

NUCLEAR REGULATORY COMMISSION

[NRC-20YY-XXXX]

**Interim Enforcement Policy for an Open Phase Condition Design Vulnerability in
Electric Power Systems for Operating Reactors**

AGENCY: Nuclear Regulatory Commission.

ACTION: Policy statement; revision.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is issuing an interim Enforcement Policy that allows the NRC staff (the staff) to exercise enforcement discretion for:

1. Certain noncompliances with the requirements specified in the technical specifications (TSs) for “Electrical Power Systems,” (typically TS Section 3.8);
2. Certain noncompliances with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion (GDC) 17, “Electric Power Systems,” and certain nonconformances with analogous principal design criteria specified in the updated final safety analysis report (UFSAR)¹ as well as noncompliances with the design criteria for protection systems

¹ In the Staff Requirements Memorandum for SECY-92-223, dated September 18, 1992 (ADAMS Accession No. ML003763736), the Commission decided not to apply the GDC to plants with construction permits issued prior to May 21, 1971. Pre-GDC plants were evaluated on a plant specific basis and are presumed to comply with the intent of the GDC because those licenses were granted using comparable evaluation criteria reflected in the FSAR.

under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3), as specified in the facility's licensing basis.

This interim enforcement policy applies to operating power reactor licensees resolving open phase condition (OPC) design vulnerabilities within each plant's electrical power system. The offsite power OPC design vulnerability, which was identified through a January 2012 Byron Station and other operating events, was that the existing protective relay schemes for the engineered safety features (ESF) buses were not designed to detect a degraded offsite power source due to an OPC and automatically transfer the ESF buses to the onsite power system.

DATES: This policy revision is effective **[INSERT DATE OF PUBLICATION]**. The NRC is not soliciting comments on this revision to its Enforcement Policy at this time.

ADDRESSES: Please refer to Docket ID [NRC-20YY-XXXX](#) when contacting the NRC about the availability of information regarding this document. You may obtain publicly-available information related to this document using any of the following methods:

- **Federal Rulemaking Web site:** Go to <http://www.regulations.gov> and search for Docket ID [NRC-20YY-XXXX](#). 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 <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 in this document (if that document is available in ADAMS) is provided the first time that a document is referenced.

- **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.

The NRC maintains the [Enforcement Policy](#) on its Web site at <http://www.nrc.gov>; select "Public Meetings and Involvement," then "Enforcement," and then "Enforcement Policy." The Enforcement Policy is available in ADAMS under Accession No. ML15029A148.

FOR FURTHER INFORMATION CONTACT: Robert Fretz, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; telephone: 301-415-1980; e-mail: Robert.Fretz@nrc.gov.

SUPPLEMENTARY INFORMATION:

Background

On January 30, 2012, an operating event at Byron Station, Unit 2, revealed a design vulnerability where an OPC in the plant's offsite power supply caused a loss of certain safety functions powered by the site's alternating current (AC) electric power systems. The loss of these safety functions occurred because the electric power system's protection scheme was unable to detect and isolate the loss of a single phase between the transmission network and the onsite power distribution system. The resulting degraded and unbalanced voltage conditions on redundant ESF buses led to the tripping of equipment required for normal plant operations and safe shutdown. The inability of the protection scheme to detect an OPC and automatically transfer power from the affected electric power system allowed the degraded

offsite power system to remain connected to ESF buses, and prevented other onsite AC sources (e.g., emergency diesel generators) from starting and powering these buses. As a result, certain equipment required for safe operations remained powered by the degraded AC source and were put in jeopardy to either rely on internal safety features to lock-out and protect the vulnerable components or risk damage from overheating. Furthermore, equipment relied on for safe shutdown was also at risk of being unavailable for a period of time outside the plant's accident analysis, even after restoration of an operable power source.

As a result of the Byron Station event, the staff issued NRC Information Notice 2012-03, "Design Vulnerability in Electric Power System," dated March 1, 2012 (ADAMS Accession No. ML120480170), to inform licensees of the circumstances at Byron Station as well as describe the events at other plants involving a similar offsite power OPC design vulnerability.

On July 27, 2012, the staff issued NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System" (ADAMS Accession No. ML12074A115), and requested information from licensees about the operating configuration and the ability of protection schemes for ESF buses to detect and automatically respond to an OPC. The NRC staff reviewed the licensees' responses to NRC Bulletin 2012-01 and prepared a summary report dated February 26, 2013 (ADAMS Accession No. ML13052A711).

In addition to these generic communications, the NRC staff has been working with nuclear industry representatives, and licensees for operating and new reactors to resolve the OPC issue. These outreach activities have included numerous public meetings held between March 2012 and January 2015.

On October 9, 2013, the Nuclear Energy Institute (NEI) notified the NRC (ADAMS Accession No. ML13333A147) that the industry's Chief Nuclear Officers approved a formal initiative to address OPCs, and that the initiative represented a formal commitment among nuclear power plant licensees to address the OPC design vulnerability for operating reactors. The current schedule to complete actions to resolve the OPC design vulnerability under this initiative is December 31, 2018 (see NEI letter dated March 16, 2015, ADAMS Accession No. ML15075A455 and attachment, ML15075A456).

The NRC staff provided a response to the industry's initiative, including its planned open phase isolation system (OPIS), in a letter to NEI dated November 25, 2014 (ADAMS Accession No. ML14120A203). The staff noted that the capability of the onsite power system to permit functioning of structures, systems, and components (SSCs) may depend on successful operation of OPIS, and that the proposed solution needs to fully address GDC 17 or the principal design criteria specified in each plant's UFSAR. The staff also communicated functional criteria for demonstrating compliance with existing regulatory requirements.

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 17, "Electric Power Systems," establishes requirements for the design of nuclear power plant electric power systems for which a construction permit application was submitted after the Commission published the GDC in 1971, requiring, in part, that:

An onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety. The safety function for each system (assuming the other system is not functioning) shall be to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences, and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents...

GDC 17 also requires, in part, that:

Provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies.

For current operating power plants designed before the promulgation of GDC 17, the UFSAR sets forth design criteria analogous to GDC 17² which requires, in part, that plants have an offsite and an onsite electric power system with adequate capacity and capability to ensure the functioning of structures, systems, and components important to safety in the event of anticipated operational occurrences and postulated accidents.

While the NRC understands that nuclear power plant licensees have committed to take certain actions to resolve the OPC design vulnerability under the industry initiative, the staff maintains that the potential for OPCs occurring in offsite power sources must be considered in the electric power system design as a part of the current licensing basis (CLB) for nuclear power plants, and is necessary to comply with GDC 17 or conform to the analogous design criteria in the UFSAR, as well as comply with the design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3) and 10 CFR 50.36, "Technical Specifications," associated with an OPC.

The NRC and licensees at all nuclear plants have understood that electrical faults, in general, are credible failure mechanisms and that open-circuit faults (i.e., OPCs), in particular, can occur on one, two, or all three phases of an electrical power system. However, because the design vulnerability involving certain offsite power OPCs was not previously recognized,

² Additional information can be found in NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System": Summary Report (ADAMS Accession No. ML13052A711)

licensees may not have considered all potential OPC scenarios in complying with GDC 17 or conforming to the analogous principal design criteria in the UFSAR, as well as complying with the design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3). As a result, the potential for offsite power OPCs and their associated design vulnerabilities was not specifically identified as an issue during the licensing reviews of the current operating nuclear power plants. Therefore, these plants may not have been designed to detect and mitigate the consequence of an OPC in its electric power systems and, thus, may not be in compliance with GDC 17 or in conformance with the applicable principal design criteria in the UFSAR, as well as in compliance with 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3).

The NRC staff has determined that compliance with regulatory requirements and conformance with comparable licensing basis provisions may be established if each licensee addresses the design issue based on the plant-specific electric power system design, design basis loading conditions, and electrical system operating configuration for normal, abnormal, and accident conditions.

If a licensee determines that its electric power system is not in compliance with GDC 17 or the design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3) and 10 CFR 50.36, or is not in conformance with the analogous UFSAR principal design criteria, as described in the CLB, an operability determination must be performed. To be considered operable, the required initiation times necessary to meet the specified safety functions in GDC 17 or the analogous design criteria in the UFSAR, and other requirements must account for the detection and transfer of offsite power circuits with an OPC to the onsite power system.

When evaluating the effect of a degraded or nonconforming condition on an SSC's capability to perform any of its specified safety functions, a licensee may decide to implement

compensatory measures as an interim action until final corrective action to resolve the condition is completed. Compensatory measures may be used to maintain or enhance an operable but degraded or nonconforming SSC's capability to perform its specified safety functions and may also be used to restore inoperable SSCs to an operable but degraded or nonconforming status.³

If a licensee is actively resolving OPC design vulnerabilities and meets the criteria described in Interim Enforcement Policy (IEP) 9.3, "Enforcement Discretion for Electric Power System Open Phase Condition Design Vulnerability," the NRC will normally exercise enforcement discretion for noncompliances with GDC 17 and the TS section for "Electrical Power Systems" (typically TS Section 3.8) associated with "AC Sources-Operating" and "AC Sources-Shutdown," and nonconformances with analogous design criteria in the UFSAR, as well as noncompliances with the protection systems requirements under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3).

This interim policy recognizes that the corrective actions and compensatory measures implemented by licensees have sufficiently reduced the risk associated with an offsite power OPC, and provide reasonable assurance of adequate protection of public health and safety. The interim compensatory measures include, but are not limited to, operator awareness and procedure modifications.

The NRC will keep this interim policy in place until January 30, 2019, unless specified otherwise. Licensees shall comply with all other requirements, as applicable, unless explicitly replaced or amended in the Enforcement Policy.

³ NRC Inspection Manual Chapter 0326, Section 07.03

The NRC recognizes that, for some licensees, compliance with the CLB does not require that the design of the electric power system consider all potential OPCs in offsite power sources, and that these licensees have nevertheless committed to implementing interim compensatory measures and plant modifications under the industry initiative. In the event that the actions taken by a licensee to correct the OPC design vulnerability do not adequately address potential OPCs that might occur in offsite power sources by the date committed to under the industry's initiative (December 31, 2018), the NRC staff may consider implementing plant-specific backfits in accordance with 10 CFR 50.109, "Backfitting." The staff has reviewed the backfitting issue and has prepared a Documented Evaluation (ADAMS Accession No. ML15254A208) that supports the conclusion that the consideration of potential OPCs in offsite power sources is necessary to bring a facility into conformance with the licensee's written commitments. This evaluation further supports updating the CLB for operating nuclear reactors, on a plant-specific basis, to require that the electric power systems meet GDC 17 or the analogous principal design criteria specified in the UFSAR, and other applicable regulatory requirements, assuming all potential OPCs in offsite power.

Accordingly, the NRC has revised its Enforcement Policy to read as follows:

Interim NRC Enforcement Policy

9.3 Enforcement Discretion for Electric Power System Open Phase Condition Design Vulnerability

This section sets forth the interim Enforcement Policy (IEP) that the NRC will follow to exercise enforcement discretion for certain noncompliances with the requirements specified in the technical specification (TS) section for "Electrical Power Systems" (typically Section 3.8) and

action statement(s) associated with “AC Sources-Operating” and “AC Sources-Shutdown” which would require a reactor shutdown or prevent a reactor startup if a licensee is unable to come into conformance within the Limiting Condition for Operation (LCO) TS completion times for the applicable TS Condition. Enforcement discretion would also be exercised for noncompliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion (GDC) 17, “Electric Power Systems,” and nonconformance with analogous design criteria in the updated final safety analysis report (UFSAR) for a plant, as well as noncompliance with design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3). This interim policy is applicable to operating power reactor licensees resolving offsite power open phase condition (OPC) design vulnerabilities within each plant’s electrical power system. Power reactor licensees intending to cease power operations and begin decommissioning activities before January 30, 2019, need only perform the immediate actions listed below.

If the licensee determines that the electric power system is not in compliance with GDC 17 or the design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3), or is not in conformance with the analogous UFSAR principal design criteria, as described in the licensee’s current licensing basis, an operability determination must be performed. If the licensee concludes that the electrical power system is inoperable, the licensee must perform the required action(s) of applicable TS(s) until the LCO(s) can be met. In certain instances, a licensee may not meet the LCO(s) and the associated required action(s) within the completion time allowed by TS, and would be required to enter a shutdown action statement or prevented from restarting the facility.

Under this IEP, the NRC will normally not take enforcement action for a violation of TSs associated with “Electric Power Systems” (i.e., “AC Sources-Operating” and “AC

Sources-Shutdown”), noncompliance with GDC 17, or nonconformance with analogous principal design criteria in the UFSAR, as well as noncompliance with the design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3), if the licensee implements the following actions:

Corrective Actions

a. Immediate Actions

If not already performed, within 30 days of issuance of the IEP, the licensee must:

1. Enter the noncompliance with GDC 17 or the design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3), or the nonconformance with the UFSAR principal design criteria, into the corrective action program;
2. Perform an operability determination to evaluate the effect of the noncompliance with GDC 17 or the design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3), or the nonconformance with the UFSAR principal design criteria;
3. Implement compensatory measures as an interim action until final corrective action to resolve the nonconforming condition is completed; and
4. Assess and manage plant risk related to maintenance and surveillance activities in accordance with 10 CFR 50.65(a)(4).

b. Short Term Actions

If not already performed, the licensee must:

1. Within 60 days of the issuance of this IEP, establish a schedule for completing a corrective action for the structures, systems and components (SSCs) determined to be degraded or nonconforming within a time frame commensurate with the safety significance of the condition in accordance with 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Criterion XVI, "Corrective Action." This schedule is subject to NRC inspection.
2. Within 12 months of the issuance of this IEP, the licensee shall submit license amendments, in accordance with 10 CFR 50.90, if plant modifications necessary to meet its licensing basis require NRC prior-approval in accordance with 10 CFR 50.59 (e.g., changes to the TSs).

Although this IEP provides discretion from immediate action such as shutting down the plant as detailed above, in determining whether the licensee is making reasonable efforts to complete corrective actions promptly, the NRC will consider safety significance, the effects on operability, the significance of the degradation, and what is necessary to implement the corrective action. The NRC may also consider the time needed for design, review, approval, or procurement of the repair or modification; the availability of specialized equipment to perform the repair or modification; and whether the plant must be in hot or cold shutdown to implement the actions. If the licensee does not resolve the degraded or nonconforming condition or does not appropriately justify a longer completion schedule, the staff would conclude that corrective action has not been timely and would consider taking enforcement action. Factors that should be considered are (1) the identified cause, including contributing factors and proposed corrective actions, (2) existing conditions and compensatory measures, including the acceptability of the schedule for repair and replacement activities, (3) the basis for why the repair or replacement activities will not be accomplished prior to restart after a planned outage

(e.g., additional time is needed to prepare a design/modification package or to procure necessary components), and (4) review and approval of the schedule by appropriate site management and/or oversight organizations⁴.

c. Long Term Actions

By January 30, 2019, the licensee must complete all required plant modifications, including implementation, testing, and placing into operation, necessary to ensure that the electric power systems comply with GDC 17, the analogous principal design criteria in the UFSAR regarding all potential OPCs in offsite power sources, and 10 CFR 50.55a(h) for protection systems.

1. Facility modifications must satisfy all design standards consistent with the plant's current licensing basis (e.g., for an OPC, a non-Class 1E circuit should not preclude the onsite electrical power system from being able to perform its safety function given a single failure in the onsite power system).
2. The OPC should be automatically detected and alarmed in the main control room under all operating electrical system configurations and loading conditions.
3. If offsite power circuits are degraded due to an OPC, the ESF protection schemes should be able to automatically transfer power sources to the onsite power system within the time frames assumed in the accident analysis and without actuating any protective devices, given a concurrent design basis event.

⁴ NRC Inspection Manual Chapter 0326, Section 07.02

4. TS Surveillance Requirements and LCOs for equipment used for mitigation of OPC should be consistent with the operability requirements specified in the existing plant TSs.

If a noncompliance with GDC 17 or the design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3), or a nonconformance with the UFSAR principal design criteria, results in SSCs being declared inoperable, the inoperability should not serve as the basis for suspending the performance of required surveillance tests or maintenance activities, nor as the basis for preventing the change of modes (e.g., shutting-down or restarting the reactor), under this interim policy. Licensees shall comply with all other requirements, as applicable.

This interim policy will remain in place until January 30, 2019, unless specified otherwise.

PROCEDURAL REQUIREMENTS:

Paperwork Reduction Act Statement

This policy statement does not contain new or amended information collection requirements subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). Existing requirements were approved by the Office of Management and Budget, approval numbers 3150-0010 and 3150-0136.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

Congressional Review Act

This interim enforcement policy is a rule as defined in the Congressional Review Act (5 U.S.C. §§ 801-808). However, the Office of Management and Budget has not found it to be a major rule as defined in the Congressional Review Act.

Dated at Rockville, Maryland, this day of 2016.

For the Nuclear Regulatory Commission.

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