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

Serial No.	20-167
NRA/SS	R0
Docket No.	50-336
License No.	DPR-65

DOMINION ENERGY NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2
ALTERNATIVE REQUEST RR-05-06 - INSPECTION INTERVAL EXTENSION FOR STEAM GENERATOR PRESSURE-RETAINING WELDS AND FULL-PENETRATION WELDED NOZZLES

In accordance with 10 CFR 50.55a(z)(1), Dominion Energy Nuclear Connecticut, Inc. (DENC) hereby requests Nuclear Regulatory Commission (NRC) approval of proposed alternative request RR-05-06 for Millstone Power Station Unit 2 (MPS2). This proposed alternative requests to extend the inspection interval for ASME Section XI, Table IWB-2500-1, Examination Category B-B and B-D and Table IWC-2500-1, Examination Category C-A and C-B, component exams from 10 years to 30 years.

The proposed alternative request RR-05-06, which includes a summary of the key aspects of the technical basis for this extension request, is provided in Attachment 1. The plant-specific applicability of the technical basis to MPS2 and the MPS2 inspection history is provided in Attachments 2 and 3, respectively. Lastly, the inspection history for these components, as obtained from an industry survey, is presented in Attachment 4.

The duration of the proposed alternative is requested for the remainder of the current fifth 10-year inservice inspection interval and through the following sixth 10-year inspection interval, currently scheduled to end on March 31, 2040.

NRC review and approval of the proposed alternative request is respectfully requested by August 1, 2021.

If you have any questions or require additional information, please contact Shayan Sinha at (804) 273-4687.

Sincerely,

Mark D. Sartain
Vice President – Nuclear Engineering & Fleet Support

Attachments:

1. Alternative Request RR-05-06 – Inspection Interval Extension for Steam Generator Pressure-Retaining Welds and Full Penetration Welded Nozzles
2. Plant-Specific Applicability
3. Millstone Unit 2 Inspection History for the Third and Fourth 10-Year Inspection Intervals
4. Results of Industry Survey

Commitments made in this letter: None

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Serial No. 20-167
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ATTACHMENT 1

ALTERNATIVE REQUEST RR-05-06

INSPECTION INTERVAL EXTENSION FOR STEAM GENERATOR PRESSURE–RETAINING WELDS AND FULL PENETRATION WELDED NOZZLES

MILLSTONE POWER STATION UNIT 2
DOMINION ENERGY NUCLEAR CONNECTICUT, INC.

Alternative Request RR-05-06

Proposed Alternative
In Accordance with 10 CFR 50.55a(z)(1)

--Acceptable Level of Quality and Safety--

1.0 ASME CODE COMPONENTS AFFECTED:

Code Class: Class 1 and Class 2

Description: Steam generator (SG) pressure-retaining welds and full penetration welded nozzles

Examination Categories: Class 1, Category B-B, pressure-retaining welds in vessels other than reactor vessels
Class 1, Category B-D, full penetration welded nozzles in vessels
Class 2, Category C-A, pressure-retaining welds in pressure vessels
Class 2, Category C-B, pressure-retaining nozzle welds in vessels

Item Numbers: B2.31 – Steam generators (primary side), head welds, circumferential
B2.40 – Steam generators (primary side), tubesheet-to-head weld
B3.130 – Steam generators (primary side), nozzle-to-vessel welds
C1.10 – Shell circumferential welds
C1.20 – Head circumferential welds
C1.30 – Tubesheet-to-shell weld
C2.21 - Nozzle-to-shell (nozzle-to-head or nozzle-to-nozzle) welds
C2.22 - Nozzle inside radius sections

Component IDs:

Millstone Unit 2, Steam Generator 1		
Component ID	**Component Description**	**ASME Item No.**
SG-1-BHC-1-A	Stay Cylinder Base to Hemisphere (Head)	B2.31
SG-1-TSS-3-A	Stay Cylinder to Tube Sheet	B2.31
SG-1-BHC-2-A	Hemisphere (Head) to Tube Sheet	B2.40
SG-1-NH-2-A	Loop 1A Cold Leg Nozzle to Hemisphere (Head)	B3.130
SG-1-NH-4-A	Hot Leg Nozzle to Hemisphere	B3.130
SG-1-NH-5-A	Loop 1B Cold Leg Nozzle to Hemisphere (Head)	B3.130

Millstone Unit 2, Steam Generator 1		
Component ID	**Component Description**	**ASME Item No.**
1-SC-2A	Lower Cone to Shell Weld	C1.10
1-SC-3	Cone to Upper Shell Weld	C1.10
1-SC-4	Hand Hole Ring to Shell Circumferential Weld	C1.10
1-SC-5	Upper Shell to Lower Shell Circumferential Weld	C1.10
1-SC-6	Lower Cone to Upper Cone	C1.10
SG-1-THS-1	Secondary Head Circumferential Weld to Shell	C1.20
SG-1-THS-2	Head Circumferential Weld	C1.20
1-BHSC-2A	Hand Hole Ring to Tube Sheet Circumferential Weld	C1.30
SG-1-FW-1	Feed Water Nozzle to Shell Weld	C2.21
SG-1-MS-1	Main Steam Nozzle to Head Weld	C2.21
SG-1-FW-IR-1	Feed Water Nozzle Inside Radius Section	C2.22
SG-1-MS-IR-1	Main Steam Nozzle Inside Radius Section	C2.22

Millstone Unit 2, Steam Generator 2		
Component ID	**Component Description**	**ASME Item No.**
SG-2-BHC-1-A	Stay Cylinder Base to Hemisphere (Head)	B2.31
SG-2-TSS-3-A	Stay Cylinder to Tube Sheet	B2.31
SG-2-BHC-2-A	Hemisphere (Head) to Tube Sheet	B2.40
SG-2-NH-2-A	Loop 2A Cold Leg Nozzle to Hemisphere (Head)	B3.130
SG-2-NH-4-A	Hot Leg Nozzle to Hemisphere (Head)	B3.130
SG-2-NH-5-A	Loop 2B Cold Leg Nozzle to Hemisphere (Head)	B3.130
2-SC-6	Lower Cone to Upper Cone	C1.10
2-SC-2A	Lower Cone to Shell Weld	C1.10
2-SC-3	Cone to Upper Shell Weld	C1.10
2-SC-4	Hand Hole Ring to Shell Circumferential Weld	C1.10
2-SC-5	Upper Shell to Lower Shell Circumferential Weld	C1.10
SG-2-THS-1	Secondary Head Circumferential Weld to Shell	C1.20
SG-2-THS-2	Head Circumferential Weld	C1.20
2-BHSC-2A	Hand Hole Ring to Tube Sheet Circumferential Weld	C1.30
SG-2-FW-1	Feed Water Nozzle to Shell Weld	C2.21
SG-2-MS-1	Main Steam Nozzle to Head Weld	C2.21
SG-2-FW-IR-1	Feed Water Nozzle Inside Radius Section	C2.22
SG-2-MS-IR-1	Main Steam Nozzle Inside Radius Section	C2.22

2.0 REQUESTED APPROVAL DATE:

Approval is requested no later than August 1, 2021.

3.0 APPLICABLE CODE EDITION AND ADDENDA:

The fifth 10-year inservice inspection interval Code of record for Millstone Power Station Unit 2 (MPS2) is the 2013 Edition of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components."

4.0 APPLICABLE CODE REQUIREMENT:

ASME Section XI IWB-2500(a), Table IWB-2500-1, examination Categories B-B and B-D and IWC-2500(a), Table IWC-2500-1, Examination Categories C-A and C-B require examination of the following Item Nos.:

Item No. B2.31 - Volumetric examination of essentially 100% of the weld length of all welds during the first Section XI inspection interval. For successive inspection intervals the examination may be limited to one vessel among the group of vessels performing a similar function. The examination volume is shown in Figure IWB-2500-3.

Item No. B2.40 - Volumetric examination of essentially 100% of the weld length of all welds during the first Section XI inspection interval. For successive inspection intervals the examination may be limited to one vessel among the group of vessels performing a similar function. The examination volume is shown in Figure IWB-2500-6.

Item No. B3.130 - Volumetric examination of all nozzles during each Section XI inspection interval. The examination volume is shown in Figures IWB-2500-7(a), (b), (c) and (d).

Item No. C1.10 - Volumetric examination of essentially 100% of the weld length of the cylindrical-shell-to-conical shell-junction welds and shell (or head)-to-flange welds during each Section XI inspection interval. In the case of multiple vessels of similar design, size, and service (such as steam generators, heat exchangers), the required examinations may be limited to one vessel or distributed among the vessels. The examination volume is shown in Figure IWC-2500-1.

Item No. C1.20 - Volumetric examination of essentially 100% of the weld length of the head-to-shell weld during each Section XI inspection interval. In the case of multiple vessels of similar design, size, and service (such as steam generators, heat exchangers), the required examinations may be limited to one vessel or distributed among the vessels. The examination volume is shown in Figure IWC-2500-1.

Item No. C1.30 - Volumetric examination of essentially 100% of the weld length of the tubesheet-to-shell welds during each Section XI inspection interval. In the case of multiple vessels of similar design, size, and service (such as steam generators, heat exchangers), the required examinations may be limited to one vessel or distributed among the vessels. The examination volume is shown in Figure IWC-2500-2.

Item No. C2.21 - Volumetric and surface examination of all nozzle welds at terminal ends of piping runs during each Section XI inspection interval. In the case of multiple vessels of similar design, size, and service (such as steam generators, heat exchangers), the required examinations may be limited to one vessel or distributed

among the vessels. The examination area and volume are shown in Figures IWC-2500-4(a), (b), or (d).

Item No. C2.22 - Volumetric examination of all nozzle inside radius sections at terminal ends of piping runs during each Section XI inspection interval. In the case of multiple vessels of similar design, size, and service (such as steam generators, heat exchangers), the required examinations may be limited to one vessel or distributed among the vessels. The examination volume is shown in Figures IWC-2500-4(a), (b), or (d).

5.0 REASON FOR REQUEST:

Electric Power Research Institute (EPRI) performed assessments in References [1-1] and [1-2] of the basis for the ASME Section XI examination requirements specified for the above listed ASME Section XI, Division 1 examination categories for steam generator welds and components. The assessments include a survey of inspection results from 74 domestic and international nuclear units and flaw tolerance evaluations using probabilistic fracture mechanics (PFM) and deterministic fracture mechanics (DFM). The Reference [1-1] and [1-2] reports concluded that the current ASME Code Section XI inspection interval of ten years can be increased significantly with no impact to plant safety. Based on the conclusions of the two EPRI reports, Dominion Energy Nuclear Connecticut, Inc. (DENC) is requesting an alternate inspection interval for the subject welds. The Reference [1-1] and [1-2] reports were developed consistent with the recommendations provided in EPRI's White Paper on PFM [1-12].

6.0 PROPOSED ALTERNATIVE AND BASIS FOR USE:

DENC is requesting an inspection alternative to the examination requirements of ASME Section XI, Tables IWB-2500-1 and IWC-2500-1 for the following examination categories and item numbers:

ASME Category	Item No.	Description
B-B	B2.31	Steam generators (primary side), head welds, circumferential
B-B	B2.40	Steam generators (primary side), tubesheet-to-head weld
B-D	B3.130	Steam generators (primary side), nozzle-to-vessel welds
C-A	C1.10	Shell circumferential welds
C-A	C1.20	Head circumferential welds
C-A	C1.30	Tubesheet-to-shell weld
C-B	C2.21	Nozzle-to-shell (nozzle to head or nozzle to nozzle) welds
C-B	C2.22	Nozzle inside radius sections

The proposed alternative is to increase the inspection interval for these examination items to 30 years (from the current ASME Code Section XI 10-year requirement) for the remainder of the fifth 10-year inspection interval and through the following sixth 10-year inspection interval, which is currently scheduled to end on March 31, 2040. A summary of the key aspects of the technical basis for this request is provided below. The applicability of the technical basis to MPS2 is demonstrated in Attachment 2.

Degradation Mechanism Evaluation

An evaluation of degradation mechanisms that could potentially impact the reliability of the SG welds and components was performed in References [1-1] and [1-2]. The degradation mechanisms that were evaluated included stress corrosion cracking (SCC), environmental assisted fatigue (EAF), microbiologically influenced corrosion (MIC), pitting, crevice corrosion, erosion-cavitation, erosion, flow accelerated corrosion (FAC), general corrosion, galvanic corrosion, and mechanical/thermal fatigue. Other than the potential for EAF and mechanical/thermal fatigue, there were no active degradation mechanisms identified that significantly affect the long-term structural integrity of the SG welds and components covered in this request. Therefore, these fatigue-related mechanisms were considered in the PFM and DFM evaluations in References [1-1] and [1-2].

Stress Analysis

Finite element analyses (FEA) were performed in References [1-1] and [1-2] to determine the stresses in the SG welds and components covered in this request. The analyses were performed using representative pressurized water reactor (PWR) geometries, bounding transients, and typical material properties. The results of the stress analyses were used in a flaw tolerance evaluation. The applicability of the FEA analysis to MPS2 is demonstrated in Attachment 2 and confirms that all plant-specific requirements are met. Therefore, the evaluation results and conclusions of References [1-1] and [1-2] are applicable to MPS2.

Flaw Tolerance Evaluation

Flaw tolerance evaluations were performed in References [1-1] and [1-2] consisting of PFM evaluations and confirmatory DFM evaluations. The results of the PFM analyses indicate that, after a preservice inspection (PSI), no other inspections are required for up to 80 years of plant operation to meet the U.S. Nuclear Regulatory Commission's (NRC's) safety goal of 10^{-6} failures per year.

For the specific case of MPS2 where PSI, followed by four 10-year interval inspections have been performed, Table 8-10 of References [1-1] and [1-2] indicates that if the inspection interval is increased to 30 years after these previous inspections, the NRC safety goal is met (with considerable margin) for up to 80 years of plant operation. The DFM evaluations provide verification of the PFM results by demonstrating that it takes approximately 80 years for a postulated flaw with an initial depth equal to the ASME Code Section XI acceptance standards to grow to a depth where the maximum stress intensity factor (K) exceeds the ASME Code Section XI allowable fracture toughness.

Inspection History

Plant operating experience (including examinations performed to-date, examination findings, examination coverage, and relief requests) is presented in Attachment 3. As shown in the attachment, some of the weld/component examinations had limited coverage. Also, as shown in Attachment 3, no flaws that exceeded the ASME Code, Section XI acceptance standards were identified during any examinations.

The inspection history for these components (as obtained from an industry survey) is presented in Attachment 4. The results of the survey indicate that these components are very flaw tolerant.

Conclusion

It is concluded that the SG pressure-retaining welds and full penetration welded nozzles are very flaw tolerant. PFM and DFM evaluations performed as part of the technical basis reports [1-1] and [1-2] demonstrate that, after PSI, no other inspections are required until 80 years to meet the NRC safety goal of 10^{-6} failures per reactor year. Plant-specific applicability of the technical basis to MPS2 is demonstrated in Attachment 2. An alternate inspection interval of 30 years provides an acceptable level of quality and safety in lieu of the current ASME Section XI 10-year inspection frequency.

Operating and examination history demonstrates that these components have performed with very high reliability, mainly due to their robust design. Attachment 3 shows the examination history for the SG welds examined in the third and fourth 10-year inspection intervals.

In 1992 (second inspection interval) both steam generators were replaced. The upper portions of the generators were reused, as identified on Figure A1. The welds and components in the upper portions of the steam generators received the required PSI examinations followed by inservice inspection (ISI) examinations through the first four inspection intervals. The new welds and components of the lower portions of the steam generators received the required PSI examinations in the second inspection interval followed by ISI examinations through the last three inspection intervals.

In addition to the required PSI examinations for these SG welds and components, DENC has performed 65 ISI examinations of the welds and components addressed by this request at MPS2 through the first four 10-year inspection intervals. No flaws that exceeded the ASME Code, Section XI acceptance standards were identified during any examinations, as shown in Attachment 3. Some of the examinations listed in Attachment 3 involved limited coverage ranging from 49% to 99%. Section 8.3.5 of Reference [1-1] and Section 8.2.5 of Reference [1-2] discuss limited coverage and determine that the conclusions of the report are applicable to components with limited coverage. In addition, it is important to note that all other inspection activities, including the system leakage test (Examination Categories B-P and C-H) will continue to be performed in accordance with the ASME Section XI requirements, providing further assurance of safety.

Finally, as discussed in Reference [1-3], for situations where no active degradation mechanism is present, it was concluded that subsequent ISI examinations do not provide additional value after PSI has been performed and the inspection volumes examined have been confirmed to be free of defects. As previously noted, the MPS2

SG welds and components covered by this request have received the required PSI examinations and follow-on ISI examinations through the first four 10-year inspection intervals found no flaws that exceeded the ASME Code, Section XI acceptance standards.

Therefore, DENC requests the NRC grant this proposed alternative in accordance with 10 CFR 50.55a(z)(1).

7.0 DURATION OF PROPOSED ALTERNATIVE:

The proposed alternative is requested for the remainder of the fifth 10-year inspection interval and through the following sixth 10-year inspection interval for MPS2. The sixth 10-year inspection interval is currently scheduled to end on March 31, 2040, recognizing that the existing 60-year license expires July 31, 2035.

8.0 PRECEDENT:

No previous submittals have been approved to provide relief from the ASME Section XI Examination Categories B-B, B-D, C-A, and C-B (Item Nos. B2.31, B2.40, B3.130, C1.10, C1.20, C1.30, C2.21, and C2.22) surface and volumetric examinations based on Reference [1-1] and [1-2] technical basis reports. However, the following is a list of approved actions (including relief requests and topical reports) related to inspections of SG welds and components:

- Letter from J. W. Clifford (NRC) to S. E. Scace (Northeast Nuclear Energy Company), "Safety Evaluation of the Relief Request Associated with the First and Second 10-Year Interval of the Inservice Inspection (ISI) Plan, Millstone Nuclear Power Station, Unit 3 (TAC No. MA 5446)," dated July 24, 2000, ADAMS Accession No. ML003730922.
- Letter from R. L. Emch (NRC) to J. B. Beasley, Jr. (SNOC), "Second 10-Year Interval Inservice Inspection Program Plan Requests for Relief 13, 14, 15, 21 and 33 for Vogtle Electric Generating Plant, Units 1 and 2 (TAC No. MB0603 and MB0604)," dated June 20, 2001, ADAMS Accession No. ML011640178.
- Letter from T. H. Boyce (NRC) to C. L. Burton (CP&L), "Shearon Harris Nuclear Power Plant Unit 1 – Request for Relief 2R1-019, 2R1-020, 2R1-021, 2R1-022, 2R2-009, 2R2-010, 2R2-011 for the Second Ten-Year Interval Inservice Inspection Program Plan (TAC Nos. ME0609, ME0610, ME0611, ME0612, ME0613, ME0614 and ME0615)," dated January 7, 2010, ADAMS Accession No. ML093561419.
- Letter from M. Khanna (NRC) to D. A. Heacock (Dominion Nuclear Connecticut Inc.), Millstone Power Plant Unit No. 2 – Issuance of Relief Requests RR-89-69 Through RR-89-78 Regarding Third 10-Year Interval Inservice Inspection Plan (TAC Nos. ME5998 Through ME6006)," dated March 12, 2012, ADAMS Accession No. ML120541062.
- Letter from R. J. Pascarelli (NRC) to E. D. Halpin (PG&E), "Diablo Canyon Plant, Units 1 and 2 – Relief Request; NDE SG-MS-IR, Main Steam Nozzle Inner Radius Examination Impracticality, Third 10-Year Interval, American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, Inservice Inspection Program (CAC Nos. MF6646 and MF6647)," dated December 8, 2015, ADAMS Accession No. ML15337A021.

In addition, there are precedents related to similar topical reports that justify relief for Class 1 nozzles:

- Based on studies presented in Reference [1-4], the NRC approved extending PWR reactor vessel nozzle-to-shell welds from 10 to 20 years in Reference [1-5].
- Based on work performed in BWRVIP-108 [1-6] and BWRVIP-241 [1-8], the NRC approved the reduction of BWR vessel feedwater nozzle-to-shell weld examinations (Item No. B3.90 for BWRs from 100% to a 25% sample of each nozzle type every 10 years) in References [1-7] and [1-9]. The work performed in BWRVIP-108 and BWRVIP-241 provided the technical basis for ASME Code Case N-702 [1-10], which has been conditionally approved by the NRC in Revision 19 of Regulatory Guide 1.147 [1-11].

9.0 ACRONYMS:

ASME	American Society of Mechanical Engineers
B&W	Babcock and Wilcox
BWR	Boiling Water Reactor
BWRVIP	Boiling Water Reactor Vessel and Internals Program
CE	Combustion Engineering
CFR	Code of Federal Regulations
DENC	Dominion Energy Nuclear Connecticut, Inc.
DFM	Deterministic fracture mechanics
EAF	Environmentally assisted fatigue
EPRI	Electric Power Research Institute
FAC	Flow accelerated corrosion
FEA	Finite element analysis
FW	Feedwater
ISI	Inservice Inspection
MIC	Microbiologically influenced corrosion
MPS2	Millstone Power Station Unit 2
MS	Main Steam
NPS	Nominal pipe size
NRC	Nuclear Regulatory Commission
NSSS	Nuclear steam supply system
PFM	Probabilistic fracture mechanics
PSI	Preservice Inspection
PWR	Pressurized Water Reactor
SCC	Stress corrosion cracking
SG	Steam Generator

10.0 REFERENCES:

1-1 Technical Bases for Inspection Requirements for PWR Steam Generator Class 1 Nozzle-to-Vessel Welds and Class 1 and Class 2 Vessel Head, Shell, Tubesheet-to-Head and Tubesheet-to-Shell Welds. EPRI, Palo Alto, CA: 2019. 3002015906.

1-2 Technical Bases for Inspection requirements for PWR Steam Generator Feedwater and Main Steam Nozzle-to-Shell Welds and Inside Radius Sections. EPRI, Palo Alto, CA: 2019. 3002014590.

1-3 American Society of Mechanical Engineers, Risk-Based Inspection: Development of Guidelines, Volume 2-Part 1 and Volume 2-Part 2, Light Water Reactor (LWR) Nuclear Power Plant Components. CRTD-Vols. 20-2 and 20-4, ASME Research Task Force on Risk-Based Inspection Guidelines, Washington, D.C., 1992 and 1998.

1-4 B. A. Bishop, C. Boggess, N. Palm, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval," WCAP-16168-NP-A, Rev. 3, October 2011.

1-5 US NRC, "Revised Safety Evaluation by the Office of Nuclear Reactor Regulation; Topical Report WCAP-16168-NP-A, Revision 2, 'Risk-Informed Extension of the Reactor Vessel In-service Inspection Interval,' Pressurized Water Reactor Owners Group, Project No. 694," July 26, 2011, ADAMS Accession No. ML111600303.

1-6 BWRVIP-108: BWR Vessels and Internals Project, Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Shell Welds and Nozzle Blend Radii, EPRI, Palo Alto, CA 2002. 1003557.

1-7 US NRC, Safety Evaluation of Proprietary EPRI Report, "BWR Vessel and Internals Project, Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Inner Radius (BWRVIP-108)," December 19, 2007, ADAMS Accession No. ML073600374.

1-8 BWRVIP-241: BWR Vessels and Internals Project, Probabilistic Fracture Mechanics Evaluation for the Boiling Water Reactor Nozzle-to-Shell Welds and Nozzle Blend Radii, EPRI, Palo Alto, CA 2010. 1021005.

1-9 US NRC, Safety Evaluation of Proprietary EPRI Report, "BWR Vessel and Internals Project, Probabilistic Fracture Mechanics Evaluation for the Boiling Water Reactor Nozzle-to-Shell Welds and Nozzle Blend Radii (BWRVIP-241)," April 19, 2013, ADAMS Accession Nos. ML13071A240 and ML13071A233.

1-10 Code Case N-702, "Alternate Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds," ASME Code Section XI, Division 1, Approval Date: February 20, 2004.

1-11 U. S. NRC Regulatory Guide 1.147, Revision 19, "Inservice Inspection Code Case Acceptability, ASME Code Section XI, Division 1," dated March 2020.

1-12 N. Palm (EPRI), BWR Vessel & Internals Project (BWRVIP) Memo No. 2019-016, "White Paper on Suggested Content for PFM Submittals to the NRC," February 27, 2019, ADAMS Accession No. ML19241A545.

ATTACHMENT 2

PLANT-SPECIFIC APPLICABILITY

MILLSTONE POWER STATION UNIT 2
DOMINION ENERGY NUCLEAR CONNECTICUT, INC.

Plant-Specific Applicability

Section 9 of References [2-1] and [2-2] provide requirements that must be demonstrated in order to apply the representative stress and flaw tolerance analyses to a specific plant. Plant-specific evaluation of these requirements for Millstone Power Station Unit 2 (MPS2) is provided in Table A1.

Table A1 indicates that all plant-specific requirements are met for MPS2. Therefore, the results and conclusions of the EPRI reports are applicable to MPS2.

Table A1

Plant-Specific Applicability of References [2-1] and [2-2] Representative Analyses to MPS2

Items Nos. B2.31 and B2.40 (SG Primary Side Shell Welds)

Category	Requirement from Reference [2-1]	Applicability to MPS2
General Requirements	The Loss of Power transient (involving unheated auxiliary feedwater being introduced into a hot SG that has been boiled dry following blackout, resulting in thermal shock of portion of the vessel) is not considered in this evaluation due to its rarity. In the event that such a significant thermal event occurs at a plant, its impact on the K_{IC} *(material fracture toughness)* value may require more frequent examinations and other plant actions outside the scope of this report's guidance.	MPS2 has not experienced a loss of power transient resulting in unheated auxiliary feedwater being introduced into a hot SG that has been boiled dry following blackout, resulting in thermal shock of portion of the vessel.
	The materials of the SG shell, FW nozzles, and MS nozzles must be low alloy ferritic steels which conform to the requirements of ASME Code, Section XI, Appendix G, Paragraph G-2110.	The MPS2 SG vessel heads, tubesheet and nozzles are fabricated of SA-508, Class 3 material, and the SG vessel shell is fabricated from SA-533, Gr. B, Cl. 1 material. Both of these materials conform to the requirements of ASME Code, Section XI, Appendix G, Paragraph G-2110 (Reference [2-3] and [2-4]).

Category	Requirement from Reference [2-1]	Applicability to MPS2
Specific Requirements	The weld configurations must conform to those shown in Figures 1-1 and Figure 1-2 of Reference [2-1]	The MPS2 weld configurations are shown in Figure A2, and conform to Figure 1-1 and Figure 1-2 of Reference [2-1].
	The SG vessel dimensions must be within 10% percent of the upper and lower bounds of the values provided in the table in Section 9.4.3 of Reference [2-1].	The MPS2 SG vessel dimensions are as follows: • SG Lower Head diameter = 165 inches • SG Upper Shell diameter = 240 inches These dimensions are within 10% of those specified in Table 9-2 in Section 9.4.3 of Reference [2-1] for CE plants (Reference [2-5] and [2-6]).
	The component must experience transients and cycles bounded by those shown in Table 5-7 of Reference [2-1] over a 60-year operating life.	As shown in Table A2, the MPS2 transients and number of cycles projected to occur over a 60-year life are bounded by those shown in Table 5-7 of Reference [2-1] for CE plants.

Item No. B3.130 (SG Primary Inlet/Outlet Nozzles)

Category	Requirement from Reference [2-1]	Applicability to MPS2
General Requirements	The Loss of Power transient (involving unheated auxiliary feedwater being introduced into a hot SG that has been boiled dry following blackout, resulting in thermal shock of portion of the vessel) is not considered in this evaluation due to its rarity. In the event that such a significant thermal event occurs at a plant, its impact on the K_{IC} (*material fracture toughness*) value may require more frequent examinations and other plant actions outside the scope of this report's guidance.	MPS2 has not experienced a loss of power transient resulting in unheated auxiliary feedwater being introduced into a hot SG that has been boiled dry following blackout, resulting in thermal shock of portion of the vessel.
	The materials of the SG shell and nozzles must be low alloy ferritic steels which conform to the requirements of ASME Code, Section XI, Appendix G, Paragraph G-2110.	The MPS2 SG vessel primary head, tubesheet and primary nozzles are fabricated of SA-508, Class 3 material, and the SG vessel shell is fabricated from SA-533, Gr. B, Cl. 1 material. Both of these materials conform to the requirements of ASME Code, Section XI, Appendix G, Paragraph G-2110. (References [2-3] and [2-4])
Specific Requirements	The weld configurations must conform to those shown in Figures 1-3 through 1-5 of Reference [2-1]	The MPS2 weld configurations are shown in Figure A3, and conform to Figure 1-5 of Reference [2-1].
	The piping attached to the primary inlet and outlet nozzles (RCS piping) for the various designs must be within 10% percent of the values provided in the table in Section 9.4.2 of Reference [2-1].	The MPS2 primary inlet/outlet nozzle and piping dimensions are as follows: • SG primary side inlet nozzle = 42 inches NPS • SG primary side outlet nozzle = 30 inches NPS These dimensions are within

Category	Requirement from Reference [2-1]	Applicability to MPS2
		10% of those specified in Table 9-1 in Section 9.4.2 of Reference [2-1] for CE plants. (Reference [2-8])
	The component must experience transients and cycles bounded by those shown in Table 5-7 of Reference [2-1] over a 60-year operating life.	As shown in Table A2, the MPS2 transients and number of cycles projected to occur over a 60-year life are bounded by those shown in Table 5-7 of Reference [2-1] for CE plants.

Items Nos. C1.10, C1.20 and C1.30 (SG Secondary Side Shell Welds)

Category	Requirement from Reference [2-1]	Applicability to MPS2
General Requirements	The Loss of Power transient (involving unheated auxiliary feedwater being introduced into a hot SG that has been boiled dry following blackout, resulting in thermal shock of portion of the vessel) is not considered in this evaluation due to its rarity. In the event that such a significant thermal event occurs at a plant, its impact on the K_{IC} (*material fracture toughness*) value may require more frequent examinations and other plant actions outside the scope of this report's guidance.	MPS2 has not experienced a loss of power transient resulting in unheated auxiliary feedwater being introduced into a hot SG that has been boiled dry following blackout, resulting in thermal shock of portion of the vessel.
	The materials of the SG shell, FW nozzles, and MS nozzles must be low alloy ferritic steels which conform to the requirements of ASME Code, Section XI, Appendix G, Paragraph G-2110.	The MPS2 SG vessel heads, tubesheet and nozzles are fabricated of SA-508, Class 3 material, and the SG vessel shell is fabricated from SA-533, Gr. B, Cl. 1 material. Both of these materials conform to the requirements of ASME Code, Section XI, Appendix G, Paragraph G-2110 (References [2-3] and [2-4]).
Specific Requirements	The weld configurations must conform to those shown in Figure 1-7 and Figure 1-8 of Reference [2-1].	The MPS2 weld configurations are shown in Figures A4-1 and A4-2, and conform to Figure 1-7 and Figure 1-8 of Reference [2-1].
	The SG vessel dimensions must be within 10% percent of the upper and lower bounds of the values provided in the table in Section 9.4.4 of Reference [2-1].	The MPS2 SG vessel dimensions are as follows: • SG Lower Head diameter = 165 inches • SG Upper Shell diameter = 240 inches These dimensions are within

Category	Requirement from Reference [2-1]	Applicability to MPS2
		10% of those specified in Table 9-3 in Section 9.4.4 of Reference [2-1] for CE plants (References [2-5] and [2-6]).
	The component must experience transients and cycles bounded by those shown in Table 5-9 of Reference [2-1] over a 60-year operating life.	As shown in Table A3, the MPS2 transients and number of cycles projected to occur over a 60-year life are bounded by those shown in Table 5-9 of Reference [2-1].

Items Nos. C2.21 and C2.22 (MS and FW Nozzle to Shell Welds and Inside Radius Sections)

Category	Requirement from Reference [2-2]	Applicability to MPS2
General Requirements	The nozzle-to-shell weld shall be one of the configurations shown in Figure 1-1 or Figure 1-2 of Reference [2-2].	The MPS2 MS and FW nozzles are shown in Figures A5 and A6 and are representative of the configuration shown in Figure 1-2 of Reference [2-2].
	The materials of the SG shell, FW nozzles, and MS nozzle must be low alloy ferritic steels which conform to the requirements of ASME Code, Section XI, Appendix G, Paragraph G-2110.	The MPS2 MS and FW nozzles are fabricated of SA-508, Class 2 material, the SG vessel secondary head is fabricated from SA-516 Gr 70 and upper secondary cylinder is fabricated from SA-533, Gr. B, Cl. 1 material. These materials conform to the requirements of ASME Code, Section XI, Appendix G, Paragraph G-2110 (References [2-9] and [2-10]).
	The SG must not experience more than the number of all transients shown in Table 5-5 of Reference [2-2] over a 60-year operating life.	As shown in Table A4, the MPS2 SG is not projected to experience more than the number of the transients shown in Table 5-5 of Reference [2-2]).
SG Feedwater Nozzle	The piping attached to the FW nozzle must be 14-inch to 18-inch NPS.	The MPS2 FW piping lines are 18-inch NPS (18"-EBB-6 on Reference [2-11]).
	The FW nozzle design must have an integrally attached thermal sleeve.	The MPS2 FW nozzle configuration has an integrally attached thermal sleeve (Reference [2-12]).

Category	Requirement from Reference [2-2]	Applicability to MPS2
	Auxiliary feedwater nozzles connected directly to the SG are not covered in this evaluation.	N/A for MPS2.
SG Main Steam Nozzle	For Westinghouse and CE plants, the piping attached to the SG MS nozzle must be 28-inch to 36-inch NPS.	MPS2 is a CE 2-loop PWR. The MPS2 MS piping lines are both 34-inch NPS (34"-EBB-2 on Reference [2-11]).
	For B&W SGs, the piping attached to the main steam nozzle must be 22-inch to 26-inch NPS.	N/A for MPS2 since it is a CE 2-loop unit.
	The SG must have one main steam nozzle that exits the top dome of the SG.	MPS2 has one MS nozzle per SG that exits the top dome of each SG as shown in Figure A1.
	The main steam nozzle shall not significantly protrude into the SG (e.g., see Figure 4-7 of Reference [2-2]) or have a unique nozzle weld configuration (e.g., see Figure 4-6 of Reference [2-2]).	The MPS2 MS nozzle configuration (shown in Figure A6) does not protrude significantly into the SG as shown in Figure 4-7 of Reference [2-2] and does not have a unique weld configuration as shown in Figure 4-6 of Reference [2-2] (Reference [2-10]).

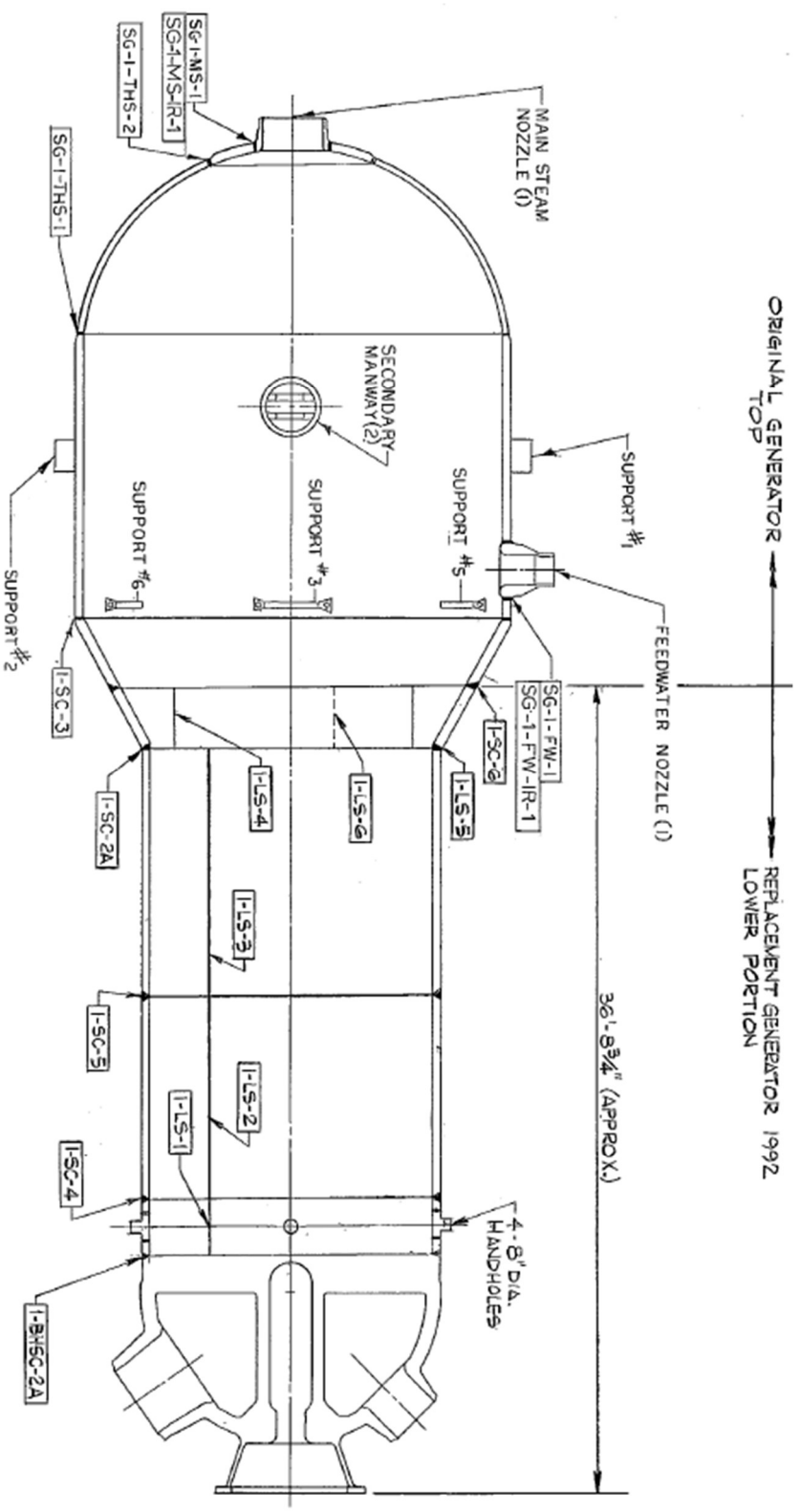


Figure A1. Millstone Unit 2 SG Layout

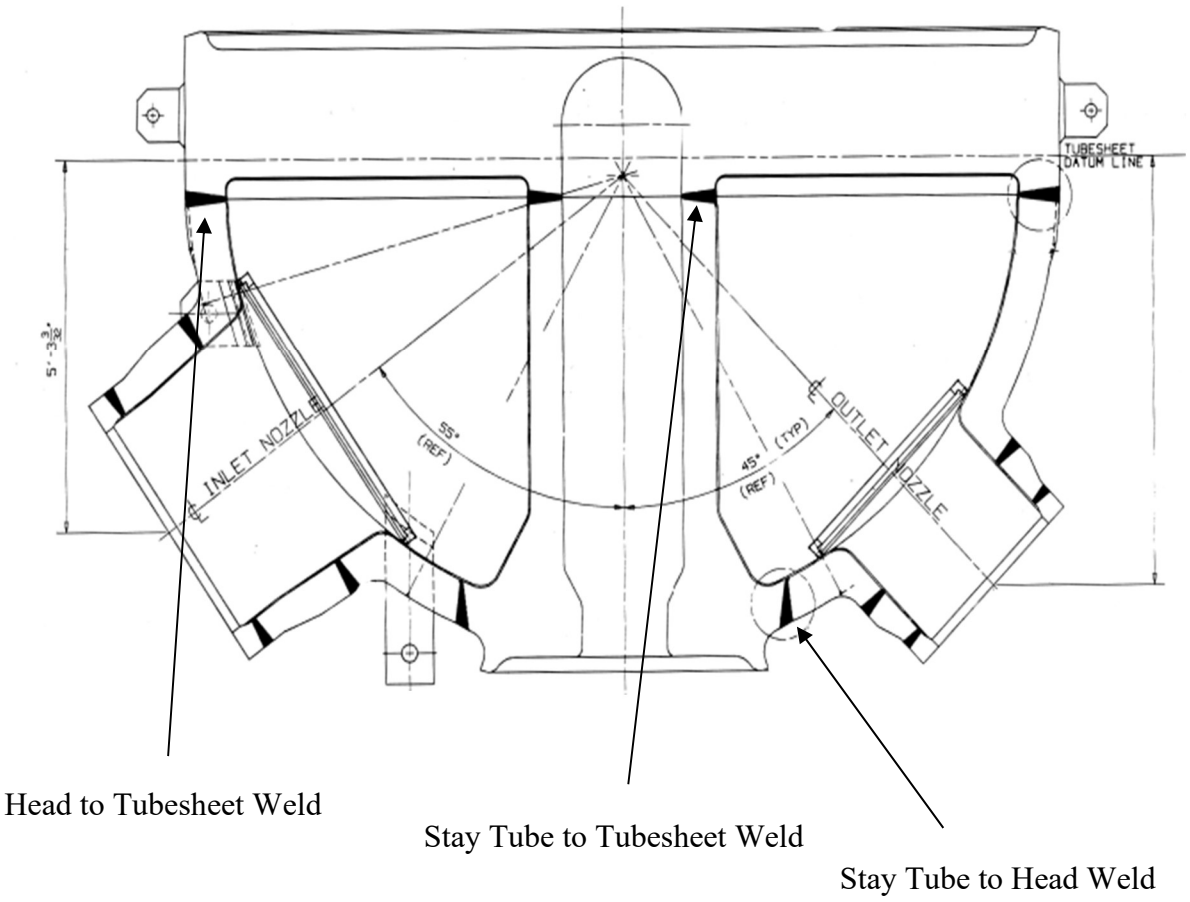


Figure A2. Millstone Unit 2 SG Primary Side Head Welds Configuration

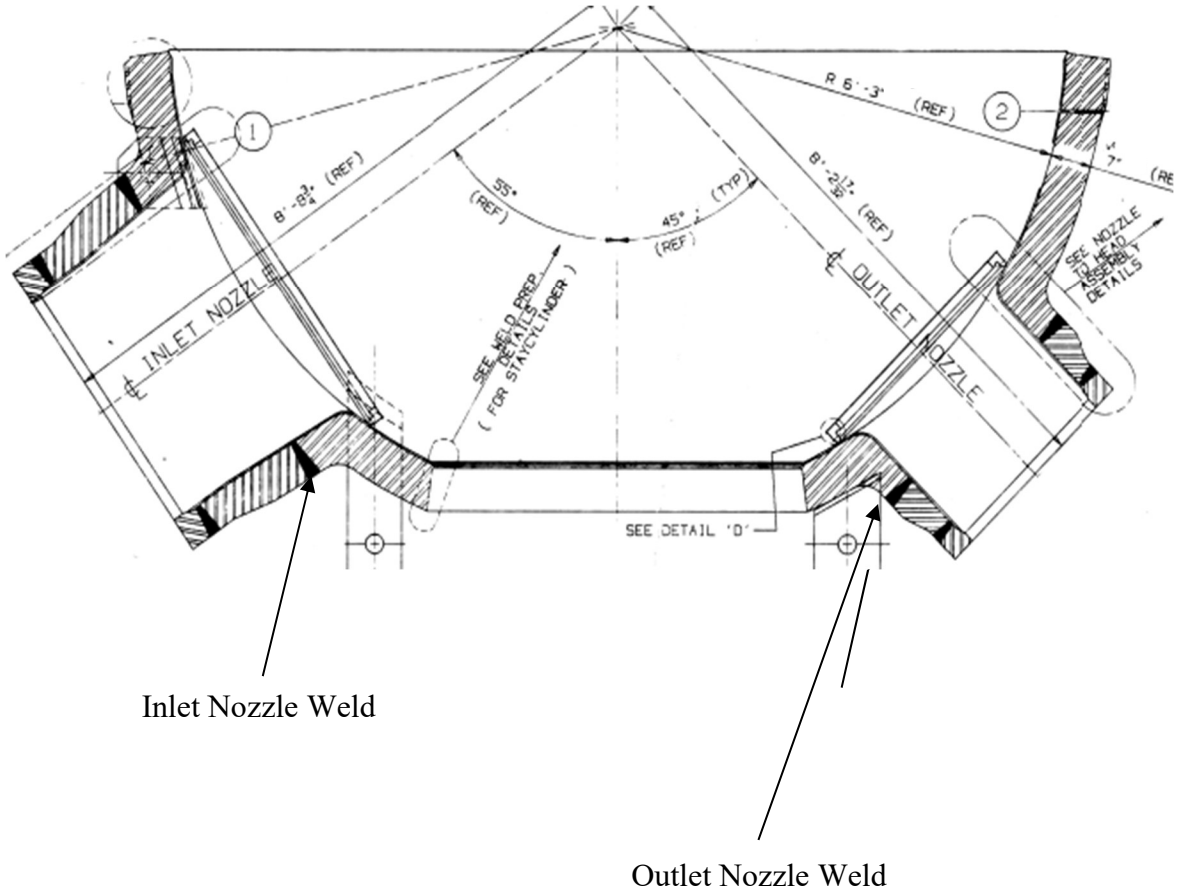
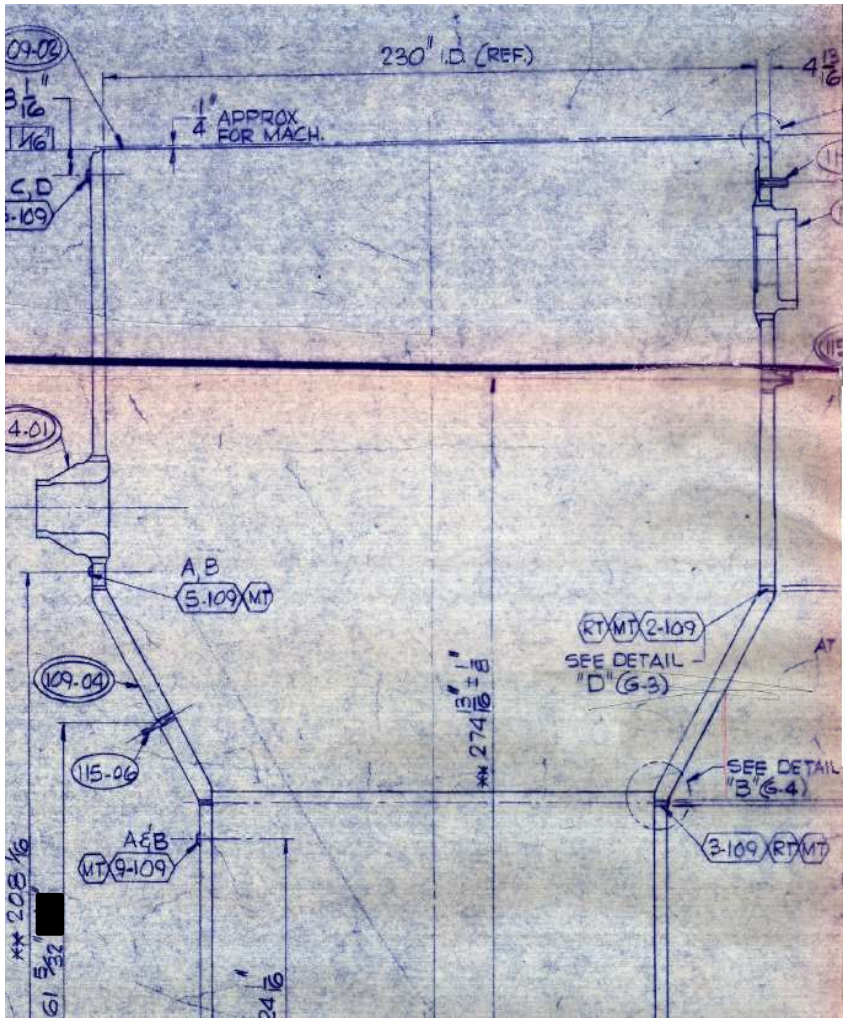
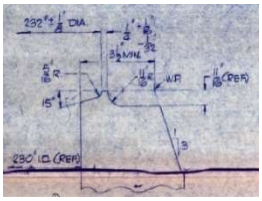
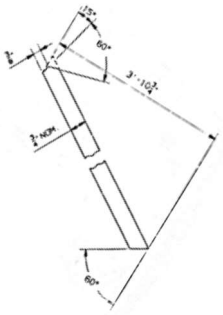


Figure A3. Millstone Unit 2 SG Primary Side Inlet/Outlet Nozzle Configuration





Head to Shell



Cone to Upper Shell
And Cone to Cone

Figure A4-1. Millstone Unit 2 SG Secondary Side Shell Welds Configuration

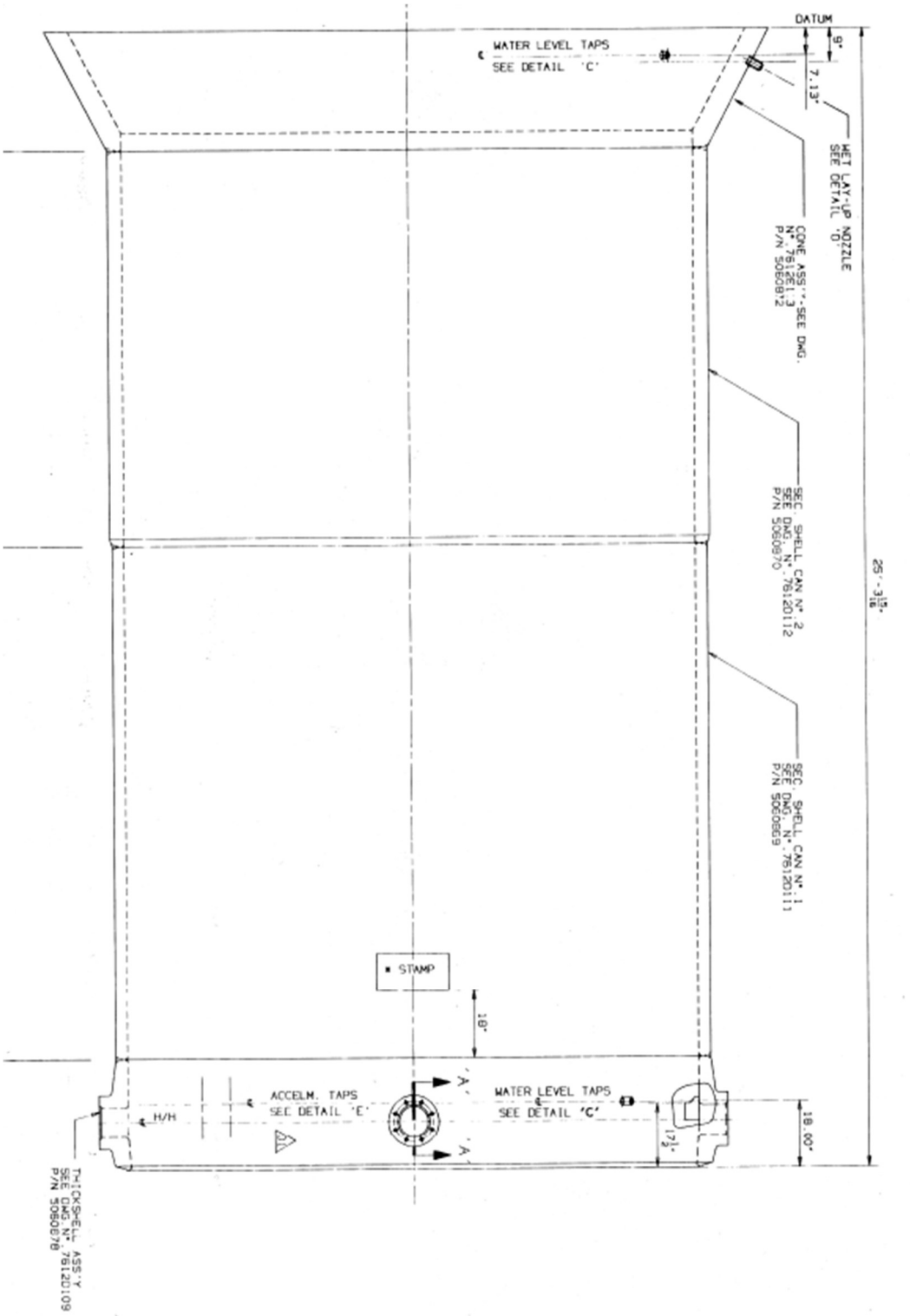


Figure A4-2. Millstone Unit 2 SG Secondary Side Shell Welds Configuration

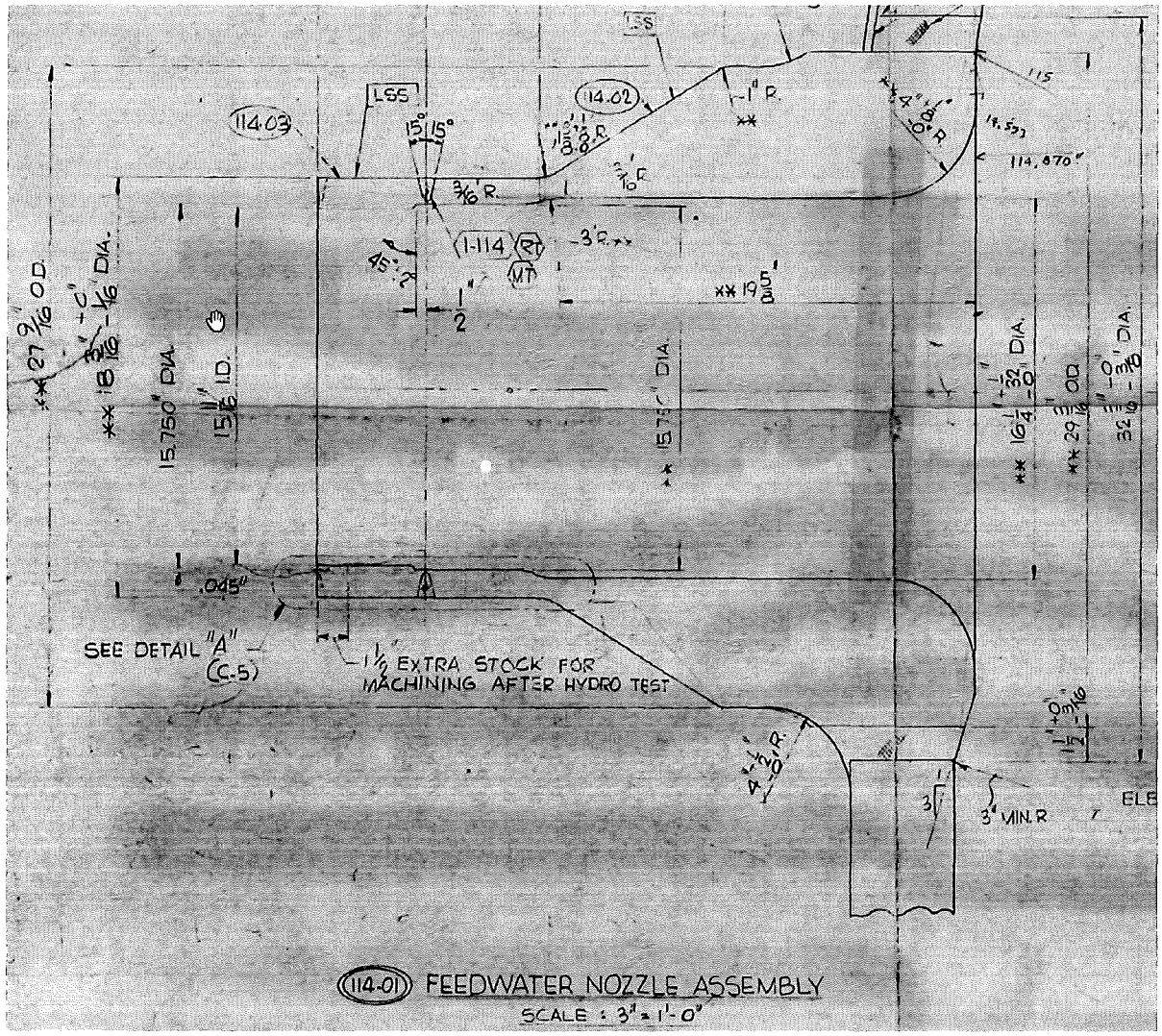


Figure A5. Millstone Unit 2 SG Feedwater Nozzle Configuration

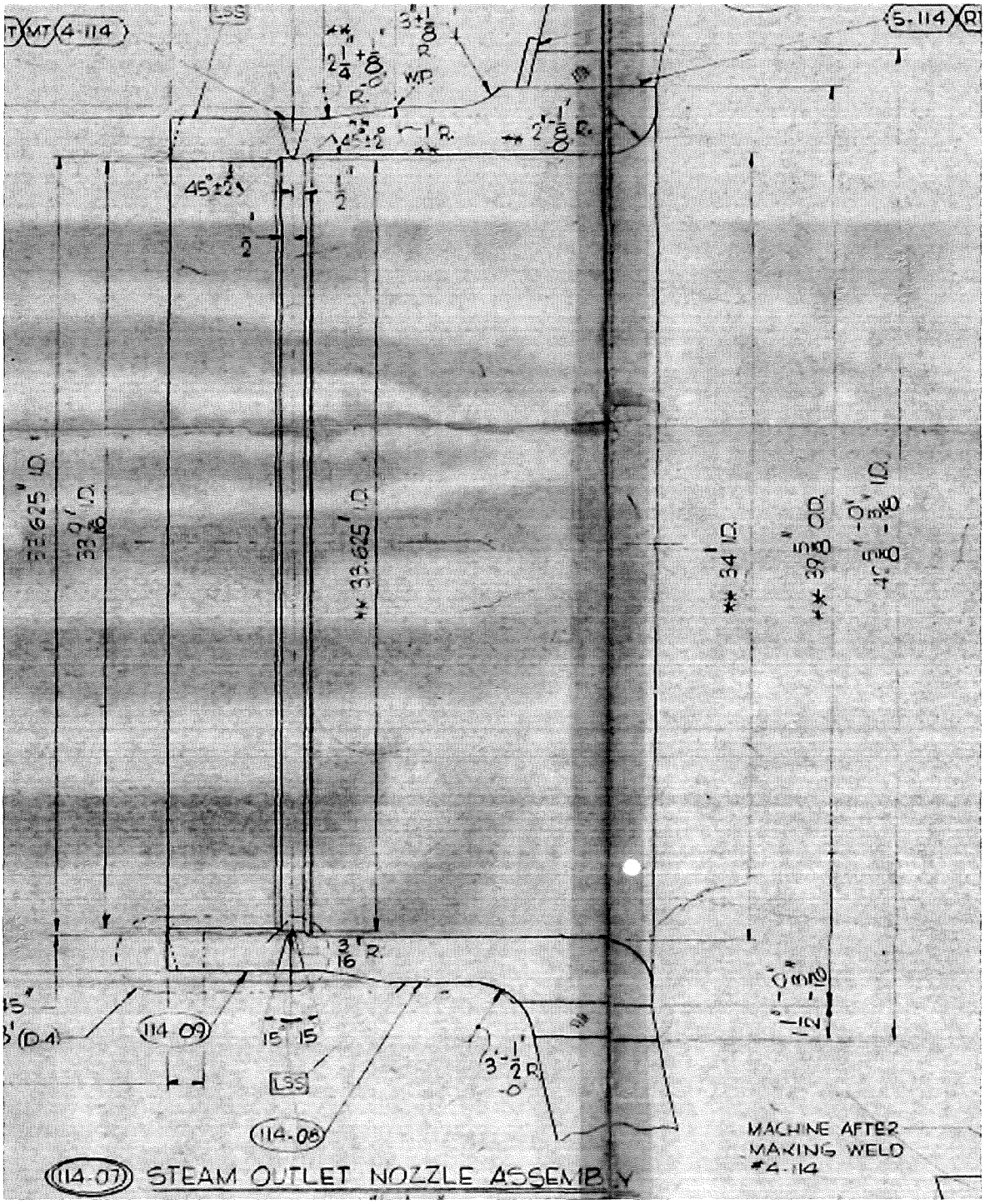


Figure A6. Millstone Unit 2 SG Main Steam Nozzle Configuration

Table A2 – MPS2 Data for Thermal Transients for Stress Analysis of the PWR SG Primary-Side Head Welds (Comparison to Table 5-7 of Reference [2-1])

Transient	Max Thot °F	Min Thot °F	Max Tcold °F	Min Tcold °F	Max Press PSIG	Min Press PSIG	60-Year Cycles
Heatup/Cooldown EPRI Report 3002015906	545	70	545	70	2235	0	300
Heatup/Cooldown MP2	535	70	535	70	2235	0	121
Plant Loading / Unloading EPRI Report 3002015906	610	550	550	545	2300	2300	5000
Plant Loading / Unloading MP2	Not typical operation, not counted – See Note 1						
Reactor Trip EPRI Report 3002015906	615	530	565	530	2435	1700	360
Reactor Trip MP2	595	535	550	530	2250	1900	216
Note 1	Load following operation not typical. Plant Loading / Unloading transients not counted per Report SIR-03-062 Table 2-2						

Table A3 MPS2 Data for Thermal Transients for Stress analysis of the PWR SG Secondary-Side Vessel Welds (Comparison to Table 5-9 of Reference [2-1])

Transient	Max Tss °F	Min Tss °F	Max Press PSIG	Min Press PSIG	60-Year Cycles
Heatup/Cooldown EPRI Report 3002015906	545	70	1000	0	300
Heatup/Cooldown MP2	530	70	850	0	121
Plant Loading / Unloading EPRI Report 3002015906	610	550	2300	2300	5000
Plant Loading / Unloading MP2	Not typical Operation, not counted – See Note 1				
Reactor Trip EPRI Report 3002015906	555	530	1130	1000	360
Reactor Trip MP2	535	520	910	800	216
Note 1	Load following operation not typical. Plant Loading / Unloading transients not counted per Report SIR-03-062 Table 2-2				

Table A4 – MPS2 Data for Thermal Transients Applicable to PWR SG Feedwater and Main Steam Nozzles (Comparison to Table 5-5 of Reference [2-2])

Transient			
	Cycles from Table 5-5 of EPRI Report 3002014590	Millstone Unit 2 60-year projected cycles from calculation NCFM-04321M2 Rev 3 Attachment E	Millstone Unit 2 60-year allowable cycles from calculation NCFM-04321M2 Rev 3 Attachment E
Heatup/Cooldown	300	121	500
Plant Loading	5000	Not Typical / Not Counted – Note 1	15000 - Note 1
Plant Unloading			
Loss of Load	360	8	40
Loss of Power	60	0	40
Note 1	Load following operation not typical. Plant Loading / Unloading transients not counted per Report SIR-03-062 Table 2-2		

REFERENCES:

2-1 Technical Bases for Inspection Requirements for PWR Steam Generator Class 1 Nozzle-to-Vessel Welds and Class 1 and Class 2 Vessel Head, Shell, Tubesheet-to-Head and Tubesheet-to-Shell Welds. EPRI, Palo Alto, CA: 2019. 3002015906.

2-2 Technical Bases for Inspection requirements for PWR Steam Generator Feedwater and Main Steam Nozzle-to-Shell Welds and Inside Radius Sections. EPRI, Palo Alto, CA: 2019. 3002014590.

2-3 BWC-7612-SR-2, Revision 0, "Replacement Steam Generators Transient Analysis Stress Report," Section 4.0, pp. 1 and 12.

2-4 Drawing No. 25203-29145, Sheet 313, "Material and Parts List," Revision 2.

2-5 Drawing No. 25203-29145, Sheet 296, "Lower Replacement Steam Generator Sub Assembly," Revision 1.

2-6 Drawing No. 25203-29145, Sheet 3, "General Arrangement and Assembly Elevation Steam Generator," Revision 6.

2-7 Millstone Calculation No. NCFM-04321M2, "2010 FatiguePro Data Evaluation for Millstone Unit 2," Revision 3

2-8 Drawing No. 25203-26014, Sheet 1, "Piping and Instrumentation Diagram Reactor Coolant System," Revision 41

2-9 CENC-1176, "Analytical Report for MP2 Steam Generator," Revision 0, pp. A2, A17, and A20.

2-10 Drawing No. 25203-29145, Sheet 13, "Nozzle Detail Steam Generator," Revision 7.

2-11 Drawing No. 25203-26002, Sheet 1, "Piping and Instrumentation Diagram Main Steam from Generators," Revision 88.

2-12 Drawing No. 25203-29145, Sheet 171, "F/W Thermal Sleeve Detail," Revision 1

ATTACHMENT 3

MILLSTONE UNIT 2 INSPECTION HISTORY FOR THE THIRD AND FOURTH 10-YEAR INSPECTION INTERVALS

MILLSTONE POWER STATION UNIT 2
DOMINION ENERGY NUCLEAR CONNECTICUT, INC.

MILLSTONE UNIT 2 INSPECTION HISTORY

SG Primary Side Shell Welds

Item No.	Examination Date	Interval/Period (Outage)	Component ID	Examination Results	Coverage	Relief Request
B2.31	11/08/06	3rd Interval / 3rd Period (M2RF17)	SG-2-BHC-1-A	Acceptable	49.58%	RR-89-14
	10/17/18	4th Interval / 3rd Period (M2RF25)	SG-1-BHC-1-A	Acceptable	88.33%	RR-04-31 (In progress)
	4/16/08	3rd Interval / 3rd Period (M2RF18)	SG-1-BHC-1-A	Acceptable	72.90%	RR-89-14
	10/16/18	4th Interval / 3rd Period (M2RF25)	SG-2-TSS-3-A	Acceptable	100%	N/A
	11/07/06	3rd Interval / 3rd Period (M2RF17)	SG-2-TSS-3-A	Acceptable	100%	N/A
B2.40	11/07/06	3rd Interval / 3rd Period (M2RF17)	SG-2-BHC-2-A	Acceptable	99.59%	N/A
	4/10/11	4th Interval/ 1st Period (M2RF20)	SG-1-BHC-2-A	Acceptable	99.60%	N/A
	05/15/00	3rd Interval / 1st Period (M2RF13)	SG-1-BHC-2-A	Acceptable	90.1%	N/A

SG Secondary Side Shell Welds

Item No.	Examination Date	Interval/Period (Outage)	Component ID	Examination Results	Coverage	Relief Request
C1.10	10/19/18	4th Interval/ 3rd Period (M2RF25)	1-SC-2A	Acceptable	99.55%	N/A
	4/23/08	3rd Interval / 3rd Period (M2RF18)	1-SC-2A	Acceptable	94.50%	N/A
	4/29/14	4th Interval/ 2nd Period (M2RF22)	1-SC-3	Acceptable	100%	N/A
	4/22/08	3rd Interval / 3rd Period (M2RF18)	1-SC-3	Acceptable	100%	N/A
C1.20	4/29/14	4th Interval/ 2nd Period (M2RF22)	SG-1-THS-1	Acceptable	100%	N/A
	10/29/03	3rd Interval / 2nd Period (M2RF15)	SG-1-THS-1	Acceptable	100%	N/A
	4/29/14	4th Interval / 2nd Period (M2RF22)	SG-1-THS-2	Acceptable	100%	N/A
	10/28/03	3rd Interval / 2nd Period (M2RF15)	SG-1-THS-2	Acceptable	98.60%	N/A
C1.30	10/19/18	4th Interval / 3rd Period (M2RF25)	1-BHSC-2A	Acceptable	97.53%	N/A
	4/16/08	3rd Interval / 3rd Period (M2RF18)	1-BHSC-2A	Acceptable	97.30%	N/A

SG Primary Side Nozzles

Item No.	Examination Date	Interval/Period (Outage)	Component ID	Examination Results	Coverage	Relief Request
B3.130	4/19/14	4th Interval/ 2nd Period (M2RF22)	SG-1-NH-2-A	Acceptable	72.4%	RR-04-28
	4/21/05	3rd Interval/ 2nd Period (M2RF16)	SG-1-NH-2-A	Acceptable	54%	RR-89-70
	4/19/14	4th Interval/ 2nd Period (M2RF22)	SG-1-NH-4-A	Acceptable	72.5%	RR-04-28
	4/19/05	3rd Interval/ 2nd Period (M2RF16)	SG-1-NH-4-A	Acceptable	56%	RR-89-70
	4/19/14	4th Interval/ 2nd Period (M2RF22)	SG-1-NH-5-A	Acceptable	72.4%	RR-04-28
	4/25/05	3rd Interval/ 2nd Period (M2RF16)	SG-1-NH-5-A	Acceptable	55%	RR-89-70
	10/21/12	4th Interval/ 1st Period (M2RF21)	SG-2-NH-2-A	Acceptable	73.3%	RR-04-17
	02/23/02	3rd Interval/ 1st Period (M2RF14)	SG-2-NH-2-A	Acceptable	100%	N/A
	10/21/12	4th Interval/ 1st Period (M2RF21)	SG-2-NH-4-A	Acceptable	72.5%	RR-04-17
	02/23/02	3rd Interval/ 1st Period (M2RF14)	SG-2-NH-4-A	Acceptable	100%	N/A
	10/21/12	4th Interval /1st Period (M2RF21)	SG-2-NH-5-A	Acceptable	72.4%	RR-04-17
	02/23/02	3rd Interval / 1st Period (M2RF14)	SG-2-NH-5-A	Acceptable	100%	N/A

SG Secondary Side Nozzles

Item No.	Examination Date	Interval/Period (Outage)	Component ID	Examination Results	Coverage	Relief Request
C2.21	4/29/14	4th Interval/ 2nd Period (M2RF22)	SG-1-FW-1	Acceptable	88.8%	RR-04-29
	3/02/02	3rd Interval/ 1st Period (M2RF14)	SG-1-FW-1	Acceptable	74.7%	RR-89-73
	10/24/15	4th Interval/ 2nd Period (M2RF23)	SG-2-MS-1	Acceptable	73.6%	RR-04-29
	10/28/03	3rd Interval/ 2nd Period (M2RF15)	SG-2-MS-1	Acceptable	56.3%	RR-89-73
C2.22	4/29/14	4th Interval/ 2nd Period (M2RF22)	SG-1-FW-IR-1	Acceptable	100%	N/A
	03/02/02	3rd Interval/ 1st Period (M2RF14)	SG-1-FW-IR-1	Acceptable	100%	N/A
	10/20/15	4th Interval/ 2nd Period (M2RF23)	SG-2-MS-IR-1	Acceptable	100%	N/A
	10/27/03	3rd Interval/ 2nd Period (M2RF15)	SG-2-MS-IR-1	Acceptable	100%	N/A

Serial No. 20-167
Docket No. 50-336

ATTACHMENT 4

RESULTS OF INDUSTRY SURVEY

MILLSTONE POWER STATION UNIT 2
DOMINION ENERGY NUCLEAR CONNECTICUT, INC.

Overall Industry Inspection Summary for Code Items B2.31, B2.32, B2.40, B3.130, C1.10, C1.20, and C1.30

The results of an industry survey of past inspections of SG nozzle-to-shell welds, inside radius sections and shell welds are summarized in Reference [4-1]. Table C1 provides a summary of the combined survey results for Item Nos. B2.31, B2.32 (see Table Note 3), B2.40, B3.130, C1.10, C1.20, and C1.30. The results of the industry survey identified numerous steam generator (SG) examinations being performed with no service-induced flaws being detected. Performing these examinations adversely impact outage activities including worker exposure, personnel safety, and radwaste. A total of 74 domestic and international boiling water reactor (BWR) and pressurized water reactor (PWR) units responded to the survey and provided information representing all PWR plant designs currently in operation in the United States. This included 2-loop, 3-loop, and 4-loop PWR designs from each of the PWR nuclear steam supply system (NSSS) vendors (i.e., Babcock and Wilcox (B&W), Combustion Engineering (CE), and Westinghouse). A total of 1324 examinations for the components of the affected Item Nos. were conducted, with 1098 of these specifically for PWR components. The majority of the PWR examinations were performed on SG welds.

A relatively small number of flaws were identified during these examinations which required flaw evaluation. None of these flaws were found to be service-induced. For Item No. B2.40, examinations at two units at a single plant site identified multiple flaws exceeding the acceptance criteria of ASME Code Section XI; however, these were determined to be subsurface-embedded fabrication flaws and not service-induced (see Table Note 1). For Item No. C1.20, two PWR units reported flaws exceeding the acceptance criteria of ASME Code, Section XI. In the first unit, a single flaw was identified, and was evaluated as an inner diameter surface imperfection. Reference [4-3] indicates that this was a spot indication with no measurable through-wall depth. This indication is therefore not considered to be service-induced but rather fabrication-related. A flaw evaluation per IWC-3600 was performed for this flaw and it was found to be acceptable for continued operation. In the second unit, multiple flaws were identified (see Table Note 2). As discussed in References [4-4] and [4-5], these flaws were most likely subsurface weld defects typical of thick vessel welds and not service-induced. A flaw evaluation per IWC-3600 was performed for these flaws and they were found to be acceptable for continued operation.

Table C1 – Summary of Survey Results

Item No.	No. of Examinations			No. of Reportable Indications		
	BWR	PWR	Total	BWR	PWR	Total
B2.31	0	30	30	0	0	0
B2.32 (Note 3)	0	13	13	0	0	0
B2.40	0	183	183	0	Note 1	Note 1
B3.130	0	135	135	0	0	0
C1.10	140	305	445	0	0	0
C1.20	54	319	373	0	Note 2	Note 2
C1.30	32	113	145	0	0	0
Totals	**226**	**1098**	**1324**	**0**	**Notes 1 and 2**	**Notes 1 and 2**

Table Notes:

(1) Two PWR W-2 Loop units at a single plant reported multiple subsurface embedded fabrication flaws.
(2) A single PWR W-2 Loop unit reported multiple flaws [4-4, 4-5].
(3) Item No. B2.32 was evaluated in the Reference [4-1] technical basis and included in the industry survey, but is not contained in the scope of this alternative request.

Overall Industry Inspection Summary for Code Items C2.21, C2.22, and C2.32

The results of an industry survey of past inspections of SG main steam (MS) and feedwater (FW) nozzles are summarized in Reference [4-2]. Table C2 provides a summary of the combined survey results for Item Nos. C2.21, C2.22, and C2.32 (see Table Note 1). The results of the industry survey identified numerous SG MS and FW Nozzle-to-Shell Welds and Nozzle Inside Radius Section examinations being performed with no service-induced flaws being detected. Performing these examinations adversely impact outage activities including worker exposure, personnel safety, and radwaste. A total of 74 domestic and international BWR and PWR units responded to the survey and provided information representing all PWR plant designs currently in operation in the United States. This included 2-loop, 3-loop, and 4-loop PWR designs from each of the PWR NSSS vendors (i.e., B&W, CE, and Westinghouse). A total of 727 examinations for Item Nos. C2.21, C2.22, and C2.32 (see Table Note 1) components were conducted, with 563 of these specifically for PWR components. The majority of the PWR examinations were performed on SG MS and FW nozzles. Only one PWR examination identified two (2) flaws that exceeded ASME Code Section XI acceptance criteria. The flaws were linear indications of 0.3" and 0.5" in length and were detected in a MS nozzle-to-shell weld using magnetic particle examination techniques. The indications were dispositioned by light grinding (ADAMS Accession No. ML13217A093).

Table C2 – Summary of Survey Results

Plant Type	Number of Units	Number of Examinations	Number of Reportable Indications
BWR	27	164	0
PWR	47	563	2
Totals	**74**	**727 (Note 1)**	**2**

Table Note:

(1) Item No. C2.32 was evaluated in the Reference [4-2] technical basis and included in the industry survey, but is not contained in the scope of this alternative request.

REFERENCES:

4-1 Technical Bases for Inspection Requirements for PWR Steam Generator Class 1 Nozzle-to-Vessel Welds and Class 1 and Class 2 Vessel Head, Shell, Tubesheet-to-Head and Tubesheet-to-Shell Welds. EPRI, Palo Alto, CA: 2019. 3002015906.

4-2 Technical Bases for Inspection requirements for PWR Steam Generator Feedwater and Main Steam Nozzle-to-Shell Welds and Inside Radius Sections. EPRI, Palo Alto, CA: 2019. 3002014590.

4-3 Letter from F. A. Kearney (Exelon) to U. S. NRC, "Byron Station Unit 2 90-Day Inservice Inspection Report for Interval 3, Period 3, (B2R17)," dated July 29, 2013, Docket No. 50-455, ADAMS Accession Number ML13217A093.

4-4 Letter from J. M. Sorensen (NMC) to U. S. NRC, "Unit 1 Inservice Inspection Summary Report, Interval 3, Period 3 Refueling Outage Dates 1-19-2001 to 2-25-2001 Cycle 20 / 05-26-99 to 02-25-2001," dated May 29, 2001, Docket Nos. 50-282 and 50-306, ADAMS Accession Number ML011550346.

4-5 Letter from J. P. Solymossy (NMC) to U. S. NRC, "Response to Opportunity For Comment On Task Interface Agreement (TIA) 2003-01, "Application of ASME Code Section XI, IWB-2430 Requirements Associated With Scope of Volumetric Weld Expansion at the Prairie Island Nuclear Generating Plant" (Tac Nos. MB7294 and MB7295)," dated April 4, 2003, Docket Nos. 50-282 and 50-306, ADAMS Accession Number ML031040553.