



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
REGION II
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ATLANTA, GEORGIA 30303-1257

May 23, 2018

Mr. Tom Simril
Site Vice President
Duke Energy Corporation
Catawba Nuclear Station
4800 Concord Road
York, SC 29745-9635

**SUBJECT: CATAWBA NUCLEAR STATION – NRC SUPPLEMENTAL INSPECTION
REPORT 05000414/2018040 AND ASSESSMENT FOLLOW-UP LETTER**

Dear Mr. Simril:

On May 10, 2018, the U.S. Nuclear Regulatory Commission (NRC) completed a supplemental inspection using Inspection Procedure (IP) 95001, "Supplemental Inspection Response to Action Matrix Column 2 Inputs." The NRC inspection team discussed the results of this inspection and the implementation of your corrective actions with you and other members of your staff. The results of this inspection are documented in the enclosed report.

The NRC performed this inspection to review your station's actions in response to a White finding in the mitigating systems cornerstone which was documented and finalized in NRC Inspection Report 05000414/2017013 (ADAMS Accession No. ML17289A300). On April 6, 2018, your staff informed the NRC that your station was ready for the supplemental inspection.

The NRC determined that your staff's evaluation identified that the primary root causes of the White finding were: 1) the Portec voltage regulator design is resulting in bridge rectifier diode damage, 2) root cause C-05-1926 (Condition Report 01435421) did not apply adequate analysis techniques, and 3) less than adequate performance of operating experience (OE) evaluations. The corrective actions to preclude repetition were to: 1) modify the emergency diesel generator (EDG) voltage regulator to address design weaknesses for all four Catawba Nuclear Station EDGs based on detailed simulation of the voltage regulator to prevent diode damage, 2) implement a diode and silicon-controlled rectifier (SCR) replacement preventive maintenance (PM) activity at a frequency of no greater than 18 months, and 3) issue a procedure revision to AD-PI-ALL-0400, "Operating Experience Program," that addressed crediting previously completed actions for OE insight, crediting future engineering changes, and reviewing historical performance trends to ensure PM strategy changes are identified. During this supplemental inspection, the inspectors determined that the licensee performed a comprehensive evaluation of the issue. The NRC inspectors did not identify any finding or violation of more than minor significance.

After reviewing Catawba Nuclear Station, Unit 2, performance in addressing the White finding subject of IP 95001, "Supplemental Inspection Response to Action Matrix Column 2 Inputs," the NRC concluded that your actions met the objectives of IP 95001. Therefore, in accordance with the guidance in Inspection Manual Chapter 0305, "Operating Reactor Assessment Program," the White finding will only be considered in assessing plant performance for a total of four quarters. As a result, the NRC determined the performance at Catawba Nuclear Station, Unit 2, to be in the Licensee Response Column of the Reactor Oversight Process Action Matrix as of July 1, 2018.

This letter, its enclosure, and your response (if any) will be made available for public inspection and copying at <http://www.nrc.gov/reading-rm/adams.html> and at the NRC Public Document Room in accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding."

Sincerely,

/RA/

Frank Ehrhardt, Chief
Reactor Projects Branch 1
Division of Reactor Projects

Docket No.: 50-414
License No.: NPF-52

Enclosure:
IR 05000414/2018040

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**U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report**

Docket Number(s): 50-414

License Number(s): NPF-52

Report Number(s): 05000414/2018040

Enterprise Identifier: I-2018-040-0001

Licensee: Duke Energy Carolinas, LLC

Facility: Catawba Nuclear Station, Unit 2

Location: York, SC 29745

Inspection Dates: May 7, 2018, through May 10, 2018

Inspectors: D. Hardage, Senior Resident Inspector (Sequoyah Nuclear Station)
M. Toth, Project Engineer

Approved By: Frank Ehrhardt, Chief
Reactor Projects Branch 1
Division of Reactor Projects

Enclosure

SUMMARY

The NRC continued monitoring licensee performance by conducting a supplemental inspection at Catawba Unit 2 in accordance with the Reactor Oversight Process. The Reactor Oversight Process is the NRC's program for overseeing the safe operation of commercial nuclear power reactors. Refer to <http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/index.html> for more information.

List of Findings and Violations

No findings were identified.

Additional Tracking Items

Type	Issue number	Title	Report Section	Status
NOV	05000414/2017011-01	Failure to adequately establish and adjust preventive maintenance for emergency diesel generator excitation system diodes.	95001	Closed

INSPECTION SCOPES

Inspections were conducted using the appropriate portions of the inspection procedures (IPs) in effect at the beginning of the inspection unless otherwise noted. Currently approved IPs with their attached revision histories are located on the public website at <http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/index.html>. Samples were declared complete when the IP requirements most appropriate to the inspection activity were met consistent with Inspection Manual Chapter (IMC) 2515, "Light-Water Reactor Inspection Program - Operations Phase." The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel to assess licensee performance and compliance with Commission rules and regulations, license conditions, site procedures, and standards.

DESCRIPTION OF THE ISSUE

On April 11, 2017, during monthly surveillance testing of the 2A EDG, in accordance with PT/2/A/4350/002A, "Diesel Generator 2A Operability Test," the EDG output breaker unexpectedly tripped open on an overcurrent relay actuation. The breaker opened approximately three minutes after reaching full load (5750 kW). The diesel was subsequently secured and declared inoperable. During troubleshooting, the licensee discovered that diode CR4 in the EDG excitation circuit shorted, causing the diesel output breaker to trip open on overcurrent. The 2A EDG was returned to service on April 14, 2017, following replacement of the excitation system diodes. Condition Report 2116069 was initiated to investigate the diode failure.

The licensee failed to develop PM strategies which considered OE for the EDG excitation system. Specifically, the licensee did not effectively incorporate OE documented in their corrective action program into the preventive maintenance activities for EDG excitation system diodes. As a result, a condition adverse to quality associated with the elevated diode temperatures was uncorrected. The NRC issued a White inspection finding in the mitigating systems cornerstone for this issue on October 16, 2017.

OTHER ACTIVITIES – TEMPORARY INSTRUCTIONS, INFREQUENT AND ABNORMAL

95001 - Supplemental Inspection Response to Action Matrix Column 2 Inputs

Inspectors reviewed the licensee's root causes, contributing causes, extent of condition, and extent of cause determinations. Inspectors assessed whether the licensee's corrective actions to address the root and contributing causes were sufficient to prevent recurrence. The highlights of the performance review and NRC's assessment are documented below:

- (1) Problem Identification: The finding involved a failure to adequately develop and adjust preventive maintenance activities in accordance with procedure AD-EG-ALL-1202, "Preventive Maintenance and Surveillance Testing Administration," thus allowing a condition adverse to quality to remain uncorrected.
 - a) The issue was NRC-identified after inspectors reviewed the 2A EG output breaker trip that occurred on April 11, 2017, during monthly surveillance testing.
 - b) The licensee's Root Cause Evaluation (RCE) 02116069 documented that there was an opportunity to identify the cause in 2005, however, root cause C-05-1926 (CR

01435421) did not apply adequate analysis techniques. Additionally, the RCE documented that the licensee missed opportunities to address the failure of the diode, by initiating diode replacement preventive maintenance activities or by completion of a voltage regulator engineering change (EC).

- c) The NRC determined this issue was White, a finding of low to moderate safety significance, as documented in inspection report 05000414/2017013. In addition, RCE 02116069 documented the consequences of the issue, which included the following:
- 2A EDG output breaker 2ETA-18 tripped open
 - Station entered a technical specification 72 hour action statement
 - 2A EDG accrued unplanned unavailability hours

(2) Root Cause, Extent-of-Condition, and Extent-of-Cause Evaluation

- a) The licensee used the following investigative techniques to complete RCE 02116069:
- equipment reliability form
 - fault tree analysis
 - events and causal factors chart
 - industry comparison
 - hazard barrier target analysis
 - support/refute matrix
 - vendor failure analysis
 - performance analysis
 - safety culture evaluation

The inspectors determined that the licensee evaluated the issue using systematic methodologies to identify root and contributing causes.

- b) The licensee's RCE included an event narrative, a description of involved equipment, equipment historical information, an OE review, and investigative techniques listed in the previous section. The licensee's RCE documented the root causes of the White finding were:
- the Portec voltage regulator design is resulting in bridge rectifier diode damage
 - root cause C-05-1926 did not apply adequate analysis techniques, and
 - less than adequate performance of operating experience evaluations

Based on the documented work performed for this root cause evaluation, the inspectors concluded that the root cause evaluation was conducted to a level of detail commensurate with the significance of the problem.

- c) The licensee's RCE included an evaluation of internal and external operating experience. The licensee also considered previous occurrences. Based upon the considerations described in the analysis, the inspectors concluded that the analysis appropriately considered prior occurrences of the issue and knowledge of prior operating experience.

- d) The licensee's RCE considered the extent of condition associated with the White finding. The RCE documented the results of the same-similar methodology used in the evaluation, which included: 1) all six of the exciter bridge rectifier diodes for all four EDG control panels have been replaced (EOC-CA1), 2) a 40 year replacement PM was established for the 125 VDC auctioneering diode assemblies (EOC-CA2), and 3) procedure IP/0/B/4974/051, "SSF Generator Inspection and Maintenance," has been revised to include reverse bias testing on voltage regulator diodes at rated voltage conditions (EOC-CA3). The inspectors concluded that the licensee's RCE adequately addressed the extent of condition for the issue.

The licensee's RCE considered the extent of cause associated with the White finding. The licensee concluded several performance improvement areas were necessary, including a technical adequacy review of historical RCEs and previous OE evaluations for risk-significant component related Level 3 and Level 4 INPO Event Reports. The licensee also reviewed a statistically significant sample of OE items that showed design or PM weaknesses to determine if the concerns were properly addressed. Additionally, the licensee completed an assessment of Catawba's operating history for PRA risk-significant and MSPI system components to determine if any Catawba Nuclear Station component was an outlier compared to industry operating experience. Issues stemming from these reviews were entered into the corrective action program and assigned corrective actions. The inspectors concluded that the licensee's RCE adequately addressed the extent of cause for the issue.

- e) The licensee performed a safety culture analysis and associated the root causes with weaknesses in the following safety culture aspects: Design Margin (H.6), Conservative Bias (H.14), Evaluation (P.2), and Operating Experience (P.5). The inspectors determined that the RCE included an appropriate consideration of whether a weakness in any safety culture component was a root cause or significant contributing cause of the issue.

(3) Corrective Actions

- a) The inspectors determined that appropriate corrective actions were specified for each root cause and contributing cause. The inspectors also determined that corrective actions were prioritized with consideration of significance and regulatory compliance. The licensee has taken the following corrective actions to preclude repetition (CAPR): 1) implemented a diode and SCR replacement PM activity at a frequency of no greater than 18 months, and 2) issued a procedure revision to AD-PI-ALL-0400, "Operating Experience Program," that addressed crediting previously completed actions for OE insight, crediting future engineering changes, and reviewing historical performance trends to ensure PM strategy changes are identified. The inspectors determined that the licensee specified appropriate CAPRs for each root cause.
- b) The inspectors concluded that the corrective actions had been prioritized with consideration to risk significance and regulatory compliance. Inspectors also determined the licensee assigned appropriate performance improvement actions for the RCE extent of cause review.

- c) The inspectors determined that the licensee adequately established a schedule for implementing and completing the corrective actions. The corrective actions that were associated with the root causes were completed in a timely manner. At the time of the inspection, only the voltage regulator EC implementation CAPR (RC1-CA1) was still open, and is scheduled for completion in May 2021. The inspectors noted the first new voltage regulator system is scheduled to be installed in 2A EDG during the fall outage of 2019. Subsequent installations for the remaining EDGs are scheduled afterward. As mentioned previously, until the new voltage regulator is installed, existing voltage regulator diode and SCR replacement will be performed at a frequency of no greater than 18 months.
- d) As documented in RCE 02116069, the licensee had established measures for determining the effectiveness of assigned corrective actions. The effectiveness reviews are scheduled but had not been completed at the time of the inspection. The assigned actions include the following:
- perform diode testing and vendor destructive component analysis 18 and 72 months after completion of the voltage regulator design change and installation
 - review a sample of completed OE evaluations since the issuance of the newly revised AD-PI-ALL-0400, "Operating Experience Program," Rev. 7
 - review the Plant Health Committee OE Oversight board governance activities

The inspectors reviewed the effectiveness review plans and assigned management actions, and determined that appropriate quantitative or qualitative measures of success had been developed.

- e) The inspectors determined that appropriate corrective actions were assigned by the licensee's root cause. The NRC inspectors determined that NOV 05000414/2017011-01 related to this supplemental inspection has been adequately addressed in both corrective actions taken and planned.

(4) Evaluation of IMC 0305 Criteria for Treatment of Old Design Issues

The licensee did not request credit for self-identification of an old design issue; therefore, the risk-significant issue was not evaluated against the IMC 0305 criteria for treatment of an old design issue.

(5) Assessment of licensee's evaluation and corrective actions

The inspectors determined that the licensee performed a comprehensive evaluation of the issue. The inspectors concluded that the licensee's actions met all of the inspection objectives of IP 95001. Therefore, in accordance with the guidance in Inspection Manual Chapter 0305, "Operating Reactor Assessment Program," the White finding will only be considered in assessing plant performance for a total of four quarters. As a result, the NRC determined the performance at Catawba Nuclear Station, Unit 2, to be in the Licensee Response Column of the Reactor Oversight Process Action Matrix as of July 1, 2018.

EXIT MEETINGS AND DEBRIEFS

No proprietary information was retained by the inspectors or documented in this report.

On May 10, 2018, the inspectors presented the supplemental inspection results to Mr. T. Simril, Site Vice President, and other members of the licensee staff.

Following the supplemental inspection exit meeting, Mr. F. Ehrhardt conducted a regulatory performance meeting with Mr. T. Simril and other members of the licensee staff.

DOCUMENTS REVIEWED

95001 - Supplemental Inspection Response to Action Matrix Column 2 Inputs

Condition Reports

Designation	Description	
02116069	Root Cause Evaluation for 2A EDG Overcurrent Trip	
02183163	Common Mode failure evaluation	
01463709	Assignment 31 RCE	
C-06-8777	Root Cause Evaluation for Unit 1 Reactor Coolant Leakage Event 1NC-13 and 1NC-106	
01569949	IER L4-12-82, Emergency Diesel Generator Leaks	
02085136	IER L3-16-24, Emergency Diesel Generator Bearing Failure	
02197218	Thermography WO task instructions	

Condition Reports Generated as a Result of Inspection

Designation	Description	Date
02204696	Potential closure issue w NCR 2116069 RC3CA3	5/8/18
02204698	Potential imprv. in ST3825, Equipment WO Hi	5/8/18
02204714	AD-EG-ALL-1207 PRR	5/8/18
02204932	AD-EG-ALL-1207 PRR	5/9/18

Miscellaneous

Designation	Description	
WO Query	Table of outstanding NCRs and WOs for EDG support systems	
RCE Closure Packages	RCE Closure Packages for RCE 02116069	
Meeting Minutes	OE Review Subcommittee Meeting Minutes for 3/6/18, 4/18/18, and 5/3/18.	
Historical Thermography Data	Spreadsheet for 1A, 1B, 2A, and 2B EDG diode temperatures from 2005 - present	
Committee Charts	Organization Charts for the PHC, PHS, and OE Review Subcommittee	
2183898	NCS 95001 Mock Inspection Assessment Report	
2181758-06	Flex Cause Evaluation – OE Program Escalation	

Miscellaneous

Designation	Description	
Diode Inspection	Completed WOs for temperature dots inspections after EDG run for 1B EDG (3/9/18) and 2A EDG (2/8/18)	
NC State Final Report to Duke Energy	Review of Information and Discussion of EDG Excitation System Diode CR4 Failure, September 12, 2017	
DFR Solutions Report	Power Diode Analysis for Catawba Nuclear Station 1A Emergency Diesel Generator, May 26, 2017 (failure analysis)	
DFR Solutions Report	Power Diode and SCR Analysis for Catawba Nuclear Station 2A Emergency Diesel Generator, May 16, 2017	
Altran Report	Evaluation of Diodes from 1B EDG, 17-0201-TR-000, June 2017, Rev. 0	
MPR Report	MPR Design Review of EDG Excitation System Diode Failures, Recommended Actions to Resolve In-Service Diode Failures, 2079-0047-RPT-001, Rev. 0	
CNS Report	2A EDG Test Results for 6/14/17	
CNS Report	1B EDG Test Results completed by the Root Cause Evaluation Team during OP/1/A/6350/002, 6/8/17	

Procedures

Designation	Description	Revision
AD-EG-ALL-1202	Preventive Maintenance and Surveillance Testing Administration	6
AD-PI-ALL-0105	Effectiveness Reviews	1
AD-PI-ALL-0400	Operating Experience Program	6, 7
AD-EG-ALL-1207	Plant Health Process	5
AD-LS-ALL-0002	Regulatory Correspondence	5
AD-PI-ALL-0100	Corrective Action Program	16
AD-PI-ALL-0101	Root Cause Evaluation	5
AD-WC-ALL-0210	Work Request Initiation, Screening, Prioritization and Classification	9
AD-EG-ALL-1211	System Performance Monitoring and Trending	6

Work Orders

Designation	Description	
20246273	Inspect Voltage Regulator Diode temperature labels (1A EDG)	
20246272	Inspect Voltage Regulator Diode temperature labels (1B EDG)	
20246274	Inspect Voltage Regulator Diode temperature labels (2A EDG)	
20246277	Inspect Voltage Regulator Diode temperature labels (2B EDG)	
20243168-01	1 EQC VR A, Install Heat Sensitive Labels on Diodes	
20238765-01	1 EQC VR B, Replace diodes with old diodes	
20240512-02	2 EQC VR B, Install Heat Sensitive Labels	
20092269-01	1 EQC VR A: D/G Voltage Reg Thermography (old revision)	
01724280-01	2 EQC VR A: D/G Voltage Reg Thermography (new revision)	