UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE RD. SUITE 210
LISLE, IL 60532-4352

November 29, 2022

EA-22-062

Mr. David P. Rhoades
Senior Vice President
Constellation Energy Generation, LLC
President and Chief Nuclear Officer (CNO)
Constellation Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: QUAD CITIES NUCLEAR POWER STATION, UNIT 2 - FINAL SIGNIFICANCE DETERMINATION OF A WHITE FINDING, NOTICE OF VIOLATION, AND ASSESSMENT FOLLOW UP LETTER; NRC INSPECTION REPORT (05000254/2022091 and 05000265/2022091)

Dear Mr. Rhoades:

This letter provides Constellation Energy Generation, LLC (CEG) the final significance determination of the preliminary White finding discussed in our previous communication dated August 8, 2022, which included Inspection Report 05000254/2022090 and 05000265/2022090. The finding involved the failure of one of the four electromatic relief valves (ERVs) associated with the automatic depressurization subsystem (ADS) to actuate during surveillance testing. As a result, the valve was inoperable from April 7, 2020, until March 21, 2022. An extent-of-condition review identified no similar operability concerns with the remaining Unit 1 or Unit 2 ERVs. The inspection report can be found in the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the US Nuclear Regulatory Commission (NRC) Web site at https://www.nrc.gov/reading-rm/adams.html at Accession Number ML22209A232.

In letter dated September 15, 2022 (ML22272A527), you provided a response to the NRC staff preliminary determination regarding the finding. Your response indicated that CEG does not dispute that a performance deficiency in maintenance caused the ERV failure. Your response proffered that CEG's own plant specific probabilistic risk assessment concluded that the risk significance of the performance deficiency was Green, a finding of very low safety significance. Enclosure 1 provides NRC's evaluation of your response.

After considering the information developed during the inspection and the additional information you provided in your letter dated September 15, 2022, the NRC has concluded that the finding is appropriately characterized as White, a finding of low to moderate safety significance.

You have 30 calendar days from the date of this letter to appeal the staff's determination of significance for the identified White finding. Such appeals will be considered to have merit only if they meet the criteria given in the IMC 0609, Attachment 2. An appeal must be sent in writing to the Regional Administrator, Region III 2443 Warrenville Road, Suite 210, Lisle, IL 60532-4532.

The NRC has also determined that the failure to have documented procedures of a type appropriate to the circumstances for rebuilding the 2-0203-3B ERV is a violation of Title 10 of the *Code of Federal Regulations* (CFR), Appendix B, Criterion V, "Instructions, Procedures, and

Drawings" as cited in the enclosed Notice of Violation (Notice) (Enclosure 2). The circumstances surrounding the violation were described in detail in the subject inspection report. In accordance with the NRC Enforcement Policy, the Notice is considered escalated enforcement action because it is associated with a White finding.

The NRC has concluded that the information regarding the reason for the violation, the corrective actions taken and planned to correct the violation and prevent recurrence, and the date when full compliance was achieved is already adequately addressed on the docket in Inspection Report 05000254/2022090 and 05000265/2022090, Licensee Event Report (LER) 265/2022-001-00, and your letter dated September 15, 2022. Therefore, you are not required to respond to this letter unless the description therein does not accurately reflect your corrective actions or your position.

As a result of our review of Quad Cities' performance, including this White finding, we have assessed Quad Cities Nuclear Power Station to be in the Regulatory Response column of the NRC's Action Matrix, effective the third quarter of 2022. Therefore, we plan to conduct a supplemental inspection using Inspection Procedure 95001, "Supplemental Inspection Response to Action Matrix Column 2 (Regulatory Response) Inputs," for this finding, when your staff has notified us of your readiness for this inspection. This inspection procedure is conducted to provide assurance that the root cause and contributing cause of risk significant performance issues are understood, the extent of condition and the extent of cause are identified, and the corrective actions are sufficient to prevent recurrence.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response, if you choose to provide one, will be made available electronically for public inspection in the NRC Public Document Room or from the ADAMS, accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the Public without redaction.

Sincerely,

Signed by Giessner, Jack
on 11/29/22

John B. Giessner
Regional Administrator

Docket Nos. 050-00265
License Nos. DPR-30

Enclosures:
1. NRC response to Constellation Energy Generation' September 15, 2022, Letter
2. Notice of Violation

cc: Distribution via LISTSERV®
State of Illinois

NRC RESPONSE TO INFORMATION
PROVIDED BY CONSTELLATION ENERGY GENERATION
IN LETTER DATED SEPTEMBER 15, 2022

In a letter dated September 15, 2022, Constellation Energy (licensee) provided a response to the NRC's preliminary significance determination regarding the finding. In the response, the licensee indicated that it recognized a performance deficiency occurred. The response indicated that after reviewing new information, which was attached to the response letter, the licensee had reassessed the safety significance and believed the finding was of very low safety significance (Green).

The licensee concluded that the finding should be characterized as Green using NRC Inspection Manual Chapter 0609 Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." The following describes the licensee's evaluation as discussed in their letter as well as the NRC response.

In their response the licensee documented two main considerations in support of their revised assessment showing that the risk associated with this issue should be Green (ΔCDF of 7.9E-7/year):

1. Definition of Fail to Start (FTS) for a turbine-driven pump and modification of the Automatic Depressurization System (ADS) success criteria for non-Anticipated Transient Without SCRAM (ATWS) events to 1-of-5 logic with the successful operation of Reactor Core Isolation Cooling (RCIC) for one hour.
2. Following an ATWS event successful operation of ADS requires less than all five of the ADS valves to accomplish emergency depressurization.

The licensee did not provide a sensitivity analysis as part of its submittal.

NRC Response to Consideration 1:

The difference in the definition of FTS for a turbine-driven pump is only influential when combined with the revised ADS success criteria. The licensee defined the FTS event differently in their Probabilistic Risk Assessment (PRA) than how those events are evaluated in the Standardized Plant Analysis Risk (SPAR) models, and specifically in the Quad Cities SPAR model. The licensee, in their plant specific PRA model, groups Fail to Run (FTR) for the first hour with FTS. The SPAR model breaks down the failures into three groups: FTS, failure to run (FTR) early and FTR late. The FTR early is modeled for 1 hour and FTR late is modeled for the final 23 hours of the total 24-hour mission time.

In their submittal, the licensee stated that following a plant shutdown, the ADS, comprised of four electromatic relief valves (ERVs) and one Target Rock safety relief valve, can successfully fulfill its depressurization function through opening of just a single valve (either one ERV or the Target Rock valve) after the RCIC pump has been in continuous operation for at least one hour. This differs from the 2-of-5 ADS success criterion if no high-pressure injection occurs.

The NRC reviewed and considered the information presented by the licensee in evaluation QC-SDP-003, “Significance Determination Process Evaluation Results for Unit 2 ERV 3B Fail to Open,” Revision 0. This evaluation credits a 1-of-5 ADS depressurization success criterion after RCIC has operated for one hour. The NRC also reviewed and considered the information presented by the licensee in evaluation QC-MISC-042, “Quad Cities ERV Failure MAAP Calculations,” Revision 0, which the licensee performed in support of consideration 1. The SRAs consulted with subject matter experts and concluded that changing the ADS success criteria for this SDP was inappropriate since the licensee evaluation does not adequately address uncertainties and sensitivities.

Specifically, the evaluation has a case that included High Pressure Coolant Injection (HPCI) operation for one hour that showed significant core heat-up approaching the licensee’s defined core damage threshold. This evaluation was performed using only the Target Rock valve, which has a higher flow capacity than the ERVs as documented in QC-PSA-005.09, “Reactor Pressure Control and Automatic Depressurization System (ADS) Notebook,” Revision 3, and showed that operation with that one Safety Relief Valve (SRV) was close to the core damage threshold. However, the licensee’s SDP analysis credits any SRV, without acknowledging or addressing the lower flow rates of the four ERVs. Small changes in input assumptions could have a noticeable and non-trivial impact on the outcome and therefore it is not appropriate to consider the sequences a clear success. For example, changes in the SRV flow rate could have a noticeable impact on the ability of the SRV to depressurize the reactor and increase the time before low pressure systems could inject. In order to understand the condition more appropriately it would be necessary to perform a sensitivity analysis to study the effects of varying the SRV flow rate and how sensitive those variations are at different time points, which the licensee did not address. The lack of uncertainty and sensitivity analyses is especially significant because the licensee’s analysis showed that significant core heat-up could occur.

Therefore, the NRC concluded that using the 2-of-5 success criterion continued to be appropriate for the purposes of this SDP.

NRC Response to Consideration 2:

The licensee also presented a revised depressurization success criterion following an ATWS event. The original SPAR model contained an ADS depressurization success criterion of 5-of-5 following an ATWS event. The model required that all five ADS valves open for ADS to be successful. The licensee stated in their submittal that fewer than five ADS valves opening would be sufficient. The licensee further stated that failure of ERV 3B by itself would not prevent ADS from performing its function. The SRAs reviewed this change and considered it appropriate.

In evaluation QC-MISC-042 the licensee used a 2-of-5 ATWS ADS depressurization success criterion. However, the licensee did not address the wider use of the 2-of-5 ATWS ADS depressurization success criterion and as a result, the SRAs changed the DE3 fault tree from a 5-of-5 success criterion for depressurization to a 4-of-5 success criterion. Sensitivities performed on further changing the ATWS ADS success criterion to 3-of-5 and 2-of-5 showed that risk was not reduced further because the top event representing over-pressurization during an ATWS still has a requirement of 4-of-5 ADS success criterion.

The SRAs considered that modifying the ATWS manual depressurization success criterion to 4-of-5 was appropriate because the SPAR model ATWS sequences cover a broader spectrum of ATWS sequences and not just the specific event covered by the MAAP evaluation.

NRC Revised SDP from Licensee Considerations 1 and 2:
The SRAs determined that revising the ADS success criteria further was not warranted and maintained the 2-of-5 criterion. The SRAs determined the ATWS success revision was reasonable and incorporated the revised success criteria (4-of-5) the NRC assessment. The revised estimated risk due to Internal Events of 2.5E-6/year versus 3E-6/year in the preliminary estimate. The risk contribution due to External Events remained similar to the previous estimate of 1E-6/year.

The consideration of points 1 and 2 and the sensitivity analyses shown below support the SRAs determination that the issue should remain of low to moderate safety significance (White).

Sensitivity Analyses

Several sensitivity analyses were performed to support the SRAs' assessment.

1. The SRAs performed a sensitivity analysis to specifically address the licensee's revised success criteria for the ADS function. The licensee contends that if the high-pressure injection (HPI) function fails early, at or before 1 hour, then ADS requires 2-of-5 valves to function but if HPI fails later, after 1 hour, then ADS only requires 1-of-5 valves to function for successful depressurization. The SRAs were not confident that only 1 hour of HPI was adequate to relax the ADS success criteria, but generally believed it could be relaxed after some period of initial successful high-pressure injection. The SRAs considered a 4-hour period of HPI operation to be necessary before the ADS success criteria could be relaxed.

   To perform this sensitivity evaluation and generally mimic the licensee's assumption, the SRAs changed the RCIC and HPCI failure to run probability to consider a 4-hour HPI mission time with the 2-of-5 valve ADS success criteria. In the SPAR model, this was performed by changing the failure to run "late" term for HPCI and RCIC. The "late" term was modified by changing the mission time from 24 hours to 3 hours. Given that there is a separate failure to run "early" term for 1 hour, the total failure to run in the sensitivity case is for a 4-hour period.

   The SRAs calculated an Internal Events ΔCDF of 1.28E-6/year for this sensitivity case. This sensitivity does not account for the risk of "late" HPI failures with a relaxed manual depressurization (DEP) success criteria (1-of-5) because the risk was already determined to be above the Green/White threshold. Any further analysis, to consider a 1-of-5 success criteria for the remaining 20 hours, would only further increase the risk.

2. A sensitivity analysis was performed that included the Target Rock valve as part of the common cause grouping. There could be linking factors in the base case analysis that could link the Target Rock valve to the other four ERVs. This was done by setting house event HE-SPAR-TRVCCF to “True". Including the Target Rock valve as part of the common cause grouping increases the risk by approximately 4E-7. This increases the overall Internal Events risk from 2.5E-6 to 2.9E-6/year.

   The Risk Assessment of Operational Events Handbook (ML17348A149) provides guidance on the treatment of coupling factors for common cause failure (CCF) and the development of common cause component groups based on similarity of design, maintenance, operation, etc. The risk estimate that includes the Target Rock valve in the common cause component group (CCCG) is presented here in a sensitivity analysis for consideration but is not included in the base case because it was not considered in the preliminary SDP evaluation. This consideration of CCF across all the ADS valves is an area where risk is slightly underestimated.

Conclusion

The NRC considered the information provided by the licensee and determined that it did not change the preliminary significance of the finding (White). The licensee proposed revised PRA success criteria for the ADS depressurization function in the base model under conditions where high pressure injection is initially successful for 1 hour. The licensee's refinements involve complex changes to the base PRA model. These changes do not change the fact that the reliability of the ADS was impacted for more than a year due to the performance deficiency of the failure of ERV 3B. The SRAs determined that the licensee’s suggested changes to the SPAR model for this SDP would be a significant change in the historical methods of evaluating ERV events and would be inconsistent with the principles of scrutability and repeatability outlined within IMC 0308, Attachment 3, “Technical Basis for Significance Determination Process.”

The licensee did not provide any information on new structures, systems, and components (SSCs) nor procedures or mitigating strategies that were not previously considered. Our best estimate internal event risk calculation, combined with insights regarding external event risk and the sensitivity evaluations performed, were collectively used to arrive at the risk-informed decision that this finding is of low to moderate safety significance (White).

NOTICE OF VIOLATION

Constellation Energy Generation, LLC
Quad Cities Nuclear Power Station

Docket Nos. 050-00265
License Nos. DPR-30
EA-22-062

During a U.S. Nuclear Regulatory Commission (NRC) inspection conducted May 23, 2022, to July 14, 2022, a violation of NRC requirements was identified. In accordance with the NRC Enforcement Policy, the violation is listed below:

> Title 10 of the *Code of Federal* Regulations (10 CFR) Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," requires, in part, that activities affecting quality be prescribed by documented procedures of a type appropriate to the circumstances and be accomplished in accordance with these procedures.
>
> Contrary to the above, from January 22, 2020, to March 20, 2022, the licensee failed to have documented procedures of a type appropriate to the circumstances for rebuilding the 2-0203-3B ERV solenoid actuator, an activity affecting quality, including the appropriate acceptance criteria for determining that the activity had been satisfactorily accomplished. Specifically, the licensee failed to provide instructions in the rebuild work package specifying the correct orientation of the two plunger well plastic guides when placing them back into the plunger well. Additionally, during the rebuild, technicians manually straightened the upper guide bracket of the solenoid actuator without the use of a documented procedure or instruction to perform the activity and without acceptance criteria to determine that the activity was accomplished satisfactorily.

This violation is associated with a White Significance Determination Process finding.

The NRC has concluded that information regarding the reason for the violation, the corrective actions taken and planned to correct the violation and prevent recurrence, and the date when full compliance was achieved is already adequately addressed on the docket in Inspection Report Nos. 05000254/2022090 and 05000265/2022090), LER 265/2022-001-00, and CEG's letter dated September 15, 2022. However, you are required to submit a written statement or explanation pursuant to 10 CFR 2.201 if the description therein does not accurately reflect your corrective actions or your position. In that case, or if you choose to respond, clearly mark your response as a "Reply to a Notice of Violation," include the EA number, and send it to the US Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001 with a copy to the Regional Administrator, Region 3, and a copy to the NRC Resident Inspector at the facility that is the subject of this Notice, within 30 days of the date of the letter transmitting this Notice of Violation (Notice).

If you contest this enforcement action, you should also provide a copy of your response, with the basis for your denial, to the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001.

If you choose to respond, your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. Therefore, to the extent possible, the response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the Public without redaction.

In accordance with 10 CFR 19.11, you may be required to post this Notice within two working days of receipt.

Dated this 29th day of November 2022

EA-22-062 - QUAD CITIES FINAL SIGNIFICANCE DETERMINATION OF A WHITE FINDING, NOV DATE November 29, 2022

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DATE	Nov 10, 2022	Nov 10, 2022	Nov 10, 2022	Nov 18, 2022
OFFICE	NRR/DRO	R-III/DRP/B3/BRO	R-III	
NAME	CMiller RFelts for *RF*	DBetancourt-Roldan *DB*	JGiessner *JG*	
DATE	Nov 18, 2022	Nov 28, 2022	Nov 29, 2022	

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