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September 29, 2016

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Serial No. 16-204A
MPS Lic/TFO R0
Docket Nos.: 50-336
50-423
License Nos.: DPR-65
NPF-49

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION
FOLLOW-UP TO REPLY TO A NOTICE OF VIOLATION EA-16-090

By letter dated, May 4, 2016, the Nuclear Regulatory Commission (NRC) issued Notice of Violation (NOV) EA-16-090 to Dominion Nuclear Connecticut, Inc. (DNC) regarding corrective actions taken to address failures of the Millstone Power Station Unit 3 (MPS3) turbine driven auxiliary feedwater control system.

By letter dated June 3, 2016, DNC responded to Notice of Violation EA-16-090. DNC committed to perform a comprehensive evaluation of additional methods to improve design and operating margins within the TDAFW pump linkage and control system, and to notify the NRC of the results of the comprehensive review and any planned actions.

Attachment 1 describes the results of the comprehensive evaluation and planned actions.

If you have any questions or require additional information, please contact Mr. Jeffry Langan at (860) 444-5544.

Sincerely,

Daniel G. Stoddard
Senior Vice-President Nuclear Operations

Commitments made in this letter: No additional commitments

Attachment: Follow-Up to Reply to a Notice of Violation EA-16-090

IEDI
NRR

cc: U.S. Nuclear Regulatory Commission
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ATTACHMENT

FOLLOW-UP TO REPLY TO A NOTICE OF VIOLATION
EA-16-090

MILLSTONE POWER STATION UNITS 2 and 3
DOMINION NUCLEAR CONNECTICUT, INC.

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RESULTS OF COMPREHENSIVE EVALUATION

Background

MPS3 has experienced operational challenges with the Turbine Driven Auxiliary Feedwater (TDAFW) pump speed control. This resulted in the May 4, 2016 Notice of Violation EA-16-090 (Reference 1). DNC evaluated the condition and took corrective actions as described in the June 3, 2016 Notice of Violation response (Reference 2).

While the corrective actions taken assure continued operability and reliability, DNC identified that an additional assessment was warranted to improve design and operating margin.

Scope

The scope of the evaluation was to perform a comprehensive review of additional methods to improve the design and operating margins within the TDAFW pump linkage and control system. This evaluation was to "consider additional changes to the governor rack starting position, vendor recommendations for linkage improvements, benchmarking other utilities with reliable operation for performance improvements, and possible changes to the governor control system."

Results

Governor Rack Starting Position:

In 1995, DNC informed the NRC that TDAFW pump procedures had been revised to specify a rack setting of greater than 5.0 as part of an action plan to address a condition where the TDAFW pump did not start within the time required by the Technical Specifications (Reference 3). This was a result of condensate buildup in the TDAFW pump steam supply lines. DNC implemented a design change in the fall of 2014 to replace the steam traps with continuous flow to prevent condensate buildup.

After the overspeed trip on February 22, 2016, the governor control valve rack setting was adjusted from the specified setting of greater than 5.0 (typically set to 10.0) to a

specified setting between 5.0 and 6.0. This change has resulted in an increase in stem force at startup by a factor of approximately 4.5 compared to the force available with a rack setting of 10.0. This improves the margin of the force available to operate the governor control valve during pump startup while still allowing the turbine to accelerate to the proper speed within the required 90 seconds.

The recent comprehensive evaluation indicates that a lower rack setting is possible for improved steam flow control during initial start-up, while continuing to ensure the valve is sufficiently open to accelerate the turbine within its 90 second start time requirement. The lower rack setting has the benefit of increasing the available governor valve stem force to provide more margin to throttling closed the control valve at startup. For example, implementing a standby rack setting of 3.5 can result in an additional improvement in stem force by a factor of approximately 2. This results in a total improvement in stem force by a factor of approximately 8.5, compared to the force available at a rack setting of 10.0. DNC intends to implement a lower rack setting if in situ testing validates this to be effective in gaining margin to overspeed while maintaining margin to start time.

Linkage Improvements:

The vendor of the Heim joints and spherical bearing recommended lubrication of the Heim joints and the spherical bearing to reduce friction. DNC has implemented the vendor recommendations and established a frequency to perform this action every refueling outage, as noted in the June 3, 2016 reply to the Notice of Violation. Benchmarking has indicated that other stations lubricate the linkage and cam joints at a frequency of equal to every refueling outage or longer. The comprehensive evaluation reviewed these actions and determined the actions address the linkage issues and would continue to be effective at maintaining reliability provided the maintenance is continued.

Benchmarking for Performance Improvements:

DNC contacted four utilities considered to have a reliable operating TDAFW pump system to assess for potential improvements at DNC. Additionally, industry operating experience was reviewed to identify potential improvement areas. An industry expert participated in the evaluation for improved margin.

It was determined that a well maintained mechanical/analog system with the proper valve stem material (which MPS3 has) will provide reliable operation. Assessments of the maintenance practices performed at these utilities did not identify any maintenance improvements to gain additional operating or design margin beyond the actions already taken by DNC.

Governor Replacement:

The TDAFW turbine/governor vendor does not recommend or support a different analog governor. After assessing operating experience from other stations, evaluating the causes of the MPS3 TDAFW pump issues, and reviewing the design and operation of the control system (including the linkage), DNC does not plan to use a different mechanical/analog governor and/or a different linkage.

Modifications to Steam Admission:

The comprehensive evaluation assessed the following options to reduce the steam flow through the steam supply valves during the initial turbine acceleration phase as a way to improve margin for turbine acceleration and stem load:

- Staggering the opening of the three steam supply valves so only one opens at a time.
- Increasing the valve opening stroke time by reducing the depressurization rate of the Air Operated Valve actuator diaphragm.
- Replacing the trim for the existing steam supply valves with an equal percentage trim to reduce steam flows early in the valve stroke but still maintain adequate flow at full open.

Each option would require a modification to the plant design. The optimal design parameters for the above steam supply valve modifications would require a dynamic analysis of the system start-up where these parameters could be varied to optimize timing of the steam supply. While these options may improve margin to overspeed, the options may introduce new failure modes and reduce margin in start time. DNC does not plan to implement the options to reduce steam flow through the steam supply valves during the initial turbine acceleration phase at this time.

Digital Governor Replacement:

The TDAFW turbine/governor vendor indicated that a digital governor is an option for MPS3. This was also identified as a possible option by the comprehensive evaluation which assessed the benefits and challenges of a digital governor replacement.

The TDAFW turbine/governor vendor recommended governor replacement would be a digital control system with an electromechanical actuator. This option eliminates the mechanical governor and the issues associated with the mechanical linkage. Operating experience was reviewed and the challenges a design change to a digital governor would entail were evaluated and compared to the actions planned to maintain the current mechanical governor. It was determined that the digital governor modification is not warranted at this time due to the inherent complexity, need for external safety related power supply, and new failure modes.

Summary:

The actions previously taken to maintain the mechanical governor include making a governor control rack setting adjustment, providing additional training for Operations and Maintenance, repacking the valve every refueling outage, and periodically lubricating the TDAFW pump control linkage. DNC plans to implement a design change to replace the control valve bonnet oversized stuffing box to address the condition that contributed to the February 22, 2016 TDAFW pump overspeed trip.

As a result of the comprehensive evaluation, lowering the rack setting is expected to improve TDAFW pump starting performance. DNC intends to implement a lower rack setting if in situ testing validates this to be effective. If the actions to lower the rack setting do not achieve the desired margin improvements, other options, including a change to a digital governor, will be reconsidered.

Actions Identified to Improve Operating and Design Margin

The comprehensive evaluation concurred with the actions previously taken or planned to improve operating margin. The evaluation identified that a lower rack setting is expected to provide additional margin to overspeed trip. DNC intends to implement a lower rack setting if in situ testing validates this to be effective. This action is being tracked in the station corrective action program.

Date When Full Compliance Will Be Achieved

The TDAFW pump remains fully operable and in compliance with its Technical Specifications. As specified in the June 3, 2016 reply to the Notice of Violation, the date when full compliance with the provisions of 10 CFR 50 Appendix B, Criterion XVI to "assure that the cause of the condition is determined and corrective actions preclude repetition," remains November 30, 2017, after the control valve bonnet oversized stuffing box is replaced.

References

1. G. T. Dentel (NRC) to D. Heacock (Dominion), "Millstone Power Station – Integrated Inspection Report 05000536/2016001 and 05000423/2016001, and Notice of Violation," May 4, 2016.
2. D. G. Stoddard (Dominion) to NRC, "Dominion Nuclear Connecticut, Inc., Millstone Power Station, Reply to a Notice of Violation; EA-16-090," June 3, 2016.
3. J. F. Opeka (Northeast Utilities) to NRC, "Millstone Nuclear Power Station, Unit No. 3, Request for Plans Regarding Auxiliary Feedwater Issues, NRC Inspection Nos. 50-245, 336, 423/95-31," November 1, 1995.