have limited applicability and may be controversial in that some engineers believe they should be used and others believe they deteriorate the cable to the point of premature failure. Some of the newer techniques (low frequency AC, PD, etc.) have not been used long enough to validate their effectiveness at early detection of potential failures or to validate that the tests do not cause premature failure. There is no consensus among the various industry experts on what tests to do for the various voltage classes and insulation types of cables in use and what acceptance criteria to use. Trending of megger readings, time domain reflectometry (TDR) or other types of tests may work in a laboratory under tightly controlled environmental conditions but is not effective in a real operating power plant. Additionally there is a lack of baseline data for installed cables comparison.	Not incorporated. Use of labs or other suitable vendors or methods are options available to the licensees. See staff response to comment A-10 (page 8) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	S-28 (Attachment, page 7)	28. Diagnostic techniques that are currently available have limited applicability and may be controversial in that some engineers believe they should be used and others believe they deteriorate the cable to the point of premature failure. Some of the newer techniques (low frequency AC, PD, etc.) have not been used long enough to validate their effectiveness at early detection of potential failures or to validate that the test do not cause premature failure. There is no consensus among various industry experts on what test to do for the various voltage classes and insulation types of cables in use and what acceptance criteria to use. Trending of megger reading, TDR or other types of tests may work in a laboratory under tightly controlled environmental conditions but is not effective in a real operating power plant. Additionally, there are no baseline data for the installed cables for trending purpose.	Not incorporated. Use of labs or other suitable vendors or methods are options available to the licensees. See staff response to comment A-10 (page 8) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-D21 (Enclosure, page 39)	Diagnostic techniques that are currently available have limited applicability and may be controversial in that some engineers believe they should be used and others believe they deteriorate the cable to the point of premature failure. Some of the newer techniques (low frequency AC, PD, etc.) have not been used long enough to validate their effectiveness at early detection of potential failures or to validate that the tests do not cause premature failure. There is no consensus among the various industry experts on what tests to do for the various voltage classes and insulation types of cables in use and what acceptance criteria to use. Trending of megger readings, TDR or other types of tests may work in a laboratory under tightly controlled environmental conditions but is not effective in a real operating power plant. Additionally there are no baseline data for the installed cables for trending purpose. To date, only IEEE Std 400.2 for Tan Delta measurement provides guidance and acceptance criteria for testing of crosslinked polyethylene insulation. Consensus guidance and acceptance criteria have yet to be developed for other materials.	Not incorporated. Use of labs or other suitable vendors or methods are options available to the licensees. See staff response to comment A-10 (page 8) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	A-11 (Attachment, pages 5-6)	11. In addition, the <u>Discussion</u> section states: *"A diagnostic cable test program provides reasonable confidence that the cable will perform its intended function. The frequency of the test should be commensurate with the observed cable test results. To avoid unplanned outages and unanticipated failures, certain licensees have adopted a baseline frequency of 5 years for new cables or more frequent testing when insulation degradation is observed."* IEEE-400, Section 4.4, "Need for Testing," states: *"The decision to employ maintenance testing must be evaluated by the individual user, taking into account the costs of a service failure, including intangibles, the cost of testing, and the possibility of damage to the system."* Utilizing functional testing until there is some indication that there is an issue with the population of cables represents a valid approach. The MV cables in use at most plants are similar for safety-related and non-safety related applications. The non-safety related cables are typically subjected to similar environmental conditions as the safety-related cables, and the non-safety related cables are typically exposed to greater electrical stresses. They are continuously energized, operated at a voltage closer to the cable's rating, and not necessarily de-rated as conservatively as safety-related cables. If there is an increasing failure trend on	A-11 Not Incorporated. The need and frequency for cable testing addresses NRC staff's safety concerns. The staff is using only nuclear industry experience because the cables in the nuclear industry have been a higher quality product line available at the time of construction because of the requirement imposed through 10 CFR 50 Appendix B program for safety-related cables that form the majority of the cables in scope. The staff agrees that cable failures are low when the entire cable population is considered at a plant. However, the failure rate of the cables within the scope of this GL was much higher. The NEI survey was not made available to the NRC staff.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		the non-safety cables, this serves as an alert for action on the safety-related cables. After the failure mode of the non-safety cables is determined, the relevance can be applied to determine the need to act on the safety-related cables. There is significant cost associated with cable diagnostic testing. The equipment must be de-energized and de-terminated, resulting in increased equipment unavailability and a potential for causing errors in re-connecting. The Nuclear Energy Institute (NEI) survey indicates that the majority of cable failures have occurred in a limited type of cable construction at a limited number of sites. Given no site specific and cable-type failure history, it could be concluded that maintenance testing is not warranted.	
1	N-D8 (Enclosure, pages 36-37)	IEEE 400 states under Section 4.4, Need for Testing: "The decision to employ maintenance testing must be evaluated by the individual user, taking into account the costs of a service failure, including intangibles, the cost of testing, and the possibility of damage to the system." A valid approach is to utilize functional testing until there is some indication that there is an issue with the population of cables. The medium voltage cables in use at most plants are similar for safety related and non-safety related applications. The non-safety related cables are typically subjected to similar environmental	Not Incorporated. The failure rate of the cables within the scope of this GL was much higher. See staff response to comment A-11 (page 16) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	Comment #	Comment	Resolution
		conditions as the safety related cables, and the non-safety related cables are typically exposed to greater electrical stresses; they are continuously energized, operated at a voltage closer to the cables rating, and not necessarily de-rated as conservatively as safety related cables. If there is an increasing failure trend on the non-safety cables, this serves as an alert for action on the safety related cables. After the failure mode of the non-safety cables is determined, the relevance can be applied to determine the need to act on the safety related cables. There is significant cost associated with cable diagnostic testing. The equipment must be de-energized and de-terminated resulting in increased equipment unavailability and a potential for causing errors in re-connecting. The NEI 2005 Medium Voltage Underground Cable Survey indicates that the majority of cable failures have occurred in a limited type of cable construction at a limited number of sites. Given no site specific/cable type failure history, the user should conclude that maintenance testing is not warranted.	

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	A-28 (Attachment, page 10)	28. The testing methodologies identified are only effective for shielded MV cables. The 23 Licensee Event Reports (LERs) represent both MV and LV cables. Since the causes of failure for MV and LV cables are different, the monitoring plans for these cables should be addressed separately.	A-28 Partially Incorporated. The staff is including this concern on low voltage power cables because certain plants of older vintage have safety buses and emergency diesel generators (EDG) at 480 V range for operating safety related and other risk significant loads. There had been power cable failures in this voltage range and for DC cables. Additionally, the staff identified safety-related 480 V cable failures at one nuclear station and 250 V DC cable failures at two nuclear stations in inaccessible or underground locations. Though there are only about a dozen cables susceptible to moisture-induced damage in a nuclear station, the staff found 23 licensee event reports (LERs) and two morning reports since 1988 on failures of buried medium-voltage cables from insulation failure. In this GL, staff is seeking how low voltage and medium voltage power cables are monitored. The staff recognizes that techniques for testing unshielded cables are limited. Also, see Bin 3 on industry experience/data.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-S1d (Enclosure, page 7)	The testing methodologies identified are only effective for shielded (medium voltage) cables. Although the 23 LERs represent both medium voltage and low voltage cables, the survey result show that the concern is only for wet, medium voltage underground cables.	Partially Incorporated. In this GL, staff is seeking how low voltage and medium voltage power cables are monitored. The staff recognizes that techniques for testing unshielded cables are limited. See staff response to comment A-28 (page 19) of Bin 1 and Bin 3 on industry experience/data.
1	A-30 (Attachment, page 11)	30. Current "state-of-the-art" cable testing technology is not as impressive as implied within the proposed GL. The recognized methodologies (i.e., partial discharge and tan-delta) require that the cable be shielded in order to provide meaningful results. LV cables do not have shields, and more than 20% of the industry does not have shielded 4 kilovolt (kV) cables. The recognized methodologies do not have established acceptance criteria. External factors such as temperature and humidity have a significant impact on the results. Absent quantitative acceptance criteria, the qualitative results could provide some ranking of similar cables; however, none of the tests can accurately predict remaining cable life. The recognized MV cable testing methodologies require that the cables be disconnected from their sources and loads. This requires reworking all of the connections since most designs do not utilize means for quick disconnects. Reworking the connections introduces the likelihood of errors or damage.	Partially Incorporated. In this GL, staff is seeking how low voltage and medium voltage power cables are monitored. The staff recognizes that techniques for testing unshielded cables are limited. See staff response to comment A-28 (page 19) of Bin 1 and Bin 3 on industry experience/data on cable testing.

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1	P-3 General (Letter, page 2)	3. We agree that there is an aging management issue with MV cables that are constantly energized in wetted environments. However, cable failures have been random in nature. There is no indication that there is any vulnerability to multiple equipment failures. Failures that have occurred with higher frequencies have historically been attributed to manufacturing defects and installation damage.	P-3 Not Incorporated. The staff is addressing underground or inaccessible power cable failures because the rate of failures for cables within the scope of this GL has been higher in the plant. Failures in EDG cables, emergency service water pump cables, and so forth could affect multiple systems during accident mitigation. Several causes and combination of causes were identified for cable failures. The staff is inquiring about processes in place to avoid in-service failures during accident scenarios. The bases for this request under 10 CFR 50.54(f) are addressed in Bin 3.
1	P-9 Discussion (Letter, page 3)	9. The Discussion Section states: "The incipient failures of these cables can go undetected because these cables generally remain de-energized when the plant is generating power." However, given the absence of some sort of installation (or mechanical) damage, we do not believe that this is true. We are not aware of any industry evidence that would suggest that a de-energized underground cable experiences significant aging of a magnitude severe enough to render it unavailable when called upon to perform its intended function. In addition, these cables are regularly energized, and therefore monitored, during surveillance testing.	Partially Incorporated. The GL reference was only to those plants that have power source line up through the auxiliary transformer. See staff response to comment A-2 (page 4) of Bin 1. The staff is enquiring about processes in place to avoid in-service failures during accident scenarios. See staff response to comment P-3 (page 21) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	P-10 Discussion (Letter, page 3)	10. The Discussion Section states: “Potential cable failures can be detected through state-of-the-art techniques for measuring and trending the condition of cable insulation.” However, in the context of underground wetted cables, this is not entirely accurate. There is no industry standard for accurately detecting cable degradation in this environment and/or predicting cable life. A series of tests is typically employed with limited usefulness. While this may be considered state of-the art, it hardly meets the threshold for predicting potential cable failures. The Discussion Section later discusses various testing techniques that have helped licensees assess the condition of the cable insulation. This is a more accurate representation of what the current technologies available today can do.	Partially Incorporated. The GL has been revised in the Discussion section as follows: “Some licensees have detected cable degradation prior to failures though techniques for measuring and trending the condition of cable insulation. The licenses can assess the condition of cable insulations with reasonable confidence using one or more of the following testing techniques. The staff is requesting information on “inspection, testing and monitoring programs, to detect degradation….” A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. Use of labs or other suitable vendors or methods are options available to the licensees. See Bin 3 on industry experience/data and comment I-1 (page 35) of Bin 1 for testing techniques.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	P-11 Discussion (Letter, page 3)	11. The cables referred to in the first and second bullets are functionally tested with the Emergency Diesel Generator surveillance test as described above. In addition, multiple cable failures have not been an issue due to the random nature of cable failures.	Not Incorporated. In the Discussion section of the GL, the staff identified diagnostic testing as an option adopted by some licensees. Diagnostic testing is necessary to evaluate cable degradation which could result in multiple failures. The staff is addressing underground or inaccessible cable failures because the rate of failures for cables within the scope of this GL has been higher in the plant. See staff response to comments A-1 (page 2) and P-3 (page 21) of Bin 1.
1	S-9 (Attachment, page 3)	9. In general, the suggested newer diagnostic techniques (low frequency AC, PD, etc.) that are currently available are still unproven, unpredictable, not consistently reproducible. These tests have not been used long enough to validate their effectiveness at early detection of potential failures or to validate that the tests do not cause premature failure. There is no consensus among the various industry experts on what tests to use for the various voltage classes and insulation types of cables in use and what acceptance criteria to use. There is no known ultimate failure mechanism for EPR and thus identification of a useful test for monitoring aging has not been possible. Physical logistics of some of the larger test equipment make them impractical for most power plant applications and the lack of a consistent ground plane makes testing for insulation resistance, high voltage and partial discharge ineffective.	Not Incorporated. The staff is requesting information on "inspection, testing and monitoring programs, to detect degradation…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. Use of labs or other suitable vendors or methods are options available to the licensees. The staff recognizes that testing techniques are limited for unshielded cables. See Bin 3 on industry experience/data and comment I-1 (page 35) of Bin 1 for testing techniques.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-G11 (Enclosure, pages 4-5)	In general, some of the suggested newer diagnostic techniques that are currently available are still unproven, unpredictable, not consistently reproducible. They have not been used long enough to validate their effectiveness at early detection of potential failures or to validate that the tests do not cause premature failure. There is no consensus among the various industry experts on what tests to do for the various voltage classes and insulation types of cables in use and what acceptance criteria to use. There is no known ultimate failure mechanism for EPR and thus identification of a useful test for monitoring aging has not been possible. Physical logistics of some of the larger test equipment make the equipment impractical for most power plant applications and the lack of a consistent ground plane for plants with unshielded cable makes testing for insulation resistance, high voltage, and partial discharge ineffective. When testing is indicated, guidance from IEEE Std 400, which represents the consensus of the industry, should be the basis. Even then, even the consensus test method must be applied in a thoughtful manner that depends on the specific insulation and configurations in use. One test type does not fit all situations and some cable configurations may be un-testable.	Not Incorporated. The staff is requesting information on "inspection, testing and monitoring programs, including surveillance programs, to detect degradation…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. Use of labs or other suitable vendors or methods are options available to the licensees. See Bin 3 on industry experience/data and comment I-1 (page 35) of Bin 1 for examples of testing techniques.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	S-10 (Attachment, page 4)	10. Most degradation mechanisms would cause medium voltage cables to fail randomly and would not affect the "operability" of multiple accident-mitigation systems (i.e., the degradation would affect reliability not represent a common mode failure affecting operability). Electrical degradation of low voltage cables is not expected because of the low electrical stresses in the insulation. EPRI report NP-7485 defines cable operability as the continued ability of the cable to support the performance of its connected equipment's nuclear safety-related function which includes being able to support the function of the connected equipment even when the cable is exposed to harsh environments related to accidents. With safety-related equipment there are typically surveillance procedures which demonstrate "operability," i.e., the ability of the equipment to perform its safety related functions under normal plant operating conditions.	S-10 Not Incorporated. The staff is addressing cable failures from all causes. Test programs should be customized to suit the service of the cable to prevent in-service failures. Also, see staff response to comment A-1 (page 2) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-P1 (Enclosure, pages 19-20)	Most degradation mechanisms would cause medium voltage cables to fail randomly and would not affect the "operability" of multiple accident-mitigation systems, i.e. the degradation would affect reliability not represent a common mode failure affecting operability. Electrical degradation of low voltage cables is not expected because of the low electrical stresses in the insulation. EPRI report NP-7485 defines cable operability as the continued ability of the cable to support the performance of its connected equipment's nuclear safety-related function which includes being able to support the function of the connected equipment even when the cable is exposed to harsh environments related to accidents. With safety-related equipment there are typically surveillance procedures which demonstrate "operability", i.e. the ability of the equipment to perform its safety related function under normal plant operating conditions.	Not Incorporated. The staff is addressing power cable failures from all causes. See staff response to comment S-10 (page 25) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	S-17 (Attachment, page 5)	17. Physical logistics of some of the larger test equipment make them impractical for most power plant applications and the lack of a consistent ground plane makes testing for insulation resistance, high voltage and partial discharge ineffective.	Not Incorporated. The staff is requesting information on "inspection, testing and monitoring programs, to detect degradation…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. Use of labs or other suitable vendors or methods are options available to the licensees. See Bin 3 on industry experience/data and comment I-1 (page 35) of Bin 1 for examples of testing techniques.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-B8 (Enclosure, page 24)	Physical logistics of some of the larger test equipment make them impractical for most power plant applications and the lack of a consistent ground plane makes testing for insulation resistance, high voltage and partial discharge ineffective.	Not Incorporated. The staff is requesting information on "inspection, testing and monitoring programs, to detect degradation…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. Use of labs or other suitable vendors or methods are options available to the licensees. See Bin 3 on industry experience/data and comment I-1 (page 35) of Bin 1 for and examples of testing techniques.
1	S-18 (Attachment, page 5)	18. In service failures need to be addressed separately from failures which occurred during maintenance. A cable that fails during a DC Hipot test when the equipment is in maintenance should be considered a success because the degraded cable was identified before it failed in service.	S-18 Not Incorporated. The staff also sees this (diagnostic) test result as a success. The staff is addressing power cable failures from all causes. The LERs generally do not report failures that happened during a scheduled maintenance activity.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-B9 (Enclosure, page 24)	In service failures need to be addressed separately from failures which occurred during maintenance. A cable that fails during a DC Hi-pot test when the equipment is in maintenance should be considered a success because the degraded cable was identified before it failed in service.	Not Incorporated. The staff is addressing power cable failures from all causes. The staff also sees this (diagnostic) test result as a success. See staff response to comment S-18 (page 27) of Bin 1.
1	S-23 (Attachment, page 6)	23. The cable qualification performed in accordance with IEEE 383 will not ensure that cables will perform in a submerged environment. The submergence requirements are demonstrated by testing performed to ICEA standards.	Not Incorporated. The staff agrees with this comment. Also, see staff response to comment S-35 (page 30) of Bin 1.
1	N-B14 (Enclosure, page 26)	The cable qualification performed in accordance with IEEE 383 will not ensure that cables will perform in a submerged environment. The submergence requirements are demonstrated by testing performed to ICEA standards.	Not Incorporated. The staff agrees with this comment. Also, see staff response to comment S-35 (page 30) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	S-29 (Attachment, page 7)	29. There have been several attempts to get industry consensus for monitoring techniques: EPRI Report NP-7485 "Power Plant Practices to Ensure Cable Operability,"EPRI Report TR-105581 "Improved Conventional Testing of Power Plant Cables,"and a draft IEEE Standard (circulated in 2001 but never published) P1186/D10, Recommended Practices for the Evaluation on the Installed Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations. None of these have provided enough guidance and acceptance criteria to be beneficial in condition monitoring of cables.	Not Incorporated. The staff is requesting information on "inspection, testing and monitoring programs, to detect degradation…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. Use of labs or other suitable vendors or methods are options available to the licensees. See Bin 3 on industry experience/data and comment I-1 (page 35) of Bin 1 for testing techniques.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-D22 (Enclosure, pages 39-40)	There have been several attempts to get industry consensus for monitoring techniques: EPRI Report NP-7485 "Power Plant Practices to Ensure Cable Operability," EPRI Report TR105581 "Improved Conventional Testing of Power Plant Cables," and a draft IEEE Standard (circulated in 2001 but never published) P1 186/1b0, Recommended Practices for the Evaluation of Installed Cable Systems for Class 11 Circuits in Nuclear Power Generating Stations. None of these have provided enough guidance and acceptance criteria to be beneficial in condition monitoring of cables.	Not Incorporated. The staff is requesting information on "inspection, testing and monitoring programs, to detect degradation…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. Use of labs or other suitable vendors or methods are options available to the licensees. See Bin 3 on industry experience/data and comment I-1 (page 35) of Bin 1 for testing techniques.
1	S-34 (Attachment, page 9)	34. The "state of the art" in cable testing is misrepresented. This statement implies that the cable condition can be determined with the use of various in-situ tests. I do not believe this to be the case.	Not Incorporated. Use of labs or other suitable vendors or any of the methods available are options to the licensees. See staff response to comment A-10 (page 8) of Bin 1 and Bin 3 on industry experience/data on testing techniques.
1	N-D27 (Enclosure, pages 42-43)	The "state of the art" in cable testing is misrepresented. This statement implies that the cable condition can be determined with the use of various in-situ tests; this is not the case.	Not Incorporated. Use of labs or other suitable vendors or methods are options available to the licensees. See staff response to comment A-10 (page 8) of Bin 1 and Bin 3 on industry experience/data.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	S-35 (Attachment, page 9)	35. Is a diagnostic cable test program only recommended for cables not rated for submergence? The testing requirements detailed in the letter are only applicable if this is the case.	S-35 Partially Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. The GL was revised to request for information on manufacturer, date of the failure and type of service to identify if the problem is continuing and to share the industry knowledge on how the problems were resolved. Also, see staff response to comments A-11 (page 16) and S-10 (page 25) of Bin 1.
1	N-D28 (Enclosure, page 43)	Is a diagnostic cable test program only recommended for cables not rated for submergence? The testing requirements detailed in the letter are only applicable if this is the case.	Partially Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. See staff response to comment S-35 (page 30) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-G2 (Enclosure, page 1)	The Insulated Conductors Committee (ICC) of the IEEE Power Engineering Society is recognized as the industry consensus group for cables. Members of that committee represent both the distribution and the nuclear industries. As the ICC is the industry group on medium voltage cables, any design, installation or testing practices identified in ICC standards and codes should be the basis for this issue. Any design; installation or testing practices not endorsed by ICC standards and guides should be viewed as in development or suspect.	N-G2 Not Incorporated. The NRC staff's focus is on safety. The NRC staff routinely endorses industry guidance through Regulatory Guides when a standard is available for addressing all the related issues. The staff is requesting information on "inspection, testing and monitoring programs, to detect degradation…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. Use of labs or other suitable vendors or methods are options available to the licensees. See Bin 3 on industry experience/data and comment I-1 (page 35) of Bin 1 for testing techniques.
1	N-D2 (Enclosure, page 34)	The NRC should acknowledge that the IEEE Insulated Conductors Committee (ICC) is the industry consensus group for medium voltage cables. Neither the industry nor the NRC should be doing anything not seen as consensus.	Not Incorporated. The NRC staff's focus is on safety. See staff response to N-G2 (page 31) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-G12 (Enclosure, page 5)	10CFR54 and the GALL E-3 program already address inaccessible medium voltage underground (MVU) cable and set forth a testing and monitoring-based aging management program that has been judged to be acceptable to the NRC Staff. 'With initial testing scheduled to take place prior to the start of the period of extended operation, this will shortly provide a benchmark for the condition of these cables in the oldest plants, many of which have already started testing.	N-G12 Not Incorporated. The Advisory Committee on Reactor Safeguards (ACRS) expressed concern on the present GALL program. NRR shared this concern and opted to pursue this issue under operating reactors program. ACRS was informed of this action during the development of the GL and was offered an opportunity to comment on it. NRR will brief the ACRS before the GL is issued.
1	N-A8 (Enclosure, pages 29-30)	The letter as currently written is inconsistent with NUREG-1801, Generic Aging Lessons Learned (GALL) Report. NUREG-1801 Table 6 addresses aging of various cable types for various aging mechanisms. NUREG-1801 Volume 2 Sections XI.E1, XI.E2, and XI.E3 provide aging management programs for the various cable types and aging mechanisms. The aging effect/mechanism identified for inaccessible cable located in underground environments (installed in conduits or direct buried) is a significant voltage (2 kV to 15 kV) in the presence of moisture resulting in water trees.	Not Incorporated. The Advisory Committee on Reactor Safeguards (ACRS) expressed concern on the present GALL program. NRR will brief the ACRS before the GL is issued. See staff response to comments N-G12 (page 31) of Bin 1. The staff is addressing underground or inaccessible power cable failures because the rate of failures for cables within the scope of this GL has been higher in the plant. See staff response to comment P-3 (page 21) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-G16 (Enclosure, page 5)	In order to test much of the medium voltage underground cable, we need to take portions of the electrical system out of service and may even need to disassemble it, placing the plant is a high risk significant condition. Thus, testing does not gain us anything relative to a "run to first failure and replace" strategy.	N-G16 Not Incorporated. The frequency and level of testing may need to be based on the observed rate of degradation. The testing is considered prudent by a few licensees in light of the avoided failures during actual demand. Cable testing needs to be administered during the appropriate operating condition and without undue risk to the plant just as any other maintenance activity. This GL is an information request only.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-S17 (Enclosure, pages 16-17)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: These sentences in the generic letter over estimate the state of the art in cable testing. At least 22 units have unshielded medium cable with no ground plane. A ground plane is needed to allow meaningful electrical testing. Some cable insulations are amenable to electrical testing and some are not. For example, IEEE Std 400 has both recommended tests and acceptance criteria for XPLE. No such recommendations are made for EPR. Tan delta testing may be application to black EPR, but a final position has not been adopted. While proponents of many types of tests make strong claims, utility experience indicates far more uncertainty in the value of the results and the ability of tests to truly separate degraded cables from good.	N-S17 Not Incorporated. The industry needs to consider tests that are appropriate to the cable installation to prevent unanticipated failures. The information collected from this GL will allow for a more comprehensive review of utility experience. The information gathering through this GL will allow more comprehensive review of utility experience. Also, see staff response to comment A-28 (page 19) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
1	N-D1 (Enclosure, pages 33-34)	With respect to the need for testing, there is nothing that says it has to be diagnostic. Functional testing is adequate until the site experiences a failure, or there is indication of issues with a specific lot of cables. At that time, diagnostic testing, if feasible, can be performed to prioritize replacements of the cables. I believe the NEI 2005 Medium Voltage Underground Cable Survey data would support that this is exactly what the industry has been doing and that it has been effective in driving down the failure rate.	Not Incorporated. In the Discussion section of the GL, the staff identified diagnostic testing as an option adopted by some licensees. Diagnostic testing is necessary to evaluate cable degradation and prevent multiple failures of safety related equipment. See staff response to comment A-1 (page 2) of Bin 1 and comment A-General 1 (page 111) of Bin 5.
1	N-D29 (Enclosure, pages 43-44)	Regulatory Guide 1.118: "Periodic Testing of Electric Power and Protection Systems" states that IEEE Std. 338-1987 provides a method acceptable to the NRC Staff for satisfying the Commission's regulations with respect to periodic testing of electric power … systems, subject to a few exceptions that aren't relevant to cable testing. IEEE Std. 338-1987 states: "6.1 General Considerations - The periodic surveillance testing program for the safety system shall include, as applicable, functional tests (including channel functional tests), instrument channel checks, verification of proper calibration, and response time tests. It shall also establish the extent and frequency of the testing required commensurate with plant safety concerns."	N-D29 Not Incorporated. The information collected will be used to determine whether the existing guidance should be updated and if necessary then in what manner should the guidance be modified. The staff is requesting information on "inspection, testing and monitoring programs, to **detect degradation**…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. See staff response to comment N-G-2 (page 31) of Bin1 comment S-32 (page 98) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		Some of the stated applicable program objectives are: "2) Identify high failure rates, 7) Provide tests that simulate, as much as practicable, the actual operating conditions during which the system under test would be required to operate, 8) Provide for alteration of the test interval, and 9) Derive the periodic surveillance testing program from considerations such as component failure modes, applicable reliability and availability analysis, and other historical data."	
1	I-1	NRC must be congratulated for recognizing the importance of periodic monitoring of the condition of certain nuclear plant cables. As a provider of testing services for such cable systems (Re: The Oconee Nuclear Plant), we wish to provide the following guidelines, which may help nuclear plant owners/operators in facilitating the performance of meaningful monitoring tests... [for details see full documents in ADAMS Accession Nos. ML052310353 and ML052780381]	Not Incorporated. The NRC appreciates Imcorptech's providing industry experience/data concerning periodic monitoring of the condition of certain nuclear plant cables.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	A-21 (Attachment, page 8)	21. Regarding GDC-4, the *Applicable Regulatory Requirements* section states: *"Structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation."* As discussed previously, MV cables used in nuclear power plants are designed such that they are suitable for use in wet environments.	Partially Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. See staff response to comment S-35 (page 30) of Bin 1.
2	N-A1 (Enclosure, page 27)	Medium voltage cables used in nuclear power plants are designed such that they are suitable for use in wet environments.	Partially Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. See staff response to comment S-35 (page 30) of Bin 1.
2	N-G4 (Enclosure, page 2)	The content of this letter and the references contained within address medium voltage cables. The word "cable" is used numerous times and should be revised to "medium voltage cable". The letter should be modified to clarify that the concern is for medium voltage cables that are exposed to significant voltage and are in the presence of moisture.	Partially Incorporated. The staff's concern is not limited to only medium power voltage cables. The staff is including this concern on low voltage power cables because certain plants of older vintage have safety buses and emergency diesel generators (EDG) at 480 V range for operating safety related and other risk significant loads. See staff response to comment A-28 (page 19) of Bin 1 and comment A-26a (page 43) of Bin 2.
2	N-G6 (Enclosure, page 2)	Sandia's Aging Management Guide and other aging management reviews to help facilitate License Renewal substantiated that the wet-aging stressor is limited to medium voltage cables under simultaneous 'significant' moisture and voltage exposure.	Partially Incorporated. The staff's concern is not limited to only medium voltage power cables. The staff is including this concern on low voltage power cables because certain plants of older vintage have safety buses and emergency diesel generators (EDG) at 480 V range for operating safety related and other risk significant loads. See staff response to comment A-28 (page 19) of Bin 1 and comment A-26a (page 43) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-S2 (Enclosure, pages 7-8)	The scope of the generic letter beginning (Title) and ending (Three Requested Information Items) needs to be narrowed to wet-aged medium Voltage cables, consistent with the Background and Discussion text. The only text that may minimally refer to low voltage cables is the following under Discussion: "Certain plants have reported failures in other safety systems such as auxiliary feedwater and containment spray systems with AC and DC power and control cables routed underground or along other inaccessible paths. ..." Such vague reference does NOT constitute a basis for broadening a legitimate medium voltage cable wet-aging concern to include low voltage cables. Sandia's "Aging Management Guideline" (SAND96-0344, especially chapters 4 and 6) and EPRI TR-103834 "Effects of Moisture on the Life of Power Plant Cables" establish that the wet-aging insulation stressor is only applicable to energized and wet medium voltage cables [5 KV and higher cable ratings]	Partially Incorporated. The staff's concern is not limited to only medium voltage power cables. The staff is including this concern on low voltage power cables because certain plants of older vintage have safety buses and emergency diesel generators (EDG) at 480 V range for operating safety related and other risk significant loads. The information gathering through this GL will allow more comprehensive review of utility experience. See staff response to comment A-28 (page 19) of Bin 1 and comment A-26a (page 43) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-S5 (Enclosure, page 9)	Low voltage cables have been included in the scope with essentially no reasoning or basis. Logic is offered for the medium voltage cables that there is a small population and a few failures would be significant. No such discussion is provided for low voltage cables and no data or failure discussions have been provided indicating why rare, low voltage failures in wet conditions are a safety concern. The Cable AMG identified a total 173 failures of field cables in the NPRDS system during a 19 year period. Of these failures, only 5 were associated with moisture intrusion. Given the large number of low voltage circuits (-8,000 per plant), these few failures in approximately 100 plants indicate a truly small concern. The Staff has not made the case that there is a significant issue related to degradation of wet, low voltage cables.	Partially Incorporated. The staff is including this concern on low voltage power cables because certain plants of older vintage have safety buses and emergency diesel generators (EDG) at 480 V range for operating safety related and other risk significant loads. The staff agrees that certain cables were designed to withstand wet conditions. See staff response to comments A-28 (page 19) and S-35 (page 30) of Bin 1 and N-S2 (page 31) of Bin 2.
2	A-23 (Attachment, page 9)	23. The <u>*Applicable Regulatory Requirements*</u> section, last paragraph, first sentence, states: *"These design criteria require that cables which are routed underground be capable of performing their function when subjected to anticipated environmental conditions such as moisture or flooding."* Although this statement may be accurate, it implies that cables are not qualified for use in wet locations. The cables are designed/specified as acceptable for their operating environment, including moisture and flooding.	Not Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. See staff response to comment S-35 (page 30) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-A3 (Enclosure, pages 27-28)	Although this statement is true, it implies that cables aren't qualified for use in wet locations. The cables are designed/specified as acceptable for their operating environment including moisture and flooding.	Not Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. See staff response to comment S-35 (page 30) of Bin 1.
2	A-24 (Attachment, page 9)	24. The *Discussion* section, second paragraph following examples, first sentence, states: *"As cables that are not qualified for wet environments are exposed to wet environments, they will continue to degrade with an increasing possibility that more than one cable will fail on demand from a cable or switching fault."* Cables used in nuclear power plants are designed/specified for use in wet environments. Although the first sentence in this paragraph may be accurate, it is irrelevant to MV cables in nuclear power plants. Cable faults (i.e., over-currents) do not cause MV cable failures. During routine surveillance testing, normally de-energized cables are subjected to switching transients that are typical of those expected during accident demands.	A-24 Not Incorporated. The switching surges could be a cause of failure if the insulation has significantly degraded. These surges are below the voltage-withstand capability tests if administered at the appropriate voltage level. The absence on any insulation testing leads to unanticipated failures. Also, see staff response to comment S-35 (page 30) of Bin 1 and comment A-14 (page 86) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-D3 (Enclosure, page 34)	Cables used in Nuclear Power Plants are designed/specified for use in wet environments. Although the first sentence in this paragraph is true, it's irrelevant to medium voltage cables in Nuclear Power Plants. A cable faults (over-currents) in one medium voltage cable will not cause cascade failures in other medium voltage cable failures. Protective relaying and circuit breakers isolate the faulted cable and there is no mechanism involved that would cause other cables to simultaneously fail. During routine surveillance testing, normally de-energized cables are subjected to switching transients that are typical of those expected during accident demands. Accordingly, there is no unusual condition that would occur under a LOCA-LOOP situation that would cause multiple simultaneous failures.	Not Incorporated. The switching surges could be a cause of failure if the insulation has significantly degraded. These surges are below the voltage-withstand capability tests if administered at the appropriate voltage level. The absence on any insulation testing leads to unanticipated failures. Also, see staff response to comment S-35 (page 30) of Bin 1 and comment A-14 (page 86) of Bin 3. For LOCA-LOOP conditions, the cables would be required to operated for a long duration that could result in failures of degraded insulation.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	A-26a (Attachment, page 9)	Earlier versions of the proposed GL (i.e., February 2004) raised concerns with MV underground/below grad cables. The majority of the discussion provided within this version of the proposed GL is relevant to MV cables; however, the *Requested Information* section asks for all failures to "inaccessible or underground" cables, "For all voltage levels."	A-26a Partially Incorporated. The scope was clarified in the Requested Information section of the GL to identify power cables: "Provide a history of inaccessible or underground power cable failures, for all cables that are within the scope of 10 CFR 50.65 (the Maintenance Rule), for all voltage levels." Inaccessible areas are susceptible for a wide variety of influences such as condensation, water immersion, chemical influences, etc., that could cause power cable failures. The staff is collecting information on all types of failures to decide if further regulatory actions are necessary. The staff also clarified the current information in No. 2 of the Requested Information section to identify power cables: "... inaccessible or underground power cables, that support EDGs, offsite power, ESW, service water, component cooling water and other systems that are within the scope of 10 CFR 50.65 (the Maintenance Rule)." Also, see staff response to comment A-28 (page 19) of Bin 1 and comment A-27 (page 44) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	A-26 (Attachment, page 9)	26. The early discussions focus on water intrusion as the major contributor to failure, yet the actions are associated with inaccessible cables. The definition of inaccessible could include all cables within conduits (above and below grade), and all cables within containment.	Not Incorporated. The staff is collecting information on all types of failures to decide if further regulatory actions are necessary. See staff response to comment A-26a (page 43) of Bin 2.
2	N-S1b (Enclosure, page 7)	The early discussion focus on water intrusion as the major contributor to failure, yet the actions are associated with inaccessible cables. The definition of inaccessible, which is not provided, could include all cables within conduits (above and below grade) and all cable within containment.	Not Incorporated. The staff is collecting information on all types of failures to decide if further regulatory actions are necessary. Inaccessible areas are where the cable environment cannot be confirmed to be desirable for preserving cable insulation integrity. There should not be insulation failures if the environment is not undesirable. This GL is collecting information to find out areas of the plant that are susceptible for causing insulation failures. See staff response to comment A-26a (page 43) of Bin 2.
2	N-G5 (Enclosure, page 2)	'Inaccessible' is undefined, ambiguous, and ripe for mis-interpretation by both the licensees and NRC. Taken to extreme, this could mean every 'risk significant' cable in the plant. Any cable in a conduit is pretty much visually inaccessible, as are probably most in a packed tray.	Not Incorporated. The staff is collecting information on all types of failures to decide if further regulatory actions are necessary. See staff response to comment N-S1b (page 42) of Bin 2 and A-26a (page 43) of Bin 2.
2	A-27 (Attachment, page 9)	27. Failure mechanisms such as "treeing" are discussed, which are associated with MV cables.	A-27 Not Incorporated. The staff agrees that "treeing" is usually associated with MV cables. However, the staff is not limiting the GL only to MV cables but seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for cable failures. Also, see staff response to the first paragraph of A-26a (page 43) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-S1c (Enclosure, page 7)	Failure mechanism such as "treeing" are discussed; these are associated with medium voltage cables only.	Not Incorporated. The staff agrees that "treeing" is usually associated with MV cables. See staff response to comment A-27 (page 44) of Bin 2.
2	P-6 Background (Letter, page 2)	6. Failures of cables due to water trees applies only to medium voltage (MV) cables (and above) that are constantly energized because only they have sufficient field strength to allow trees to propagate and convert to electrical trees. This does not apply to low voltage cables, control cables, instrumentation cables, and MV cables that are not energized or are only energized infrequently. Therefore, these cables should not be included in the scope of this GL.	Not Incorporated. The staff agrees that "treeing" is usually associated with MV cables. See staff responses to comments A-27 (page 44) and the first paragraph of A-26a (page 43) of Bin 2.
2	P-15 Requested Information (Letter, page 4)	15. The wording in items 1 & 2 of the Requested Information section, pg 44129 should reference medium voltage level cable; not all voltage levels. There are no industry studies or industry evidence which suggests that there are any concerns (failures due to water/electrical treeing or other insulation degradation issues) with cable voltages less than those considered as medium voltage.	Not Incorporated. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of power cable failures to decide if further regulatory actions are necessary. See staff responses to comments A-27 (page 44) and the first paragraph of A-26a (page 43) of Bin 2.
2	N-D15 (Enclosure, page 37)	De-energized cables and low voltage cables do not exhibit water trees due to a lack of sufficient voltage to cause the required electrical stress.	Not Incorporated. The staff agrees that "treeing" is usually associated with MV cables. See staff response to comment A-27 (page 44) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	S-3 (Attachment, page 1)	3. Water treeing acting in conjunction with electrical stress treeing has a probable risk for ultimate cable failure at some point in time. However, there is no evidence that electrical stress in low voltage cable applications is sufficient enough to cause a cable failure. It is believed and documented (EPRI) that electrical stress impact on 5Kv cable is minimal. However, past Generic Letter examples do not support the belief. Therefore, the 5kV cables should be included in the DGL, but lower voltage cables should not be within the DGL's scope.	Not Incorporated. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of power cable failures to decide if further regulatory actions are necessary. See staff responses to comments A-27 (page 44) and the first paragraph of A-26a (page 43) of Bin 2 and comment A-28 (page 19) of Bin 1.
2	N-S23 (Enclosure, page 18)	Water treeing acting in conjunction with electrical stress treeing has a probable risk for ultimate cable failure at some point in time. Nonetheless, there is no evidence that electrical stress in low voltage cable applications is sufficient enough to cause a cable failure. It is believed and documented (EPRI) that electrical stress impact on 5Kv cable is minimal; however, past Generic Letter examples do not support the belief. Thus, the 5Kv cables should be included in the generic letter, but lower voltage cables should not be within the generic letter's scope.	Not Incorporated. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of power cable failures to decide if further regulatory actions are necessary. See staff responses to comments A-27 (page 44) and the first paragraph of A-26a (page 43) of Bin 2 and comment A-28 (page 19) of Bin 1.
2	S-22 (Attachment, page 6)	22. The letter seems to imply that water treeing and electrical treeing is a concern for low voltage cable.	Not Incorporated. The staff agrees that "treeing" is usually associated with MV cables. See staff responses to comments A-27 (page 44) and the first paragraph of A-26a (page 43) of Bin 2 and comment A-28 (page 19) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-B13 (Enclosure, pages 25-26)	The letter seems to imply that water treeing and electrical treeing is a concern for low voltage cable.	Not Incorporated. The staff agrees that "treeing" is usually associated with MV cables. See staff responses to comments A-27 (page 44) and the first paragraph of A-26a (page 43) of Bin 2 and comment A-28 (page 19) of Bin 1.
2	P-2 General (Letter, page 1)	2. There is no justification for the broad scope of the proposed GL. The title of the proposed GL implies that it is only applicable to accident mitigation systems. Further, the Background section of the proposed GL only discusses failures of MV cables. However, Requested Information section (1) includes all cable types, including, but not limited to, low voltage power, control, instrumentation, and medium voltage power within the scope of 10 CFR 50.65. This is despite the fact that underground wetted-cable degradation phenomenon is most prevalent in medium-voltage cables (i.e. those in the 13.8 kV, 6.9 kV and 4.16 kV ranges). The proposed GL offers no evidence that underground wetted cable degradation is a problem in low-voltage cables. However, the proposed GL specifically states that the low voltage cables need to be included in any monitoring program.	Not Incorporated. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of power cable failures, including underground wetted degradation in low-voltage cables, to decide if further regulatory actions are necessary. See staff responses to comments A-26a (page 43) and A-27 (page 44) of Bin 2 and comments A-28 (page 19) and S-35 (page 30) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	P-5 General (Letter, page 2)	5. The proposed GL requests information on inaccessible or underground cable failures. Inaccessible cables encompass underground cables, but the scope of inaccessible-cables isn't much broader and moves way-beyond those that are just underground. This has far reaching plant implications. Rather than using the terms inaccessible or underground, the scope of the proposed GL should be limited to cables subject to operating in a wet environment.	Not Incorporated. The staff does not agree that the GL should be limited to only cables subject to operating in a wet environment. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of power cable failures to decide if further regulatory actions are necessary. See staff response to comment S-35 (page 30) of Bin 1 and comment A-26a (page 43) of Bin 2.
2	P-14 Requested Information (Letter, page 4)	14. The title of the proposed GL is "Proposed Generic Communication: Inaccessible or Underground Cable Failures That Disable Accident Mitigation Systems." Item 1 requests that we provide a history of inaccessible or underground cable failures that are within the scope of 10 CFR 50.65 (the Maintenance Rule). The Maintenance Rule encompasses significantly more Structures, Systems, and Components than accident mitigation systems. The scope of the proposed GL should be limited to cables in accident mitigation systems.	Not Incorporated. The staff considers the current information in the Requested Information section concerning the Maintenance Rule to be adequate. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of cable failures to decide if further regulatory actions are necessary. See staff response to comment A-26a (page 43) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	S-1 (Attachment, page 1)	1. The draft generic letter (DGL) Summary references the monitoring of inaccessible or underground electrical cables. Underground cables would be considered inaccessible but the DGL wording indicates there is another group of cables which needs to be monitored. The DGL and Generic Letter 2002-12 examples have dealt with cables installed in environments below ground level. The DGL's Background makes reference to buried conduits, cable trenches, cable troughs, duct banks, etc., which are all underground environments except for possibly cable troughs. The DGL, however, continues to provide a brief discussion on cable wetting and condensation, and in fact states certain plants have experienced failures in cables routed underground or in other inaccessible paths. Does the scope of this DGL apply to above ground (inaccessible) cable paths? If so, it is unclear what these configurations would be. With no references to or examples of the other implied cable group and the DGL's title and summary not coinciding with the letter's text, the scope and intent of the DGL is unclear.	S-1 Partially Incorporated. The scope of this DGL does apply to above ground inaccessible cables paths. These paths might include above ground duct banks or other building areas where water or moisture can accumulate. The Background section of the GL has been revised as follows to include above ground duct banks: "Electrical cables in nuclear power plants are usually located in dry environments, but some cables are exposed to moisture from condensation and wetting in inaccessible locations such as buried conduits, cable trenches, cable troughs, above and underground duct banks, underground vaults, and direct-buried installations." Inaccessible areas are susceptible for a wide variety of influences such as condensation, water immersion, chemical influences, etc., that could cause power cable failures. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of power cable failures to decide if further regulatory actions are necessary. See staff response to comments P-3 (page 21), S-35 (page 30) of Bin 1, N-S1b (page 42) of Bin 2 and comment A-26a (page 43) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-G8 (Enclosure, pages 2-3)	The generic letter Summary references the monitoring of inaccessible or underground electrical cables. Underground cables would be considered inaccessible but the generic letter wording indicates there is another group of cables which needs to be monitored. The generic letter and Generic Letter 2002-12 examples dealt with cables installed in environments below ground level. The generic letter's Background makes reference to buried conduits, cable trenches, cable troughs, duct banks, etc. which are all underground environments except for possibly cable troughs. The generic letter, however, continues to provide a brief discussion on cable wetting and condensation. In fact it states certain plants have experienced failures in cables routed underground or in other inaccessible paths. The scope of this generic letter is unclear as to whether it applies to above ground (inaccessible) cable paths. With no references to or examples of the other implied cable group and the generic letter's title and summary not coinciding with the letter's text, the scope and intent of the generic letter is unclear.	Not Incorporated. The scope of this DGL does apply to above ground inaccessible cables paths. These paths might include above ground duct banks or other building areas where water or moisture can accumulate. See staff response to comment S-1 (page 50) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	S-2 (Attachment, page 1)	2. Past Generic Letter examples have dealt with cable submergence/immersion and the impact submergence may have on cable life expectancy since most cables were never tested for life expectancy for long term submergence. The DGL should focus on underground installation environments. Cable wetting and condensation issues should not be included in the scope of this DGL since cables are designed for wet environments (not including submergence) and have been tested for forty (40) year life.	Not Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. However, inaccessible areas are susceptible for a wide variety of influences such as condensation, water immersion, chemical influences, etc., that could cause cable failures. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of power cable failures to decide if further regulatory actions are necessary. See staff response to comments P-3 (page 21), S-35 (page 30) of Bin 1, N-S1b (page 42) of Bin 2 and comment A-26a (page 43) of Bin 2.
2	N-S22 (Enclosure, page 18)	Past Generic Letter examples have dealt with cable submergence/immersion and the impact submergence may have on cable life expectancy since most cables were never tested for life expectancy for long term submergence. The DGL should focus on underground installation environments. Cable wetting and condensation issues should not be included in the scope of this DGL since cables are designed for wet environments (not including submergence) and have been tested for forty (40) year life.	Not Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. However, inaccessible areas are susceptible for a wide variety of influences such as condensation, water immersion, chemical influences, etc., that could cause cable failures. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of power cable failures to decide if further regulatory actions are necessary. See staff response to comments P-3 (page 21) and S-35 (page 30) of Bin 1 and comments N-S1b (page 42) and A-26a (page 43) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	S-4 (Attachment, page 2)	4. The scope of this Generic letter is too broad. It covers both low voltage (LV) and medium voltage (MV) cables for all systems scoped in the maintenance rule. References are made throughout this letter to safety related, accident-mitigation systems, risk significant cables, emergency diesel generators, offsite power and emergency core cooling systems. The scope of this letter goes beyond long term submergence and includes inaccessible cables that are exposed to moisture from condensation as well as wetting in inaccessible locations. The basis of this proposed generic letter is the same as that of Information Notice IN 2002-12 which is a concern that a potential common-mode failure of underground cables that affect the operability of accident mitigating systems. The NRC's concern stems from reviewing 23 License Event Reports (LERs) and morning reports since 1988 that identified these failures, and they believe these reported events are only a fraction of all failures since not all cable failures are reportable. IN 2002-12 was issued in 2002 and was only limited to MV cables in wet or submerged underground conduits. The proposed Generic letter expands the scope to include LV cable as well as MV cables.	Not Incorporated. The staff is including this concern on low voltage power cables because certain plants of older vintage have safety buses and emergency diesel generators (EDG) at 480 V range for operating safety related and other risk significant loads. See staff response to comments P-3 (page 21) and S-35 (page 30) of Bin 1 and comments N-S1b (page 42) and A-26a (page 43) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-S24 (Enclosure, pages 18-19)	The scope of this Generic letter is too broad. It covers both low voltage and medium voltage cables for all systems scoped in the Maintenance Rule. References are made throughout this letter to safety related, accident-mitigation systems, risk significant cables, emergency diesel generators, offsite power, and emergency core cooling systems. The scope of this letter goes beyond long term submergence and includes inaccessible cables that are exposed to moisture from condensation as well as wetting in inaccessible locations. The basis of this proposed generic letter is the same as that of Information Notice IN 2002-12 which is a concern that a potential common-mode failure of underground cables that affect the operability of accident mitigating systems. The NRC's concern stems from reviewing 23 License Event Reports (LERs) and morning reports since 1988 that identified these failures; they believe these reported events are only a fraction of all failures since not all cable failures are reportable. IN 2002-12 was issued in 2002 and was only limited to medium voltage cables in wet or submerged underground conduits. The proposed Generic letter inappropriately expands the scope to include low voltage cable as well as medium voltage cables.	Not Incorporated. The staff is including this concern on low voltage power cables because certain plants of older vintage have safety buses and emergency diesel generators (EDG) at 480 V range for operating safety related and other risk significant loads. See staff response to comments P-3 (page 21) and S-35 (page 30) of Bin 1 and comments N-S1b (page 42) and A-26a (page 41) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	S-5 (Attachment, page 2)	5. The scope of requested information should be limited to only cables not rated for submergence to be consistent with problems identified in the letter.	Not Incorporated. The staff agrees that certain cables were designed to withstand wet conditions but this does not exclude them from the scope of the GL. See staff response to comments A-26a (page 43) of Bin 2 and comments A-28 (page 19), P-3 (page 21), and S-35 (page 30) of Bin 1.
2	N-S25 (Enclosure, page 19)	The scope of requested information should be limited to only cables not rated for submergence to be consistent with problems identified in the letter.	Not Incorporated. The staff agrees that certain cables were designed to withstand wet conditions but this does not exclude them from the scope of the GL. See staff response to comments A-26a (page 43) of Bin 2 and comments A-28 (page 19), P-3 (page 21), and S-35 (page 30) of Bin 1.
2	S-11 (Attachment, page 4)	11. Both medium voltage cables and low voltage cables typically fail to ground rather than phase to phase. In an ungrounded or high resistance ground system a single ground fault will not cause an abrupt failure causing plant transients or immediately disable accident mitigation systems but instead will bring in a ground alarm alerting the operator of a problem and provide time for orderly troubleshooting and repair of the problem cable. If ground fault tripping is used in a plants design, a cable failure could cause plant transients and disable accident mitigation systems immediately.	S-11 Not Incorporated. A fully ungrounded system at all voltage levels would have certain advantages. It could be helpful in detecting single phase to ground faults which form only a portion of the faults that cause cable failures. Also, see the second paragraph of staff response to comment P-1 (page 121) of Bin 5.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-P2 (Enclosure, page 20)	Both medium voltage cables and low voltage cables typically fail to ground rather than phase to phase. In an ungrounded or high resistance ground system a single ground fault will not cause an abrupt failure causing plant transients or immediately disable accident mitigation systems but instead will bring in a ground alarm alerting the operator of a problem and provide time for orderly troubleshooting and repair of the problem cable. If ground fault tripping is used in a plants design, a cable failure could cause plant transients and disable accident mitigation systems immediately.	Not Incorporated. A fully ungrounded system at all voltage levels would have certain advantages. See staff response to comment S-11 (page 55) of Bin 2.
2	S-12 (Attachment, page 4)	12. The scope of the generic letter is unclear. Reference is made to all of the following: • accident-mitigation systems • risk-significant cables • safety systems • EDGs, offsite power, emergency service water, service water, component cooling water, and other safety systems within the scope of 10 CFR 50.65 (the maintenance Rule)	Not Incorporated. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of power cable failures to decide if further regulatory actions are necessary. See staff responses to comments A-26a (page 43) and N-S1b (page 42) of Bin 2, comment A-16 (page 75) of Bin 3, and comment S-10 (page 25) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-P3 (Enclosure, pages 20-21)	The scope of the generic letter is unclear. Reference is made to all of the following: • accident-mitigation systems • risk-significant cables • safety systems • EDGs, offsite power, emergency service water, service water, component cooling water, and other safety systems within the scope of 10 CFR 50.65 (the Maintenance Rule)	Not Incorporated. The staff is seeking information on power cable failure data to ascertain if there are plant areas that are susceptible for all types of power cable failures to decide if further regulatory actions are necessary. See staff responses to comment A-26a (page 43) of Bin 2, comment A-16 (page 75) of Bin 3, and comment S-10 (page 25) of Bin 1.
2	S-19 (Attachment, page 6)	19. The scope of the draft specifically includes inaccessible cables in conduit, cables exposed to condensation, and low voltage cable. This is too broad a scope and includes cables that will not be adversely affected by water.	Partially Incorporated. In this GL, staff is seeking how low voltage and medium power voltage cables are monitored. Inaccessible areas are susceptible for a wide variety of influences such as condensation, water immersion, chemical influences, etc. See staff response to comments A-28 (page 19), P-3 (page 21), and S-35 (page 30) of Bin 1 and comment A-26a (page 43) of Bin 2.
2	N-B10 (Enclosure, pages 24-25)	The scope of the draft specifically includes inaccessible cables in conduit, cables exposed to condensation, and low voltage cable. This is too broad a scope and includes cables that will not be adversely affected by water.	Partially Incorporated. In this GL, staff is seeking how low voltage and medium power voltage cables are monitored. Inaccessible areas are susceptible for a wide variety of influences such as condensation, water immersion, chemical influences, etc. See staff response to comments A-28 (page 19), P-3 (page 21), and S-35 (page 30) of Bin 1 and comment A-26a (page 43) of Bin 2.
2	S-25 (Attachment, page 7)	25. The generic letter states that none of the cables were designed or qualified for long-term wetting or submergence. If cables are designed for long term submergence is this adequate justification to disposition this issue with no further action required?	Not Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. However, that is not adequate to not require any other actions for the cable. If there are failures within the expected life of the cable, a program is needed to prevent unanticipated failures. See staff response to comment S-35 (page 30) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-B16 (Enclosure, page 26)	The generic letter states that none of the cables were designed or qualified for long-term wetting or submergence. If cables are designed for long term submergence is this adequate justification to disposition this issue with no further action required?	Not Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. However, that is not adequate to not require any other actions for the cable. If there are failures within the expected life of the cable, a program is needed to prevent unanticipated failures. See staff response to comment S-35 (page 30) of Bin 1.
2	S-27 (Attachment, page 7)	27. Again this depends on the design of the ground system (ungrounded, high resistance grounded or ground fault tripping).	S-27 Partially Incorporated. The Discussion section of the GL has been revised as follows: "Until isolated by a breaker, the fault current or transient voltages would propagate on the immediate power systems, ~~trip breakers that operate near their trip setpoint~~ and potentially fail other systems with degraded insulations systems." The staff recognizes that the inverse time characteristics of the over current relay acts very fast to clear the fault. However, until it is cleared, the system experiences the effects of the fault current. The insulation systems near failure would be susceptible to failure during such transient voltages. Also, see first paragraph of staff response to comment A-24 (page 39) of Bin 2.
2	N-D20 (Enclosure, pages 38-39)	Again this depends on the design of the ground system (ungrounded, high resistance grounded, or ground fault tripping).	Partially Incorporated. The staff recognizes that the inverse time characteristics of the over current relay acts very fast to clear the fault. See staff response to comment S-27 (page 58) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	S-30 (Attachment, page 8)	30. Energizing a normally de-energized cable is not a common mode failure. There are no applications in which a cable or its associated component is never tested or maintained to ensure operability. For this scenario to be of concern it must be assumed that the overall condition of the equipment is unknown. Then if an accident occurs we will simply hope equipment will perform. This is not correct.	S-30 Not Incorporated. The staff agrees with the scenario, but the comment does not address how the cable insulation condition is known to substantiate the basis for incorrect assumption. Also, see staff response to comment S-35 (page 30) of Bin 1.
2	N-D23 (Enclosure, page 40)	Energizing a normally de-energized cable is not a common mode failure. There are no applications in which a cable (or its associated component) is never tested or maintained to ensure operability. For this scenario to be of concern, it must be assumed that the overall condition of the equipment is unknown. Then, if an accident were to occur we will simply hope equipment will perform; this assumption of unknown equipment condition is not correct.	Not Incorporated. The staff agrees with the scenario, but the comment does not address how the cable insulation condition is known to substantiate the basis for incorrect assumption - staff response to comment S-30 (page 59) of Bin 2.
2	S-31 (Attachment, page 8)	31. If cables are qualified for wet or submerged environments can the position be taken that the cables are not adversely degrading overtime and further testing is not required?	Not Incorporated. The staff agrees that certain cables were designed to withstand wet conditions but has concerns that there is a possibility for degradation over time. If there are failures within the expected life of the cable, a program is needed to prevent unanticipated failures. See staff response to comment S-35 (page 30) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-D24 (Enclosure, pages 40-41)	If cables are qualified for wet or submerged environments, can the position be taken that the cables are not adversely degrading overtime and further testing is not required? No. Thus, the industry is monitoring cable aging and determining the best testing to predict cable issues.	Partially Incorporated. The staff recognizes industries agreement on this concern. The purpose of this GL is to seek information on how low and medium power voltage cables are monitored. See staff response to comment S-35 (page 30) of Bin 1.
2	S-33 (Attachment, page 8)	33. The letter indicates in several places that the cable failures can be attributed to installation misapplications. The following statement is correct only if the cable has been misapplied. If the cable is rated to perform in a submerged environment this should not be an issue.	S-33 Not Incorporated. The staff agrees with the comment but the staff's statement does not imply a global misapplication. The staff is referring to cases where the cables not qualified for the wet environment used in underground applications. Also, see staff response to comment S-35 (page 30) of Bin 1.
2	N-D26 (Enclosure, pages 41-42)	The letter indicates in several places that the cable failures can be attributed to installation misapplications. The statement is correct only if the cable has been misapplied. If the cable is rated to perform in a submerged environment insulation degradation should not be an issue.	Not Incorporated. The staff agrees with the comment but the staff's statement does not imply a global misapplication. See staff response to comment S-33 (page 60) of Bin 2.
2	N-G13 (Enclosure, page 5)	Energized cables are continuously monitored during their in-service use and failures would be immediately noticed and addressed.	The staff agrees that the cable staying energized is a level of monitoring to verify basic cable integrity. The stresses on the power cable are much higher when the cable is called upon for accident mitigation with continuous design bases loading. A program is needed to prevent in-service failures. See staff response to comment S-32 (page 104) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-G14 (Enclosure, page 5)	Cables that are not normally energized, even when exposed to water, do not have an aging stressor (electric field) present that drives them to premature failure.	Not Incorporated. The LERs do indicate several failures that occurred while the cables were energized and certain cases when the cable failed within minutes of energization. See staff response to comments A-13 (page 70) and A-12 (page 69) of Bin 3 and comment A-1 (page 2) of Bin 1.
2	N-G18 (Enclosure, pages 5-6)	What does "exposure to significant moisture" really mean? The NRC definition is apparently "for more than a few days" and their interpretation is so narrow that all cable in any underground inaccessible location is considered exposed to significant moisture. Based on operating experience, the base condition for a challenging aging environment should be "prolonged exposure to water for more than a few years."	N-G18 Not Incorporated. Staff agrees with the definition of significant moisture. The staff is currently collecting data on failures. These data will be considered to identify the need for further actions. Also, see staff response to comment A-13 (page 70) of Bin 3.
2	N-G21 (Enclosure, page 6)	Little electrical degradation will occur if the cable is de-energized for most of its service life. Water-enhanced aging essentially needs three conditions above 4KV levels: • A manufacturing flaw (void or inclusion) or installation damage (e.g., shield disruption, cut, or permanent insulation compression) • Long-term presence of water (not "Rain and drain") • Long-term energization (not a few hours of energization for a surveillance test)	Not Incorporated. The LERs do indicate several failures that occurred while the cables were energized and certain cases when the cable failed within minutes of energization. The staff is addressing power cable failures from all causes. See staff response to comments S-10 (page 25) and A-1 (page 2) of Bin 1 and comments A-13 (page 70) and A-12 (page 69) of Bin 3 and comment N-S9 (page 59) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-S9 (Enclosure, pages 11-12)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: There is an assumption that most safety cables are de-energized at all times and that water related deterioration occurs during the de-energized period. While it is true that water is likely to permeate the insulation no matter whether the cable is energized or not, electrical degradation and polymer damage requires the cable to be energized. Electrochemical and electro-mechanical degradation mechanisms require an electrical stress across the insulation. Accordingly, little electrical degradation will occur if the cable is de-energized for most of its service life. Water-enhance aging essentially needs three conditions at 4 kV to 13 kV levels: • A manufacturing flaw (void or inclusion) or installation damage (e.g., shield disruption, cut, or permanent insulation compression) • Long-term presence of water (not "Rain and drain") • Long-term energization (not a few hours of energization for a surveillance test).	N-S9 Not Incorporated. Water permeating into the insulation cracks could cause the cable to fail when it is energized on a valid demand. The staff is addressing power cable failures from all causes. Also, see staff response to comment S-10 (page 25) of Bin 1 and comment for N-S6 (page 100) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		For cables that are de-energized for most of their life, little degradation from wetting is expected to occur. So the likelihood of failure upon energization is very low. Simultaneous failure of multiple cables is extremely unlikely.	
2	N-S3 (Enclosure, page 8)	Per the hosts of IEEE / PES / Insulated Conductors Committee literature, the scope should be further refined to define the wet-aging of the medium voltage cables to those which are wetted and energized [voltage] simultaneously for long continuous periods [months to years]. This point was made abundantly in recent drafts of the NEI 'white paper' on medium voltage underground cables.	Not Incorporated. The LERs do indicate several failures that occurred while the cables were energized and certain cases when the cable failed within minutes of energization. The staff is addressing power cable failures from all causes. See staff response to comment comments S-10 (page 25) and A-1 (page 2) of Bin 1 and comments A-13 (page 70) and A-12 (page 69) of Bin 3 comment A-26a (page 41) of Bin 2, and comment A-General 1 (page 120) of Bin 5.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-S4 (Enclosure, page 8)	The scope of the requested action is not properly defined. Most of the proposed generic letter indicates that the scope is wet cables in underground service. This is indicated by statements such as: •"However, some cables are exposed to *moisture from condensation and wetting in inaccessible locations such as buried conduits, cable trenches, cable troughs, duct banks, underground vaults and direct buried installations.",* and •"Information Notice (IN) 2002-12 described medium voltage cable failures at Oyster Creek and Davis-Besse and several other plants which experienced long-term flooding problems in manholes and duct banks in which safety related cables were submerged." The "Requested Information" section does not indicate that the request is limited to "wet" cables nor does it indicate that it is limited to underground applications. As written, the "Requested Information" section can he construed as requiring all inaccessible cables to be in scope, whether dry or not, whether inside the plant or outside. This scope should be limited to wet, medium voltage underground cable.	Not Incorporated. The staff is collecting information on all types of failures to decide if further regulatory actions are necessary. See staff response to comments A-28 (page 19) and S-35 (page 30) of Bin 1 and comment A-26a (page 41) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-S10 (Enclosure, pages 12-13)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: The assumption that off-site power cables are de-energized continuously. This is wrong. Off-site power circuits are energized continuously and generally are the normal feed for safety circuits. Off-site power cable failure is known immediately by the loss power to the associated bus.	Partially Incorporated. The GL reference was only to those plants that have power source line up through the auxiliary transformer. See staff response to comment A-2 (page 4) of Bin 1 and comment S-6 (page 101) of Bin 3.
2	N-D14 (Enclosure, page 37)	The cables from the offsite power to the safety bus are energized when the plant is generating power.	Partially Incorporated. The GL reference was only to those plants that have power source line up through the auxiliary transformer. See staff response to comment A-2 (page 4) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-S13 (Enclosure, page 14)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: It is true that fault currents are several order of magnitude greater than operating current. However, the second sentence is a total misinterpretation of how a protective relay functions. Normal currents are no where near the trip point for a protective over-current relay. Protective over-current relays are designed with inverse time characteristics such that a sudden, large fault current will cause them to operate very quickly. The design of electrical protective systems for 4 kV and greater systems are designed to have "selectivity" such that the relay local to the fault operates first and higher level relays only operate should a protective relay or the local circuit breaker fail to perform their function. Cascading electrical failures have not been a significant problem in nuclear plants.	Partially Incorporated. The staff recognizes that the inverse time characteristics of the over current relay acts very fast to clear the fault. See staff response to comment S-27 (page 58) of Bin 2 and comment S-6 (page 101) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-S16 (Enclosure, page 16)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: De-energized cables do not suffer electrical degradation, during the period when they are de-energized. Periodic surveillance testing of the associated system indicates their functionality. Continuously energized cable that has damage or defects will degrade slowly when wet. The rate of degradation is proportional to the size of the defect and the applied voltage. The rate of degradation is inversely proportional to the thickness of insulation. Since the size and nature of defects are random, as is the size and nature of installation damage, simultaneous failure of multiple cables is very, very unlikely because aging rates, and therefore, time to failure will differ from cable to cable.	Not Incorporated. The capability for design bases functions for extended duration cannot be confirmed through brief cycles of operation as done in surveillance testing. While there may be some level of statistical support to conclude that all failures are decreasing or are random, we need to recognize that most of the statistics is not based on cables performing at design bases loading or duration. See staff response to comment A-1 (page 2) of Bin 1 and comments A-13 (page 70), the second paragraph of staff response to comment A-15 (page 71) and S-6 (page 101) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-S19 (Enclosure, page 17)	Does the scope of this letter (For both low voltage and medium voltage cables) supersede NRC's earlier concern on failures of medium voltage Underground cables subject to water submergence? Does this letter supplement the previously noted (medium voltage underground cables) concern?	Not Incorporated. The scope of this GL has expanded on previous concerns to include low voltage power cables. The staff is collecting information on all types of failures to decide if further regulatory actions are necessary. See staff response to comments A-28 (page 19) and S-35 (page 30) of Bin 1 and comment A-26a (page 43) of Bin 2.
2	N-S20 (Enclosure, pages 17-18)	More clarification/intent, as well as the rationale, is needed for addressing inaccessible cables. Does the scope include wetted environment of inaccessible cables only or does the scope include inaccessible in a general sense? The scope is not clear	Not Incorporated. The scope of the GL includes all inaccessible environments - wetted of nonwetted. The staff is collecting information on all types of failures to decide if further regulatory actions are necessary. See staff response to comments P-3 (page 21) and S-36 (page 30) of Bin 1 and comments A-26a (page 43) and N-S19 (page 65) of Bin 2.
2	N-S21 (Enclosure, page 18)	The generic letter needs more explanation or indication of which sub-systems of accident mitigation systems must be addressed.	Not Incorporated. The GL already states the subsystems that fall within the MR must be addressed. See staff response to comment P-3 (page 21) of Bin 1 and comment A-26a (page 43) of Bin 2.
2	N-D16 (Enclosure, page 38)	In most situations, cables can be maintained in a dry condition by adjusting the inspection and drainage frequency. In cases where the water table is close to the cables, sump pumps may be required. A good cable program will take all these factors into account and keep the cables dry.	Not Incorporated. The staff agrees that periodic draining of water would reduce the rate of degradation but it does not prevent cable failures. See staff response to comment S-15 (page 103) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
2	N-R2 (Enclosure, page 44)	The background and discussion information address medium voltage cables only.	Partially Incorporated. The staff is including this concern on low voltage power cables because certain plants of older vintage have safety buses and emergency diesel generators (EDG) at 480 V range for operating safety related and other risk significant loads. The GL was revised to include this information. See staff response to comment A-28 (page 19) of Bin 1.
3	A-12 (Attachment, page 6)	12. The <u>*Purpose*</u> section, page 2, Item (1), states: *"Alert the licensees on the potential susceptibility of certain cables to affect the operability of multiple accident mitigation systems."* There is no supporting evidence provided within the document, or obtained during the NEI MV Cable Survey, that identifies a common mode failure mechanism for underground cables.	A-12 Not Incorporated. The basis for the GL is the Licensee Event Reports that document power cable failures and regional morning reports. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006, and will be addressed by the NRC staff separately. Also, see staff response to comment A-1 (page 2) of Bin 1, comment A-16 (page 75) of Bin 3 and comment A-General 1 (page 112) of Bin 5.
3	N-P4 (Enclosure, page 21)	There is no supporting evidence provided within the document, or obtained during the NEI 2005 Medium Voltage Underground Cable Survey, that identifies an abrupt failure mechanism for underground cables.	Not Incorporated. The basis for the GL is the Licensee Event Reports that document power cable failures and regional morning reports. See staff response to comment A-12 (page 69) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	A-13 (Attachment, page 6)	13. The *Background* section, fourth paragraph, second sentence, states: *"When the staff observed that some of the cables qualified for 40 years through the equipment qualification program were also failing at several nuclear stations, a detailed review was conducted."* The paragraph continues, *"These reported events are believed to be only a very small fraction of the failures since not all cable failures are reportable. In most of the reported cases...."* A conclusion should not be developed based upon beliefs and use of the term *most.* NEI has surveyed the nuclear industry regarding failure history of MV cables subjected to wet environments. The results of this survey should be used as the basis for the conclusions.	A-13 Not Incorporated. The staff is addressing this issue for all types of power cable failure modes and not a specific type of failure mode. The LERs do indicate several failures that occurred while the cables were energized and certain cases when the cable failed within minutes of energization. The staff recognizes that the failures could be the result of a combination of causes or due to one dominant cause. Also, see staff response to comment A-12 (page 69) of Bin 3.
3	N-B3 (Enclosure, pages 22-23)	The staff review does not appear to be very detailed, if it didn't research the majority of the failures; it also uses terms like "believed" and "most".	Not Incorporated. The basis for the GL is the Licensee Event Reports that document power cable failures and regional morning reports. The staff is addressing this issue for all types of power cable failure modes and not a specific type of failure mode. See staff response to comments A-12 (page 69) and A-13 (page 70) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-A16 (Enclosure, page 33)	This appears to be a skewed interpretation of information from the October 2004 Cable Users Meeting. Further data presented in the April 2005 Cable Users Group Meeting provided the greater insights from the data from the NEI 2005 Medium Voltage Underground Cable Survey. A formal reference should be given for such statements.	Not Incorporated. The basis for the GL is the Licensee Event Reports that document power cable failures and regional morning reports. The staff is addressing this issue for all types of power cable failure modes and not a specific type of failure mode. See staff response to comments A-12 (page 69) and A-13 (page 70) of Bin 3.
3	A-15 (Attachment, page 7)	15. The <u>*Applicable Regulatory Requirements*</u> section, last paragraph, states: *"However, the recent industry cable failure data indicates a trend in unanticipated failures of underground/inaccessible cables that are important to safety."* The proposed GL has not provided any data to support an increasing trend in cable failures. NEI/EPRI analysis of MV underground cables has shown just the opposite trend, in that there is a decreasing trend in cable failures as the cable population becomes older.	A-15 Not Incorporated. The staff considered the trend in failures but did not find that it was increasing. The cable failure chart presented in ML052780354 NEI Comments on the GL, last page, indicate failures continuing to happen at various age levels. Certain licensees have opted to replace all the cables in the susceptible areas and that would reduce the failures per year. The cable heat up from continued service induces further stresses on the insulation. While there may be some level of statistical support to conclude that all failures are decreasing or are random, it is necessary to recognize that most of the statistics is not based on cables performing at design bases loading or duration. During the accident mitigation phase, many of the safety related loads would be performing at or near capacity for a long duration.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-A4 (Enclosure, page 28)	The generic letter has not provided any data to support an increasing trend in cables. NEI/EPRI analysis of medium voltage underground cables has shown just the opposite; there is a decreasing trend in cable failures as the cable population becomes older.	Not Incorporated. The staff considered the trend in failures but did not find that it was increasing. See staff response to comment A-15 (page 71) of Bin 3.
3	N-S14 (Enclosure, pages 14-15)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: Cables do have manufacturer's tests to demonstrate wet environment capability. It is true that cables are aging and that individual cable failures may occur in old cable systems. Plants that have experienced a number of individual failures over the course of a few years have either elected to replace all of the cables in wet conditions or have implemented a test program with replacement based on condition. The NEI 2005 Medium Voltage Underground Cable Survey data shows that the failure rate is NOT increasing in the manner that this statement infers. A trend that would lead to multiple simultaneous events is not indicated by the data.	Partially Incorporated. The frequency and level of testing may need to be based on the observed rate of degradation. Certain licensees have opted to replace all the cables in susceptible areas and that would reduce the failures per year. The staff considered the trend in failures but did not find that it was increasing. See staff response to comments N-G16 (page 32) and S-35 (page 30) of Bin 1, comment N-S16 (page 64) of Bin 2, and comments A-15 (page 71) and S-6 (page 101) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-S15 (Enclosure, page 15)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: While multiple failures would be a problem, there is no basis that indicates that multiple failures are to be expected, and there is no history indicating that de-energized cables fail upon energization. Multiple simultaneous events are not likely based on failure history. No increasing trend in failures has appeared. The figure following this Table shows an increasing trend of age of cable at time of failure and a steady trend line for number of failures per year.	Not Incorporated. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuos duty during accident mitigation. The staff considered the trend in failures but did not find that it was increasing. See staff response to comment N-S16 (page 64) of Bin 2 and comments A-15 (page 71) and A-16 (page 75) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	A-16 (Attachment, page 7)	16. The *Discussion* section, first sentence, states: *"Although nuclear plant systems are designed against single failures, undetected degradation of cables due to preexisting manufacturing defects or wetted environments of buried or inaccessible cables could result in multiple equipment failures."* The proposed GL has not provided any data to support common mode failure of cables. Industry experience is contrary to this supposition in that cable failures have been shown to be random and time related. None of the examples cited are common mode failures, nor could the causes identified in this section result in the failure of more than one cable.	A-16 Not Incorporated. See staff response to comment A-15 (page 71) of Bin 3. The staff agrees that an example with multiple cable failure is not presented. However, a cable failure causing more than one component failure is given in the Davis Besse event. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuos duty during accident mitigation.
3	N-D4 (Enclosure, page 34)	The generic letter has not provided any data to support common mode failure of cables. Industry experience is contrary to this supposition in that cable failures have been shown to be random and time related. None of the examples cited are common mode failures, nor could the causes identified in this section result in the failure of more than one cable.	Not Incorporated. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuos duty during accident mitigation. See staff response to comment A-16 (page 75) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-G15 (Enclosure, page 5)	Failures are truly random, since no two cables have exactly the same manufacturing, installation, or service conditions. Thus, multiple or common-mode failures are extremely (statistically) unlikely.	N-G15 Not Incorporated. When you consider a nuclear station in general, several cables in scope of the GL are the same voltage range, made by the same manufacturer, installed by the same company in the same period, and often subject to comparable environment. During prolonged operation during accident conditions, more than one failure is likely if insulation has degraded. Also, see staff response to comment A-16 (page 75) of Bin 3.
3	S-21 (Attachment, page 6)	21. The assertion that most cable damage worsens over time is incorrect. The source of the damage, the type of damage and the application must all be considered when evaluating cable damage. The majority of cable damage that occurs within the power plant will not worsen over time, or lead to cable failure.	Not Incorporated. The staff recognizes that the failures could be the result of a combination of causes or due to one dominant cause, including time-related degradation. The staff is addressing this issue for all types of power cable failure modes based on available data and not a specific type of failure mode. See staff response to comment A-13 (page 70) of Bin 3.
3	N-B12 (Enclosure, page 25)	The assertion that most cable damage worsens over time is incorrect. The source of the damage, the type of damage and the application must all be considered when evaluating cable damage. The majority of cable damage that occurs within the power plant will not worsen over time, or lead to cable failure.	Not Incorporated. The staff recognizes that the failures could be the result of a combination of causes or due to one dominant cause, including time-related degradation. The staff is addressing this issue for all types of power cable failure modes based on available data and not a specific type of failure mode. See staff response to comment A-13 (page 70) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	A-18 (Attachment, page 7)	18. The <u>*Discussion*</u> section, of the proposed GL states: *"While a single failure may be manageable, multiple failures of this kind would pose undue challenges for the plant operators."* Though this sentence may be true, a common mode failure path that would affect multiple cables has not been demonstrated.	Not Incorporated. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuos duty during accident mitigation. See staff response to comments A-16 (page 75) and A-17 (page 96) of Bin 3.
3	N-D6 (Enclosure, page 35)	The sentence is true; however, a common mode failure path that would affect multiple cables has not been demonstrated.	Not Incorporated. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuos duty during accident mitigation. See staff response to comments A-16 (page 75) and A-17 (page 96) of Bin 3.
3	A-19 (Attachment, page 8)	19. The <u>*Summary*</u> *section,* second paragraph, second sentence, states: *"Adequate monitoring will ensure that cables will not fail abruptly and cause plant transients or disable accident mitigation systems when they are needed."* Although there is nothing inherently incorrect with this statement on a philosophical level, there is no supporting evidence provided within the document, or obtained during the NEI MV Cable Survey, that identifies an abrupt failure mechanism for underground cables.	Not Incorporated. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuos duty during accident mitigation. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006, and will be addressed by the NRC staff separately. See staff response to comments A-16 (page 75) and A-17 (page 96) of Bin 3, Bin 3 on industry experience/data and comment A-General 1 (page 120) of Bin 5.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-SM2 (Enclosure, page 45)	Although there is nothing inherently incorrect with this statement on a philosophical level, there is no supporting evidence provided within the document, or obtained during the NEI 2005 Medium Voltage Underground Cable Survey that identifies an abrupt failure mechanism for underground cables.	Not Incorporated. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuous duty during accident mitigation. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006, and will be addressed by the NRC staff separately. See staff response to comments A-16 (page 75) and A-17 (page 96) of Bin 3, Bin 3 on industry experience/data and comment A-General 1 (page 120) of Bin 5.
3	A-25 (Attachment, page 9)	25. The *Requested Information* section, Item (1): Responding to this item will take in excess of the 40 hours, contrary to the statement identified in *Reasons for Requested Information* section. NEI has already collected this information for MV cables installed below grade, which appears to be the population of cables discussed predominantly throughout the proposed GL.	A-25 Partially Incorporated. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006. The staff addressed their issues of this letter in a public meeting with ACRS as a part of the presentation of this GL. The staff believes that cable failure data would be a part of the corrective action package/problem report maintained by the licensees and that it would be available through an electronic retrieval process. The staff has revised the burden to 60 hours.
3	N-R1 (Enclosure, page 44)	Response to this step will take in excess of the 40 hours identified under "Reasons for Requested Information." NEI has already collected this information for medium voltage cables installed below grade, which appears to be the population of cables discussed	Partially Incorporated. The staff has revised the burden hours to 60 hours. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006, and will be addressed by the NRC staff separately. See staff response to comment A-25 (page 78) of Bin 3 and

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		predominantly throughout the proposed generic letter.	comment A-General 1 (page 120) of Bin 5.
3	S-36 (Attachment, page 9)	36. Most of the information being requested has already been supplied to NEI.	Not Incorporated. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006, and will be addressed by the NRC staff separately. See first paragraph of staff response to comment A-25 (page 78) of Bin 3 and comment A-General 1 (page 120) of Bin 5.
3	N-R3 (Enclosure, page 44)	Most of the information being requested has already been supplied to NEI.	Not Incorporated. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006, and will be addressed by the NRC staff separately. See first paragraph of staff response to comment A-25 (page 78) of Bin 3 and comment A-General 1 (page 120) of Bin 5.
3	S-26 (Attachment, page 7)	26. Mention is made of recent industry cable failure data, what is the source?	S-26 Not Incorporated. The industry cable failure data is referring to LERs reported to NRC.
3	N-A17 (Enclosure, page 33)	Mention is made of recent industry cable failure data, what is the source?	Not Incorporated. The industry cable failure data is referring to LERs reported to NRC - staff response to comment S-26 (page 79) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	S-8 (Attachment, page 3)	8. Based on IN 2002-12, NEI was tasked in 2004, to work with the nuclear industry to determine the extent of the problem and issue a white paper with their findings and to develop and present proposals to the NRC. NEI is conducting a survey of all plants to determine the number and type of MV cables installed at each plant and the percentage of underground cables. The survey also requests information about the number of failures and the types of cables involved that occurred at each plant. When NEI's work is complete, there will be real failure data from all plants for the NRC to work with instead of speculations. This NEI work is still ongoing and the NRC should wait till this effort is completed and have a better informed and complete picture before issuing any letters.	Not Incorporated. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006, and will be addressed by the NRC staff separately. See staff response to comment A-25 (page 78) of Bin 3 and A-General 1 (page 111) of Bin 5.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-G10 (Enclosure, page 4)	Based on IN 2002-12, NEI was tasked in 2004, to work with the nuclear industry to determine the extent of the problem and issue a white paper with their findings and develop and present proposals to the NRC. NEI is conducting a survey of all plants to determine the number and type of medium voltage cables installed at each plant and the percentage of underground cables. The NEI 2005 Medium Voltage Underground Cable Survey also requests information about the number of failures and the types of cables involved that occurred at each plant. When NEI's work is complete there will be real failure data from nuclear plants for the NRC to work with instead of speculations. This NEI work is still ongoing and the NRC should wait till this effort is completed in order to have a better informed and complete picture before issuing any letters.	Not Incorporated. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006, and will be addressed by the NRC staff separately. See staff response to comment A-25 (page 78) of Bin 3 and A-General 1 (page 111) of Bin 5.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	P-14 Reasons for Requested Information (Letter, page 4)	16. The Reasons for Requested Information section states "The staff considers 40 hours of information collection burden to be reasonable in light of the benefit gained to identify and correct unanticipated failures of accident mitigation systems." However, given the broad scope of information requested (systems other than those that mitigate accidents and low voltage cables), the data collection will significantly exceed 40 hours, and is not justified based on the small number of actual failures in the industry, system (train) redundancies, surveillance testing performed, and monitoring already being performed in accordance with other plant programs such as the Maintenance Rule (10 CFR 50.65).	Partially Incorporated. The duration for data collection has been revised to 60 hrs. See staff response to comment A-25 (page 78) of Bin 3.
3	N-A13 (Enclosure, pages 31-32)	The reinserted phrase, missing in the potential generic letter, changes the intent. A concept under the Maintenance Rule is to do additional maintenance and inspection when failures occur to preclude further failures. 67% of the plants have not experienced failures of wet underground cable. Those that have had failures traced to general long-term aging have elected to replace susceptible cables or test and replace them upon condition. It seems that the intent of the Maintenance Rule is being met.	N-A13 Not Incorporated. The staff agrees that part of the Maintenance Rule is to do additional maintenance and inspection when failures occur to preclude further failures. While 67% of plants not experiencing failure for underground medium voltage cables is good; it is based on normal use or surveillance. The insulation monitoring is needed to prevent failures during accident mitigation. Also, see staff response to comments A-13 (page 70) and A-15 (page 71) of Bin 3 and comment A-General 1 (page 112) of Bin 5.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	S-24 (Attachment, page 6)	24. There is no evidence that there is a generic issue with cables installed in a wet or submerged environment. The NRC inference is not founded. NEI data indicates that almost 70% of plants have had no cable failures due to submerged environments.	Not Incorporated. While 67% of plants not experiencing failure for underground medium voltage cables is good; it is based on normal use or surveillance. The insulation monitoring is needed to prevent failures during accident mitigation. See staff response to comment N-A13 (page 77) of Bin 3.
3	N-B15 (Enclosure, page 26)	There is no evidence that there is a generic issue with cables installed in a wet or submerged environment. The NRC inference is not founded. NEI data indicates that almost 70% of plants have had no cable failures due to submerged environments.	Not Incorporated. While 67% of plants not experiencing failure for underground medium voltage cables is good; it is based on normal use or surveillance. The insulation monitoring is needed to prevent failures during accident mitigation. See staff response to comment N-A13 (page 77) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	S-7 (Attachment, page 3)	7. Based on NEI's work to date, preliminary data indicates that there is no evidence that there is a generic issue with cables installed in a wet or submerged environment 70% of the Units that responded to the survey thus far have reported no failures and the plants with cable failures are taking appropriate action. The dominant contributors reported to early failures of wet underground cable are manufacturing defects and damage during or following installation. The older types of XLPE and black EPR cables that were reported to fail early are being eliminated and are being replaced predominantly with red EPR and thereby increasing the longevity of the overall cable systems. The new Okonite red EPR (post 1974) cable manufacturing process and cable formulation is better than the old black EPR and there have not been any reported aging related failures. The NRC emphasis should be on what the plants that have problems are doing about it and not to force all plants into using a test until it is proven to be meaningful and effective.	Not Incorporated. While 67% of plants not experiencing failure for underground medium voltage cables is good; it is based on normal use or surveillance. The insulation monitoring is needed to prevent failures during accident mitigation. See staff response to comment N-A13 (page 77) of Bin 3. Use of labs or other suitable vendors or methods are options available to the licensees. See staff response to comment A-10 (page 8) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-G9 (Enclosure, pages 3-4)	Based on NEI's work to date, preliminary data indicates that there is no evidence that there is a generic issue with cables installed in a wet or submerged environment. About 70% of the Units that responded to the NEI 2005 Medium Voltage Underground Cable Survey thus far have reported no failures and the plants with cable failures are taking appropriate action. The dominant contributors reported to early failures of wet underground cable are manufacturing defects and damage during or following installation. The older types of XLPE and black EPR cables that were reported to fail early are being eliminated and are being replaced predominantly with red EPR and thereby increasing the longevity of the overall cable systems. The new Okonite red EPR (post 1974) cable manufacturing process and cable formulation is better than the old black EPR and there have not been any reported aging related failures. The NRC emphasis should be on what the plants that have problems are doing about it and not to force all plants into using a test until it is proven to be meaningful and effective.	Not Incorporated. While 67% of plants not experiencing failure for underground medium voltage cables is good; it is based on normal use or surveillance. The insulation monitoring is needed to prevent failures during accident mitigation. See staff response to comment N-A13 (page 77) of Bin 3. Use of labs or other suitable vendors or methods are options available to the licensees. See staff response to comment A-10 (page 8) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	A-14 (Attachment, pages 6-7)	14. The <u>*Background*</u> section, first paragraph, states: *"Cable failures have a variety of causes: Manufacturing defects, damage caused by shipping and installation, and exposure to electrical transients or abnormal operating conditions during operation. Most of these defects worsen over time as insulation degradation leads to cable failure."* The logic connecting these two statements needs to be developed. The first statement includes many generalities that are not indicative of both MV and LV cables. The concluding statement uses lumped generalities to build its case. For instance, there have been some identified manufacturing defects in MV cables (i.e., contaminants in cross-linked polyethylene (XLPE) early extrusions) that do worsen over time. There does not appear to be an issue with manufacturing defects in LV cables worsening over time. There is minimal nuclear industry experience with electrical transients causing LV or HV cable failures. There is experience where lightning surges have caused failures of HV cables; however, cables installed in nuclear power plants are not subjected to surges of this magnitude. There has been experience where excessive high temperatures, both external and internal, have caused premature failure of MV and LV cables; however, the proposed GL is not addressing this particular issue. Damage	A-14 Not Incorporated. The staff recognizes that the failures could be the result of a combination of causes or due to one dominant cause. The staff is addressing this issue for all types of power cable failure modes and not a specific type of failure mode. See staff response to comment A-13 (page 70) of Bin 3, comment A-28 (page 19) of Bin 1 and comment A-24 (page 39) of Bin 2. .

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		that occurs during shipping or installation is typically identified during post installation testing, and may or may not worsen with age. Refer to Comment 29 below regarding the cause of cable failures.	
3	N-B2 (Enclosure, page 22)	The logic connecting these two statements needs to be developed. The first statement includes many generalities that aren't indicative of both low and medium voltage cables. The concluding statement plays on these lumped generalities to build its case. For instance, there have been some identified manufacturing defects in medium voltage cables (inclusions in XLPE early extrusions) that do worsen over time; there doesn't appear to be an issue with manufacturing defects in low voltage cables worsening over time. There is minimal industry experience with electrical transients causing low voltage or high voltage cable failures. T here has been experience where excessive high temperatures (external and internal) has caused premature failure of medium voltage and low voltage cables, however this particular issue isn't being addressed by the generic letter. Damage that occurs during shipping or installation is typically identified during post installation testing, and may or may not worsen with age.	Not Incorporated. The staff recognizes that the failures could be the result of a combination of causes or due to one dominant cause. See staff response to comment A-14 (page 82) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	A-20 (Attachment, page 8)	20. The <u>*Background*</u> section, last paragraph, last sentence, states: *"In most of the reported cases, the failed cables were in service for 10 years or more and none of these cables were identified as designed or qualified for long-term wetting or submergence."* The MV cables used in nuclear power plants are typical of cables used in the underground residential distribution circuits of most of the utility distribution systems in the country. The XLPE cables in use in the nuclear power plants were specified to National Electrical Manufacturers Association (NEMA) WC-7 (ICEA S-6-524), which states, *"3.1 Material ... This insulation is suitable for use on power cables in wet or dry locations...."* The ethylene propylene rubber (EPR) cables in use in nuclear power plants were specified to NEMA WC-8 (ICEA S-68-516) which states: *"Material ... This insulation is suitable for use on cables in wet or dry locations...."* The rubber insulated cables in use in nuclear power plants were specified to NEMA WC-3 (ICEA S-19-81). Table 3-1 of that standard provides the suitability for wet and dry locations for the various grades of rubber. The specific grade of rubber insulation needs to be identified in order to determine its suitability. The majority of the MV cables in use in the nuclear industry are XLPE or EPR. These cables are suitable for use in wet locations.	Partially Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. The staff assessment and the current action are based on reported failures. See staff response to comment S-35 (page 30) of Bin 1.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-B1 (Enclosure, pages 21-22)	The medium voltage cables used in nuclear power plants are typical of cables used in the underground residential distribution circuits of most of the utilities (distribution) in the country. The XLPE cables in use in the nuclear power plants were specified to NEMA WC 7 (ICEA S-6-524) which states: "3.1 Material … This insulation is suitable for use on power cables in wet or dry locations…" The EPR cables in use in nuclear power plants were specified to NEMA WC 8 (ICEA S-68516) which states: "Material … This insulation is suitable for use on cables in wet or dry locations …" The rubber insulated cables in use in nuclear power plants were specified to NEMA WC 3 (ICEA S-1981). Table 3-1 of that standard provides the suitability for wet and dry locations for the various grades on rubber; the specific grade of rubber insulation needs to be identified in order to determine its suitability. The majority of the medium voltage cables in use in the nuclear industry are XLPE or EPR; these cables are suitable for use in wet locations.	Partially Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. The staff assessment and the current action are based on reported failures. See staff response to comment S-35 (page 30) of Bin 1.
3	A-29 (Attachment, pages 10-11)	29. MV cables used in nuclear power plants are expected to have very long lives - at least the 40 years of the initial licensed period. However, the cable manufacturers and non-nuclear power users of MV cables have since recognized that cables manufactured during the 1970s did not always meet expectations. By the mid 1980s,	Not Incorporated. If the deenergized cable had a degraded insulation from any of the causes, it fails after it is called upon for service. The staff recognizes that the failures could be the result of a combination of causes or due to one dominant cause. This GL is collecting data on power cable failures to see further NRC actions are necessary. See staff response to comments703 (page

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		the industry identified a number of improvements, including insulation reformulation, improved cleanliness to reduce impurities, tighter quality controls, and improved manufacturing methods that were incorporated into cables manufactured later. Fortunately for the nuclear industry, even though problems existed with cable design and manufacturing in some cases, the voltage stresses in nuclear applications are relatively low. Most power cables have a basic impulse insulation level (BIL) capability that is comparable to other electrical equipment with similar voltage ratings. Cable insulation must be able to withstand brief voltage spikes from switching inductive loads, such as motors, without breakdown or inception of partial discharging. Cables are designed and manufactured to have a high BIL throughout their operating life. The majority of early nuclear plant cables were constructed with XLPE, black EPR, or gray EPR, although a few plants have natural or butyl rubber insulated cables. In dry applications, these cables have very long lives. However, if both energized and continuously wet, especially with the presence of significant manufacturing flaws, lives of less than 40 years can be expected for some cables. Cables are now produced with higher quality extrusion practices,	67) and S-34 (page 97) of Bin 3 and comment A-24 (page 41) of Bin 2. Also, see staff responses to Bin 3 on industry experience/data.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		with high cleanliness and better materials, thereby reducing the probability of contaminants and voids, while leading to longer service lives. Contaminants and voids are a significant problem in wetted extruded cable insulations because they disturb the potential gradient within the insulation and increase the potential across the remaining good insulation, thereby increasing the effects of water-enhanced degradation. For XLPE, the water-enhanced degradation takes the form of water treeing in which the potential gradient gradually forces the water to create small channels in the polymer that look like "trees under magnification. The exact mechanism of water-enhanced degradation of EPR is less understood and more difficult to observe due to the opacity of the material. Different types of EPR are in use and EPR subtypes have different susceptibilities to water-enhanced degradation. Pink (red) EPR, which is now used in most EPR MV cable designs, is hydrophobic and less prone to water-enhanced degradation than black EPR. Gray EPR cables were purposely designed to have small leakage currents through the insulation that prevent charge buildup. This design prevents charge buildup to the point where water-enhanced degradation can occur. The NEI survey has identified a failure free history for brown EPR. The water-enhanced	

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		degradation does not cause direct breakdown of the XLPE or EPR, but rather reduces the dielectric strength of the insulation, eventually weakening the material to the point where it is susceptible to voltage surges that can initiate partial discharging. Partial discharging causes relatively rapid electrical degradation, leading to an electric tree and a faulted condition in weeks to months following inception. Instantaneous failure in the weakened condition would only be expected under severe lightning surge conditions. However, nuclear plant MV circuits are not directly exposed to lightning strike conditions, given that the cables are either inside buildings or underground and not terminated to equipment exposed to lightning. Additionally, cables must be energized in order for partial discharging to occur. If the cables are not energized, there are no electrical stresses, and there is no electrical degradation of the insulation. The presence of water, by itself, does not cause premature degradation of the cables.	
3	N-S8 (Enclosure, pages 10-11)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but, have not been reported. An example is:	N-S8 Not Incorporated. The staff referred to an instance when even the environmentally qualified cable failed in the underground service. Certain licensees have used environmentally qualified cables for all safety related applications for convenience. This reference was not intended to require 10 CFR 50.49 qualifications for cables within the scope of this GL.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		Medium voltage cables in use at nuclear plants were designed and tested for wet or dry applications. These cables are located in "mild environments" under the requirements of 10CFR50.49. Accordingly, there is no requirement to perform an IEEE Std 323 qualification for underground applications. The cables were procured to S-66-524 (NEMA WC 7) for XLPE, ICEA S-68-516 (NEMA WC 8) for EPR, or ICEA S-19-81(NEMA WC 3) for various rubber insulations. These standards required manufacturers to perform EM-60 Accelerated Water Absorption Tests to verify insulation stability under wet conditions. Manufacturers often performed these tests for extended periods to verify stability in wet conditions. These tests verified that the insulation was satisfactory for extended periods. The NEI 2005 Medium Voltage Underground Cable Survey data indicates that early failures were most often related to manufacturing defects and installation damage in conjunction with wet conditions. Wet conditions alone did not lead to early failure. Even for XLPE, a material known to be susceptible to water-treeing, the early failures were associated with defects or damage, not long-term wetting alone.	Also, see staff response to comment S-35 (page 30) of Bin 1, comment S-6 (page 101) of Bin 3, and comment A-General 1 (page 112) of Bin 5.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	P-12 Discussion (Letter, page 3)	12. The FRN states "As cables that are not qualified for wet environments are exposed to wet environments, they will continue to degrade with an increasing possibility that more than one cable will fail on demand from a cable fault or a switching transient." We are unclear as to why this is germane to the GL. As far as we know, the only medium voltage cables in use in nuclear plants have EPR or XLPE insulation. NEI 05-02 "Medium Voltage Underground Cable White Paper" discusses the susceptibility of MV insulation is to degradation in underground environments. It states that while subject to aging in a wet environment, EPR and XLPE MV cable insulations along with the various jacket configurations were manufactured for wet conditions. There is no discussion about them not being qualified for wet environments or that they need to be installed in completely dry environments.	Not Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. The staff recognizes that the failures could be the result of a combination of causes or due to one dominant cause. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006. The staff addressed the issues of their letter in a public meeting with ACRS as a part of the presentation of this GL. See staff response to comment S-35 (page 30) of Bin 1 and comment A-14 (page 86) of Bin 3. Also see staff response to comment A-General 1 (page 116) of Bin 5 concerning the NEI white paper.
3	N-D13 (Enclosure, page 37)	The Medium Voltage Cable White Paper by NEI concludes that the trend in the number of cables failing is essentially flat.	Not Incorporated. NRC has not received any data on cable failure besides what was received in response to the GL. A white paper from NEI was received on May 1, 2006. The staff considered the trend in failures but did not find that it was increasing. See staff response to comment A-15 (page 71) of Bin 3 and A-General 1 (page 120) of Bin 5.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	A-17 (Attachment, page 7)	17. In addition, the *Discussion* section highlights events concerning Davis-Besse. The Davis-Besse cable failure is not an example of a cascading failure. The failure of one non-safety related power cable to a non-safety related distribution center resulted in the loss of downstream, non-safety related connected loads. There was no over-tripping (i.e., loads tripping erroneously as a result of fault current) associated with this event. The major cause of failure of MV cables is due to overvoltage stresses in that sustained over-current will result in the generation of heat, which may take life out of cables, but will not result in immediate failure unless the cable fuses. Available fault current is not sufficient to cause cable fusing in the brief time it takes for a breaker to operate. Lack of breaker coordination is not a cable failure issue. If a cable failure results in fault currents several orders of magnitude over the normal current, the only voltage transient is a reduction in nominal voltage. Reduced voltage transients do not stress cables and cause cable failures.	A-17 Partially Incorporated. The licensee's assessment shared during the NRC inspection indicated "... it is estimated that a known insulation degradation associated with HAAE4 likely faulted first and created a transient on the 13.8kV, A bus which led to secondary faulting of MP2-1 ... Breaker HA08 and HAEE4 tripped.... This caused loss of Circ. Water pump #1 and substations E4 and E6. ..... required the unit to reduce reactor power." See staff response to comment S-27 (page 58) of Bin 2. This event was included to indicate the potential for fault current transients causing further equipment or cable failures.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-D5 (Enclosure, page 35)	There are so many unrelated and unsupported statements made in this paragraph, it's impossible to comprehend the intent. The Davis Besse cable failure is not an example of cascading; the failure of one non-safety related power cable to a distribution center resulted in the loss of downstream, connected loads. There was no over-tripping (loads tripping erroneously as a result of fault current) associated with this event. The majority cause of failure of medium voltage cables is due to over voltage stresses; sustained over-current will result in the generation of heat, which may take life out of cables, but will not result in immediate failure unless the cable fuses. Available fault current is not sufficient to cause cable fusing in the time it takes for a breaker to operate. Lack of breaker coordination is not a cable failure issue. If a cable failure results in fault currents several orders of magnitude over the normal current, the only voltage transient is a reduction in nominal voltage; reduced voltage transients do not stress cables and cause cable failures.	N-D5 Partially Incorporated. This event was included to indicate the potential for fault current transients causing further equipment or cable failures. The GL Discussion section has been revised as follows to include a safety-related power cable failure and its impact on the plant: " When Oyster Creek, Unit 1, was in shutdown, the station lost power to a 4160 VAC due to a ground fault on the underground cable between the EDG and the safety bus. The loss of power led to a trip of reactor protection system channel 2, a full reactor scram signal and main steam line isolation." See staff response to comment A-17 (page 96) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	P-7 Background (Letter, page 2)	7. One of the examples cited in GL is an incident at Davis-Besse. While the proposed GL is for cables that disable accident mitigation systems, this event involved a circulating water pump which is non-safety related, and not an accident mitigating component.	Partially Incorporated. This event was included to indicate the potential for fault current transients causing further equipment or cable failures. The GL Discussion section has been revised to include a safety-related power cable failure and its impact on the plant. See staff response to comments A-16 (page 75), A-17 (page 94) and N-D5 (page 95) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-S12 (Enclosure, pages 13-14)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: Review of the Davis Besse Inspection report cited in the proposed generic letter shows two misinterpretations. First, the 13.8 kV circuit breaker for the circulating water pump did not trip. The cable that failed was the feed to the 13.8 kV bus. That de-energized the 13.8 kV bus and the two non-safety busses connected to it. Secondly, there was no cascade event. All three busses and their loads were non-safety buses and are not in the scope of the Maintenance Rule. The Inspection Report did not indicate that the event was a safety concern. Rather, the event was cited in conjunction with a number of other events to support a conclusion.	Partially Incorporated. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuos duty during accident mitigation. The GL Discussion section has been revised to include a safety-related power cable failure and its impact on the plant. See staff response to comments A-15 (page 71), A-16 (page 75), A-17 (page 94) , and N-D5 (page 95) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-D17 (Enclosure, page 38)	The Davis Besse 'trip' of a 13.8KV circulating water pump breaker and possible cascaded breaker operations caused by 'an underground cable insulation failure' does not constitute multiple cables failing simultaneously, as alluded by the subsequent paragraph referring to 'an increasing possibility that more than one cable will fail' in the same event. Fault current exposures are not relevant to the wet-aging stressor, but the transient over-voltages are more pertinent.	Not Incorporated. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuos duty during accident mitigation. See staff response to comments A-15 (page 71), A-16 (page 75), and A-17 (page 94) of Bin 3.
3	N-D19 (Enclosure, page 38)	The Davis Besse 'trip' of a 13.8 kV circulating water pump breaker and possible cascaded breaker operations caused by 'an underground cable insulation failure' is inappropriately presented. The generic letter refers to an inspection report that was not upset by the particular event in which a non-safety 13.8KV and two non-safety 4KV busses were lost. The event had no safety significance. The inspection report was pointing out that this was one of a number of cable problems at Davis Besse and a program to fix the problem needed to be put in place. The generic letter presents the issue as if some great risk was involved; it was not. It was not a cascade event. The 13.8KV feed cable to the 13.8KV bus was lost. The 13.8KV bus was the only feed to the 4KV non-safety feeds.	Partially Incorporated. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuos duty during accident mitigation. The GL Discussion section has been revised to include a safety-related power cable failure and its impact on the plant. See staff response to comments A-15 (page 71), A-16 (page 75), A-17 (page 94), and N-D5 (page 95) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-G7 (Enclosure, page 2)	There is data from manufactures that show design qualification (not nuclear environmental qualification). The NRC appears to not appreciate that design qualification standards exist independent of nuclear environmental qualifications.	Not Incorporated. The staff is using only nuclear industry experience. See staff response to comment S-35 (page 30) of Bin 1 and comment S-14 (page 100) of Bin 3.
3	S-6 (Attachment, page 2)	6. Cables documented as failing as a result of being water immersed are indeed not meeting their intended 40 year life expectancy. This is somewhat justified in that most cables were not tested or qualified for water immersion, but only for wet environments. The thirty-five (35) insulation failures referenced in the DGL are of concern, but does not indicate a trend since 1988. To imply there are many more cable failures than what is being reported is not a proven fact or verifiable, but highly subjective. If the DGL believes this to be true, then all cables could be brought into the scope of the DGL since cable failures are not being reported.	S-6 Not Incorporated. The staff is addressing this issue for all types of power cable failure modes and not a specific type of failure mode. See staff response to comment A-13 (page 70) of Bin 3. The LER reports do not include failures identified during testing and the failures that affected only a part of a two-train system. The staff has knowledge of a few failures of this nature from morning reports generated by the regional offices. The staff is referring to such failures that did not meet the LER reporting requirements or a morning report as unreported failures.
3	S-13 (Attachment, page 5)	13. While a number of cable failures have occurred though out the industry, the proportion of failures to the millions of feet of installed cable is very low especially in low voltage power and control and instrumentation cables.	S-13 Not Incorporated. The staff agrees that cable failures are low when the entire cable population is considered at a plant. However, the failure rate of the power cables within the scope of this GL was much higher.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-B4 (Enclosure, page 23)	While a number of cable failures have occurred through out the industry, the proportion of failures to the millions of feet of installed cable is very low especially in low voltage power, as well as in control and instrumentation cables.	Not Incorporated. The staff agrees that cable failures are low when the entire cable population is considered at a plant. However, the failure rate of the power cables within the scope of this GL was much higher - staff response to comment S-13 (page 101) of Bin 3.
3	S-14 (Attachment, page 5)	14. Medium and low voltage cables of similar construction to those installed in nuclear power plants are installed by the millions of feet in distribution systems throughout the country and the world. Most are exposed to wetting and are in inaccessible locations such as buried conduits, etc. Why not learn from the power distribution industry rather than basing regulation on the relatively small population of cables installed in nuclear power plants?	S-14 Not Incorporated. The staff is using only nuclear industry experience because the cables in the nuclear industry have been a higher quality product line available at the time of construction because of the requirement imposed through 10 CFR 50 Appendix B program for safety related cables that forms the majority of the cables in scope.
3	N-B5 (Enclosure, page 23)	Medium and low voltage cables of similar construction to those installed in nuclear power plants are installed by the millions of feet in distribution systems throughout the country and the world. Most are exposed to wetting and are in inaccessible locations such as buried conduits, etc. Why not learn from the power distribution industry rather than basing regulation on the relatively small population of cables installed in nuclear power plants?	Not Incorporated. The staff is using only nuclear industry experience. See staff response to comment S-14 (page 102) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	S-15 (Attachment, page 5)	15. At Diablo Canyon, periodically draining manholes, maintaining sump pumps, etc., in order to remove standing water in pull boxes to minimize the duration cables are exposed to water has proven effective at minimizing in service cable failures for medium voltage cables.	S-15 Not Incorporated. The staff agrees that periodic draining of water would reduce the rate of degradation but it does not prevent cable failures. The GL already states, "periodic draining may decrease the rate of insulation degradation but it does not prevent cable failures."
3	N-B6 (Enclosure, page 23)	At Diablo Canyon, periodically draining manholes, maintaining sump pumps, etc. in order to remove standing water in pull boxes to minimize the duration cables are exposed to water has proven effective at minimizing in service cable failures for medium voltage cables.	Not Incorporated. The staff agrees that periodic draining of water would reduce the rate of degradation but it does not prevent cable failures. See staff response to comment S-15 (page 103) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	S-32 (Attachment, page 8)	32. This statement seems to be on both sides of the fence. Energized cables in a wet environment will not show the degradation that is occurring because they are energized. Non-energized cable will degrade because they are not energized.	S-32 Not Incorporated. The energized cable fails when the insulation degradation continues to the point of failure. If the de-energized cable had a degraded insulation from any of the causes, it fails after it is called upon for service. The staff agrees that the cable staying energized is a level of monitoring to verify the basic cable integrity. The stresses on the cable are much higher when the cable is called upon for accident mitigation with continuous design bases loading. The staff is requesting information on "inspection, testing and monitoring programs, to **detect degradation**…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. Also, see staff response to comment A-13 (page 70) of Bin 3.
3	N-D25 (Enclosure, page 41)	This statement seems to be on both sides of the fence. Energized cables in a wet environment will not show the degradation that is occurring because they are energized. Non-energized cable will degrade because they are not energized.	Not Incorporated. The energized cable fails when the insulation degradation continues to the point of failure. If the de-energized cable had a degraded insulation from any of the causes, it fails after it is called upon for service. See staff response to comment S-32 (page 102) of Bin 3.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-G20 (Enclosure, page 6)	Multiple failures may be a problem depending on the cable purpose, equipment served, fault location, and level of training of operators for multiple failures. Consideration in plant design of an electrical "event" with a single failure that is also in the electrical system is a multiple failure that the plant already has procedures and training to deal with. Much of our operator simulator and plant emergency response organization training goes beyond this with multiple electrical failures being required in scenarios to get to the Site and General Emergency categories.	N-G20 Not Incorporated. The staff agrees that some of the multiple failures could be managed with the existing procedures. However, it would be undue taxing on the operators to address power cable-failure-related problems during an accident scenario when we could limit such failures.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-S6 (Enclosure, page 9)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: Review of the LERs indicates that a number are not medium voltage insulation failure. These events (a few are low voltage events; some appear to be unrelated to reported events are cable). There is no reason to believe that the number of legitimate events is a "small fraction" of the events related to wet failures of medium voltage cable. Industry data resulting from the NEI 2005 Medium Voltage Underground Cable Survey on wet underground medium voltage cables indicates that the actual number is closer to 46 events. Some of these failures are of cables that are outside the scope of the Maintenance Rule.	Not Incorporated. The staff is referring to such failures that did not meet the LER reporting requirements or a morning report as unreported failures. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006, and will be addressed by the NRC staff separately. See staff response to comments A-13 (page 70) and S-6 (page 101) of Bin 3 and comment P-3 (page 21) of Bin 1. In response to the NEI 2005 Medium Voltage Underground Cable Survey results, see staff response to comment A-General 1 (page 116) of Bin 5.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-S7 (Enclosure, pages 9-10)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: While each of these may contribute to degradation, none of them by themselves tend to cause failure. Some manufacturing defects or installation damage can lead to early failure by themselves. These are generally self evident in very early failures (e.g., before 10 to 15 years of service). After that point, failure is more related to conditions that enhance the defect such as water immersion. The combination of the water and the less critical defect lead to long-term failure at a point shorter than the desired life of 40 or more years. Electrical transients generally will not affect cable with sound insulation unless lightning strikes a component directly connected to the cable, which is rare since the terminations of most of the cables under consideration are located indoors (only 1 of 46 underground wet medium voltage cable events from the NEI 2005 Medium Voltage Underground Cable Survey	Not Incorporated. The staff is referring to such failures that did not meet the LER reporting requirements or a morning report as unreported failures. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006, and will be addressed by the NRC staff separately. See staff response to comments A-13 (page 70) and S-6 (page 101) of Bin 3 and comment P-3 (page 21) of Bin 1. In response to the NEI 2005 Medium Voltage Underground Cable Survey results, see staff response to comment A-General 1 (page 116) of Bin 5. Also, see staff response to comment A-24 (page 42) of Bin 2 about switching surges.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		was related to a lightning strike). Most switching surges are at low levels by comparison to the withstand capability of all cables but those with very advanced degradation. Even then, the voltage surge from switching is unlikely to cause immediate failure, but rather start partial discharge that could lead to the ultimate failure of the cable.	

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
3	N-S11 (Enclosure, page 13)	In numerous places, the proposed generic letter makes statements that are supposition or misinterpretations. In some case speculations are given that a great number of failures have occurred but have not been reported. An example is: The proposed communication states that failure of a cable to a diesel would prevent operation of the diesel and similarly the failure of a cable to an emergency service water pump could cause safety systems associated with the cooling of the train to be out of service. This is true but has been considered under the single failure criterion. There is a very, very low likelihood of simultaneous multiple failures of medium voltage cables upon energization. Of the 46 failures to date, only one has been at the time of energization (resulting from a review of INPO databases). The rest occurred during an extended period of energization. Accordingly, even when failures occur, they do not tend to occur at initial energization.	Not Incorporated. The staff is addressing this issue for all types of power cable failure modes and not a specific type of failure mode. Failures in EDG cables, emergency service water pump cables, and so forth could affect multiple systems during accident mitigation. Additionally, the cable failure that could impact multiple components or a train would need a suitable condition monitoring to avoid unanticipated failures. See staff response to comments A-13 (page 70), A-15 (page 71), and A-16 (page 75) of Bin 3 and comments A-1 (page 2) and A-3 (page 5) and P-3 (page 21) of Bin 1.
4	A-6 (Attachment, page 3)	6. In the *Applicable Regulatory Requirements* section: the NRC references General Design Criteria (GDC) -18, 'Inspection and testing of electrical power systems. "The excerpt provided in the proposed GL is quoted out of context. The full text of GDC-18 reads as follows (please	A-6 Partially Incorporated. The capability for design bases functions for extended duration cannot be confirmed through brief cycles of operation. See staff response to comment A-1 (page 2) of Bin 1 concerning cable testing.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		note, the underlined words were omitted from the proposed GL): *Electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing of important areas and features, such as wiring, insulation, connections, and switchboards, to assess the continuity of the systems and the condition of their components. The systems shall be designed with a capability to test Periodically (1) the operability and functional performance of the components of the systems, such as onsite power sources. relays, switches, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operation sequence that brings the systems into operation, including operation of applicable portions of the protection system. and the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system."* This GDC requires that the capability for functional testing be provided within the design of the system. All of the testing indicated within the GDC is accomplished by surveillance testing, or by having the MV cables continuously energized, possibly carrying full load current. There is no requirement within the GDC for diagnostic testing.	The GL section on regulatory requirements was revised as follows: "Electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing of important ... features, such as wiring, insulation, ... to assess the continuity of the systems and the condition of their components. ... the operability of the systems as a whole and, ... the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system." This GL is requesting this information in order to verify the condition of the cable.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
4	N-A5 (Enclosure, page 28)	The full GDC-18 reads: "Criterion 18--Inspection and testing of electric power systems. Electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing of important areas and features, such as wiring, insulation, connections, and switchboards, to assess the continuity of the systems and the condition of their components. The systems shall be designed with a capability to test periodically (1) the operability and functional performance of the components of the systems, such as onsite power sources, relays, switches, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operation sequence that brings the systems into operation, including operation of applicable portions of the protection system, and the transfer of power among the nuclear power unit, the offsite power system, and the onsite power system." This GDC requires that the capability for functional testing be provided within the design of the system. All of the testing indicated within the GDC is accomplished by surveillance testing, or by having the medium voltage cables continuously energized, possibly carrying full load current. There is no requirement within the GDC for diagnostic testing.	Partially Incorporated. This GL is requesting this information in order to verify the condition of the cable. See staff response to comment A-6 (page 107-108) of Bin 4.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
4	A-7 (Attachment, page 3-4)	7. The *Applicable Regulatory Requirements* section also references 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," paragraph (a)(1). The excerpt provided in the proposed GL is quoted out of context. The full requirement reads as follows (please note, the underlined words were omitted from the proposed GL): "*Each holder of a license to operate a nuclear power plant under ∮∮ 50.21(b) or 50.22 shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that such structures, systems, and components, as defined in paragraph (b), are capable of fulfilling their intended functions.*" The subsequent paragraph of the regulation states that monitoring is not required *"where it has been demonstrated that the performance or condition of a structure, system, or component is being effectively controlled through the performance of appropriate preventive maintenance, such that the structure, system, or component remains capable of performing its intended function."* Functional testing of cables demonstrates that the system or component is capable of performing its intended function. A significant portion of the industry has not experienced any cable failures; therefore, no supplemental	A-7 Not Incorporated. This GL is requesting this information in order to verify the condition of the cable. See staff response to comment A-1 (page 2) of Bin 1 concerning cable testing.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
		monitoring requirements should be imposed under this regulation.	
4	A-8 (Attachment, page 8)	8. The *Applicable Regulatory Requirements* section of the proposed GL cites 10 CFR 50, Appendix. B, Criteria XI, *"Test Control."* The excerpt provided in this proposed GL is taken out of context. The full text reads as follows (please note, the underlined words were omitted from proposed GL): *"A test program shall be established to assure that all testing required to demonstrate that <u>structures, systems, and</u> components will perform satisfactorily in service is identified and performed <u>in accordance with written test procedures which incorporate the requirements and acceptance limits contained in applicable design documents."</u>* The focus of the criteria is that testing is done in accordance with written procedures. MV Cable testing, as required for compliance with Appendix B, Criteria XI is performed either by being continuously energized or under the surveillance program.	Not Incorporated. This GL is requesting this information in order to verify the condition of the cable. See staff response to comment A-7 (page 113) of Bin 4.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
4	N-A6 (Enclosure, page 29)	The full Criteria reads: "A test program shall be established to assure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service is identified and performed in accordance with written test procedures which incorporate the requirements and acceptance limits contained in applicable design documents." The focus of the criteria is that testing is done in accordance with written procedures. Medium voltage cable testing, as required for compliance with Appendix B, Criteria XI, is performed either by being continuously energized or under the surveillance program.	Not Incorporated. This GL is requesting this information in order to verify the condition of the cable. See staff response to comment A-7 (page 113) of Bin 4.
4	N-A14 (Enclosure, page 32)	A key section of the sentence is missing: "in accordance with written test procedures which incorporate the requirements and acceptance limits contained in applicable design documents.'' Criterion XI requires tests to be performed under approved procedures. It is not dictating the performance of the tests.	N-A14 Not Incorporated. Criterion XI from Appendix B of 10 CFR Part 50 states "a test program shall be established" and "identified and performed." Performing the test also is required in this regulation.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
4	A-22 (Attachment, pages 8-9)	22. Regarding GDC-17, the excerpt provided in the *Applicable Regulatory Requirements* section is quoted out of context. The following provides the full text from GDC-17 (please note, the underlined text was missing from the proposed GL): *"Provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of. or coincident with, the loss of power generated by the nuclear power unit. the loss of power from the transmission network, or the loss of power from the onsite electric power supplies."* The intent of this complete sentence is related to system stability. The design of the plant electrical systems should be such that the loss of the unit, transmission system or onsite supplies do not cause the remaining supplies to be lost. The statement is subsequently used in support of the argument related to cascading failures. The proposed GL has not made a valid argument related to cascading failures.	A-22 Not Incorporated. The staff is bringing industry attention to the fact that undetected near-failure conditions of more than one cable could lead to multiple failures when cables are called upon for continuos duty during accident mitigation. See staff response to comment A-16 (page 75) of Bin 3. Also, GDC-17 does address system reliability and also the power availability. Cable failure does result in inability to provide power to the respective bus.
4	N-A2 (Enclosure, page 27)	The intent of this complete sentence is related to system stability; the design of the plant electrical system should be such that the loss of the unit, transmission system or onsite supplies do not cause the remaining to supplies to be lost. The statement is subsequently used in support of the argument related to cascading failures. The proposed generic letter has not made a valid argument related to cascading failures.	Not Incorporated. Cable failure does result in inability to provide power to the respective bus. See staff response to comment A-22 (page 116) of Bin 4.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
4	P-4 General (Letter, page 2)	4. Nuclear plant safety systems are designed with redundancy in accordance with 10 CFR 50, Appendix A, General Design Criterion 17. Since there is no indication of multiple equipment failures in the industry and plants are designed with this defense in depth safety system redundancy, the staff's desire to monitor and/or test all wetted cable is an unnecessary regulatory burden.	Not Incorporated. Cable failure does result in inability to provide power to the respective bus. See staff response to comment A-22 (page 116) of Bin 4.
4	P-8 Applicable Regulatory Requirements	8. Required surveillance testing of critical safety components includes the cabling (power and control) as part of the functional test. We believe that this meets the requirements of 10 CFR Part 50, Appendix B, Criterion XI. An example of this would be periodic testing of Emergency Diesel Generators which would include functional testing of power cables and associated control cables.	P-8 Partially Incorporated. This GL is requesting this information in order to verify the condition of the cable. See staff response to comment A-6 (page 109) of Bin 4. Also, the use of test signal for continuity would be appropriate (as stated in GDC) for control and instrumentation cable. This is not an "appropriate" test for verifying the condition of power cables because the power cables stress the insulation much greater than control and instrumentation cables.
4	N-A12 (Enclosure, page 31)	This GDC covers surveillance testing from initiating signal through completion of action and of inspection of components. The wiring and insulation discussed is of components such as metal clad switchgear. The remainder of the GDC shows the focus. The interpretation that this clause covers field cable is a very broad interpretation and certainly exceeds the original intent.	Not Incorporated. Inclusion of field cables does meet the original intent of the GDC. See second paragraph of staff response to comment P-8 (page 118) of Bin 4.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
4	N-G19 (Enclosure, page 6)	The intent of the GDCs was met by the original designs and installations "that were thoroughly reviewed and approved by the NRC." Further regulation may not be necessary.	N-G19 Not Incorporated. The compliance to the GDC needs to be preserved for ensuring the safety of the plant. In this GL, the staff requests information that would be essential to ascertain if further NRC actions are necessary.
4	N-A9 (Enclosure, page 30)	While the listed applicable regulatory requirements seem to build to support the conclusion that there must be programs for wet cable, some manipulation of the meaning and intent has occurred. The intent of the GDCs was met by the original design and installations.	Not Incorporated. The compliance to the GDC needs to be preserved for ensuring the safety of the plant. See staff response to comment N-G19 (page 118) of Bin 4.
4	N-A10 (Enclosure, page 30)	This criterion was met in the design. Wet duty cables were purchased and installed.	Partially Incorporated. The staff agrees that certain cables were designed to withstand wet conditions. However, if there are failures within the expected life of the cable, a program is needed to prevent unanticipated failures during accident mitigation. See staff response to comment S-35 (page 31) of Bin 1.
4	N-A11 (Enclosure, pages 30-31)	The plant design provided for this requirement. Multiple simultaneous failures are not likely and this GDC was met by the original design.	Not Incorporated. The compliance to the GDC needs to be preserved for ensuring the safety of the plant. Failures in EDG cables, emergency service water pump cables, and so forth could affect multiple systems during accident mitigation. See staff response to comments A-22 (page 116) and N-G19 (page 118) of Bin 4 and comment P-3 (page 21) of Bin 1.
4	N-A15 (Enclosure, pages 32-33)	No one would debate that these are the overall intention of the General Design Criteria. The industry has met these criteria with the designs of the plants.	Not Incorporated. The compliance to the GDC needs to be preserved for ensuring the safety of the plant. See staff response to comment N-G19 (page 118) of Bin 4.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
5	A-General 1 (Letter, page 1, paragraph 4)	... Exelon/AmerGen recommends that the NRC reconsider issuance of the GL, and that the NRC work with NEI and the industry's MV Underground Cable Task Force in order to develop recommendations that could be evaluated and implemented, as necessary, by the industry in order to satisfactorily address and resolve this issue.	A-General 1 Not Incorporated. The cable issue was addressed in a letter to NEI on February 6, 2004. A public meeting was conducted in June 2004. On September 9, 2004, NEI promised a white paper by October 2004. The staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006. The staff addressed their issues of this letter in a public meeting with ACRS as a part of the presentation of this GL.
5	N-G1 (Enclosure, page 1)	The insights gained from the industry's experiences in the area of cable management will be of considerable value as the Industry works with the NRC staff and other stakeholders in further refining the suitable strategy for cable management. This strategy should be consistent with existing Commission direction, Industry experience, and proven technology. Prior to issuing a generic letter, we propose further dialogue with the members of the NRC staff and other stakeholders, regarding this important matter.	Not Incorporated. Again, the staff has reviewed the chart provided at the end of the GL comments from NEI. A white paper from NEI was received on May 1, 2006. See staff response to comment A-General 1 (page 116) of Bin 5.
5	A-General 2 (Letter, page 2, paragraph 5)	Exelon/AmerGen fully supports NEI's position and comments concerning this Proposed GL.	See staff response to NEI comments.
5	T-1 (Letter, page 2)	TVA endorses the collective industry comments provided by NEI's September 30, 2005, letter on this issue.	See staff response to NEI comments.

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Bin #	**Comment #**	**Comment**	**Resolution**
5	P-1 General (Letter, page 1)	1. Progress Energy recognizes the importance of this matter and appreciates the staffs efforts on this proposed Generic Letter (GL). However, we believe that the proposed GL is overreaching and unnecessary. It characterizes random failures as multiple equipment failures, uses events involving medium voltage (MV) cables as justification for including low voltage cables, and references unproven technology (i.e. broadband impedance spectroscopy), for which there are no industry standards, to meet the intent of the GL. However, if the staff decides to issue the GL, we have the specific comments listed below.	P-1 Partially Incorporated. This comment endorses the staff concern on potential cable failures for the medium voltage cables. If there are failures within the expected life of the cable, a program is needed to prevent unanticipated failures. The staff is addressing power cable failures from all causes. Additionally, the cable failure that could impact multiple components or a train would need a suitable condition monitoring to avoid unanticipated failures. Also, see staff response to comments A-10 (page 8) and A-28 (page 19) of Bin 1 and comment A-26a (page 44) of Bin 2.

Table 3: Resolution Matrix for Comments			
Bin #	**Comment #**	**Comment**	**Resolution**
5	N-1 (Letter, page 2)	Nonetheless, the industry recognizes that plants with no failures to-date of wet, medium voltage underground cables should be prepared for a failure and commit to formal assessment of any failure by a competent laboratory experienced in assessment of medium voltage cable failures. We believe that inspection/monitoring and assessing wet, medium voltage underground cables is prudent.	N-1 Partially Incorporated. This comment endorses the staff concern on potential cable failures for the medium voltage cables. The staff is requesting information on "inspection, testing and monitoring programs, including surveillance programs, to detect degradation…." A program that can detect degradation could predict potential failure and avoid it through a planned replacement or repair. The staff agrees that certain cables were designed to withstand wet conditions. If there are such cables suitable for 40 to 60 years of service in wet environment, the industry could share that information. However, if there are failures within the expected life of the cable, a monitoring program is needed to prevent unanticipated failures. Also, see staff response to comment A-28 (page 19) of Bin 1.
5	N-G17 (Enclosure, page 5)	There is no mention of any cost benefit or PRA evaluation of medium voltage underground cable failures versus cost of a testing program and its nuclear and personnel risks.	N-G17 Not Incorporated. This is addressed as a compliance issue.