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Dominion®

October 12, 2016

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

Serial No. 16-376
NRA/WDC R0
Docket No. 50-336
License No. DPR-65

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2
RESPONSE TO FOLLOW-UP REQUEST FOR ADDITIONAL INFORMATION FOR LICENSE AMENDMENT REQUEST TO REVISE ECCS TS 3/4.5.2 AND FSAR CHAPTER 14 TO REMOVE CHARGING (CAC NO. MF7297)

In a letter dated January 25, 2016, Dominion Nuclear Connecticut, Inc. (DNC) requested an amendment to Facility Operating License No. DPR-65 for Millstone Power Station Unit 2 (MPS2). The proposed amendment would revise MPS2 Technical Specification (TS) 3.5.2, "Emergency Core Cooling Systems, ECCS Subsystems - $T_{avg} \geq 300°F$," to remove the charging system and eliminate Surveillance Requirement 4.5.2.e. The proposed amendment would also revise MPS2 Final Safety Analysis Report (FSAR) Chapter 14 relative to the long-term analysis in Section 14.6.1, "Inadvertent Opening of a Pressurized Water Reactor Pressurizer Pressure Relief Valve," and would clarify the existing discussion regarding the application of single failure criteria. An update to the associated TS Bases was included to address the proposed change. In an email dated May 12, 2016, the Nuclear Regulatory Commission (NRC) transmitted a request for additional information (RAI) related to the amendment request. In a letter dated June 27, 2016, DNC responded to the RAI. In an email dated September 12, 2016, the NRC transmitted a follow-up RAI. DNC agreed to respond to the RAI by October 12, 2016.

The attachment to this letter provides DNC's response to the NRC's RAI.

Should you have any questions in regard to this submittal, please contact Wanda Craft at (804) 273-4687.

Sincerely,

Dan Stoddard

Daniel G. Stoddard
Senior Vice President and Chief Nuclear Officer

Vicki L. Hull
NOTARY PUBLIC
Commonwealth of Virginia
Reg. # 140542
My Commission Expires May 31, 2018

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Daniel G. Stoddard, who is Senior Vice President and Chief Nuclear Officer of Dominion Nuclear Connecticut, Inc. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 12TH day of October, 2016.

My Commission Expires: 5-31-18.

Vicki L. Hull
Notary Public

ADD1
NRR

Commitments made in this letter: None.

Attachment:

Response to Follow-Up Request for Additional Information for License Amendment Request to Revise ECCS TS 3/4.5.2 and FSAR Chapter 14 to Remove Charging

cc: U.S. Nuclear Regulatory Commission
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ATTACHMENT

RESPONSE TO FOLLOW-UP REQUEST FOR ADDITIONAL INFORMATION FOR LICENSE AMENDMENT REQUEST TO REVISE ECCS TS 3/4.5.2 AND FSAR CHAPTER 14 TO REMOVE CHARGING

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2

In a letter dated January 25, 2016, Dominion Nuclear Connecticut, Inc. (DNC) requested an amendment to Facility Operating License No. DPR-65 for Millstone Power Station Unit 2 (MPS2). The proposed amendment would revise MPS2 Technical Specification (TS) 3.5.2, "Emergency Core Cooling Systems, ECCS Subsystems - T_{avg} ≥ 300°F," to remove the charging system and eliminate Surveillance Requirement 4.5.2.e. The proposed amendment would also revise MPS2 Final Safety Analysis Report (FSAR) Chapter 14 relative to the long-term analysis in Section 14.6.1, "Inadvertent Opening of a Pressurized Water Reactor Pressurizer Pressure Relief Valve," and would clarify the existing discussion regarding the application of single failure criteria. An update to the associated TS Bases was included to address the proposed change. In an email dated May 12, 2016, the Nuclear Regulatory Commission (NRC) transmitted a request for additional information (RAI) related to the license amendment request (LAR). In a letter dated June 27, 2016, DNC responded to the RAI. In an email dated September 12, 2016, the NRC transmitted a follow-up RAI. This attachment provides DNC's response to the RAI.

Follow-up RAI – 1

In the response to RAI-6 documented in DNC letter dated June 27, 2016 (ADAMS Accession No. ML16182A037), the licensee stated that "If the initiating event involves the inadvertent opening of the PORV(s) [power-operated relief valve] (IOPORV) event, MPS2 Emergency Operating procedure EOP 2525, "Standard Post-trip Actions," directs the operator to close the associated PORV block valve(s)".

Please provide evidence to show that the PORVs and/or the associated block valves can be closed on demand during an IOPORV event. The requested information should address one of the following two conditions applicable to MPS2:

(a) Condition 1: The PORVs and/or the associated block valves can be credited for closure in the water or steam-water conditions during an IOPORV event.

Provide a discussion of the test data that qualify the PORVs and/or the associated block valves for closure in the water or steam-water conditions.

(b) Condition 2: The PORVs and/or the associated block valves are not qualified for closure in water or steam-water conditions during an IOPORV event. If the PORVs and/or associated block valves are not qualified please address the following:

The IOPORV event, an ANS Condition II event, is a depressurization event. The steam releases from the opening PORVs result in a decrease in the Reactor Coolant System (RCS) pressure. If operators do not take appropriate actions to terminate the RCS depressurization by either closing the PORV or its block valve, the safety injection (SI) system will be actuated when the RCS pressure decreases to the low

pressurizer reactor protection system signal. Injection of the high pressure safety injection (HPSI) pump flow following the SI actuation signal could fill the pressurizer and result in water or steam-water mixture discharge through the open PORV and the associated block valve. For water or steam-water mixture discharge through the PORV and its block valve, the valves must be assumed to fail to close, if they are not qualified for water or steam-water mixture releases. As a result, the event initiating with an American Nuclear Society (ANS) Condition II (i.e., IOPORV event) escalates to an ANS Condition III event (i.e., an unisolable small-break loss-of-coolant accident (SBLOCA)). This result would not meet the acceptance criterion (AC) for the analysis of the anticipated operational occurrences (AOOs). For the IOPORV event (an AOO), Standard Review Plan (SRP) 15.6.1 indicates that in meeting the AC, the event must not generate a more serious condition plants without other faults occurring independently. In addition, the MPS2 licensing basis as discussed in FSAR (final safety analysis report), Table 14.0.1-1 identifies the IOPPRV event (including IOPORV event) as a moderate frequency event and the acceptance criteria in FSAR Section 14.0.1.1 specify that the event should not generate a more serious plant condition without other faults occurring independently. The staff believes the MPS2 classification of plant conditions as discussed in FSAR Section 14.0.1 are consistent with the referenced ANS Conditions.

In order to satisfactorily resolve the concern of meeting the SRP 15.6.1 AC discussed above, the licensee is requested to demonstrate that an IOPORV event assuming the opening of one PORV and show that the operator has sufficient time to close the PORV and/or its block valve before the pressurizer overfill occurs, preventing an ANS Condition II event from escalating to an ANS Condition III event (i.e., a moderate frequency event escalating to an infrequent fault or limiting condition). The requested information should include:

i) The maximum achievable operator action time to close the PORV or its block valve during an IOPORV event and the basis supporting the determined operator action time.

ii) A discussion of the adequacy of the computer code and methods used for the IOPORV analysis.

iii) A discussion of the assumptions and values of key plant parameters (such as HPSI flow, decay heat model, pressurizer water level) used in the IOPORV analysis to demonstrate that they are conservative, resulting in a minimum time for the pressurizer overfill to occur, and

iv) The results of the analysis of the IOPORV event, including a discussion of the sequence of events.

DNC Response

This DNC follow-up response answers Part (a) Condition 1 to demonstrate that the MPS2 pressurizer PORV block valves can be credited for closure under the conditions predicted from the analysis of an IOPORV. The response is based on analysis of the block valve closure requirements under water and steam-water conditions using Version 3.5 of Electric Power Research Institute (EPRI) Motor Operated Valve (MOV) Performance Prediction Methodology (PPM) and a review of valve test data from EPRI Technical Report TR-103229-V1/V2. Therefore, Part (b) Condition 2 does not apply.

Maximum Conditions Expected During an IOPORV Event

The table below provides a summary of the maximum expected two-phase flow rate and bounding saturated liquid flow rate through an inadvertently opened pressurizer PORV and the associated thermal-hydraulic conditions that the associated PORV block valve will be required to close against.

Maximum Conditions Expected During an IOPORV Event		
Thermal-Hydraulic Condition	Maximum Two-Phase Conditions Through an Inadvertently Opened PORV	Maximum Saturated Liquid Flow Conditions Through an Inadvertently Opened PORV
Pressure (psia)	1150	1150
Saturation Temperature (°F)[1]	562	562
Void Fraction	0.4	0.0
Quality (%)	3.73	0.00
Enthalpy (btu/lb)	588.0	564.77
Maximum Flow (lb/hr)	237,953	314,875

(1) 2000 ASME Steam Tables

Analysis of PORV Block Valves

A calculation has been performed using Version 3.5 of EPRI MOV PPM. This version of the code has been approved by the NRC in a letter dated April 2, 2015 (ML15075A012). The NRC stated in part: "The NRC staff also concluded that the changes made in versions 3.4 and 3.5 do not alter the methodology or introduce new methods. Therefore, the NRC staff finds that versions 3.4 and 3.5 of EPRI TR-103237, Revision 2, are acceptable for referencing in licensing applications and that an updated safety evaluation is not currently required."

Two prediction runs were completed to demonstrate that the block valves have the ability to close under both saturated water conditions and two-phase flow conditions. The block valves are normally-open Velan, 2½ inch flex wedge gate valves with welded body guide rails located upstream of the PORVs. Their primary function is to isolate a leaking or stuck open PORV. In the event the PORV is stuck open or leaking, the operator closes the block valve to block the flow. It was conservatively assumed that the downstream pressure is zero. Results from the calculation are summarized below:

Closing Stroke

EPRI MOV PPM Application determined the stroke to be predictable with no guide/seat damage.

Flow Condition @1150 psia	Required Thrust (lbs)	Available Thrust[1] (lbs)	Margin
Saturated Water	7337	16,721	127%
Two-Phase Flow	6454	16,721	159%

(1) MPS2 Target Thrust/Torque Calculation for PORV block valves (2-RC-403 and 2 -RC-405) indicate a close design limit of 17,980 lbs. Actual periodic verification test data for the current setting of the torque switch confirmed 16,721 lbs for 2-RC-403 and 17,202 lbs for 2-RC-405. For conservatism, 16,721 lbs was used for calculation of margin for both 2-RC-403 and 2-RC-405.

The analyzed thrust required to close the PORV block valve during an IOPORV is less than the available thrust by a significant margin. Thus, the PORV block valves can be credited to close on demand during an IOPORV event with saturated liquid or two-phase conditions.

Review of Test Data and the EPRI Model

Qualification of the PORV block valves for closure in water or steam-water conditions is based on the following references:

- EPRI Technical Report TR-103229-V1, EPRI Performance Prediction Program Gate Valve Model Report Volume 1: Summary Through Appendix C, November 1994
- EPRI Technical Report TR-103229-V2, EPRI Performance Prediction Program Gate Valve Model Report Volume 2: Appendix D Through H, November 1994

The EPRI reports document the comparisons of model predictions with flow loop and in situ test data and show that the gate valve model predicts bounding values of stem thrust. In addition, the model predicts which tests would result in damage to the valve. Comparisons were made for a wide range of gate valve designs and fluid conditions.

The conservative nature of the predictions indicates that the model is an appropriate tool for design purposes.

The model was validated by comparing thrust predictions to data for 199 strokes from 29 valves tested in flow loops and in nuclear power plants. The flow conditions included ambient water, hot (non-flashing) water, flashing water and steam at low flow, high flow, and blowdown conditions.

In EPRI Technical Report TR-103229-V1, Valve No. 13 is a Velan, 2½ inch, 1500 Class, flex wedge gate valve with welded body guide rails, which is similar to the configuration of the MPS2 PORV block valves. Therefore, the MPS2 block valves are bounded by the EPRI test report.

Testing was performed with water at low flow, high flow, and blowdown conditions with temperatures from ambient up to 659°F and differential pressures (DP) from 1307 to 2664 psi. Results are shown in the table below:

Valve No.	Fluid Medium	Flow type	Temperature (°F)	Range of DP (psi)	Range of Flow (ft/sec)
13	Water	Normal	68 – 70	1307 – 2649	14.8 – 16.4
	Water	High	71 – 72	1362 – 2664	39.0 – 51.6
	Water	Blowdown	659	2658	Choked

Maximum closing thrusts obtained from measured versus predicted results are as follows for normal flow (14.8 to 16.4 ft/sec) for DPs of 1307 psi (approx. 50%), 1986 psi (approx. 75%), and 2649 psi (100%) for Valve No. 13:

Valve No.	Thrust Type	Maximum Closing Thrust (lbs) at Normal Flow			
		25% DP	50% DP	75% DP	Full DP
13	Predicted	---	7705	11609	14731
	Measured	---	6253	9196	11657

Maximum closing thrusts obtained from measured versus predicted results are as follows for high flow (39.0 to 51.6 ft/sec) for DPs of 1362 psi (approx. 50%), 1998 psi (approx. 75%), and 2664 psi (100%) for Valve No. 13:

Valve No.	Thrust Type	Maximum Closing Thrust (lbs) at High Flow			
		25% DP	50% DP	75% DP	Full DP
13	Predicted	---	8018	---	14758
	Measured	---	6528	---	11487

EPRI Technical Report TR-103229-V1 documents testing which performed high flow closure strokes for numerous valves ranging from 2½ to 10 inches in size and velocities from 33 to 72 ft/sec. During high flow tests, the buildup of DP across a valve occurs over a greater portion of the stroke. Low flow testing at 15 ft/sec versus 50 ft/sec confirms this. During high flow closure tests, the stem thrust behavior was similar to that which occurred in low flow tests, except that the stem thrust increased earlier in the stroke. This is evident in the low flow and high flow data above. The flow velocity of the MPS2 PORV block valves for the saturated water flow rate was calculated to be 78 ft/sec. This is bounded by the EPRI testing on Valve 13 (similar to the MPS2 PORV block valves), which was conducted at choked flow conditions. The flow velocity is not a critical parameter in the analysis, but does provide insight as to when the disc will start to become loaded (i.e., the higher the flow rate, the sooner the disc becomes loaded in the stroke).

The measured values are similar to the values calculated for the MPS2 PORV block valves. The closing thrust required for a DP of 1135 psi (43% of 2664 psi) is 6454 lbs for two-phase flow and 7337 lbs for saturated water, which demonstrates margin and correlation with testing results and calculated results. The analyzed DP is on the order of 50% of the tested DP. As shown in the "Maximum Closing Thrust at High Flow" table above, at 50% DP, the range of calculated DPs (6454 lbs to 7337 lbs) closely correlates to the range of predicted and measured DPs (6528 lbs to 8018 lbs). Significant margin is available between the demand to close at a DP of 1135 psi and the measured capability of this type of valve to close at more than two times this DP (i.e., 2664 psi).

Conclusions

Analysis using the NRC-approved EPRI PPM for the conditions expected during an IOPORV event demonstrates that the MPS2 PORV block valves have significant thrust margin and will close on demand. Velan 2½ inch valves similar to the MPS2 PORV block valves were included in the test database used to develop the EPRI model. In conclusion, the MPS2 PORV block valves can be credited to close on demand during an IOPORV event with saturated liquid or two-phase conditions.