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

Serial No. 13-379
NLOS/WDC R0
Docket No. 50-336
License No. DPR-65

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2
PROPOSED ALTERNATIVE REQUEST RR-04-16 FOR THE USE OF ENCODED PHASED ARRAY ULTRASONIC EXAMINATION TECHNIQUES (PAUT) IN LIEU OF RADIOGRAPHY

Pursuant to 10 CFR 50.55a(a)(3)(ii), Dominion Nuclear Connecticut, Inc. (DNC) requests Nuclear Regulatory Commission (NRC) approval of Alternative Request RR-04-16, for Millstone Power Station Unit 2 (MPS2), in that the current Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. ASME Code, Section III requires that ASME Class 2 carbon steel circumferential pipe weld joints be examined utilizing radiographic examination techniques to satisfy nondestructive examination requirements. DNC requests approval to use encoded Phased Array Ultrasonic Examination Techniques (PAUT) as an alternative to radiographic examination. The supporting basis for this request is contained in the enclosure to this letter.

DNC anticipates needing this alternative request to support the next scheduled MPS2 refueling outage in spring 2014 (2R22) and requests approval by March 6, 2014. However, if piping examination results are acceptable for continued operation, piping replacement may be deferred.

If you have any questions regarding this submittal, please contact Wanda Craft at (804) 273-4687.

Sincerely,

Dan Stoddard

Daniel G. Stoddard
Senior Vice President – Nuclear Operations

Enclosure :

1. Alternative Request RR-04-16 Proposed Alternative to ASME Section III.

Commitments made in this letter: None

A047
NRR

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ENCLOSURE

ALTERNATIVE REQUEST RR-04-16
PROPOSED ALTERNATIVE TO ASME SECTION III

MILLSTONE POWER STATION UNIT 2
DOMINION NUCLEAR CONNECTICUT, INC.

Proposed Alternative
In Accordance with 10 CFR 50.55a(a)(3)(ii)

-- Code Requirements Would Result in Hardship or Unusual Difficulty Without a Compensating Increase in The Level of Quality and Safety --

1. ASME Code Components Affected

ASME Code Class:	Code Class 2
References:	ASME Section III, Paragraph NC 5200 and NC 5300
Examination Category:	N/A
Item Number:	N/A
Description:	Feedwater and Auxiliary Feedwater piping associated with two containment penetrations that provide Feedwater supply to Steam Generators No. 1 and No. 2
Components:	28", 18" and 6" diameter circumferential butt welds

The number of welds at the penetration associated with Steam Generator No. 1 requiring radiography (RT) following replacement is twelve (12). This includes:

- Eight - 18" schedule 60 Feedwater piping (0.750" nominal wall) welds,
- One - 28" Containment Penetration Flued Head weld,
- One - 18" by 6" Vesselet weld (at the 6" Auxiliary Feedwater piping branch connection), and
- Two - 6" Auxiliary Feedwater piping (0.280" nominal wall) welds.

The number of welds at the penetration associated with Steam Generator No. 2 requiring radiography (RT) following replacement is eleven (11). This includes:

- Seven - 18" schedule 60 Feedwater piping (0.750" nominal wall) welds,
- One - 28" Containment Penetration Flued Head weld,
- One - 18" by 6" Vesselet weld (at the 6" Auxiliary Feedwater piping branch connection), and
- Two - 6" Auxiliary Feedwater piping (0.280" nominal wall) welds.

This results in a total number of twenty-three welds that will require radiography (RT) as part of the replacement.

Use of encoded Phased Array Ultrasonic Examination Techniques (PAUT) is requested as an alternative during repair and replacement activities on the ASME Class 2 circumferential piping butt welds described above. The specific components are limited to carbon steel base and filler material with wall thickness and diameters within the demonstrated procedure ranges in accordance with the process described in Section 5.

In addition, the geometry must allow 100% examination coverage of the weld volume, which includes the weld-to-base material interface on each side of the weld.

2. **Applicable Code Edition and Addenda**

ASME Section XI, 2004 Edition (No Addenda).

3. **Applicable Code Requirement**

The 2004 Edition of ASME Section XI, paragraph IWA-4221 (Construction Code and Owner's Requirements) requires the owner to use the requirements of the construction code for repair and replacement activities. The examination requirements for ASME Section III, Class 2 circumferential butt welds are contained in the ASME Code, Section III, paragraph NC-5200. The requirement is to perform radiographic examinations of these welds using the acceptance standards specified in paragraph NC-5300.

ASME Section III Code Case N-659-2 documents alternative examination requirements in the form of ultrasonic examination requirements, but is not currently accepted for use in Regulatory Guide 1.84, Design, Fabrication, and Materials Code Case Acceptability, ASME Section III.

4. **Reason for Request**

Replacement of the Millstone Power Station Unit 2 (MPS2) Feedwater and Auxiliary Feedwater piping at both containment penetrations is scheduled for the spring 2014 refueling outage. The affected piping segments are identified as the highest ranked priority for preemptive replacement at MPS2. The intent is to replace the ASTM A106B and A234 Grade WPB piping and affected components with ASTM A335, Grade P22 (2.25 % Chromium , 1% Molybdenum) material which is more resistant to Flow Accelerated Corrosion (FAC). Preemptive replacement of this piping with FAC resistant piping will eliminate/reduce future inspection requirements and consequently the radiological dose incurred in support of those inspections. Examination of this piping is complicated by the installation of significant structural elements (i.e., pipe whip restraints) which must be removed to gain access to the piping and reinstalled upon completion of the inspection.

DNC anticipates needing this alternative request to support the next scheduled MPS2 refueling outage in spring 2014 (2R22). However, if piping examination results are acceptable for continued operation, piping replacement may be deferred.

The reasons for this alternative request are grouped into two areas; personnel safety and outage support. The use of ultrasonic examination techniques will eliminate the personnel safety risk of radiological exposure associated with radiographic exams currently required by the code. Specifically, the planned exposure and the potential for accidental exposure associated with transporting, positioning, and exposing a source for the radiographic examinations is eliminated. In addition to reducing personnel safety risk, there is an overall reduction in dose for the examinations. This is realized by the use of an encoded scanner, remote analysis processes, and the limited number of personnel needed to

perform the examinations. The ultrasonic examination technique encoded PAUT crew size would be 2 or 3; whereas, radiography crews range from a minimum of 5 to upwards of 15.

With regard to outage support, the use of encoded PAUT will reduce the time associated with a given weld examination and subsequent documentation of examination results. The encoded PAUT examinations can be performed as soon as the weld joint surface is prepared. In addition, other outage activities in the area are not impacted during the examination. There is also a reduction in overall outage risk by eliminating the need to stop and start critical maintenance and operations tasks affected by the radiographic exclusion area. Additional savings are realized by eliminating the need for large amounts of support from radiation protection personnel, boundary guards, and other support personnel.

5. Proposed Alternative and Basis for Use

DNC is proposing the use of encoded PAUT examination technique in lieu of the code required radiographic examination for the feedwater piping replacement in containment during the upcoming MPS2 Refueling Outage 22 (2R22). Similar techniques are being used throughout the nuclear industry for examination of dissimilar metal welds, overlaid welds, as well as other applications; including B31.1 piping replacements. This proposed alternative request includes requirements that provide an acceptable level of quality and safety. The capability of the alternative technique is comparable to the examination methods documented in the ASME Code Sections III, VIII, and IX, and associated code cases (references 3, 5, 6, 8, 9, 10, 11 and 12) using ultrasonic examinations for weld acceptance.

5.1 Proposed Alternative

DNC is proposing to perform encoded PAUT examination techniques using demonstrated procedures, equipment and personnel in accordance with the process documented below:

(1) The welds to be examined shall meet the surface conditioning requirements of the demonstrated ultrasonic procedure. The surface shall be conditioned (smooth) such that transducers may properly couple with the scanning surface with no more than a 1/32-inch gap between the search unit and the scanning surface.

(2) The ultrasonic examination shall be performed with equipment, procedures, and personnel qualified by performance demonstration.

(3) The ultrasonic examination shall include 100% of the weld volume, which includes the weld-to-base material interface on each side of the weld. A supplemental examination shall also be used to identify laminations that could limit angle beam examinations. The lamination examination procedure, or portion of the procedure, is not required to be qualified to these requirements and may be performed using non-encoded techniques.

(4) The acceptance standards for volumetric ultrasonic examination shall be in accordance with ASME Section III, NC-5330 "Ultrasonic Acceptance Standards" with evaluation of flaw indications in accordance with the procedure rather than using a 20% amplitude reference level threshold.

(5) The ultrasonic examination shall be performed using encoded (position and amplitude) examination methods.

(6) A written ultrasonic examination procedure qualified by performance demonstration for flaw detection, characterization, and sizing shall be used. The written examination procedure shall:

(a) Contain a statement of scope that specifically defines the limits of procedure applicability (e.g., minimum and maximum thickness, minimum and maximum diameter, scanning access).

(b) Specify which parameters are considered essential variables. The procedure shall specify a single value or a range of values for the essential variables.

(c) List the examination equipment, including manufacturer and model or series.

(d) Define the scanning requirements such as, beam angles, scan patterns, beam direction, maximum scan speed, extent of scanning, and access requirements.

(e) Contain a description of the calibration method (e.g., actions required to insure that the sensitivity and accuracy of the signal amplitude and time outputs of the examination system, whether displayed, recorded, or automatically processed, are repeated from examination to examination).

(f) Describe the method and criteria for the discrimination and characterization of indications (e.g., geometric versus flaw indications, surface versus subsurface indications, and flaw type).

(g) Describe the surface preparation requirements.

(7) Performance demonstration specimen(s) shall conform to the following requirements:

(a) The specimen(s) shall be fabricated from ferritic material with the same inside diameter (ID) cladding process, if applicable.

(b) The demonstration specimen(s) shall contain a weld representative of the joint to be ultrasonically examined, including the same welding processes.

(c) For welds not greater than 2 inches (50.8mm) in thickness, the demonstration set shall include specimens not thicker than 0.1 inch (2.5mm) more than the minimum thickness, nor thinner than 0.5 inch (13mm) less than the maximum thickness for which the examination procedure is applicable. The demonstration set shall include the maximum diameter within 0.5 inch (13mm) of the nominal pipe size,

and the maximum diameter for which the examination procedure is applicable. If the procedure is applicable to outside diameters (OD) 24 inches (610mm) or larger, the specimen set must include at least one specimen 24 inches OD (610mm) or larger but need not include the maximum diameter. For piping greater than 2 inches (50.8mm) in thickness, the specimen set shall contain specimens that are at least 90% of the thickness of the component to be examined.

(d) The demonstration specimen scanning and weld surfaces shall be representative of the production surfaces to be examined.

(e) The demonstration specimen(s) shall include both planar and volumetric fabrication type flaws (e.g., lack of fusion, crack, incomplete penetration, and inclusions) representative of the welding process of the production weld(s) to be examined. The flaws shall be distributed throughout the thickness of the weld.

(f) The demonstration set shall include specimens with through-wall flaw sizes evenly distributed with the smallest flaw size approximately the thickness of one weld bead.

(g) Grading units shall be 0.25 inch (6mm) longer than the actual flaw and unflawed grading units shall be a minimum of 1 inch (25mm).

(8) Ultrasonic procedures shall be qualified by performance demonstration in accordance with the following requirements:

(a) The procedure shall be demonstrated using a non-blind, open demonstration, in which personnel have specific knowledge of flaw locations in the demonstration specimens or a blind demonstration.

(b) The procedure demonstration specimen set shall be representative of the procedure scope and limitations (e.g., thickness range, diameter range, material, access, and surface condition).

(c) As a minimum, the demonstration set shall include specimens to represent the minimum and maximum diameter and thickness covered by the procedure.

(d) The procedure demonstration specimen set shall include at least 30 flaws.

(e) At least 60 percent of the flaws shall be planar type flaws applicable to the welding process.

(f) At least two flaws, but no more than 30 percent of the flaws, shall be oriented perpendicular to the weld fusion line.

(g) For the demonstration of single-side access capabilities, at least 30 percent of the flaws shall be located on the far side of the weld centerline and at least 30 percent of the planar flaws shall be located on the near side of the weld centerline.

(9) Procedure performance demonstration acceptance criteria:

(a) Flaw indications must be detected and recorded in accordance with the procedure.

(b) To be qualified for flaw detection, intended flaws within the demonstration set shall be detected. Objective evidence of the flaw's detection must be provided to the organization administering the tests.

(c) To be qualified for flaw length sizing, volumetric flaws must be sized within 0.25 inch (6mm) of the true length.

(10) Ultrasonic examination personnel shall be qualified in accordance with ASME Section XI, IWA-2300. In addition, examination personnel shall demonstrate their capability to detect, characterize and size flaws by performance demonstration using the qualified procedure in accordance with the following requirements:

(a) The personnel demonstration shall be conducted in a blind fashion (flaw information is not provided).

(b) The demonstration specimen set shall contain at least 10 flaws.

(c) At least 60 percent of the flaws shall be planar type flaws applicable to the welding process.

(d) At least one flaw, but no more than 20 percent of the flaws, shall be oriented perpendicular to the weld fusion line.

(e) Flaws shall be distributed throughout the entire weld (ID to OD and side to side).

(f) For the demonstration of single-side access capabilities, at least 30 percent of the flaws shall be located on the far side of the weld centerline and at least 30 percent of the planar flaws shall be located on the near side of the weld centerline.

(11) Personnel performance demonstration acceptance criteria:

(a) To be qualified for flaw detection, 80 percent or greater of the intended flaws within the demonstration set shall be detected, and no more than 20% of the grading units shall contain a false call. To be qualified for flaw characterization, 80 percent or greater of the intended flaws within the demonstration set shall be correctly characterized as planar (which includes cracks, lack of fusion and incomplete penetration) or volumetric (which includes slag and porosity). Any non-flaw condition (geometry, etc.) reported as a flaw shall be considered a false call.

(b) To be qualified for flaw length sizing, volumetric flaws must be sized within 0.25 inch (6mm) of the true length.

(12) The pre-service examinations will be performed per ASME Section XI (Reference 4)

5.2 Basis for Use

The overall basis for this relief is that encoded PAUT is equivalent to or superior for detecting and sizing critical (planar) flaws as compared to the required radiographic examination. In this regard, the basis for the proposed alternative was developed from numerous codes, code cases, associated industry experience, articles, and the results of RT and encoded PAUT examinations.

6. Duration of Proposed Alternative

DNC requests approval of this relief for the remainder of the fourth 10-year Inservice Inspection interval for MPS2 that began on April 1, 2010 and is scheduled to end on March 31, 2020.

7. Conclusion

10 CFR 50.55a(a)(3) states:
"Proposed alternatives to the requirements of paragraphs (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:

(i) The proposed alternatives would provide an acceptable level of quality and safety, or

(ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety."

The proposed alternative discussed in this relief request is in accordance with 10 CFR 50.55a(a)(3)(ii), in that the current Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

8. Precedents

Oconee Relief Request 2006-ON-001, dated June 20, 2006; requested relief on butt welds between the Pressurizer Level and Sample Tap nozzles and their respective Safe Ends. The reason for the relief was based on the difficulty to perform the code required radiography. The alternative was to perform ultrasonic examination per similar requirements to Code Case N- 659-0.

Callaway Relief Request ET 06-0029, dated September 1, 2006; requested relief on main steam and feedwater piping welds being replaced due to flow assisted corrosion. The reason for the relief was based on the acceptability of the proposed ultrasonic examination alternative process, radiation exposure reduction, outage costs and duration, and radiography exposure risk.

Palo Verde Nuclear Generating Station Relief Request 48, dated August 1, 2012, (ADAMS Accession No. ML12229A046). NRC approval dated April 12, 2013 (ADAMS Accession No. ML13091A177).

9. References

1. ASME Section III Code Case N-659-2, dated June 9, 2008; Use of Ultrasonic Examination in Lieu of Radiography for Weld Examination Section III, Divisions 1 and 3
2. Pacific Northwest National Laboratory Report PNNL-19086, Replacement of Radiography with Ultrasonics for the Nondestructive Inspection of Welds - Evaluation of Technical Gaps - An Interim Report, dated April 2010
3. ASME B31.1, Case 168, dated June 1997; Use of Ultrasonic Examination in Lieu of Radiography for B31. 1 Application
4. ASME Section III and XI 2004 Edition, No Addenda
5. ASME Section III Code Case N-818, dated December 6, 2011; Use of Analytical Evaluation approach for Acceptance of Full Penetration Butt Welds in Lieu of Weld Repair
6. ASME Code Case 2235-9, dated October 11, 2005; Use of Ultrasonic Examination in Lieu of Radiography Section I, Section VIII, Divisions 1 and 2, and Section XII
7. Journal of Pressure Vessel Technology, Technical Basis for ASME Section VIII Code Case 2235 on Ultrasonic Examination of Welds in Lieu of Radiography; Rana, Hedden, Cowfer and Boyce, Volume 123, dated August 2001
8. ASME Code Case 2326, dated January 20, 2000; Ultrasonic Examination in Lieu of Radiographic Examination for Welder Qualification Test Coupons Section IX
9. ASME Code Case 2541, dated January 19, 2006; Use of Manual Phased Array Ultrasonic Examination Section V
10. ASME Code Case 2558, dated December 30, 2006; Use of Manual Phased Array E-Scan Ultrasonic Examination Per Article 4 Section V
11 ASME Code Case 2599, dated January 29, 2008; Use of Linear Phased Array E-Scan Ultrasonic Examination Per Article 4 Section V
12. ASME Code Case 2600, dated January 29, 2008; Use of Linear Phased Array S-Scan Ultrasonic Examination Per Article 4 Section V
13. ASME Section XI Code Case N-713, dated November 10, 2008; Ultrasonic Examination in Lieu of Radiography
14. EPRI presentation, dated May 2010; Ultrasonic Capability study for reduction of weld repair during the construction-UT Technical Presentation