UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 12, 2012

Mr. David A. Heacock
President and Chief Nuclear Officer
Dominion Nuclear Connecticut, Inc.
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA 23060-6711

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 2 – ISSUANCE OF RELIEF REQUESTS RR-89-69 THROUGH RR-89-78 REGARDING THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM PLAN (TAC. NOS. ME5998 THROUGH ME6006)

Dear Mr. Heacock:

By letter dated March 30, 2011,[1] as supplemented by letter dated September 22, 2011,[2] Dominion Nuclear Connecticut, Inc. (DNC or the licensee) submitted relief requests (RRs) RR-89-69, RR-89-70, RR-89-71, RR-89-72, RR-89-73, RR-89-74, RR-89-75, RR-89-76, RR-89-77, and RR-89-78 for Millstone Power Station, Unit No. 2 (MPS2). DNC requested relief from certain requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code*, Section XI for the third 10-year inservice inspection (ISI) interval, in which the licensee adopted the 1989 Edition with no Addenda. The third 10-year ISI interval began on April 1, 1999, and ended on March 31, 2010. The NRC contracted Pacific Northwest National Laboratory to assist with the review of these requests.

Attachment 2 of DNC's supplement contains proprietary information; as such, that information is being withheld from public disclosure.[3] The information contained in Attachment 2 is marked proprietary in its entirety, and therefore, no non-proprietary version is available.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii), the licensee requested relief from inservice inspection items listed in RRs RR-89-69, RR-89-70, RR-89-71, RR-89-72, RR-89-73, RR-89-74, RR-89-75, RR-89-76, RR-89-77, and RR-89-78 on the basis that the code requirements are impractical.

The NRC staff has reviewed the licensee's submittals and concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RRs RR-89-69 (in part)[4], RR-89-70, RR-89-71, RR-89-72, RR-89-73, RR-89-74, RR-89-75, RR-89-76, and

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[1] Agencywide Documents Access and Management System Accession (ADAMS) Accession ML110960361

[2] ADAMS Accession Nos.: Package No. ML112730177, Letter No. ML11273A049, and Attachment No. ML11273A050 (non-public)

[3] ADAMS Accession No. ML112930347

[4] As outlined in the attached safety evaluation for 7 of the 10 items in RR-89-69, the licensee requested relief from the ASME Code, Section XI, Item B1.21 and B1.22 requirements. ASME Code, Section XI, Items B1.21 and B1.22 require the accessible length of the subject welds to be examined. The licensee stated in its request that the accessible length of the subject welds were examined. Therefore, the licensee met the ASME Code requirements for these welds and does not need relief from the ASME Code requirements.

RR-89-77. The NRC staff also concludes that ASME Code system leakage test is impractical for the subject piping listed in RR-89-78. The NRC staff has concluded that based on the volumetric, surface and/or visual examination coverage obtained, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject components.

Therefore, the NRC staff grants relief in accordance with 10 CFR 50.55a(g)(6)(i) for the subject examinations of the components contained in RRs RR-89-69 (in part), RR-89-70, RR-89-71, RR-89-72, RR-89-73, RR-89-74, RR-89-75, RR-89-76, RR-89-77, and RR-89-78. The NRC staff has further determined that granting these RRs to 10 CFR 50.55a(g) is authorized by law and will not endanger life or property, or the common defense and security, and is otherwise in the public interest given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any question, please contact the Project Manager, Carleen Sanders, at 301-415-1603.

Sincerely,

Meena Khanna, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-336

Enclosure:
As stated

cc w/encl: Distribution via Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

THIRD 10-YEAR INSERVICE INSPECTION INTERVAL

REQUEST FOR RELIEF NOS. RR-89-69, RR-89-70, RR-89-71, RR-89-72, RR-89-73, RR-89-74, RR-89-75, RR-89-76, RR-89-77, AND RR-89-78

MILLSTONE POWER STATION, UNIT NO. 2

DOMINON NUCLEAR CONNECTICUT, INC.

DOCKET NUMBER 50-336

1.0 INTRODUCTION

By letter dated March 30, 2011,[1] as supplemented by letter dated September 22, 2011,[2] Dominion Nuclear Connecticut, Inc. (DNC or the licensee) submitted relief requests (RRs) RR-89-69, RR-89-70, RR-89-71, RR-89-72, RR-89-73, RR-89-74, RR-89-75, RR-89-76, RR-89-77, and RR-89-78 for Millstone Power Station, Unit No. 2 (MPS2). DNC requested relief from certain requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code*, Section XI for the third 10-year inservice inspection (ISI) interval, in which the licensee adopted the 1989 Edition with no Addenda. The third 10-year ISI interval began on April 1, 1999, and ended on March 31, 2010. The NRC staff contracted Pacific Northwest National Laboratory (PNNL) to assist with the review of these requests.

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Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii), the licensee requested relief from inservice inspection items listed in RRs RR-89-69, RR-89-70, RR-89-71, RR-89-72, RR-89-73, RR-89-74, RR-89-75, RR-89-76, RR-89-77, and RR-89-78 on the basis that the code requirements are impractical.

2.0 REGULATORY REQUIREMENTS

The ISI of ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by 10 CFR 50.55a(g), except where specific relief has been requested by the licensee pursuant to 10 CFR 50.55a(g)(5)(iii) and granted by the Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(g)(6)(i).

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[1] Agencywide Documents Access and Management System Accession (ADAMS) Accession No. ML110960361
[2] ADAMS Accession Nos.: Package No. ML112730177, Letter No. ML11273A049, and Attachment No. ML11273A050 (non-public)
[3] ADAMS Accession No. ML112930347

10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety; or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ASME Code of Record for MPS2 third 10-year interval inservice inspection program, which ended on March 31, 2010, is the 1989 Edition, with no Addenda.

3.0 EVALUATION

The information provided by the licensee in support of the requests for alternatives to ASME Code requirements has been evaluated and the bases for disposition are documented below. For clarity, the licensee's requests have been evaluated in several parts according to ASME Code Examination Category.

3.1 Request for Relief RR-89-69, ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Items B1.11, B1.12, B1.21, and B1.22, Pressure Retaining Welds in Reactor Pressure Vessel (RPV)

ASME Code Requirement

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Items B1.11 and B1.12 require essentially 100 percent volumetric examination of the length of reactor pressure vessel circumferential and longitudinal shell welds as shown in Figures IWB-2500-1 and -2, respectively. Examination Category B-A, Items B1.21 and B1.22 require essentially 100 percent volumetric examination of the accessible length of circumferential and meridional head welds on the RPV as shown in Figure IWB-2500-3. ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds," allows credit for essentially 100 percent coverage of the weld provided greater than 90 percent coverage of the examination volume or surface area, as required, has been examined. ASME Code Case N-460 has been approved for use by the NRC in Regulatory Guide 1.147, Revision 16 (RG 1.147, Revision 16), "Inservice Inspection Code Case Acceptability."

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination of ASME Code, Class 1 RPV circumferential and longitudinal shell welds, and circumferential and meridional head welds listed in Table 3.1.1 below.

Table 3.1.1 – ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A

ASME Code Item	Weld ID	Weld Type	Coverage Obtained Percent
B1.11	SC-2	Middle Shell-to-Lower Shell Weld	82.6
B1.12	LSL-1	Lower Shell Longitudinal Weld (90 Deg.)	76.8
B1.12	MSL-1	Middle Shell Longitudinal Weld (90 Deg.)	39.1
B1.21	HS-1	Lower Shell-to-Lower Head Weld	72.5
B1.22	BHV-1	Lower Head Meridional Weld (30 Deg.)	53.3
B1.22	BHV-2	Lower Head Meridional Weld (90 Deg.)	43.4
B1.22	BHV-3	Lower Head Meridional Weld (150 Deg.)	53.3
B1.22	BHV-4	Lower Head Meridional Weld (210 Deg.)	43.4
B1.22	BHV-5	Lower Head Meridional Weld (270 Deg.)	53.3
B1.22	BHV-6	Lower Head Meridional Weld (330 Deg.)	43.4

Licensee's Basis for Relief Request (as stated)

> Due to the design of the reactor pressure vessel (RPV), geometric configuration and permanent obstructions limit the volumetric examination coverage of the subject welds.
>
> During the third 10-year RPV examination, the best available technology was used in performing the automated ultrasonic examination from the inside surface of the RPV. The examinations were performed with equipment, procedures and personnel qualified in accordance with the requirements of the ASME Section XI, Appendix VIII, 1995 Edition thru 1996 Addenda, as implemented by the Performance Demonstration Initiative (PDI) program.
>
> The examination of the six (6) lower head meridional welds were limited due to obstructions from the flow skirt that is permanently attached to the

inside of the RPV. Additionally, three (3) of these meridional welds are also limited due to the obstruction of the core support lugs that are permanently attached to the RPV. The examination of the lower shell to lower head weld was limited due to the obstructions from the core barrel stabilizer and core support lugs that are permanently attached to the inside of the RPV. The examination of two (2) of the lower and middle shell longitudinal welds, and the middle shell-to-lower shell weld were limited due to the obstructions from the permanent surveillance specimen holder tubes.

These noted permanent obstructions on the inside surface of the RPV prevent achieving the essentially 100% examination coverage required by [ASME] Code. Due to the high dose rates in the area, attempts to improve examination coverage from the outside surface of the RPV would result in a significant increase in the radiation exposure to personnel without a commensurate increase in the level of quality and safety.

To increase examination coverage on the subject welds requires a significant design modification or replacement of components with a different design to eliminate the noted obstructions. This is impractical due to the cost, additional radiation exposure and impact to plant equipment.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

NRC Staff Evaluation

The ASME Code requires essentially 100 percent volumetric examination of pressure retaining welds in the RPV. However, the design configuration of the RPV circumferential and longitudinal shell welds, and circumferential and meridional head welds, limit complete examinations due to permanently attached components adjacent to the welds. In order to effectively increase the examination coverage, the RPV and adjacent components would require design modifications or replacement. This would place a burden on the licensee; thus, examining essentially 100 percent of the ASME Code-required volumes is impractical.

The design of the MPS2 RPV limits the examination of the subject welds as shown in technical descriptions and sketches provided by the licensee. The subject RPV welds listed in Table 3.1.1 above were examined using 45-degree shear and 45- and 70-degree refracted longitudinal wave scans with equipment, procedures and personnel that were qualified by performance demonstration according to ASME Code Section XI, Appendix VIII. Examinations of the subject welds were performed with automated ultrasonic (UT) inspection equipment from the inside surface of the RPV. The licensee stated that performing these examinations from the outside surface would cause a significant increase in radiation exposure without a compensating increase in the level of quality or safety.

For the Middle Shell-to-Lower Shell Circumferential Weld SC-2, and the Middle Shell Longitudinal Welds LSL-1 and MSL-1, the UT examinations were restricted due to the close proximity of surveillance specimen holder tubes to the welds. The licensee was able to obtain between 39.1 percent and 82.6 percent of the required ASME Code volume. Five subsurface indications were detected on RPV Circumferential Weld SC-2 and were all evaluated as being acceptable by the criteria of IWB-3510-1 of ASME Code, Section XI. For the Middle Shell-to-Lower Shell Weld SC-2 and Lower and Middle Longitudinal Seam Welds LSL-1 and MSL-1, the licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the subject welds due to their design geometries and proximity of integral RPV appurtenances.

Based on the volumetric coverage obtained, along with the full examination of other RPV pressure retaining welds, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

ASME Code, Section XI, Items B1.21 and B1.22 require that the lower shell-to-lower head circumferential Weld HS-1 and lower head meridional Welds BHV-1 through BHV-6 be subject to essentially 100 percent volumetric examination of the "accessible length" of the welds. The licensee stated in its response to the NRC request for additional information (RAI) that these welds were examined for essentially 100 percent of their accessible length. As such, the coverage volumes listed in Table 3.1.1 above are applied to the entire weld length; not only the accessible weld length. The three subsurface indications detected on RPV circumferential Weld HS-1 were all evaluated as being acceptable by the criteria of IWB-3510-1 of ASME Code, Section XI. Therefore, the licensee met the examination requirements for the subject ASME Code, Items B1.21 and B1.22 welds and relief is not required.

3.2 Request for Relief RR-89-70, ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Item B3.130, Full Penetration Welded Nozzles in Vessels

ASME Code Requirement

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Item B3.130 requires 100 percent volumetric examination of full penetration Class 1 nozzle-to-vessel welds on the steam generator (SG) as shown in Figures IWB-2500-7 (a) through (d), as applicable. ASME Code Case N-460 allows credit for essentially 100 percent coverage of the weld provided greater than 90 percent coverage of the examination volume or surface area, as required, has been examined. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 16.

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examinations for the SG nozzle-to-vessel welds listed below in Table 3.2.1.

Table 3.2.1 – ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D			
ASME Code Item	Weld ID	Weld Type	Coverage Obtained Percent
B3.130	SG-1-NH-2-A	Cold Leg Nozzle-to-Hemisphere	54.0
B3.130	SG-1-NH-4-A	Hot Leg Nozzle-to-Hemisphere	56.0
B3.130	SG-1-NH-5-A	Cold Leg Nozzle-to-Hemisphere	55.0

Licensee's Basis for Relief Request (as stated)

> The subject steam generator nozzle-to-vessel welds were examined with a manual ultrasonic technique using pulse echo ultrasonic instruments and transducers. The best available technology was used to achieve the maximum examination coverage practical. Limitations imposed by the nozzle configuration preclude obtaining 100% coverage. This configuration with the nozzle outside radius and outside diameter [OD] taper are within close proximity of the weld and prevents scanning in these areas. This limits the circumferential, axial scan and straight beam coverage that can be obtained.
>
> No alternative methods or advanced technologies were considered capable of increasing the ASME code coverage.
>
> To increase examination coverage on the subject welds would require a significant design modification or replacement of components with a different design to eliminate the noted obstructions which is considered impractical due to the cost, additional radiation exposure and impact to plant equipment.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

NRC Staff Evaluation

The ASME Code requires 100 percent volumetric examination of ASME Code, Class 1 nozzle-to-vessel welds. However, the design configuration of the subject welds limit access for UT scanning. In order to effectively increase the examination coverage, the nozzle-to-vessel welds would require design modifications. This would place a burden

on the licensee; thus, 100 percent ASME Code-required volumetric examinations are considered impractical.

The SG nozzle-to-vessel welds shown in Table 3.2.1 above are constructed of carbon steel material with internal stainless steel cladding. The welds on the subject nozzles extend the full thickness of the SG vessel head. These nozzles are of the 'set-in' design which essentially makes the welds concentric rings aligned parallel with the nozzle axes in the through-wall direction of the SG vessel. This nozzle design geometry limits ASME Code-required UT angle beam examinations to be performed primarily from the vessel side of the welds.

As shown on the sketches and technical descriptions included in the licensee's submittal, examinations of the subject SG nozzle-to-vessel welds have been completed to the extent practical with volumetric coverage ranging from approximately 54.0 percent to 56.0 percent (see Table 3.2.1 above) of the ASME Code-required volume. The examination volumes included the weld and base materials near the inside surface of the weld joint, which are the highest regions of stress, and where one would expect degradation sources to be manifested should they occur. The SG nozzle-to-vessel weld examinations were performed with manual UT techniques in accordance with the applicable requirements of the ASME Code, Section V, Article 4. The welds were examined using 0-degree longitudinal and 45- and 60-degree shear waves with supplemental 30-degree shear waves for both of the cold leg nozzle welds. There were three indications detected on the SG nozzles that were evaluated to be non-relevant internal geometrical reflections.

Although UT scans were primarily limited to the vessel side, studies have found that inspections conducted through carbon steel are equally effective whether the UT waves have only to propagate through the base metal, or have to also propagate through the carbon steel weldment.[4] Therefore, it is expected that the UT techniques employed by the licensee would detect structurally significant flaws that might occur on either side of the subject welds due to the fine-grained carbon steel microstructures.

The licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the subject nozzle-to-vessel welds due to their design. Based on the volumetric coverage obtained for the subject welds, and considering the licensee's performance of UT techniques employed to maximize this coverage, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

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[4] P.G. Heasler and S. R. Doctor, 1996. Piping Inspection Round Robin, NUREG/CR-5068, PNNL-10475, U. S. Nuclear Regulatory Commission, Washington, DC. Non-public.

3.3 Request for Relief RR-89-71, ASME Code, Section XI, Table IWB-2500-1, Examination Category B-J, Item B9.11, Pressure Retaining Welds in Piping

ASME Code Requirement

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-J, Item B9.11, requires essentially 100 percent volumetric and surface examinations for circumferential piping welds, nominal pipe size 4 or larger as shown in Figure IWB-2500-8. ASME Code Case N-460 allows credit for essentially 100 percent coverage of the weld provided greater than 90 percent coverage of the examination volume or surface area, as required, has been examined. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 16.

Pursuant to 10 CFR 50.55a(b)(2)(xvi)(B), examinations performed from one side of a stainless steel pipe weld must be conducted with equipment, procedures, and personnel that have demonstrated proficiency with single-side examinations. To demonstrate equivalency to two-sided examinations, the demonstration must be performed to the requirements of ASME Code Section XI, Appendix VIII as modified by 10 CFR 50.55a(b)(2)(xv)(A) and 10 CFR 50.55a(b)(xvi)(B).

Pursuant to 10 CFR 50.55a(b)(2)(xv)(A), the following examination coverage criteria must be met when applying Supplement 2 of ASME Code Section XI, Appendix VIII: Where examination from both sides is not possible on austenitic welds, full coverage credit from a single side may be claimed only after completing a successful single-sided Appendix VIII demonstration using flaws on the opposite side of the weld.

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination of MPS2, ASME Code, Class 1 stainless steel piping welds shown in Table 3.3.1 below.

Table 3.3.1 – ASME Code, Section XI, Table IWB-2500-1, Examination Category B-J

ASME Code Item	Weld ID	Weld Type	Coverage Obtained Percent
B9.11	BSI-C-1025	12" Valve-to-Elbow	50.0
B9.11	BSI-C-1027	12" Pipe-to-Valve	50.0
B9.11	BSI-C-1029	12" Valve-to-Pipe	50.0
B9.11	BSI-C-4010	12" Valve-to-Pipe	50.0

Licensee's Basis for Relief Request (as stated)

> [R]elief is requested from the 100% volumetric examination coverage requirement for austenitic piping welds with single side access.

> The manual ultrasonic scanning techniques were performed using pulse-echo ultrasonic instruments and transducers qualified in accordance with ASME Section XI, Appendix VIII as implemented by the Performance Demonstration Initiative (PDI).
>
> There are currently no PDI-qualified single side examination procedures that demonstrate equivalency to two-sided examination procedures on austenitic piping welds. Current technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld for configurations common to domestic nuclear applications.
>
> Compliance with the [ASME] Code requirements would require extensive modification or replacement of components with a design that would allow examination from both sides of the weld which is considered impractical due to cost, additional radiation exposure and impact to plant equipment.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

NRC Staff Evaluation

The ASME Code requires essentially 100 percent volumetric and surface examinations for selected ASME Code, Section, IWB-2500-1, Examination Category B-J pressure retaining welds in piping. However, complete volumetric examinations are restricted to one side of the weld by materials and weld configurations. These conditions preclude the licensee from obtaining full volumetric examinations from both sides of these welds and there is currently no way for single-side examinations to demonstrate equivalency to two-sided examination. To gain access for examination, the welds would require design modifications. Imposition of this requirement would create a burden on the licensee; therefore, the ASME Code-required volumetric examinations are considered impractical.

As shown on the sketches and technical descriptions included in the licensee's submittal, examinations of the subject welds have been performed to the extent practical with the licensee obtaining approximately 50 percent volumetric coverage from one side of the weld (see Table 3.3.1 above). The limitations encountered during the performance of the UT examinations were caused by austenitic stainless steel materials and tapers of the valves in the valve-to-pipe and valve-to-elbow weld configurations. These configurations limit the volumetric examinations primarily to the pipe or elbow side of the welds.

Volumetric examinations on the subject welds were conducted with equipment, procedures and personnel that were qualified to the process outlined in ASME Code Section XI, Appendix VIII. These techniques have been qualified for flaws located on the near-side of the welds; far-side detection of flaws is considered to be a 'best effort.' For this reason, the licensee has taken credit for completing only 50 percent of the ASME Code-required inspection volumes on the subject piping welds. The licensee's

UT scanning techniques included combinations of 45- and/or 70-degree shear, and 60-degree refracted longitudinal waves (L-waves), from the accessible sides of the weld. L-waves have been shown to provide enhanced detection on the far-side of austenitic stainless steel welds;[5,6] therefore, while the licensee has only taken credit for obtaining 50 percent volumetric coverage, the techniques employed would have provided coverage beyond the near-side of the welds. The licensee completed the ASME Code-required surface examinations (liquid penetrant (PT)) on the subject welds with no limitations. No recordable indications were observed during the UT and surface examinations.

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject welds due to the design geometry of the welds and materials of construction. Based on the volumetric coverage obtained, and considering the full surface examination performed, it is reasonable for the NRC staff to conclude that, if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected by the examinations performed. Furthermore, the NRC staff determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

3.4 Request for Relief RR-89-72, ASME Code, Section XI, Table IWC-2500-1, Examination Category C-A, Items C1.10 and C1.30, Pressure Retaining Welds in Pressure Vessels

ASME Code Requirement

ASME, Code, Section XI, Table IWC-2500-1, Examination Category C-A, Items C1.10 and C1.30 require essentially 100 percent volumetric examination of the length of Class 2 circumferential shell and tubesheet-to-shell welds as shown Figures IWC-2500-1 and -2. ASME Code Case N-460 allows credit for essentially 100 percent coverage of the weld provided greater than 90 percent coverage of the examination volume or surface area, as required, has been examined. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 16.

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examinations of the Shutdown Cooling Heat Exchanger Flange-to-Shell Weld SIAC-A2 and Tubesheet-to-Shell Weld SIAC-A1.

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5 F. V. Ammirato, X. Edelmann, and S.M. Walker, Examination of Dissimilar Metal Welds in BWR Nozzle-to-Safe End Joints, 8th International Conference on NDE in the Nuclear Industry, ASM International, 1987.

6 P. Lemaitre, T.D. Koble, and S.R. Doctor, *PISC III Capability Study on Wrought-to-Wrought Austenitic Steel Welds: Evaluation at the Level of Procedures and Techniques*, Effectiveness of Nondestructive Examination Systems and Performance Demonstration, PVP-Volume 317, NDE-Volume 14, ASME, 1995.

Table 3.4.1 – ASME Code, Section XI, Table IWB-2500-1, Examination Category C-A			
ASME Code Item	Weld ID	Weld Type	Coverage Obtained Percent
C1.30	SIAC-A1	Tube Sheet to Shell Weld	80.75
C1.10	SIAC-A2	Flange to Shell Weld	47

Licensee's Basis for Relief Request (as stated)

[R]elief is requested from the 100% volumetric examination coverage requirement of the subject welds due to the geometric configuration and permanent obstructions which limit the volumetric coverage that can be obtained.

The shutdown cooling heat exchanger tube sheet-to-shell weld (SIAC-A1) and the flange-to-shell weld (SIAC-A2) were examined with the manual ultrasonic technique using the best technology available to achieve the maximum examination coverage practical. The examinations were performed using pulse echo ultrasonic instruments and transducers. No alternative methods or advanced technologies were considered capable of increasing the ASME code coverage.

The position of the heat exchanger tube sheet flange limits the examination coverage of the subject tube sheet-to-shell weld. The tube sheet is located within close proximity to the weld and does not provide sufficient distance from the weld to allow complete axial scanning on that side of the weld. The scanning coverage on the tube sheet side of the weld was limited for the axial scans in both directions; 96.9% with scanning from the shell side and 26.1% while scanning from the tube sheet side.

The position of the heat exchanger channel cover flange limits the examination of the subject flange-to-shell weld to scanning from the shell side only. The flange is located within close proximity to the weld and does [not] allow sufficient distance for any axial or circumferential examination scanning from the flange side of the weld. Additionally, the location of this flange limits the axial scan from the shell side to 88%.

To increase examination coverage on the subject welds would require a significant design modification or replacement of the component with a different design to eliminate the noted obstructions. This option to meet the 100% [ASME] Code examination requirement is considered impractical due to the cost, increased radiation exposure, and impact to plant equipment.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

NRC Staff Evaluation

The ASME Code requires essentially 100 percent volumetric examination of pressure retaining welds on selected ASME Code, Class 2 pressure vessels. However, for the subject welds on the MPS2 Shutdown Cooling Heat Exchanger, complete examinations are limited due to the design configuration of these components. In order to achieve greater volumetric coverage, the heat exchanger would have to be redesigned and modified. This would place a burden on the licensee; therefore the ASME Code examinations are considered impractical.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the Shutdown Cooling Heat Exchanger Flange-to-Shell Weld SIAC-A2 and Tubesheet-to-Shell Weld SIAC-A1 have been performed to the extent practical, with the licensee obtaining approximately 47.0 percent and 80.8 percent, respectively, of the required ASME Code examination volumes. The examinations are limited due to the configuration of the tubesheet that runs perpendicular to the Shutdown Cooling Heat Exchanger and the configuration of the flange and proximity of the flange bolt to the weld examination volume. The Shutdown Cooling Heat Exchanger is fabricated of SA 515 GR 70 carbon steel with stainless steel cladding on the inside diameter (ID). The licensee examined these welds completely from the shell side using 45-degree shear waves to achieve full circumferential coverage and partial axial coverage along the weld length. There were 10 recordable indications detected, but all were evaluated as acceptable internal reinforcing plate and weld root geometry.

Although UT scans were primarily limited to the vessel side, studies have found that inspections conducted through carbon steel are equally effective whether the UT waves have only to propagate through the base metal, or have to also propagate through the carbon steel weldment.[7] Therefore, it is expected that the UT techniques employed by the licensee would detect structurally significant flaws that might occur on either side of the subject welds due to the fine-grained carbon steel microstructures.

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject welds due to the design geometry of the components. However, based on the volumetric coverage obtained, and the UT techniques employed, it is reasonable to conclude that, if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected by the examinations performed. Furthermore, the NRC staff determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

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[7] Ibid 4

3.5 Request for Relief RR-89-73, ASME Code, Section XI, Table IWC-2500-1, Examination Category C-B, Item C2.21, Pressure Retaining Nozzle Welds in Vessels

ASME Code Requirement

ASME Code, Section XI, Table IWC-2500-1, Examination Category C-B, Item C2.21 requires 100 percent surface and volumetric examinations of full penetration Class 2 nozzle-to-shell (or head) welds as shown in Figures IWC-2500-4 (a) or (b), as applicable. ASME Code Case N-460 states that a reduction in examination coverage due to part geometry or interference for any ASME Code Class 1 or 2 weld is acceptable provided that the reduction is less than 10 percent, i.e., greater than 90 percent examination coverage is obtained. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 16.

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examinations for the SG nozzle-to-shell (or head) welds listed in Table 3.5.1 below.

Table 3.5.1 – ASME Code, Section XI, IWC-2500-1, Examination Category C-B

ASME Code Item	Weld ID	Weld Type	Coverage Obtained Percent
C2.21	SG-1-FW-1	SG No. 1 Feed Water Nozzle-to-Shell Weld	74.7
C2.21	SG-2-MS-1	SG No. 2 Main Steam Nozzle-to-Head Weld	56.3

Licensee's Basis for Relief Request (as stated)

> [R]elief is requested from the essentially 100% volumetric examination coverage requirements of the subject welds due to the geometric configuration and permanent obstructions which limit the volumetric coverage that can be obtained.
>
> The subject welds were examined with manual ultrasonic scanning techniques using the best technology available to achieve the maximum examination coverage practical. The examination was performed using pulse echo ultrasonic instruments and transducers. No alternative methods or advanced technologies were considered capable of increasing the ASME code coverage.
>
> The steam generator feedwater nozzle-to-shell weld was examined from the shell side. The shell side examination was restricted due to the location of a permanently welded insulation retaining ring located within

close proximity of the weld that limited the axial scanning. No examination could be performed from the nozzle side due to the nozzle configuration which precludes any meaningful examination results from that side of the weld.

The steam generator main steam nozzle-to-head weld was examined from the head side of the weld. The examination from the head side was restricted by the location of six permanently welded insulation retaining lugs that limited the coverage that could be obtained in the areas of these lugs. No examination could be performed from the nozzle side due to the nozzle configuration which precludes any meaningful examination results from that side of the weld.

To increase examination coverage on the subject welds would require removing the permanently welded retaining lugs and ring and then reattaching them by welding following examination completion. This option to meet the 100% [ASME] Code examination requirement is considered impractical due to the increased radiation exposure and impact to plant equipment.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

NRC Staff Evaluation

The ASME Code requires 100 percent volumetric and surface examinations of full penetration nozzle-to-shell (or head) welds on selected ASME Code, Class 2 pressure vessels. However, for the Feedwater and Main Steam Nozzle Welds on MSP2 SG No. 1 and 2, complete examinations are limited due to their design configuration and adjacent appurtenances. In order to achieve greater volumetric coverage, the SG nozzles and adjacent components would have to be redesigned and modified. This would place a burden on the licensee; therefore, the ASME Code examinations are considered impractical.

As shown on the sketches and technical descriptions included in the licensee's submittal, examinations of SG Feedwater Nozzle-to-Shell Weld SG-1-FW-1 and Main Steam Nozzle-to-Head Weld SG-2-MS-1 have been performed to the extent practical, with the licensee obtaining approximately 74.7 and 56.3 percent, respectively, of the required examination volume. The SG is fabricated of carbon steel, with inner diameter stainless steel cladding. The nozzles' "set-in" design essentially makes these welds concentric rings aligned parallel with the nozzle axes. For this reason, no scans could be performed from the nozzle side of the welds. The licensee also noted that a permanently welded insulation ring and 6 insulation lugs within close proximity to the welds limited the volumetric examinations. The licensee examined these welds from the shell side using 0-degree longitudinal, and 45- and 60-degree shear waves to achieve limited circumferential and axial coverage along the weld length. The licensee completed the ASME Code-required surface examinations (magnetic particle (MP)) on

the subject welds with no limitations. No recordable indications were observed during the UT and surface examinations.

Although UT scans were limited primarily to the vessel side of the welds only, studies have found that inspections conducted through carbon steel are equally effective whether the UT waves have only to propagate through the base metal, or have to also propagate through the carbon steel weldment.[8] Therefore, it is expected that the UT techniques employed by the licensee would detect structurally significant flaws that might occur on either side of the subject weld due to the fine-grained carbon steel microstructures in these materials.

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for the subject welds due to the design geometry of the welds and proximity of integral appurtenances. However, based on the volumetric coverage obtained, and the full surface examination performed, it is reasonable to conclude that, if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected by the examinations performed. Furthermore, the NRC staff determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

3.6 Request for Relief RR-89-74, ASME Code, Section XI, Table IWC-2500-1, Examination Category C-C, Item C3.20, Integral Attachments for Vessels, Piping, Pumps, and Valves

ASME Code Requirement

ASME Code, Section XI, Table IWC-2500-1, Examination Category C-C, Item C3.20, requires 100 percent surface examination of integrally welded attachments to Class 2 piping as shown in Figure IWC-2500-5. ASME Code Case N-460 states that a reduction in examination coverage due to part geometry or interference for any ASME Code Class 1 or 2 weld is acceptable provided that the reduction is less than 10 percent, i.e., greater than 90 percent examination coverage is obtained. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 16.

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required 100 percent surface examinations for the attachment welds on Main Steam Pipe Restraint, MSR-2, listed in Table 3.6.1 below.

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[8] Ibid 4

Table 3.6.1 – ASME Code, Section XI, IWC-2500-1, Examination Category C-C			
ASME Code Item	Weld ID	Weld Type	Coverage Obtained Percent
C3.20	MSR-2	MSR-2 Lug Attachment Welds	75.5

Licensee's Basis for Relief Request (as stated)

> [R]elief is requested from the essentially 100% surface examination coverage requirement of the subject welds due to the geometric configuration and obstructions caused by the pipe rupture restraint support members which limit the surface examination coverage that can be obtained.
>
> A magnetic particulate [MT] surface examination of the subject welds was performed to the maximum extent practical with the limitations caused by the obstruction of the support members of a pipe rupture restraint that are in close proximity of the welds.
>
> The subject attachment welds consist of the welds associated with a set of four lugs that are welded to the piping pressure boundary to restrict the restraint movement. Each lug is welded on all four sides. The examination of the attachment welds for these four lugs is restricted due to the location of the restraint members that limit the access for examination and the coverage that can be obtained. Alternative non-destructive examination (NDE) methods were considered, however, due to the limited access to these areas, it was determined that they would not provide any meaningful results.
>
> To increase the examination coverage, the support members of the pipe rupture restraint would need to be disassembled and removed. The removal of this large complex restraint would require a significant effort that is considered impractical due to the impact to plant equipment.

Licensee's Proposed Alternative Examination

The licensee did consider alternative examinations for the subject welds; however, the licensee determined they would not provide any meaningful results. The licensee's examinations were performed to the maximum extent practical.

NRC Staff Evaluation

The ASME Code requires 100 percent surface examination of the subject ASME Code, Class 2 integral attachment piping welds. However, surface examinations are limited due to inaccessibility and interferences caused by piping support members. In order for

the licensee to obtain 100 percent of the ASME Code-required examination coverage, the integral attachment welds would have to be disassembled and removed, causing potential damage to the support members or adjacent components. This would place a burden on the licensee; therefore, the ASME Code examination requirements are considered impractical.

As shown on the sketches and technical descriptions included in the licensee's submittals, MT testing examinations of four carbon steel Main Steam Piping Restraint Lug Attachment Welds for Support MSR-2 have been performed to the extent practical. The licensee obtained a combined surface examination coverage of approximately 75.5 percent of the ASME Code requirements. No reportable indications were detected during the limited surface examinations. There are three areas to be examined on all four welded lugs. A portion of each area is limited due to the proximity of the restraint plates near the attachment lug welds. The only way to increase examination coverage would be to disassemble the piping restraint, which weighs approximately 2500 pounds, with specialized rigging equipment. The restraint consists of a 73 inch diameter boxed steel plate ring secured by four studs that are 2 ¾-inches in diameter and 6 feet in length. The clearance between the steel ring and the 34-inch diameter pipe is minimal which could cause damage to the pipe, restraint ring or surrounding components. Also, recent ASME Code requirements, starting with the 2004 Edition, which has been approved by the NRC and was incorporated into 10 CFR 50.55a in 2009, allow examination of surface areas be limited to the portions of these areas that are accessible without removal of support members.

The licensee has shown that it is impractical to meet the ASME Code-required surface examination coverage for the subject ASME Code, Class 2 integral attachment piping welds. However, based on the surface coverage obtained if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. In addition, later NRC-approved Editions of the ASME Code have limited the examinations to only areas accessible without the removal of support members. Furthermore, the NRC staff determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

3.7 Request for Relief RR-89-75, ASME Code, Section XI, Table IWC-2500-1, Examination Category C-F-1, Items C5.11 and C5.21, Pressure Retaining Welds in Austenitic Stainless Steel or High Alloy Piping

ASME Code Requirement

ASME Code, Section XI, Table IWC-2500-1, Examination Category C-F-1, Items C5.11 and C5.21, require 100 percent surface and volumetric examination of selected Class 2 austenitic stainless steel or high alloy circumferential piping welds as shown in Figure IWC-2500-7. ASME Code Case N-460 states that a reduction in examination coverage due to part geometry or interference for any ASME Code Class 1 or 2 weld is acceptable provided that the reduction is less than 10 percent, i.e., greater than 90 percent examination coverage is obtained. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 16.

Pursuant to 10 CFR 50.55a(b)(2)(xvi)(B), examinations performed from one side of a stainless steel pipe weld must be conducted with equipment, procedures, and personnel that have demonstrated proficiency with single-side examinations. To demonstrate equivalency to two-sided examinations, the demonstration must be performed to the requirements of ASME Code Section XI, Appendix VIII, as modified by 10 CFR 50.55a(b)(2)(xv)(A) and 10 CFR 50.55a(b)(xvi)(B).

Pursuant to 10 CFR 50.55a(b)(2)(xv)(A), the following examination coverage criteria must be met when applying Supplement 2 of ASME Code Section XI, Appendix VIII: Where examination from both sides is not possible on austenitic welds, full coverage credit from a single side may be claimed only after completing a successful single sided Appendix VIII demonstration using flaws on the opposite side of the weld.

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required 100 percent volumetric examination of the ASME Code, Class 2 austenitic stainless steel welds shown in Table 3.7.1 below.

Table 3.7.1 – ASME Code, Section XI, Table IWC-2500-1, Examination Category C-F-1

ASME Code Item	Weld ID	Weld Configuration	Coverage Obtained Percent (no credit taken from the far side)
C5.11	HSI-CF-C-014	6" Pipe-to-Valve	50.0
C5.11	HSI-CF-E-050	6" Pipe-to-Tee	50.0
C5.11	HSI-CF-E-057	6" Pipe-to-Valve	50.0
C5.11	SI-CF-B-023	10" Pipe-to-Elbow	77.8
C5.11	SI-CF-C-011	6" Valve-to-Pipe	50.0
C5.11	SI-CF-D-013-1	6" Tee-to-Pipe	50.0
C5.11	SI-CF-F-046-1	6" Tee-to-Pipe	42.25
C5.11	SI-CF-F-051	6" Pipe-to-Valve	75.0
C5.11	SI-CF-X-69	12" Pipe-to-Valve	48.75
C5.11	SI-CF-X-82	12" Pipe-to-Valve	50.0
C5.21	HSI-CF-316	4" Pipe-to-Valve	44.75
C5.21	HSI-CF-351	3" Valve-to-Tee	43.5
C5.21	SI-CF-E-058	3" Pipe-to-Tee	50.0
C5.21	SI-CF-F-052	3" Tee-to-Pipe	50.0

Licensee's Basis for Relief Request (as stated)

> [R]elief is requested from the essentially 100% volumetric examination coverage requirements for austenitic piping welds with single-side access.
>
> Manual ultrasonic scanning techniques were performed using pulse-echo ultrasonic instruments and transducers qualified in accordance with ASME Section XI, Appendix VIII as implemented by the Performance Demonstration Initiative (PDI).
>
> There are currently no PDI qualified single-side examination procedures that demonstrate equivalency to two-sided examination procedures on austenitic piping welds. Current technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld for configurations common to domestic nuclear applications.
>
> There are currently no PDI qualified single-side examination procedures that demonstrate equivalency to two-sided examination procedures on austenitic piping welds. Current technology is not capable of reliably detecting or sizing flaws on the far side of austenitic weld for configurations common to domestic nuclear applications.
>
> The ASME Code required volume of these welds was interrogated ultrasonically to the maximum extent possible. No alternative methods or advanced technologies were considered capable of increasing the ASME Code coverage[.]
>
> Based on the configuration limited to single-sided access, relief is requested from complying with the essentially 100% required examination coverage for the following piping welds listed in Table [3.7.1 above]. Note that examination coverage listed was obtained during examination with no credit taken for the far side of each weld in which examination from that side could not be performed.
>
> Compliance with the [ASME] Code requirements would require extensive modification or replacement of components with a design that would allow examination from both sides of the weld. This option to meet the 100 percent [ASME] Code examination requirement for coverage is considered impractical based on the cost, additional radiation exposure and impact to plant equipment.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

NRC Staff Evaluation

The ASME Code requires 100 percent volumetric and surface examination for selected ASME Code, Class 2 pressure-retaining welds in austenitic stainless steel or high alloy circumferential piping. The volumetric examination must be applied from both sides of the weld to maximize coverage. However, volumetric examinations are limited by the geometry and material of the welds and the associated piping configurations, which restrict scanning to primarily one side only. To gain access for examination, the welds and piping would require design modifications. Imposition of this requirement would create a burden on the licensee; therefore, the ASME Code-required 100 percent volumetric examinations from both sides of the welds are considered impractical.

As shown on the sketches and technical descriptions included in the licensee's submittal, access for examination of the subject welds is limited primarily to the pipe, or tee side of the welds due to austenitic stainless steel materials, weld-o-lets, inside radii, and tapers from the valve-to-pipe, pipe-to-tee, pipe-to-elbow, and valve-to-tee weld configurations (see Table 3.7.1 above). Also, Pipe-to-Elbow Weld SI-CF-B-023 was limited on the pipe side of the weld due to a permanent box type restraint within close proximity of the weld. The UT techniques employed for these welds have been qualified through the industry's PDI, which meets ASME Code Section XI, Appendix VIII requirements. These techniques have been qualified for flaws located on the near-side of the welds; far-side detection of flaws is considered to be a 'best effort.' For this reason, the licensee has taken credit for only completing approximately 50 percent (or less) of the ASME Code-required inspection volume on many of the subject piping welds. The licensee completed the ASME Code PT surface examinations to their full extent. No unacceptable indications were noted during the performance of the volumetric or surface examinations.

The licensee's UT techniques included 45-, 60- and 70-degree shear waves and 60- and 70-degree refracted longitudinal waves (L-waves), as applicable, on many of the subject welds. L-waves have been shown to provide enhanced detection on the far-side of austenitic stainless steel welds.[9,10] While the licensee has only taken credit for obtaining near-side volumetric coverage, the techniques employed would have provided coverage beyond the near-side of the welds.

The licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the subject piping welds due to their design and ultrasonic access restrictions. Although the ASME Code-required coverage could not be obtained, the ultrasonic techniques employed would have provided full volumetric coverage for the near-side of the welds and limited volumetric coverage for the weld fusion zone and base materials on the opposite side of the welds. Based on the aggregate coverage obtained for the subject welds, and considering the licensee's performance of a full surface examination, it is reasonable for the NRC staff to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected. Furthermore, the NRC staff determined that the examinations performed

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9 Ibid 5

10 Ibid 6

to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

3.8 Request for Relief RR-89-76, ASME Code, Section XI, Table IWC-2500-1, Examination Category C-F-2, Item C5.81, Pressure Retaining Welds in Carbon or Low Alloy Steel Piping

ASME Code Requirement

ASME Code, Section XI, Table IWC-2500-1, Examination Category C-F-2, Item C5.81, requires 100 percent surface examination of selected Class 2 carbon or low alloy steel piping branch connection welds as shown in Figure IWC-2500-9 to -13, inclusive. ASME Code Case N-460 states that a reduction in examination coverage due to part geometry or interference for any ASME Code Class 1 or 2 weld is acceptable provided that the reduction is less than 10 percent, i.e., greater than 90 percent examination coverage is obtained. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 16.

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required 100 percent surface examination of the ASME Code, Class 2 Pipe Branch Connection Circumferential Weld MSB-CG-16 shown in Table 3.8.1 below.

Table 3.8.1 – ASME Code, Section XI, Table IWC-2500-1, Examination Category C-F-2

ASME Code Item	Weld ID	Weld Configuration	Coverage Obtained Percent
C5.81	MSB-CG-16	Sweepolet-to-Pipe	61.5

Licensee's Basis for Relief Request (as stated)

> [R]elief is requested from the essentially 100% surface examination coverage requirement of the subject weld due to the geometric configuration and obstructions caused by the pipe rupture restraint support members which limit the surface coverage that can be obtained.
>
> Magnetic Particle [MT] surface examination of the subject weld was performed to the maximum extent practicable with the limitations caused by the obstruction of the support members that are in close proximity of the weld.
>
> The use of liquid penetrant [PT] examination was considered as an alternative to increase the coverage, however, due to the close proximity of the support members to the subject weld, it was determined that no meaningful results could be obtained. There were no other alternative

methods or advanced technologies that were considered capable of increasing the ASME code coverage.

To increase the examination coverage, the pipe rupture restraint would need to be disassembled and removed. The removal of this large complex restraint would require a significant effort that is considered to be impractical due to the impact to plant equipment.

Licensee's Proposed Alternative Examination

The licensee did consider alternative examinations to increase the examination coverage for the subject welds; however, the licensee determined that no meaningful results could be obtained due to the configuration of the subject component. However, the licensee's examinations were performed to the maximum extent practical.

NRC Staff Evaluation

The ASME Code requires 100 percent surface examination of selected ASME Code, Class 2 carbon steel pressure retaining piping branch connection welds. However, on Weld MSB-CG-16, surface examination is limited due to the proximity of piping restraints. In order to increase volumetric coverage, this weld and surrounding supports would need to be disassembled and removed causing potential damage to the support members or adjacent components. Imposition of this requirement would create a burden on the licensee; therefore, the ASME Code-required 100 percent volumetric examination of the subject weld is considered impractical.

Weld MSB-CG-16 is a carbon steel pipe sweepolet-to-pipe configuration. As shown on the sketches and technical descriptions included in the licensee's submittal, access for examination of the subject weld is limited due to the pipe rupture restraint support members that are within close proximity to the weld. A MT surface examination of the subject weld was performed to the maximum extent practical with the licensee obtaining approximately 61.5 percent surface coverage. No recordable indications were noted during the performance of the surface examinations. The only way to increase examination coverage would be to disassemble the piping restraint, which weighs approximately 2500 pounds, with specialized rigging equipment. The restraint consists of a 73 inch diameter boxed steel plate ring secured by four studs, 2 ¾-inches in diameter and 6 feet in length, that are bolted to a permanently welded upstream portion of the support assembly. The clearance between the steel ring and the 34-inch diameter pipe is minimal which could cause damage to the pipe, restraint ring or surrounding components. Also, to obtain the full ASME Code examination, a portion of the upstream permanently welded section would need to be cut out and removed to provide adequate access for examination of the upstream side of the weld.

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage for Weld MSB-CG-16 due to the proximity of the pipe rupture restraint. It is reasonable for the NRC staff to conclude that, if significant service-induced degradation had occurred in the subject weld, evidence of it would have been detected by the examination that was performed. Furthermore, the NRC staff

determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

3.9 Request for Relief RR-89-77, Westinghouse Owners Group Application of Risk-Informed Methods, Examination Category R-A, Item R1.20, Risk Informed Piping Examinations

ASME Code Requirement

The examination requirements for the subject piping welds at MPS2 are governed by a Risk-Informed Inservice Inspection (RI-ISI) program that was approved by the NRC in a Safety Evaluation (SE) dated April 1, 2005.[11] The RI-ISI program was developed in accordance with the Westinghouse Owners Group Topical Report (TR) WCAP-14572, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report, Revision 1-NP-A." As part of the NRC-approved program, the licensee has implemented inspection requirements listed in WCAP Table 4.1-1, Examination Category R-A, Risk-Informed Piping Examination, with more detailed provisions contained in the topical report. The topical report includes a provision for requesting relief from volumetric examinations if 100 percent of the required volumes cannot be examined.

Table 4.1-1 of WCAP-14572 assigns Examination Category R-A, Item R1.20, to elements not subject to a known damage mechanism. Table 4.1-1 requires 100 percent of the examination location volume, as described in Figures IWB-2500-8(c), -9, -10, or -11, as applicable, including an additional ½-inch of base metal adjacent to the ASME Code volume, be completed for selected ASME Code, Class 1 piping welds. ASME Code Case N-460 states that a reduction in examination coverage due to part geometry or interference for any ASME Code Class 1 or 2 weld is acceptable provided that the reduction is less than 10 percent, i.e., greater than 90 percent examination coverage is obtained. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 16.

Pursuant to 10 CFR 50.55a(b)(2)(xvi)(B), examinations performed from one side of a stainless steel pipe weld must be conducted with equipment, procedures, and personnel that have demonstrated proficiency with single side examinations. To demonstrate equivalency to two-sided examinations, the demonstration must be performed to the requirements of ASME Code Section XI, Appendix VIII, as modified by 10 CFR 50.55a(b)(2)(xv)(A) and 10 CFR 50.55a(b)(xvi)(B).

Pursuant to 10 CFR 50.55a(b)(2)(xv)(A), the following examination coverage criteria must be met when applying Supplement 2 of ASME Code Section XI, Appendix VIII: Where examination from both sides is not possible on austenitic welds, full coverage credit from a single side may be claimed only after completing a successful single sided Appendix VIII demonstration using flaws on the opposite side of the weld.

[11] ADAMS Accession No. ML050740463

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from 100 percent of the ASME Code-required inspection volumes for Class 1 piping welds shown in Table 3.9.1 below.

Table 3.9.1 – WCAP RI-ISI, Examination Category R-A			
WCAP Item No.	Weld ID	Weld Type	Coverage Obtained Percentage (no credit taken from the far side)
R1.20	BPV-C-5025A	2.5" Valve-to-Pipe	50.0
R1.20	BPV-C-5043A	2.5" Valve-to-Pipe	50.0
R1.20	BPV-C-5049A	2.5" Pipe-to-Valve	50.0
R1.20	BPV-C-5051A	2.5" Pipe-to-Valve	50.0
R1.20	BSI-C-1013	12" Elbow-to-Valve	50.0
R1.20	BSI-C-2011	12" Elbow-to-Valve	50.0
R1.20	BSI-C-3012	12" Valve-to-Elbow	50.0
R1.20	BSI-C-4010A	12" Valve-to-Pipe	50.0
R1.20	BSI-C-4011	12" Pipe-to-Valve	50.0
R1.20	BSI-C-4012	12" Valve-to-Elbow	50.0

Licensee's Basis for Relief Request (as stated)

> [R]elief is requested from the 100% volumetric examination coverage requirement for austenitic piping welds with single-side access.
>
> The manual ultrasonic scanning techniques were performed using pulse-echo ultrasonic instruments and transducers qualified in accordance with ASME Section XI, Appendix VIII as implemented by the Performance Demonstration Initiative (PDI).
>
> There are currently no PDI qualified single-side examination procedures that demonstrate equivalency to two-sided examination procedures on austenitic piping welds. Current technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld for configurations common to domestic nuclear applications.
>
> When the examination area is limited to one side of an austenitic weld, examination coverage does not comply with 10 CFR 50.55a(b)(2)(xv)(A) and proficiency demonstrations do not comply with 10 CFR 50.55a(b)(2)(xvi)(B) and full coverage credit may not be claimed.

> The ASME [C]ode required volume of these welds was interrogated ultrasonically to the maximum extent possible. No alternative methods or advanced technologies were considered capable of increasing the ASME [C]ode coverage.
>
> Based on the configuration limited to single-sided access, relief is requested on complying with the 100 % required examinations coverage for the piping welds listed in Table [3.9.1]. Note that the examination coverage listed was obtained during examination with no credit taken for the far side of each weld.
>
> Compliance with the [ASME] Code requirements would require extensive modification or replacement of components with a design that would allow examination from both sides of the weld which is considered to be impractical due to cost, additional radiation exposure and impact to plant equipment.

Licensee's Proposed Alternative Examination

The licensee did not propose any alternative examinations for the subject welds. However, the licensee's examinations were performed to the maximum extent practical.

NRC Staff Evaluation

The examination requirements for the subject piping welds at MPS2 are governed by a RI-ISI program that was approved by the NRC in an SE dated April 1, 2005. This program assigns WCAP RI-ISI, Examination Category R-A, Item R1.20 to piping elements not subject to a known damage mechanism. The program requires inspection of 100% of the examination volume for the subject circumferential piping welds. However, the design configurations of these welds limit volumetric examinations. In order to increase coverage, the welds would have to be re-designed and modified. This would place a burden on the licensee; therefore, the ASME Code-required volumetric examinations are considered impractical.

As shown in the technical descriptions and sketches provided in the licensee's submittals, examinations of the subject welds have been performed to the extent practical, with the licensee obtaining volumetric coverage of approximately 50% of the required volumes of the welds. The limitations encountered during the performance of the UT examinations were caused by cast stainless steel materials and taper of the valves in the valve-to-pipe and valve-to-elbow weld configurations. These configurations limit the volumetric examinations primarily to the pipe or elbow side of the welds. The licensee considered additional examinations of welds in similar risk-informed segments of Welds BSI-C-1013, BSI-C-2011, BSI-C-3012, and BSI-C-4012, and concluded that there would not be any increase in the level of quality and safety.

Volumetric examinations on the subject welds were conducted with equipment, procedures and personnel that were qualified to the process outlined in ASME Code Section XI, Appendix VIII. These techniques have been qualified for flaws located on the near-side of the welds; far-side detection of flaws is considered to be a 'best effort.'

The licensee's UT scanning techniques included combinations of 45- and 70-degree shear, and 60-degree refracted longitudinal waves (L-waves), as applicable, on many of the subject welds. L-waves have been shown to provide enhanced detection on the far-side of austenitic stainless steel welds;[12,13] therefore, while the licensee has only taken credit for obtaining 50% volumetric coverage, the techniques employed would have provided coverage beyond the near-side of the welds, as documented for some of the welds. The UT examinations did not reveal any unacceptable flaws.

Welds BPV-C-5025A, BPV-C-5043A, BPV-C-5049A, BPV-C-5051A, BSI-C-4011, and BSI-C-4010A were new replacement welds fabricated during the third inspection interval, after the RI-ISI program had been implemented. The licensee's request for relief is for volumetric limitations experienced on these replacement welds during preservice examinations. The licensee conducted volumetric examinations for these piping welds, as part of the risk-informed population and performed baseline examinations in accordance with equipment, procedures and personnel that were qualified to the process outlined in ASME Code Section XI, Appendix VIII. No unacceptable indications were detected during these UT examinations.

The licensee has shown that it is impractical to meet the ASME Code-required preservice or inservice volumetric examination coverage for the subject replacement or continued service welds due to the design geometry of the welds and materials of construction. Based on the UT examination results and coverage obtained, it is reasonable for the NRC staff to conclude that the preservice examinations provide an adequate baseline for comparison of future inservice examinations, and if significant service-induced degradation had occurred in the subject continued service welds, evidence of it would have been detected by the examinations performed. Furthermore, the NRC staff determined that the examinations performed to the extent practical on the subject welds provide reasonable assurance of structural integrity of the subject welds.

3.10 Request for Relief RR-89-78, ASME Code, Section XI, Table IWB-2500-1, Examination Category B-P, Item B15.11, Pressure Retaining Boundary

ASME Code Requirement

ASME Code, Section XI, Examination Category B-P, Item B15.11 requires all pressure retaining components be subject to a system hydrostatic test in accordance with ASME Code, Section XI, IWB-5222. The NRC has approved ASME Section XI Code Case N-498-4, "Alternative Requirements for 10-Year System Hydrostatic Testing for Class 1, 2, and 3 Systems, Section XI, Division 1," that allows a system leakage test at or near the end of each inspection interval prior to reactor startup as an alternative to the 10-year system hydrostatic test required by ASME Code, Section XI, Table IWB-2500-1, Category B-P. The pressure retaining boundary for the test conducted at or near the end of each inspection interval shall be extended to all ASME Code, Class 1 pressure retaining components within the system boundary with a test pressure not less than the pressure corresponding with 100 percent rated reactor power. This extended boundary system leakage test is to be conducted once per inspection interval.

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12 Ibid 5

13 Ibid 6

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from performing the system leakage test at a pressure corresponding to nominal operating pressure during system operation. The licensee proposed an alternative inspection in lieu of the system leakage test required under ASME Code, Section XI, IWB-5221 for the Reactor Vessel Head Flange Leak-Off Piping.

Licensee's Basis for Relief Request (as stated)

> The Reactor Pressure Vessel (RPV) head flange seal leak detection piping is shown in Figures 1 and 2 of this attachment.[14] The piping is separated from the reactor coolant pressure boundary by one passive membrane, which is an o-ring located on the inner vessel flange. A second o-ring is located on the outside of the tap in the vessel flange. Failure of the inner o-ring is the only condition under which this line is pressurized. Therefore, the line is not expected to be pressurized during the system pressure test following a refueling outage.
>
> The configuration of this piping precludes system pressure testing while the vessel head is removed because the configuration of the vessel tap coupled with the high test pressure prevents the tap in the flange from being temporarily plugged or connected to other piping. The opening in the flange is smooth walled, making the effectiveness of a temporary seal very limited. Failure of a temporary test seal could possibly cause ejection of the device used for plugging or connecting to the vessel flange.
>
> The configuration also precludes pressurizing the line externally with the head installed. The top head of the vessel contains two grooves that hold the o-rings. The o-rings are held in place by a series of retainer clips that are housed in recessed cavities in the flange face. If a pressure test were to be performed with the head on, the inner o-ring would be pressurized in a direction opposite to its design function. This test pressure would result in a net inward force on the inner o-ring that would tend to push it into the recessed cavity that houses the retainer clips. The thin o-ring material would likely be damaged by the inward force.
>
> The RPV flange seal leak-off line would only be pressurized in the event of a failure of the inner [o]-ring. Purposely failing or not installing the inner o-ring in order to perform a pressure test would require subsequently installing a new o-ring set with the time and radiation exposure associated with removing and reinstalling the RPV head a second time to replace the o-rings.

[14] Figures 1 and 2 are not included in this Safety Evaluation

Licensee's Proposed Alternative Examination (as stated)

> For each refueling outage during the third 10-year interval, a visual (VT-2) examination was performed on the unpressurized subject piping as part of the Class 1 leakage test.
>
> If the inner o-ring should leak during the operating cycle, it would be identified by an increase in temperature of the leak-off line above ambient temperature because this is an indication of o-ring seal leakage. This increased temperature would actuate an alarm in the control room, which is closely monitored by procedure and directs operator actions allowing identification of the leakage and any further compensatory actions, if required. This leakage would be collected in the primary drain transfer tank.
>
> Additionally, the flange seal leak-off line is essentially a leakage collection/detection system and the line would only function as a Class 1 pressure boundary if the inner o-ring fails, thereby pressurizing the line. If any significant leakage did occur in the leak-off line piping itself during this time of pressurization, it would exhibit boric acid accumulation and be discernable during the VT-2 visual examination that was performed unpressurized each refueling outage.

NRC Staff Evaluation

The ASME Code requires that all ASME Code, Class 1 components within the reactor coolant system boundary undergo a system hydrostatic test at or near the end of each inspection interval. The NRC staff has accepted a system leakage test under ASME Code Case N-498-4, in lieu of the system hydrostatic test. However, the licensee requests relief from performing a system leakage test of the RPV seal leak detection piping at the ASME Code-required pressure corresponding to 100 percent rated reactor power. The piping is located between the inner and outer o-ring seals of the vessel flange and is required during plant operation to detect failure of the inner flange seal o-ring. The design of this line makes the required system leakage test difficult with the vessel head removed or in place. The NRC staff concurs with the licensee's determination that each pressure test at Code-required pressure, with the RPV head on, would require replacing at least one new o-ring. The process of de-tensioning and removing the RPV head, replacing the inner o-ring and installing the RPV head would result in additional radiation exposure to personnel. Imposing this requirement would place a burden on the licensee; therefore, the ASME Code-required system leakage test is considered impractical.

The licensee performed the VT-2 visual examination for leakage during system leakage testing each refueling outage on the unpressurized subject piping. The leak detection line is essentially a leakage collection and detection system. The line would only function as a pressure boundary if the inner o-ring fails and pressurizes the line. If the inner o-ring should leak during the operating cycle, an increase in temperature of the leak-off line would be identified by an alarm in the Control Room. Additionally, if any significant leakage were to occur in the leak-off piping itself during pressurization, then it

would exhibit boric acid accumulation, which would be visible during the VT-2 visual examinations performed. Therefore, the NRC staff has determined that the licensee's proposed alternative would provide reasonable assurance of operational readiness and structural integrity of the subject pipe segments; and is, therefore, acceptable.

4.0 CONCLUSIONS

The NRC staff has reviewed the licensee's submittals and concludes that ASME Code examination coverage requirements are impractical for the subject welds listed in RRs RR-89-69 (in part),[15] RR-89-70, RR-89-71, RR-89-72, RR-89-73, RR-89-74, RR-89-75, RR-89-76, and RR-89-77. The NRC staff also concludes that ASME Code system leakage test is impractical for the subject piping listed in RR-89-78. The NRC staff has concluded that based on the volumetric, surface and/or visual examination coverage obtained, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject components.

Therefore, the NRC staff grants relief in accordance with 10 CFR 50.55a(g)(6)(i) for the subject examinations of the components contained in RRs RR-89-69 (in part), RR-89-70, RR-89-71, RR-89-72, RR-89-73, RR-89-74, RR-89-75, RR-89-76, RR-89-77, and RR-89-78. The NRC staff has further determined that granting these RRs to 10 CFR 50.55a(g) is authorized by law and will not endanger life or property, or the common defense and security, and is otherwise in the public interest given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

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Date: March 12, 2012

[15] As outlined in the safety evaluation for 7 of the 10 items in RR RR-89-69, the licensee requested relief from the ASME Code, Section XI, Item B1.21 and B1.22 requirements. ASME Code, Section XI, Items B1.21 and B1.22 require the accessible length of the subject welds to be examined. The licensee stated in its request that the accessible length of the subject welds were examined. Therefore, the licensee met the ASME Code requirements for these welds and does not need relief from the ASME Code requirements.

RR-89-77. The NRC staff also concludes that ASME Code system leakage test is impractical for the subject piping listed in RR-89-78. The NRC staff has concluded that based on the volumetric, surface and/or visual examination coverage obtained, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff concludes that the examinations performed to the extent practical provide reasonable assurance of structural integrity of the subject components.

Therefore, the NRC staff grants relief for the subject examinations of the components contained in RRs RR-89-69 (in part), RR-89-70, RR-89-71, RR-89-72, RR-89-73, RR-89-74, RR-89-75, RR-89-76, RR-89-77, and RR-89-78. The NRC staff has further determined that granting these RRs to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property, or the common defense and security, and is otherwise in the public interest given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any question, please contact the Project Manager, Carleen Sanders, at 301-415-1603.

Sincerely,

/RA/

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Docket No. 50-336

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