[7590-01-P]

NUCLEAR REGULATORY COMMISSION

[NRC-2023-0036]

NRC Bulletin 2012-01: Design Vulnerability in Electric Power System

AGENCY: Nuclear Regulatory Commission.

ACTION: Bulletin; closure.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is issuing this notice to inform all holders of operating licenses and combined licenses for nuclear power reactors of the closure of "NRC Bulletin 2012-01: Design Vulnerability in Electric Power System" (Bulletin). NRC has completed evaluations and inspections of the responses and other actions taken by the licensees of the nuclear power plants in response to NRC Bulletin 2012-01. The staff has approved the actions to be taken by the licensee for Vogtle Units 3 and 4 following commencement of operations and will inspect these actions under the Reactor Oversight Process. The NRC staff concludes that any potential adverse impact on nuclear plant safety due to an open phase condition (OPC) in the plant offsite power system has been adequately addressed by the licensees.

DATES: NRC Bulletin 2012-01 is closed effective **[INSERT DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**.

ADDRESSES: Please refer to **NRC-2023-0036** 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 Website:** Go to https://www.regulations.gov and search for **NRC-2023-0036**. Address questions about Docket IDs in Regulations.gov to Stacy Schumann; telephone: 301-415-0624; email: Stacy.Schumann@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 https://www.nrc.gov/reading-rm/adams.html. To begin the search, 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 email to PDR.Resource@nrc.gov. For the convenience of the reader, instructions about obtaining materials referenced in this document are provided in the "Availability of Documents" section.

- **NRC's PDR:** You may examine and purchase copies of public documents, by appointment, at the NRC's PDR, Room P1 B35, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852. To make an appointment to visit the PDR, please send an email to PDR.Resource@nrc.gov or call 1-800-397-4209 or 301-415-4737, between 8 a.m. and 4 p.m. eastern time (ET), Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: Wendell Morton, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone: 301-415-1658, email: Wendell.Morton@nrc.gov.

SUPPLEMENTARY INFORMATION:

I. Introduction

The NRC is providing this technical summary in this *Federal Register* notice (FRN) to explain the basis for closure of "NRC Bulletin 2012-01: Design Vulnerability in Electric Power System." This FRN informs external stakeholders that the adverse impacts on nuclear plant safe operation due to an OPC in the plant offsite power system have been adequately addressed, and the Bulletin is closed.

II. Background

An OPC event occurred in the offsite power circuit at Bryon Unit 2 on January 30, 2012. The station auxiliary transformer (SAT) (offsite power source) high-voltage side event caused unbalanced voltage conditions on the low-voltage side of the SAT, which led to a reactor trip and tripping of certain safety related loads. The existing undervoltage degraded voltage protection scheme failed to detect the unbalanced

voltage and did not automatically separate the degraded offsite power source from the onsite power source. Operator action was required to bring the plant to a safe shutdown condition. The event is further described in the "Availability of Documents" section.

In addition to the event previously described, two additional events were discussed in NRC Information Notice 2012-03. In these events, the OPC occurred on the offsite circuits that usually remain energized without a load or with a light load during normal conditions. At the related plants, the safety and non-safety-related loads are normally fed from the main generator through unit auxiliary transformers, therefore the offsite circuits that feed the safety-related loads during plant startup or after unit trip usually remain on no-load or are lightly loaded during normal plant conditions. The OPCs at these plants were not detected for many days. If a design basis event had occurred simultaneously, the unbalanced voltages at the safety-related buses would have increased due to shifting of loads from unit auxiliary transformers to offsite circuits due an OPC and could impact the safety of plants. The degree of unbalanced voltage conditions on the plant buses due to an OPC in the offsite power circuit is dependent on the offsite circuit design parameters, plant configuration, and plant loading conditions. The unbalanced voltage condition can potentially lead to either degraded operation of the safety-related loads if the voltage unbalance is small (about five percent or less) or tripping of the safety-related loads if the voltage unbalance is large, either of which is an unsafe condition. Therefore, the timely mitigation of an OPC is necessary to ensure the safety of the plant.

In light of the Byron and other events, on July 27, 2012, the NRC issued Bulletin 2012-01: Design Vulnerability in Electric Power System. The Bulletin required that all holders of operating licenses and combined licenses for nuclear power reactors verify compliance with the regulatory requirements of General Design Criterion (GDC) 17, "Electric Power Systems," in Appendix A, "General Design Criteria for Nuclear Power Plants," to Part 50 of title 10 of the *Code of Federal Regulations* (10 CFR) or the applicable principal design criteria in the licensees' updated final safety analysis report;

and the design criteria for protection systems under 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3). The licensees were requested to describe plant design features that would allow the existing protective schemes to detect and respond to an OPC.

Licensees provided responses to the Bulletin and the NRC staff issued a summary report of the responses on February 26, 2013. In the summary report, the staff determined that for the operating plants, one or both trains of safety related electrical buses could be affected by an OPC. The NRC staff became aware of the OPC during an event at Byron Unit 2 that rendered both the offsite power system and the onsite power system unable to perform their intended safety functions. The NRC determined further regulatory action was required to ensure detection and automatic system response to an OPC at nuclear power plants. Further, the NRC determined that licensees should ensure that offsite and onsite electric power systems would remain available to permit the functioning of structures, systems, and components important to safety in the event of anticipated operational occurrences and accidents.

III. Discussion

Two public meetings were held with industry on February 13, 2013, and June 13, 2013, in which various industry representatives presented possible solutions for the detection and protection from the new challenge faced due to OPCs. The minutes from these meetings as well as presentations by industry representatives are available in the “Availability of Documents” section.

In its letter dated October 9, 2013, Nuclear Energy Institute (NEI) provided a voluntary industry initiative plan, which included a formal commitment by the licensees to address plant vulnerabilities due to potential OPCs. The initiative goal and definition included: an OPC will not prevent functioning of important-to-safety structures, systems, and components. An OPC is defined as an open phase, with or without a ground, which is located on the high voltage side of a transformer connecting a GDC 17 off-site power circuit to the transmission system. The initiative was slated for completion by December 31, 2017.

Bulletin 2012-01 stated that GDC 17 in 10 CFR Part 50, Appendix A, and 10 CFR 50.55a(h)(2) for operating plants or 10 CFR 50.55a(h)(3) for any plants after May 13, 1999, are applicable.

In its letter dated March 21, 2014, NEI provided its perspective that the protection system requirements described in 10 CFR 50.55a(h)(2), “Protection systems,” do not apply to the Open Phase Isolation Systems (OPISs).

In the letter dated August 14, 2014, NEI provided the industry position with respect to various regulatory issues related to OPC.

The NRC provided a November 25, 2014, response to NEI to address the issues raised in the March 2014 and August 2014 letters, and explained that to address OPCs, four functional requirements should be met. The letter also stated that until each licensee has addressed OPCs and informed the NRC that it is in full compliance with GDC 17, or the principal design criteria specified in the updated final safety analysis report for the specific plant regarding OPC, the staff would be recommending an interim enforcement policy (IEP) to the Commission.

NEI provided Revision 1 of the voluntary industry initiative dated March 16, 2015, with a schedule change for OPC modifications completion from December 31, 2017, to December 31, 2018.

In SECY-16-0068, dated May 31, 2016, the NRC staff proposed a revision to the Enforcement Policy to permit the staff to exercise enforcement discretion for certain noncompliance’s with technical specifications or GDC 17, and certain nonconformances with the analogous principal design criteria specified in the updated final safety analysis report, as well as noncompliance’s with 10 CFR 50.55a(h)(2) or 10 CFR 50.55a(h)(3), and 10 CFR 50.36. The potential violations could be those associated with inoperable electrical power systems (offsite and onsite) caused by an OPC design vulnerability in the offsite electric power system that would require a reactor shutdown or prevent a reactor startup if a licensee could not come into conformance within the technical specification required completion times.

In SRM-SECY-16-0068 dated March 9, 2017, the Commission disapproved the staff's request to establish an IEP. Instead, the Commission directed the staff to 1) verify that licensees have appropriately implemented the voluntary industry initiative; 2) update the Reactor Oversight Process to provide periodic oversight of industry's implementation of the OPC initiative; and 3) close the Bulletin once satisfactory implementation of the technical resolution has been verified for each licensee.

On October 31, 2017, the NRC staff issued Temporary Instruction 2515/194, to verify that licensees appropriately implemented the NEI voluntary industry initiative. The NRC inspectors verified implementation at plants where OPC modifications were substantially complete.

NEI provided Revision 2 of the voluntary industry initiative, dated September 20, 2018, with the completion schedule changed from December 31, 2018, to December 31, 2019. NEI stated that many plants had completed installation of OPIS with other plants scheduled to complete during 2018. However, the monitoring data to date had indicated that installed OPISs would have experienced undesirable spurious actuations if the automatic trip functions had been activated. NEI proposed extended monitoring periods so that licensees could refine OPIS setpoints to minimize spurious actuations.

Due to continuing spurious actuations of OPIS designs observed at some plants, NEI provided Revision 3 dated June 6, 2019, of the initiative. This revision included an option to perform a risk evaluation under certain boundary conditions to support an alarm and manual response to an OPC, instead of an automatic trip response. For plants adopting the risk-informed option, the OPIS design would change from "alarm and automatically trip (isolate)" to "alarm (detect) and manual actions" to isolate the OPC. Written plant alarm response procedures would allow operators to diagnose and take manual actions to mitigate an OPC. NEI also separately provided NEI 19-02, "Guidance for Assessing Open Phase Condition Implementation Using Risk Insights," referenced in Revision 3 of the initiative.

To evaluate whether safety significance justified requiring automatic OPIS actuation, the NRC staff performed a backfit screening and documented the results in a memo dated May 21, 2020. The analysis determined that automatic OPIS actuation would not result in a substantial increase in the overall protection of the public health and safety. Therefore, the risk-informed option in Revision 3 to the voluntary industry initiative was acceptable.

On August 18, 2020, the NRC staff issued Revision 2 of the Temporary Instruction 2515/194, to verify that licensees have appropriately implemented the NEI voluntary industry initiative, including licensees that adopted the risk-informed option. For licensees where OPIS implementation was still in the monitoring mode and spurious initiations continued to occur, many changed to the risk-informed option of the voluntary industry initiative. Approximately 65 percent of operating power reactors have adopted the risk-informed option. This change, and the COVID-19 pandemic, resulted in delays in licensees' implementation of the voluntary industry initiative and the subsequent inspections at many plants.

As required by SRM-SECY-16-0068, the Reactor Oversight Process Inspection Procedures and the Inspection Manual Chapter were revised to provide periodic oversight of industry's implementation of the OPC voluntary industry initiative.

IV. Conclusion

The staff issued closure letters to each licensee other than Southern Nuclear Company for Vogtle Units 3 and 4. ADAMS accession numbers to these letters are in the "Availability of Documents" section. The closure letters provide further details concerning how licensees addressed OPC at their facilities.

The staff has approved the actions to be taken by the licensee for Vogtle Units 3 and 4 following commencement of operations, by letter dated July 5, 2019, agreeing to the due dates and will inspect these actions under the Reactor Oversight Process. By letter dated August 29, 2018, Southern Nuclear Company to NRC (Vogtle Units 3 and 4), provided regulatory commitments and due dates regarding the OPC.

The licensees of the following plants received Bulletin 2012-01, but subsequently permanently ceased operation prior to addressing the Bulletin: Crystal River 3; Duane Arnold; Fort Calhoun; Indian Point 2; Kewaunee; Oyster Creek; Palisades; Pilgrim 1; San Onofre 2; San Onofre 3; Three Mile Island 1; Vermont Yankee.

Based on the actions taken by the NRC and licensees in response to the Bulletin, the NRC staff finds that all operating plants will continue to operate safely or safely shut down in response to an OPC event. Therefore, Bulletin 2012-01 is closed.

V. Availability of Documents

The documents identified in the following table are available to interested persons through one or more of the following methods, as indicated.

Document Description	**ADAMS Accession No.**
Information Notice 2012-03: Design Vulnerability in Electric Power System, dated March 1, 2012	ML120480170
Presentation by Exelon Nuclear – Byron Station Single Phase Failure, dated March 22, 2012	ML120810365
Licensee Event Report 2012-001-01 “Unit 2 Loss of Normal Offsite Power and Reactor Trip and Unit 1 Loss of Normal Offsite Power Due to Failure of System Auxiliary Transformer Inverted Insulators,” dated September 28, 2012	ML12272A358
Byron Unit 2 - NRC Special Inspection Team (SIT) Report, dated March 27, 2012	ML12087A213
Bulletin 2012-01: Design Vulnerability in Electric Power System, dated July 27, 2012	ML12074A115
Summary report of licensee responses, dated February 26, 2013	ML13052A711
Public meeting summary	ML13066A774 (package)
Public meeting summary	ML13196A002 (package)
Nuclear Energy Institute (NEI) voluntary industry initiative plan, dated October 9, 2013	ML13333A147
NEI perspective letter on Open Phase Isolation Systems (OPISs), dated March 21, 2014	ML14087A252 (package)
NEI letter that provided the industry position with respect to various regulatory issues related to OPC, dated August 14, 2014	ML14226A804 (package)
NRC’s response to NEI to address the issues raised in the March 2014 and August 2014 letters, and explained that to address OPCs, four functional requirements should be met, dated November 25, 2014	ML14120A203

NEI Revision 1 of the voluntary industry initiative plan, dated March 16, 2015	ML15075A454 (package)
SECY-16-0068, dated May 31, 2016	ML15219A327, Enclosure ML15219A330
SRM-SECY-16-0068, dated March 9, 2017	ML17068A297
NRC staff issued Temporary Instruction 2515/194, dated October 31, 2017	ML17137A416
NEI Revision 2 of the voluntary industry initiative, dated September 20, 2018	ML18268A114
NEI Revision 3 of the voluntary industry initiative, dated June 6, 2019	ML19163A176
NEI 19-02, “Guidance for Assessing Open Phase Condition Implementation Using Risk Insights,” dated June 20, 2019	ML19172A086
NRC backfit screening memo, dated May 21, 2020	ML19198A304
NRC Revision 2 of the Temporary Instruction 2515/194, dated August 18, 2020	ML20230A328
NRC Response to Supplemental Information for Bulletin 2012-01, Vogtle 3 and 4 (052-25 and 52-026), dated July 5, 2019	ML19182A206
Vogtle, Units 3 and 4, Supplement to Response to NRC Bulletin 2012-01, Design Vulnerability in Electric Power System, dated August 29, 2018	ML18242A012
Arkansas Nuclear 1 Closure Letter, dated March 5, 2021	ML21049A307
Arkansas Nuclear 2 Closure Letter, dated March 5, 2021	ML21049A307
Beaver Valley 1 Closure Letter, dated July 15, 2022	ML22189A184
Beaver Valley 2 Closure Letter, dated July 15, 2022	ML22189A184
Braidwood 1 Closure Letter, dated April 27, 2021	ML21102A182
Braidwood 2 Closure Letter, dated April 27, 2021	ML21102A182
Browns Ferry 1 Closure Letter, dated May 1, 2020	ML20104A192
Browns Ferry 2 Closure Letter, dated May 1, 2020	ML20104A192
Browns Ferry 3 Closure Letter, dated May 1, 2020	ML20104A192
Brunswick 1 Closure Letter, dated October 12, 2021	ML21278A002
Brunswick 2 Closure Letter, dated October 12, 2021	ML21278A002
Byron 1 Closure Letter, dated April 27, 2021	ML21102A182
Byron 2 Closure Letter, dated April 27, 2021	ML21102A182
Callaway Closure Letter, dated July 27, 2021	ML21201A105
Calvert Cliffs 1 Closure Letter, dated September 7, 2021	ML21225A432
Calvert Cliffs 2 Closure Letter, dated September 7, 2021	ML21225A432
Catawba 1 Closure Letter, dated October 19, 2021	ML21272A183
Catawba 2 Closure Letter, dated October 19, 2021	ML21272A183
Clinton Closure Letter, dated July 8, 2022	ML22186A150

Columbia Closure Letter, dated June 29, 2021	ML21165A344
Comanche Peak 1 Closure Letter, dated July 26, 2023	ML23025A353
Comanche Peak 2 Closure Letter, dated July 26, 2023	ML23025A353
Cooper Closure Letter, dated November 22, 2021	ML21323A074
D.C. Cook 1 Closure Letter, dated May 26, 2021	ML22146A113
D.C. Cook 2 Closure Letter, dated May 26, 2021	ML22146A113
Davis-Besse Closure Letter, dated July 21, 2022	ML22195A223
Diablo Canyon 1 Closure Letter, dated April 29, 2022	ML22108A286
Diablo Canyon 2 Closure Letter, dated April 29, 2022	ML22108A286
Dresden 2 Closure Letter, dated April 27, 2021	ML21102A182
Dresden 3 Closure Letter, dated April 27, 2021	ML21102A182
Farley 1 Closure Letter, dated August 23, 2021	ML21216A316
Farley 2 Closure Letter, dated August 23, 2021	ML21216A316
Fermi 2 Closure Letter, dated July 21, 2022	ML22188A089
FitzPatrick Closure Letter, November 16, 2021	ML21300A006
Ginna Closure Letter, dated September 20, 2021	ML21245A098
Grand Gulf Closure Letter, dated March 5, 2021	ML21049A307
Harris 1 Closure Letter, dated September 29, 2021	ML21252A389
Hatch 1 Closure Letter, dated September 20, 2021	ML21253A113
Hatch 2 Closure Letter, dated September 20, 2021	ML21253A113
Hope Creek 1 Closure Letter, dated March 11, 2022	ML22060A057
Indian Point 3 Closure Letter, dated March 5, 2021	ML21049A307
La Salle 1 Closure Letter, dated April 27, 2021	ML21102A182
La Salle 2 Closure Letter, dated April 27, 2021	ML21102A182
Limerick 1 Closure Letter, dated September 13, 2021	ML21245A084
Limerick 2 Closure Letter, dated September 13, 2021	ML21245A084
McGuire 1 Closure Letter, dated October 27, 2021	ML21293A026
McGuire 2 Closure Letter, dated October 27, 2021	ML21293A026
Millstone 2 Closure Letter, dated November 15, 2021	ML21295A412
Millstone 3 Closure Letter, dated November 15, 2021	ML21295A412
Monticello Closure Letter, dated July 29, 2022	ML22189A019
Nine Mile Point 1 Closure Letter, dated September 7, 2021	ML21239A052
Nine Mile Point 2 Closure Letter, dated September 7, 2021	ML21239A052
North Anna 1 Closure Letter, dated May 5, 2020	ML20065L173
North Anna 2 Closure Letter, dated May 5, 2020	ML20065L173
Oconee 1 Closure Letter, dated February 17, 2022	ML22045A024
Oconee 2 Closure Letter, dated February 17, 2022	ML22045A024

Oconee 3 Closure Letter, dated February 17, 2022	ML22045A024
Palo Verde 1 Closure Letter, April 20, 2022	ML22102A262
Palo Verde 2 Closure Letter, April 20, 2022	ML22102A262
Palo Verde 3 Closure Letter, April 20, 2022	ML22102A262
Peach Bottom 2 Closure Letter, dated September 7, 2021	ML21196A010
Peach Bottom 3 Closure Letter dated September 7, 2021	ML21196A010
Perry 1 Closure Letter, dated July 13, 2022	ML22189A177
Point Beach 1 Closure Letter, dated July 13, 2021	ML21187A153
Point Beach 2 Closure Letter, dated July 13, 2021	ML21187A153
Prairie Island 1 Closure Letter, dated May 26, 2022	ML22145A020
Prairie Island 2 Closure Letter, dated May 26, 2022	ML22145A020
Quad Cities 1 Closure Letter, dated April 27, 2021	ML21102A182
Quad Cities 2 Closure Letter, dated April 27, 2021	ML21102A182
River Bend 1 Closure Letter, dated March 5, 2021	ML21049A307
Robinson 2 Closure Letter, dated March 29, 2022	ML22083A003
Saint Lucie 1 Closure Letter, dated October 28, 2021	ML21281A012
Saint Lucie 2 Closure Letter, dated October 28, 2021	ML21281A012
Salem 1 Closure Letter, dated November 19, 2021	ML21320A204
Salem 2 Closure Letter, dated November 19, 2021	ML21320A204
Seabrook 1 Closure Letter, dated March 24, 2020	ML20071C899
Sequoyah 1 Closure Letter, dated May 1, 2020	ML20104A192
Sequoyah 2 Closure Letter, dated May 1, 2020	ML20104A192
South Texas 1 Closure Letter, dated August 5, 2020	ML20206L260
South Texas 2 Closure Letter, dated August 5, 2020	ML20206L260
Surry 1 Closure Letter, dated May 5, 2020	ML20065L173
Surry 2 Closure Letter, dated May 5, 2020	ML20065L173
Susquehanna 1 Closure Letter, dated December 6, 2021	ML21335A422
Susquehanna 2 Closure Letter, dated December 6, 2021	ML21335A422
Turkey Point 3 Closure Letter, dated July 19, 2022	ML22187A277
Turkey Point 4 Closure Letter, dated July 19, 2022	ML22187A277
VC Summer Closure Letter, dated September 14, 2021	ML21242A330
Vogtle 1 Closure Letter, dated October 22, 2021	ML21279A167
Vogtle 2 Closure Letter, dated October 22, 2021	ML21279A167
Waterford 3 Closure Letter, dated June 22, 2020	ML20171A366
Watts Bar 1 Closure Letter, dated May 1, 2020	ML20104A192
Watts Bar 2 Closure Letter, dated May 1, 2020	ML20104A192
Wolf Creek 1 Closure Letter, dated February 10, 2022	ML22040A158

Dated: March 1, 2023.

For the Nuclear Regulatory Commission.

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