NUCLEAR ENERGY INSTITUTE

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SUBJECT: "Proposed Generic Communication Inaccessible or Underground Cable Failures That Disable Accident Mitigation Systems" (70 Fed. Reg. 44127, August 1, 2005)

The Nuclear Energy Institute (NEI)[1] submits the following comments on the Nuclear Regulatory Commission's proposed generic communication. The stated purpose for this proposed generic communication is to:

1. Alert the licensees on the potential susceptibility of certain cables to affect the operability of multiple accident mitigation systems.
2. Request that addressees provide information regarding the monitoring of the inaccessible or underground electrical cables in light of the information provided in this letter.

Detailed comments on this proposed generic communication are provided in the Enclosure.

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. This Information Notice was limited to medium voltage cables in wet or submerged underground conduits. The proposed generic letter expands the scope to include low

[1] NEI is the organization responsible for establishing unified nuclear Industry policy on matters affecting the nuclear energy Industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all utilities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, materials licensees, and other organizations and individuals involved in the nuclear energy Industry.

E-REDS = ADM-03

SISP Review Complete

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voltage cables as well as medium voltage cables; although the NRC and industry experience reveals that the only concern is with energized, wet, medium voltage cables. As indicated in the attached comments, the industry has numerous concerns that the scope of the proposed generic letter exceeds the bounds of the issue of concern raised by the NRC staff.

NEI and the nuclear industry engaged in the issue of failures of wet, medium voltage underground cables after receiving the February 2004 letter from the NRC and participating in a public meeting in June 2004. We looked into the problem to determine the extent by conducting a survey of all plants to determine the number and type of medium voltage cables installed at each plant and the percentage of wet underground cables. The survey also documented information about the types of cables involved and number of failures that occurred at each plant. From the results of this survey, NEI is developing a white paper that will be provided to the NRC in October 2005. The purpose of this white paper is to discuss the potential aging issues involved with wet, medium voltage underground cables, review cable construction and improvements made over the years, and review actual operating histories based on a comprehensive survey of installed cables.

A number of activities are underway by NEI, Electric Power Research Institute (EPRI), and other stakeholders involved in maintaining the cables. Based on the NEI survey data and discussions with other plant owner/operators, utilities that have experienced failures of wet, medium voltage underground cables have taken appropriate corrective action. The rate of failures for the industry is not increasing. 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.

There are two groups of plants from data collected so far:

1. Those with failures
2. Those without failures (65%)

Those plants with significant numbers of failures are replacing like circuits or replacing circuits-based-upon-test. Dominant contributors to early failure of wet underground cables were manufacturing defects and damage during or following installation.

As indicated by very low cable failure rates, ongoing surveillances, and other testing are successful and commensurate with Regulatory Guide 1.118, "Periodic Testing of Electric Power and Protection Systems" (Institute of Electrical and Electronics Engineers (IEEE) Standard 338, "Criteria for the Periodic Testing of Nuclear Power Generating Station Safety Systems"). The standard provides design and operational criteria for the performance of periodic testing as part of the surveillance program of nuclear power plant safety systems. The periodic testing consists of functional tests and checks, calibration verification, and time response measurements, as required, to verify that the safety system performs to meet its defined safety functions. The system status, associated system documentation, test intervals, and test procedures during operation are also addressed. If further testing were required, then IEEE Standard 400, "Guide for Field Testing and Evaluation of Shielded Power Cable Systems", provides additional guidance.

Based upon the empirical results that identified the wet, medium voltage underground cables as the cables-of-concern, NEI and the industry offer the following changes to the section "Requested Information" in the proposed generic letter:

1. Provide a history of medium voltage (Rated 5 kV to 35 kV) cable failures related to wet service conditions, that are within the scope of 10CFR50.65 (the Maintenance Rule), indicating the type of cable, rated and operating voltage, years of service, and the root cause for the failure if known.
2. Provide a description and frequency of all inspection, testing, and monitoring programs, including surveillance programs, to detect degradation of medium voltage cables subjected to long-term wet aging[1] used to support systems that are within the scope of 10CFR50.65 (the Maintenance Rule).

   [1] Long-term wet aging excludes rain and drain, short-term wetting, and normally de-energized cables.
3. If a program as described in 2 is not in place, explain why you believe such a program is not necessary.

The suggested schedule for providing the requested information within 90 days of the date of the generic letter is reasonable, when the scope is limited to wet, medium voltage underground cables.

There are several issues to be addressed and resolved that were presented in the Background and Discussion sections of the proposed generic communication. We would be pleased to meet with the NRC staff to discuss these comments in further detail.

There should be a reason for NRC seeking the requested information, e.g., an emergent issue that legitimately calls into question the licensing basis of one or more licensees. Such information gathering should be based upon the significance of the requested information relative to NRC decision making that may result in further regulatory action. The information "requested" in the proposed generic letter focuses on nuclear power plant operators ensuring that cables will not fail abruptly and cause plant transients or disable accident mitigation systems when they are needed. The programs used to ensure cables will not fail abruptly are not part of the plant licensing basis; therefore, it is inappropriate to request such information under the provisions of 10CFR50.54(f).

The current use of the provisions of 10CFR50.54(f) in generic communications results in a legally binding requirement on licensees to respond under oath or affirmation that, in effect, pressures licensees to take the actions that the NRC "requests." For example, if a generic communication "requests" licensees to submit the results of a new analysis, licensees are expected to perform the analysis. The use of 10CFR50.54(f) should be clear in limiting the application of this provision to requesting for *existing* information, consistent with the intent of the Rule when it was adopted.

Further, consistent with the explicit terms of 10CFR50.54(f), its use should be reserved only for those issues that reach the threshold of information needed to determine if potential regulatory action should be considered that would result in modification, suspension, or revocation of an operating license. This would be consistent with the language in 10CFR50.54(f), as well as the underlying statutory provision in Section 182 of the Atomic Energy Act.

If you have any question related to the content of this letter, please contact me at 202-739-8080; am@nei.org or Gordon Clefton at 202-739-8086; gac@nei.org.

Sincerely,

Alexander Marion

Alexander Marion

Enclosure

c: Dr. Brian W. Sheron, NRR
Mr. Bruce A Boger, NRR
Mr. Michael E. Mayfield, NRR
Mr. Christopher I. Grimes, NRR

Comments on Draft Generic Letter Inaccessible or Underground Cable

Topic	FRN Quote	Comment
General		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.
General		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.
General		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

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		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.
General		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.
General		'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.
General		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.
General		There is data from manufacturers that show design qualification (not nuclear environmental qualification). The NRC appears to not appreciate that design qualification standards exist independent of nuclear environmental qualification.
General		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

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		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.
General		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

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		is proven to be meaningful and effective.
General		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.
General		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

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		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.
General		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.
General		Energized cables are continuously monitored during their in-service use and failures would be immediately noticed and addressed.
General		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.
General		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.
General		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.
General		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.
General		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 or

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		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."
General		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.
General		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.
General		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)
Scope		Earlier versions of the draft generic letter (2/2004) raised concerns with medium voltage, underground / below grade cables. The majority of the discussion provided within the proposed generic letter is relevant to medium voltage cables; however, the "Requested

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		Information" asks for all failures to "inaccessible or underground" cables "for all voltage levels." 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, which is not provided, could include all cables within conduits (above and below grade) and all cable within containment. Failure mechanisms such as "treeing" are discussed; these are associated with medium voltage cables only. 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 results show that the concern is only for wet, medium voltage underground cables.
Scope		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

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		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]
Scope		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.
Scope		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 be 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.

Comments on Draft Generic Letter Inaccessible or Underground Cable

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Scope		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.
Scope	"...the staff identified 23 Licensee Event Reports (LERs) and morning reports since 1988 on failures of buried medium voltage cables from insulation failure. These reported events are believed to be only a very small fraction of the failures since not all cable failures are reportable."	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 events (a few are low voltage events; some appear to be unrelated to 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.
Scope	"Cable failures have a	In numerous places, the proposed generic letter makes statements

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	variety of causes: Manufacturing defects, damage caused by shipping and installation, and exposure to electrical transients or abnormal environmental conditions during operation."	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 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.
Scope	"In most of the reported cases, the failed cables were in service for 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

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	years or more and none of these cables were identified as designed or qualified for long-term wetting or submergence."	been reported. An example is: 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.
Scope	"Although nuclear plant systems are designed against single failures, undetected degradation of cables due to pre-existing manufacturing defects or wetted environments of	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-

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	buried or inaccessible cables could result in multiple equipment failures."	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. Electro-chemical 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) 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.
Scope	"The failure of power cables that connect the offsite power to the safety bus could result in an inability to recover offsite power far beyond the coping time considered for station blackout conditions. The incipient	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

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	failures of these cables can go undetected because these cables generally remain de-energized when the plant is generating power."	generally are the normal feed for safety circuits. Off-site power cable failure is known immediately by the loss power to the associated bus.
Scope		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.
Scope	"At the Davis-Besse nuclear station, an underground cable insulation failure resulted in the trip of the 13.8 kV circulating water pump breaker and loss of power	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.

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	to two other 4 kV substations. Circulating water pump and both 4 kV substations were non-safety related. The cable showed signs of insulation degradation caused by moisture intrusion."	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.
Scope	"Generally, cable failure results in fault currents several orders of magnitude over the normal current. Until isolated by a breaker, the fault current or transient voltages travel on the immediate power systems, trip breakers that operate near their trip setpoint and fail other degraded insulation systems."	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 orders 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.
Scope	"As cables that are not	In numerous places, the proposed generic letter makes statements

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	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."	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.
Scope	"While a single failure may be manageable, multiple failures of this kind would pose undue challenges for the plant operators."	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.

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Scope	"Those degraded cables that are normally energized may fail to reveal their degraded condition, and the potential failure of the de-energized safety systems might only be revealed during a demand for the mitigation capability."	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.
Scope	"Potential cable failures can be detected through state-of-the-art techniques for measuring and trending the condition of cable insulation." "A diagnostic cable test program provides reasonable confidence that the cable will perform its intended function."	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 XLPE. No such recommendations are

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		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.
Scope	"Selective use of testing techniques, such as the partial discharge test, time domain reflectometry, dissipation factor testing, very low frequency AC testing, and broadband impedance spectroscopy"	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.
Scope		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?
Scope		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

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		inaccessible in a general sense? The scope is not clear.
Scope		The generic letter needs more explanation or indication of which sub-systems of accident mitigation systems must be addressed.
Scope		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 generic letter should focus on underground installation environments. Cable wetting and condensation issues should not be included in the scope of this generic letter since cables are designed for wet environments (not including submergence).
Scope		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 5 kV cable is minimal; however, past generic letter examples do not support the belief. Thus, the 5 kV cables should be included in the generic letter, but lower voltage cables should not be within the generic letter's scope.
Scope		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

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		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.
Scope		The scope of requested information should be limited to only cables not rated for submergence to be consistent with problems identified in the letter.
Purpose	"(1) ... potential susceptibility of certain cables to affect the operability of multiple accident-mitigation systems...."	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

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		conditions.
Purpose	"(2) ... Adequate monitoring will ensure that cables will not fail abruptly and cause plant transients or disable accident mitigation systems when they are needed...."	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.
Purpose	"Adequate monitoring will ensure that cables will not fail abruptly and cause plant transients or disable accident mitigation systems when they are needed..." Discussion: "The following are examples of risk-significant cable failures... "...the potential failure of the de-energized safety systems might only be revealed during a demand for the mitigation capability...." Requested Information:	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)

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	"(2) ... inaccessible or underground cables used to support EDGs, offsite power, emergency service water, service water, component cooling water and other systems that are within the scope of 10 CFR 50.65 (the Maintenance Rule)...."	
Purpose	"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 2005 Medium Voltage Underground Cable Survey, that identifies an abrupt failure mechanism for underground cables.
Background	Last sentence, "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 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-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 on rubber; the specific grade of rubber insulation needs to be identified in order to determine its

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		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.
Background	"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 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. There 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.
Background	4th Paragraph - The second statement is "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	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".

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	believed to be only a very small fraction of the failures since not all cable failures are reportable. In most of the reported cases...."	
Background		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, as well as in control and instrumentation cables.
Background		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?
Background	"Several other plants have reported water removal problems but have not yet reported any program for the early detection of potential failures...."	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.
Background	"Several other plants have reported water removal problems but have not yet reported any program for the early detection of potential failures...."	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

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		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.
Background	"Several other plants have reported water removal problems but have not yet reported any program for the early detection of potential failures...."	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.
Background	"Even though there are only about a dozen cables susceptible for moisture-induced damage in a nuclear station, the staff identified 23 Licensee Event Reports (LERs) and morning reports since 1988 on failures of buried medium voltage cables from insulation failure...."	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.
Background	"...some cables are exposed to moisture from condensation and wetting in inaccessible locations such as buried conduits, cable trenches, cable	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.

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	troughs, duct banks, underground vaults and direct buried installations...."	
Background	"...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...."	Most cables are designed to be installed in a wet environment.
Background	"Most of these defects worsen gradually over time as insulation degradation leads to cable failure."	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.
Background	"Cables in these environments can fail due to various failure mechanisms such as water treeing (physical degradation), electrical treeing or other mechanisms of insulation degradation over varying voltage levels that decrease the dielectric	The letter seems to imply that water treeing and electrical treeing is a concern for low voltage cable.

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	strength of the conductor insulation."	
Background	"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 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.
Background	"the staff identified 23 Licensee Event Reports (LERs) and morning reports since 1988 on failures of buried medium voltage cables from insulation failure. These reported events are believed to be only a very small fraction of the failures since not all cable failures are reportable."	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.
Background	"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 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?

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Applicable Regulatory Requirements	GDC-4 - "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."	Medium voltage cables used in nuclear power plants are designed such that they are suitable for use in wet environments.
Applicable Regulatory Requirements	GDC-17 - The excerpt provided is quoted out of context. The full sentence reads (missing portion underlined): "Provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies <u>as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power</u> 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 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.
Applicable Regulatory	Last paragraph, first sentence, "These design	Although this statement is true, it implies that cables aren't qualified for use in wet locations. The cables are designed / specified as

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Requirements	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."	acceptable for their operating environment including moisture and flooding.
Applicable Regulatory Requirements	Last paragraph, last sentence, "However, the recent industry cable failure data indicates a trend in unanticipated failures of underground / inaccessible cables that are important to safety."	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.
Applicable Regulatory Requirements	GDC-18 - The excerpt provided is quoted out of context.	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."

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		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.
Applicable Regulatory Requirements	App. B, Criteria XI - The excerpt provided is, again, taken out of context.	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.
Applicable Regulatory Requirements	Last paragraph, third sentence, "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 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.
Applicable regulatory		The letter as currently written is inconsistent with NUREG-1801,

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Requirements		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.
Applicable Regulatory Requirements		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.
Applicable Regulatory Requirements	'...part 50, Appendix A, General Design Criterion (GDC) 4 states that, "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..."'	This criterion was met in the design. Wet duty cables were purchased and installed.
Applicable Regulatory Requirements	10 CFR, part 50, Appendix A, GDC 17 states that, "Provisions shall be included to minimize the probability of losing electric power from any of the remaining [power]	The plant design provided for this requirement. Multiple simultaneous failures are not likely and this GDC was met by the original design.

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	supplies, *** loss of power from the transmission network, or the loss of power from the onsite electric power supplies."'	
Applicable Regulatory Requirements	10 CFR, part 50, Appendix A, GDC 18 states that, "Electric power systems important to safety shall be designed to permit appropriate periodic inspection and testing of important *** features, such as wiring, insulation, *** 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 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.
Applicable Regulatory Requirements	10 CFR 50.65(a) (1) states that, "Each holder of a license to operate a nuclear power plant *** shall monitor the performance or condition of structures, systems, or components, *against licensee-established	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.

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	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."	
Applicable Regulatory Requirements	10 CFR, part 50, Appendix B, Criterion XI, requires, "A test program shall be established to assure that all testing required to demonstrate that **systems, structures and * components will perform satisfactorily in service is identified and performed ..."	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.
Applicable Regulatory Requirements	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. Further, the design should minimize the probability of	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.

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	power interruption when transferring power between sources.	
Applicable Regulatory Requirements	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. However, the recent industry cable failure data indicates a trend in unanticipated failures of underground/inaccessible cables that are important to safety.	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
Applicable regulatory Requirements	However, the recent industry cable failure data indicates a trend in unanticipated failures of underground/inaccessible cables that are important to safety.	Mention is made of recent industry cable failure data, what is the source?
Discussion		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

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		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.
Discussion		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.
Discussion	Second paragraph after examples, "As cables that are not qualified for wet environments are exposed to et 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 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.
Discussion	First sentence, "Although nuclear plant systems are designed against single failures, undetected degradation of cables due to pre-existing manufacturing defects or wetted environments of buried or inaccessible	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.

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	cables could result in multiple equipment failures."	
Discussion	Davis Besse	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.
Discussion	Second paragraph after examples, "While a single failure may be manageable, multiple failures of this kind would pose undue challenges for the plant operators."	The sentence is true; however, a common mode failure path that would affect multiple cables has not been demonstrated.
Discussion	Next to last paragraph	Potential cable failures cannot be detected. Changes in the insulation

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		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.
Discussion	Last paragraph	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 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

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		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.
Discussion	First example	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.
Discussion	Second example	Power cables from the EDGs are functionally tested, typically once per month during the EDG monthly surveillance runs.
Discussion	Third example	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.
Discussion	Third paragraph after examples	The last sentence discusses both normally energized and de-energized cables. Normally energized cables are continuously monitored and any cable degradation that would render the load inoperable would be immediately identified. De-energized cables are functionally tested during the surveillance testing of the connected loads.
Discussion		The Medium Voltage Cable White Paper by NEI concludes that the trend in the number of cables failing is essentially flat.
Discussion		The cables from the offsite power to the safety bus are energized when the plant is generating power.
Discussion		De-energized cables and low voltage control cables do not exhibit water trees due to a lack of sufficient voltage to cause the required electrical stress.

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Discussion		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.
Discussion		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.
Discussion		Among the list of example testing techniques, the 'broadband impedance spectroscopy' is largely unknown and untested in the field.
Discussion		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.
Discussion	"Until isolated by a breaker, the fault current or transient voltages travel on the immediate power	This depends on the design of the ground system (ungrounded, high resistance grounded, or ground fault tripping).

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	systems, trip breakers that operate near their trip setpoint and fail other degraded insulation systems...."	
Discussion	"Potential cable failures can be detected through state-of-the-art techniques for measuring and trending the condition of cable insulation.... Selective use of testing techniques, such as the partial discharge test, time domain reflectometry, dissipation factor testing, very low frequency AC testing, and broadband impedance spectroscopy, have helped licensees assess the condition of cable insulation with reasonable confidence, such that cables can be replaced in a planned way during refueling outages...."	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 (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 next to 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 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 tests and other materials.
Discussion	"A diagnostic cable test program provides reasonable confidence that	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

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	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...."	Conventional Testing of Power Plant Cables", and a draft IEEE Standard was circulated in 2001 but was never published P1186/D10, "Recommended Practices for the Evaluation of Installed Cable Systems for Class 1I Circuits in Nuclear Power Generating Stations". None of these have provided enough guidance and acceptance criteria to be beneficial in condition monitoring of cables.
Discussion	"Although nuclear plant systems are designed against single failures, undetected degradation of cables due to pre-existing manufacturing defects or wetted environments of buried or inaccessible cables could result in multiple equipment failures."	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.
Discussion	"As cables that are not qualified for wet environments are exposed to wet environments, they	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

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	will continue to degrade with an increasing possibility ..."	cable issues.
Discussion	"Those degraded cables that are normally energized may fail to reveal their degraded condition, and the potential failure of the de-energized safety systems might only be revealed during a demand for the mitigation capability."	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.
Discussion	"Certain licensees have attempted to periodically drain the accumulated water from the cable surroundings to avoid cable failures. In areas where the water table is relatively close to the cable, the water refills the cavity soon after the draining. In other cases, the water accumulates seasonally during snow fall or rain, filling the conduit or raceways, and cables may dry out whenever the humidity	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.

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	drops. In both cases, periodic draining may decrease the rate of insulation degradation but it does not prevent cable failures."	
Discussion	"Potential cable failures can be detected through state-of-the-art techniques for measuring and trending the condition of cable insulation. The cables that are susceptible to moisture-induced failures may vary from plant to plant, and they are generally routed in underground conduits, concrete duct banks, cable trenches, cable troughs, underground vaults or direct buried installations. Selective use of testing techniques, such as the partial discharge test, time domain reflectometry, dissipation factor testing, very low frequency AC testing, and broadband impedance spectroscopy,	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.

Comments on Draft Generic Letter Inaccessible or Underground Cable

Topic	FRN Quote	Comment
	have helped licensees assess the condition of cable insulation with reasonable confidence, ..."	
Discussion	"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."	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.
Discussion	USNRC Regulatory Guide 1.118	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

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		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." 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."
Requested Information	Item (1)	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 predominantly throughout the proposed generic letter.
Requested Information		The background and discussion information address medium voltage cables only.
Requested Information		Most of the information being requested has already been supplied to NEI.
Summary	Paragraph - "(2) Adequate monitoring will ensure that cables will not fail	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

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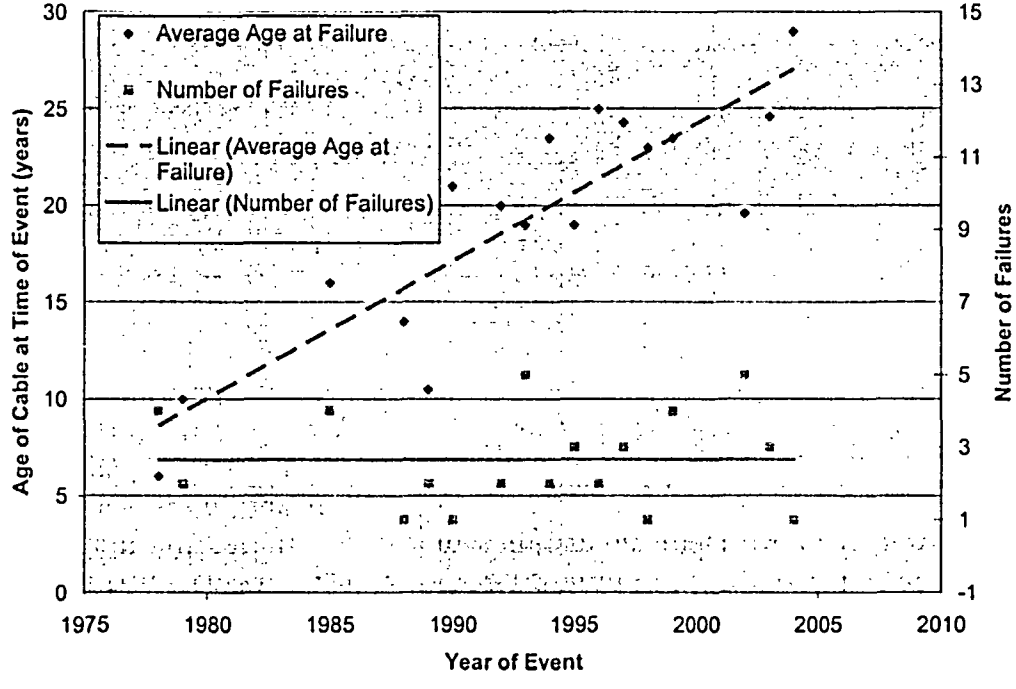
	abruptly and cause plant transients or disable accident mitigation systems when they are needed." (This same assertion also appears in the purpose.)	measurement of remaining service life in an operating cable system." There is no "adequate monitoring" that will ensure cables will not fail abruptly. The 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.
Summary	"(2) 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 2005 Medium Voltage Underground Cable Survey that identifies an abrupt failure mechanism for underground cables.



Trend of Age at Time of Failure and Number of Failures
(Source: NEI 2005 Medium Voltage Underground Cable Survey)