

NUCLEAR REGULATORY COMMISSION

10 CFR Parts 50, 52, 54, and 100

[Docket Nos. PRM-50-106; NRC-2012-0177]

Environmental Qualification of Electrical Equipment

AGENCY: Nuclear Regulatory Commission.

ACTION: Petition for rulemaking; denial.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is denying a petition for rulemaking (PRM) submitted by the Natural Resources Defense Council, Inc. (NRDC), and Mr. Paul M. Blanch (collectively, the petitioners) on June 18, 2012. The petitioners requested that the NRC amend its regulations to clearly and unequivocally require the environmental qualification of all safety-related cables, wires, splices, connections and other ancillary electrical equipment that may be subjected to submergence and/or moisture intrusion during normal operating conditions, severe weather, seasonal flooding, and seismic events, and post-accident conditions, both inside and outside of a reactor's containment building. The NRC is denying this petition because the current regulations already address environmental qualification in both mild and design basis event conditions of electrical equipment located both inside and outside of the containment building that is important to safety, and the petition does not provide significant new or previously unconsidered information sufficient to justify rulemaking.

DATES: The docket for the petition for rulemaking, PRM-50-106, is closed on **[INSERT DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**.

ADDRESSES: Please refer to Docket ID NRC-2012-0177 when contacting the NRC about the availability of information regarding this petition. You may obtain publicly-available information related to the petition by using any of the following methods:

- **Federal Rulemaking Web site:** Go to <http://www.regulations.gov> and search for Docket ID NRC-2012-0177. Address questions about NRC dockets to Carol Gallagher; telephone: 301-415-3463; e-mail: Carol.Gallagher@nrc.gov. For technical questions, contact the individual listed in the FOR FURTHER INFORMATION CONTACT section of this document.

- **NRC's Agencywide Documents Access and Management System (ADAMS):** You may obtain publicly-available documents online in the ADAMS Public Documents collection at <http://www.nrc.gov/reading-rm/adams.html>. To begin the search, select "ADAMS Public Documents" and then select "[Begin Web-based ADAMS Search.](#)" For problems with ADAMS, please contact the NRC's Public Document Room (PDR) reference staff at 1-800-397-4209, 301-415-4737, or by e-mail to pdr.resource@nrc.gov. The ADAMS accession number for each document referenced (if it is available in ADAMS) is provided the first time that it is mentioned in the SUPPLEMENTARY INFORMATION section.

- **NRC's PDR:** You may examine and purchase copies of public documents at the NRC's PDR, Room O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

FOR FURTHER INFORMATION CONTACT: Margaret Ellenson, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone: 301-415-0894; e-mail: Margaret.Ellenson@nrc.gov.

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I. The Petition

On June 18, 2012, the NRC received a petition for rulemaking filed jointly by the NRDC and Mr. Paul Blanch (ADAMS Accession No. ML12177A377). The petitioners requested that the NRC amend its regulations in parts 50, 52, 54, and 100 of title 10 of the *Code of Federal Regulations* (10 CFR) to clearly and unequivocally require the environmental qualification of all safety-related cables, wires, splices, connections and other ancillary electrical equipment that may be subjected to submergence and/or moisture intrusion during normal operating conditions, severe weather, seasonal flooding, and seismic events, and post-accident conditions, both inside and outside of a reactor's containment building.

The petition was docketed by the NRC on June 22, 2012, and was assigned Docket No. PRM-50-106. On September 27, 2012 (77 FR 59345), the NRC published a notice of receipt in the *Federal Register*. The NRC did not request public comment on PRM-50-106.

II. NRC Analysis

The petitioners raised three issues in support of their request that the NRC amend the regulations related to environmental qualification of electrical equipment at nuclear power plants. The three issues and the NRC's responses to each issue are presented in this section.

Issue 1: Through the issuance of Generic Letter (GL) 82-09, "Environmental Qualification of Safety-Related Electrical Equipment," dated April 20, 1982 (ADAMS Accession No. ML031080281), the NRC staff limited the scope of § 50.49 based on the location of the electrical equipment.

The petitioners stated that as a result of the accident at Three Mile Island, the NRC strengthened the regulatory requirements for electrical equipment by, among other things, revising § 50.49(e) to add paragraph (6) to address the possibility of electrical equipment submergence. The petitioners asserted that § 50.49(e)(6), as written, did not limit or restrict its applicability based upon the location of the equipment, but that the NRC staff limited this applicability through a question and answer (Q&A) set in GL 82-09:

Q. For equipment qualification purposes, what are the staff requirements concerning submergence of equipment outside containment?

A. The staff requires that the licensee submit documentation on the qualification of safety-related equipment that could be submerged due to a high energy line break outside containment.

The petitioners asserted that the problem with this excerpt from GL 82-09 is that safety-related cables and wires outside containment are routinely submerged in water not only during high energy line breaks (HELBs), but also during a reactor's normal operation. The petitioners argued that the 1979 Three Mile Island accident and laboratory testing have shown

that moisture intrusion and submergence of electrical cables and wires significantly increase the probability of failure, which also causes the failure of connected components such as emergency core cooling system motors and pumps, valves, controls, and instrumentation. The petitioners asserted that the safety implications from the failure of a safety-related cable inside containment submerged by an accident, outside containment submerged by a high energy line break, or outside containment submerged by nature, are identical—the safety function is lost.

NRC Response to Issue 1: The regulations at § 50.49, “Environmental qualification of electric equipment important to safety for nuclear power plants,” are applicable to electrical equipment located outside containment as well as inside. The January 21, 1983, *Federal Register* notice of the final § 50.49 rule (48 FR 2730) made this clear by noting that nuclear power plant equipment important to safety must be able to perform its safety functions throughout its installed life, and that this requirement applies to equipment inside as well as outside containment. (See 48 FR 2731.) The Q&A referenced by the petitioners is itself premised on the applicability of § 50.49 to important to safety electrical equipment outside of containment. Regardless of its location inside or outside containment, if any important to safety electrical equipment is near enough to a high energy line (e.g., steam line, feedwater, blow-down, charging, or letdown lines) that the equipment’s performance could be adversely affected by a rupture of that line, § 50.49 requires that the equipment be qualified to withstand any environmental conditions that may result from such an event. Section 50.49 was established to impose additional requirements beyond those established by § 50.65, “Requirements for monitoring the effectiveness of maintenance at nuclear power plants;” 10 CFR part 50, appendix

A, “General Design Criteria [GDC] For Nuclear Power Plants;”¹ and 10 CFR part 50, appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Processing Plants.” The additional requirements in § 50.49 apply to important to safety electrical equipment that could be subject to postulated design basis events (DBEs) that could affect: 1) the integrity of the reactor coolant pressure boundary; 2) the capability to shut the reactor down safely and keep it safe; or 3) the capability to prevent or mitigate accidents that could result in potential offsite exposures comparable to NRC emergency planning guidelines. As the cited GL 82-09 Q&A indicates, a HELB was the most probable such DBE involving submergence outside of containment for which the NRC staff believed that a power reactor’s important to safety electrical equipment must be environmentally qualified.

The NRC agrees with the petitioners that safety-related cables and other electrical equipment must be fully able to function, not only within an operating environment affected by a HELB under § 50.49, but also over the entire length of its system, even those portions not exposed to a HELB. Criterion 18 of 10 CFR part 50, appendix A, requires that electric power systems important to safety be designed so that important areas and features permit appropriate periodic inspection and testing. Example areas and features specified are the following: wiring, insulation, connections, and switchboards. Criterion 18 also requires the systems to be designed with a capability to test periodically the operability and functional performance of the components of the systems and the operability of the system as a whole.

As the petitioners rightly point out, designing the entirety of an electrical safety system for inspectability and testability is essential because “[i]t matters little if the portion of a safety-related cable inside [or] outside containment in a high energy line break area survive[s] if

¹ The GDC pertains to water cooled nuclear plants and establishes the minimum requirements for their principal design criteria (36 FR 3256; February 20, 1971, as amended).

another portion of that same cable routed underground fails due to submergence.” It is also important to note that the NRC’s design and qualification requirements for underground or inaccessible wires, cables, and ancillary equipment are inspected and enforced. The NRC’s inspection procedures direct that inspections of electrical equipment at risk of flooding or exposure to moisture be conducted annually.

The NRC disagrees with the petitioners’ assertion that GL 82-09 has restricted the applicability of § 50.49 regulatory requirements for safety-related equipment according to its location. Generic letters do not have the legal authority of a final rule promulgated after due public notice and comment, as was § 50.49. The Q&A in GL 82-09 does not exempt any safety-related equipment that could be submerged, inside or outside containment, from the environmental qualifications (EQ) requirements of § 50.49. The purpose of the GL 82-09 Q&A cited by the petitioners was simply to clarify that under § 50.49, licensees must submit information on the EQ of important to safety equipment that could be submerged due to a high energy line break outside containment. The applicability of § 50.49 is not limited to a HELB, although after more than 30 years of operating experience and risk analysis, a HELB remains the most probable DBE involving submergence outside containment that meets the § 50.49 criteria for the subset of DBEs that could result in a severe accident. The clarifying Q&A was important because the GL was providing information in the event of a HELB, not describing the entire universe of postulated DBEs to which § 50.49 could apply.

Issue 2: Safety-related cable subject to submergence, condensation, or moisture located in a “mild environment” should not be exempted from the environmental qualification requirements of § 50.49.

The petitioners argued that rulemaking is necessary to ensure that electrical cables and wires will be properly qualified for environmental conditions they may experience during normal operation (i.e., a mild environment) as well as in an accident. The petitioners claimed the need for rulemaking and clarification of § 50.49 to address cables that may be exposed to non-mild environments during normal, abnormal, and accident conditions. The petitioners noted that electrical cables and wires “are prone to accelerated failure rates when submerged in water or exposed to high humidity unless designed and qualified for these environmental conditions.” The petitioners stated that the NRC prioritized the inspection of cable penetrations after the 1979 Three Mile Island accident based on the probability of their impairment, mostly due to submergence and moisture. The petitioners argued that “[i]f these conditions cause a high probability of impairment following an accident, then it is logical to assume that these conditions produce a similar outcome in the absence of or prior to an accident as well.” In support of their case for a rulemaking to address this impairment, the petitioners also referenced a 1996 study by the U.S. Department of Energy (DOE) (ADAMS Accession No. ML031140264) and three studies by the Electric Power Research Institute (EPRI), “[Plant Support Engineering: Life Cycle Management Planning Sourcebooks: Medium-Voltage \(MV\) Cables and Accessories \(Terminations and Splices\)](#),” EPRI Product ID: 1013187; “Plant Support Engineering: Aging Management Program Development Guidance for AC and DC Low-Voltage Power Cable Systems for Nuclear Power Plants,” EPRI Product ID: 1020804; and “[Plant Support Engineering: Aging Management Program Guidance for Medium- Voltage Cable Systems for Nuclear Power Plants](#),” EPRI Product ID: 1020805. The EPRI documents are available for download from www.EPRI.com.

Also in support of their request for rulemaking to extend § 50.49 requirements to electrical equipment in mild environments, the petitioners contended that the NRC’s

requirements state only that safety systems should remain functional and do not provide conditions or acceptance criteria for degraded cables.

NRC Response to Issue 2: The NRC agrees that § 50.49 does not apply to reactor cables and electrical equipment exposed to mild environments. This section of the rule applies EQ requirements only to important to safety cables and electrical equipment that may be exposed to non-mild environments during accident conditions. The purpose of the final § 50.49 rule (48 FR 2730; January 21, 1983) was to codify accepted industry standards and NRC guidance for the EQ of safety-related electrical equipment, and non-safety-related equipment relied on by safety-related equipment, that must perform a safety function under DBE conditions.

The NRC disagrees with the petitioners' assertion that § 50.49 should be amended to extend EQ requirements to important to safety cables and electrical equipment exposed to submergence or moisture intrusion in mild environments. The existing rule specifically exempts from these requirements equipment exposed only to a "mild environment," which is defined in § 50.49(c) as an environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences.

All important to safety equipment whether in mild or non-mild environments is subject to the requirements for monitoring the effectiveness of maintenance under the maintenance rule (§ 50.65). Furthermore, all important to safety equipment at plants with construction permits issued after May 21, 1971, is also subject to the design and quality requirements in 10 CFR part 50, appendix A. In addition to the above requirements, all safety-related equipment is also subject to the quality assurance requirements of 10 CFR part 50, appendix B.

Therefore, equipment in mild environments exposed to submergence, condensation, and moisture intrusion, the kind of degradation of concern to the petitioners, is subject to several existing requirements. For important to safety equipment that could be subject to environmental conditions that may result as a consequence of a DBE, § 50.49 establishes additional requirements beyond those stipulated in § 50.65; 10 CFR part 50, appendix A; and 10 CFR part 50, appendix B.

The maintenance rule (§ 50.65) establishes requirements for monitoring the effectiveness of maintenance at nuclear power plants. Under § 50.65(a)(1), licensees are required to monitor the condition or performance of structures, systems, or components (SSCs) in a manner providing reasonable assurance that the intended SSC functions can be fulfilled. Section 50.65(b) describes the types of SSCs subject to its requirements. The maintenance rule (§ 50.65) applies to safety and non-safety SSCs that includes the following: SSCs used in the plant's emergency operating procedures or relied upon to mitigate accidents or transient unsafe conditions; SSCs whose failure could prevent safety-related SSCs from fulfilling their safety-related function; or SSCs whose failure could cause a reactor scram (unplanned action to stop the fission reaction) or the actuation of a safety-related system. With this scope, the maintenance rule (§ 50.65) already covers the equipment specified in the petition (i.e., all safety-related cables, wires, splices, connections, and other ancillary electrical equipment that may be subjected to submergence and/or moisture intrusion). Section 50.65 covers this equipment under any normal or unusual operating or post-accident conditions, whether these conditions include severe weather, seasonal flooding, or seismic events, or whether the SSCs are inside or outside of containment. The rule also covers the petitioners' specified systems and components whether or not they are exposed to submergence in water, condensation,

wetting, and other environmental stresses during routine operation and infrequent events (e.g., flooding).

In its April 2012 Regulatory Guide (RG) 1.218, "Condition-Monitoring Techniques for Electric Cables Used In Nuclear Power Plants" (ADAMS Accession No. ML103510447), the NRC described a programmatic approach and acceptable techniques for monitoring the condition of electric cable systems and their operating environments. As authority for this guidance, RG 1.218 cited 10 CFR part 50, Criterion XI, "Test Control," of appendix B. Criterion XI specifies that power reactor licensees must have a program to assure that all testing required to show that SSCs will perform satisfactorily in service is identified and performed.

The test program must include, as appropriate, operational tests of SSCs during nuclear power plant operation. Test procedures must include provisions for assuring that all prerequisites for the given test have been met, that adequate test instrumentation is available and used, and that the test is performed under suitable environmental conditions. Test results under Criterion XI must also be "documented and evaluated" to ensure that this Criterion's requirements have been satisfied. It is important to note that Criterion XI is only one of 18 criteria that are applicable to a quality assurance program for the electrical equipment at issue in this petition. Appendix B criteria establish quality assurance requirements for the design, manufacture, construction, and operation of all safety-related equipment, and all activities affecting its functions, including not only testing, but designing, purchasing, fabricating, handling, shipping, storing, cleaning, installing, inspecting, operating, maintaining, repairing, and modifying this equipment. Criterion XVI, "Corrective Action," also requires licensees to have measures assuring that conditions adverse to quality are promptly identified and corrected. Examples of such conditions are the following: failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances. For significant conditions adverse to

quality, including the potential failure of electrical equipment to function as designed, licensees must determine the cause of the condition and “assure” that corrective action is taken to preclude a repetition of the adverse condition. The identified condition, its cause, and the corrective action taken to prevent its recurrence must also be documented and the appropriate levels of management informed. In addition, for important to safety cables and electrical equipment located in an area meeting the definition of a mild environment in § 50.49, 10 CFR part 50, appendix A, GDC 4 requires that this equipment be designed to manage the conditions it will experience during normal operation, maintenance, testing, and postulated accidents.

The NRC does not agree that its existing regulations do not require sufficient protection of important to safety electrical equipment against expected or potential environmental conditions it experiences during its period of service. Regardless of whether a cable, switch, or other piece of electrical equipment must be environmentally qualified under § 50.49, it must meet maintenance, design, and quality assurance requirements established by § 50.65; 10 CFR part 50, appendix A; and 10 CFR part 50, appendix B (for safety-related equipment), to provide adequate protection for public health and safety. And regardless of whether the equipment is environmentally qualified, it is subject to the same degree of NRC oversight in the form of inspections and enforcement. A rulemaking to require the environmental qualification of all electrical equipment exposed only to mild environments is, therefore, unnecessary.

Moreover, the 1996 DOE study and three EPRI studies cited by the petitioners are well known to the NRC and do not constitute significant new information justifying a rulemaking. The NRC recognized the concern regarding the reliability of low-voltage power cable systems at reactors that the petitioner references and acted accordingly. Among other things, the NRC has revised its inspection procedures to ensure annual inspections of underground bunkers and

manholes in a continuing repeated cycle beginning with those containing the most risk-significant cables. The NRC also issued RG 1.218, describing a programmatic approach and acceptable techniques for monitoring the condition of electric cable systems and their operating environments.

The NRC disagrees with the petitioners' contention that the NRC's requirements do not provide conditions or acceptance criteria for degraded cables. Any requirement for safety-related systems to remain functional for a specified operating life is a design requirement, and any failure of the equipment before the end of that operating life would be a violation of that design requirement. Therefore, taken together, GDC 2, 4, and 18 in 10 CFR part 50, appendix A, the maintenance requirements under § 50.65, and the quality assurance testing requirements in 10 CFR part 50, appendix B, Criterion XI, effectively provide an enforceable acceptance criterion for the continued use of cables or any other electrical equipment degrading during normal operation. Criterion XI states that the measured rate of degradation must not impair the equipment's ability to function in an emergency, even if the emergency were to occur on the last day of the performance period specified in the equipment's design requirement.

Guidance for the implementation of this criterion is provided in the August 25, 2009, NRC staff regulatory resolution issue protocol, "Cable Performance Issues at Nuclear Power Plants" (ADAMS Accession No. ML092220419), which the petitioners cited as documentation of the NRC's requirements on cable and wire submergence issues. The NRC staff position in that protocol is: 1) licensees should monitor cables within the scope of the maintenance rule (§ 50.65) at an appropriate frequency to demonstrate that they can perform their design functions when called upon; and 2) cables must be designed to fulfill their intended design function in the environment to which they are subject. Under the protocol, if cables have been exposed to conditions for which they are not designed or qualified, the licensee must

demonstrate, through adequate testing or condition monitoring, that the cables can perform their intended design function for the duration of the qualified period specified in the license.

The NRC also inspects underground cables through established inspection procedures. In particular, Inspection Procedure (IP) Attachment 71111.06, "Flood Protection Measures" (ADAMS Accession No. ML11244A012), specifically directs NRC inspectors to perform an annual review of cables located in underground bunkers or manholes. The IP Attachment directs inspectors to select bunkers or manholes subject to flooding that contain multiple train or multiple risk-significant cables, and inspect those that contain more risk-significant cables before inspecting those with less risk-significant cables. The IP notes that inspectors should rotate through the bunkers or manholes until all are inspected; and then the cycle should be recommenced. The IP Attachment also clarifies that these inspections may be in addition to those for the aging management programs of plants with renewed licenses. Where "significant moisture" is identified at such plants, inspectors are to verify that the licensee takes action to keep the cables dry and assess cable degradation in accordance with the licensee's aging management program.

Issue 3: Although GDC 2 and 4 of the NRC's regulations require that cables be able to perform their design function when subjected to anticipated environmental conditions, the NRC does not apply these and other GDC to the 57 plants with construction permits issued before May 21, 1971, the effective date of the GDC rule (36 FR 3256; February 20, 1971).

Citing the August 25, 2009, NRC staff regulatory issue resolution protocol, "Cable Performance Issues at Nuclear Power Plants," the petitioners asserted that this statement defined the NRC's governing regulations on submerged cable performance as explicitly including GDC 2 and GDC 4. The GDC 2 requires reactor SSCs that are important to safety be

designed to withstand the effects of natural phenomena without loss of capability to perform their safety functions. The GDC 4 requires that these SSCs be designed to accommodate the effects of and be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents.

The petition stated that although these GDC may contain appropriate regulatory requirements for the qualification of electrical cables and wires, the NRC has determined that these requirements are not to be applied to the majority of reactors. The petitioners noted that, at the time the petition was submitted, at least 57 of the nation's 104 operating reactors had construction permits that were issued prior to the effective date of the GDC rule, and that the Commission, through guidance to the NRC staff, has determined that the GDC do not need to be applied to these 57 reactors.

NRC Response to Issue 3: The NRC disagrees with the petitioners' suggestion that the 57 plants that received construction permits prior to May 21, 1971, are not operating safely with appropriately qualified important to safety equipment. In 1992, after more than 15 years of analysis, the NRC staff recommended that the Commission retain the current policy that no exemptions from or specific backfits for the GDC are required for plants with construction permits issued before that date. In its September 18, 1992, Staff Requirements Memorandum (SRM) (ADAMS Accession No. ML003763736), the Commission endorsed the NRC staff's recommendation not to apply the GDC to plants with construction permits issued prior to the effective date of the GDC rule. This recommendation was based on the documented results of the NRC staff's evaluations of representative designs of 10 of the 57 plants against the design requirements of a 1975 Standard Review Plan for reactor license applications based on the approved GDC.

The SRM explained that at the time the GDC were promulgated, the Commission had stressed that they were not new requirements and were promulgated to articulate more clearly the licensing requirements and practice in effect at that time. The Commission stated that while compliance with the intent of the GDC is important, each plant licensed before the GDC were formally adopted was evaluated on a plant-specific basis, determined to be safe, and licensed by the NRC. Furthermore, the Commission determined that existing regulatory processes were sufficient to ensure that plants continue to be safe and comply with the intent of the GDC. As the petitioners also noted, the Commission went on to say that backfitting these 57 plants to meet the GDC would provide little or no safety benefit while requiring an extensive commitment of resources. The petitioners have not provided any significant, new, or previously unconsidered information to justify a new rulemaking or to reverse this NRC position.

III. Reasons for Denial

The NRC is denying PRM-50-106 because:

1) The NRC disagrees with the petitioners' assertion that GL 82-09 has restricted the applicability of § 50.49 regulatory requirements for safety-related equipment according to its location. This regulation is applicable to electrical equipment located outside containment as well as inside.

2) Section 50.49 explicitly excludes important to safety electrical equipment subject only to mild environments. The petitioners have not provided significant new information sufficient to justify a change to this rule. A rulemaking to require the environmental qualification of all electrical equipment exposed only to mild environments is unnecessary because existing NRC regulations require sufficient protection of important to safety electrical equipment against expected or potential environmental conditions it experiences during its period of service.

3) With regard to the reactors that received construction permits prior to May 21, 1971, the Commission determined in response to SECY-92-223, "Resolution of Deviations Identified During the Systematic Evaluation Program" (ADAMS Accession No. ML12256B290) that these plants are operating safely with appropriately qualified important to safety equipment, and that no specific backfits of the GDC to these plants were required. The petitioners have not provided any significant, new, or previously unconsidered information justifying a rulemaking to apply the GDC to the 57 reactors that received construction permits prior to May 21, 1971.

IV. Conclusion

For the reasons cited in this document, the NRC is denying PRM-50-106. The NRC is denying this petition because the current regulations already address environmental qualification in both mild and design basis event conditions of electrical equipment located

both inside and outside of the containment building that is important to safety, and the petitioners did not provide significant new or previously unconsidered information sufficient to justify rulemaking.

Dated at Rockville, Maryland, this 29th day of February, 2016.

For the Nuclear Regulatory Commission.

/RA/

Annette L. Vietti-Cook,
Secretary of the Commission.