Dominion Energy Nuclear Connecticut, Inc.
5000 Dominion Boulevard, Glen Allen, VA 23060
DominionEnergy.com

March 29, 2019

Dominion Energy®

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

Serial No. 19-082
NRA/SS R0
Docket No. 50-336
License No. DPR-65

DOMINION ENERGY NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2
PROPOSED ALTERNATIVE REQUESTS RR-05-01 and RR-05-02 FOR THE FIFTH 10-YEAR INSERVICE INSPECTION INTERVAL

Pursuant to 10 CFR 50.55a, "Codes and standards," paragraphs (z)(1) and (z)(2), Dominion Energy Nuclear Connecticut, Inc. (DENC) requests Nuclear Regulatory Commission (NRC) approval of the attached proposed alternative requests associated with the fifth 10-year inservice inspection (ISI) interval for Millstone Power Station Unit 2 (MPS2). The fifth 10-year ISI interval at MPS2, which will comply with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, 2013 Edition (no addenda), will begin on April 1, 2020 and end on March 31, 2030. DENC proposes the following alternative requests for the duration of the fifth 10-year ISI interval:

- RR-05-01, Alternative VT-2 Pressure Testing Requirements for the Lower Portion of the Reactor Pressure Vessel
- RR-05-02, Use of Encoded Phased Array Ultrasonic Examination Techniques In Lieu of Radiography

The bases for these alternative requests are provided in Attachments 1 and 2.

Alternative requests similar or identical to those listed above have been previously approved for use at MPS2.

DENC requests NRC approval of these alternative requests by March 31, 2020.

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

Sincerely,

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

A047
NRR

Commitments made in this letter: None

Attachments:

1. Alternative Request RR-05-01, Alternative VT-2 Pressure Testing Requirements for the Lower Portion of the Reactor Pressure Vessel

2. Alternative Request RR-05-02, Use of Encoded Phased Array Ultrasonic Examination Techniques In Lieu of Radiography

cc: U.S. Nuclear Regulatory Commission
Region I
2100 Renaissance Blvd
Suite 100
King of Prussia, PA 19406-2713

R. V. Guzman
Project Manager - Millstone Power Station
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Mail Stop 08 C2
Rockville, MD 20852-2738

NRC Senior Resident Inspector
Millstone Power Station

ATTACHMENT 1

ALTERNATIVE REQUEST RR-05-01
ALTERNATIVE VT-2 PRESSURE TESTING REQUIREMENTS FOR THE LOWER PORTION OF THE REACTOR PRESSURE VESSEL

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

Alternative Request RR-05-01
Alternative VT-2 Pressure Testing Requirements for the Lower Portion of the Reactor Pressure Vessel

In Accordance with 10 CFR 50.55a(z)(2)
--Hardship Without a Compensating Increase in Quality and Safety--

1. ASME Code Components Affected

ASME Code Class:	Code Class 1
Reference:	ASME Section XI, IWB-2500, Table IWB-2500-1 and IWB-5222
Examination Category:	B-P (All Pressure Retaining Components)
Item Number:	B15.10
Description:	Performance of VT-2 Pressure Testing of the Lower Portion of the Reactor Pressure Vessel (RPV)
Component:	RPV

2. Applicable Code Edition and Addenda

ASME Section XI, 2013 Edition (No Addenda)

3. Applicable Code Requirement

The following Code requirements are applicable to the examination of the lower portion of the RPV. ASME Section XI, IWB-2500, Table IWB-2500-1, Code Category B-P, Item Number B15.10 requires that all Class 1 pressure retaining components be visually, VT-2 examined each refueling outage during performance of a system leakage test. The system leakage test is performed at a pressure and temperature not less than the pressure and temperature corresponding to 100% rated reactor power. Per IWB-5222(a), the pressure retaining boundary during the system leakage test shall correspond to the reactor coolant system (RCS) boundary, with all valves in the position required for normal reactor operation startup. The visual examination shall, however, extend to and include the second closed valve at the boundary extremity.

4. Reason for Request

Pursuant to the provisions of 10 CFR 50.55a(z)(2), Dominion Energy Nuclear Connecticut, Inc. (DENC) requests Nuclear Regulatory Commission (NRC) approval to perform the examination of the lower portion of the RPV at Millstone Power

Station Unit 2 (MPS2) at different plant conditions than those required by the ASME Code. Due to the harsh conditions in the area of the RPV, performance of required examinations during a system leakage or hydrostatic test at normal operating pressure and temperature (NOP/NOT) represents undue hardship without a commensurate safety benefit.

Figure 1 provides an illustration of the arrangement of the RPV area. This area is classified as a confined space with limited air circulation and limited access. With the RCS at NOP/NOT conditions, ambient temperatures in this area are very high due to the uninsulated condition of the RPV. The high air temperature in this area creates a significant safety hazard to personnel entering this space. Additionally, the elevation of the RPV in the cubicle is relatively low with about a 2-foot distance between the floor and bottom of the vessel. The distance between the floor and the RPV poses an additional hazard to personnel in the area regarding inadvertent contact with the uninsulated vessel surface and the consequential potential for a severe burn.

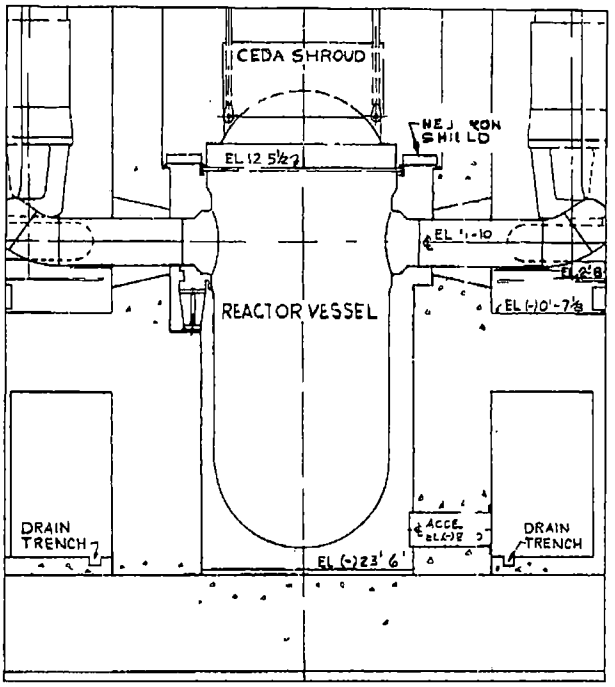

Figure 1: General Arrangement of Reactor Pressure Vessel Area

In Mode 3 (Hot Standby – NOP/NOT conditions) through Mode 6 (Refueling), radiation dose rates under the vessel are estimated to be approximately 2 to 4 R/Hr. Since no significant reduction in radiation exposure would be expected while performing the pressure testing in Mode 6 versus Mode 3, radiation exposure is not included as a reason for the request.

5. Proposed Alternative and Basis for Use

DENC proposes to conduct the VT-2 examination of the pressure retaining surfaces of the lower portion of the RPV following plant cooldown during each refueling outage (at ambient conditions). With the substantially lower RCS temperatures, the lower vessel area will also be at a lower temperature and therefore less hazardous to personnel.

The objective of the required VT-2 examination at NOP/NOT conditions is to detect evidence of leakage and thereby verify the integrity of the RCS pressure boundary. DENC believes that this objective can be achieved by the same VT-2 visual examination performed following the RCS cooldown. Since there is no insulation on the RPV in this area, evidence of leakage and boric acid corrosion occurring during the fuel cycle would be detected by visual examination following plant cooldown. The ability to visually detect evidence of leakage and boric acid corrosion in this area during the refueling outage provides reasonable assurance of leak tight integrity of the lower portion of the RPV without exposing personnel to the environmental hazards associated with entry into this area during Mode 3 at NOP/NOT conditions.

Note that there are no bottom mounted instrumentation nozzles on the RPV at MPS2. Consequently, degradation in the vessel wall with the potential to challenge the pressure boundary integrity is not expected in the absence of penetrations.

6. Duration of Proposed Alternative

This alternative request will be applied for the duration of the fifth 10-year ISI interval at MPS2 which begins on April 1, 2020 and ends on March 31, 2030.

7. Precedents

Similar alternative requests were approved for use at MPS2 during the third and fourth 10-year ISI intervals (i.e., Relief Requests RR-89-42 (ADAMS No. ML032690717) and RR-04-02 (ADAMS No. ML102940440), respectively.

ATTACHMENT 2

ALTERNATIVE REQUEST RR-05-02
USE OF ENCODED PHASED ARRAY ULTRASONIC EXAMINATION TECHNIQUES IN LIEU OF RADIOGRAPHY

MILLSTONE POWER STATION, UNIT 3
DOMINION ENERGY NUCLEAR CONNECTICUT, INC.

Alternative Request RR-05-02
Use of Encoded Phased Array Ultrasonic Examination Techniques
In Lieu of Radiography

In accordance with 10 CFR 50.55a(z)(1)
-- Proposed Alternative Provides an Acceptable Level of Quality and Safety –

1. ASME Code Components Affected

American Society of Mechanical Engineers (ASME), Boiler & Pressure Vessel (B&PV) Code, Section XI, ferritic and austenitic piping welds requiring radiography during repair/replacement activities.

2. Applicable Code Edition and Addenda

ASME Section XI, 2013 Edition (No Addenda)

3. Applicable Code Requirement

The 2013 Edition of ASME Section XI, paragraph IWA-4221 requires that items used for repair/replacement activities meet the applicable Owner's Requirements and Construction Code requirements when performing repair/replacement activities. IWA-4520 requires that welded joints made for installation of items be examined in accordance with the Construction Code identified in the Repair/Replacement Plan.

4. Reason for Request

Replacement of piping is periodically performed in support of the Flow Accelerated Corrosion (FAC) program as well as other repair and replacement activities. The use of encoded Phased Array Ultrasonic Examination Techniques (PAUT) in lieu of radiography (RT) to perform the required examinations of the replaced welds would eliminate the safety risk associated with performing RT, which includes both planned and unplanned radiation exposure to plant workers. PAUT also minimizes the impact on other outage activities normally involved with performing RT such as limited access to work locations. In addition, encoded PAUT is equivalent or superior to the code-required RT examination for ASME ferritic and austenitic piping repair/replacement welds for detecting and sizing critical (planar) flaws, such as cracks and lack of fusion. PAUT provides sizing capabilities for both depth and length dimensions of the flaw, which are required to apply the acceptance criteria of the applicable code case. RT does not provide depth sizing capabilities.

This proposed alternative is requested to support both planned and unplanned piping repair and replacement activities during the fifth 10-year inservice inspection (ISI) interval at MPS2 which begins on April 1, 2020 and ends on March 31, 2030.

5. Proposed Alternative and Basis for Use

The use of encoded PAUT is proposed in lieu of the Code-required RT examination for ASME ferritic and austenitic piping repair/replacement welds. 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 that satisfies the requirements of 10 CFR 50.55a(z)(1). 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 8.1, 8.3, 8.5, 8.6, 8.8, 8.9, 8.10, 8.11, 8.12, 8.13 and 8.14) using ultrasonic examination techniques for weld acceptance. The examinations will be performed using personnel and procedures qualified by performance demonstration in accordance with Section 5.1 below.

5.1 Proposed Alternative

(a) Use of this alternative request is limited to welds made as part of a repair/replacement activity and is subject to review by the Authorized Inspection Agency.

(b) The welds to be examined shall be conditioned such that transducers properly couple with the scanning surface with no more than a 1/32 in. (0.8 mm) gap between the search unit and the scanning surface.

(c) Ultrasonic examination shall be performed using equipment, procedures, and personnel qualified by performance demonstration as described below.

(d) The examination volume shall include 100% of the weld volume and the weld-to-base metal interface.

(1) Angle beam examination of the complete examination volume for fabrication flaws oriented parallel to the weld joint shall be performed.

(2) Angle beam examination for fabrication flaws oriented transverse to the weld joint shall be performed to the extent practical. Scan restrictions that limit complete coverage shall be documented.

(3) A supplemental straight beam examination shall be performed on the volume of base metal through which the angle beams will travel to locate any reflectors that can limit the ability of the angle beam to examine the weld. Detected reflectors that may limit the angle beam examination shall be recorded and evaluated for impact on examination coverage. The straight beam examination procedure, or the straight-beam portion of the procedure, is required to be qualified in accordance with Section V, Article 4.

(e) All detected flaws from (d)(1) and (d)(2) above shall be considered planar flaws and shall be compared to the preservice acceptance standards for volumetric examination in accordance with Article IWB-3000, IWC-3000, or IWD-3000, as applicable. Analytical evaluation for acceptance of flaws in accordance with IWB-3600, IWC-3600, or IWD-3600 is permitted for flaws that exceed the applicable acceptance standards and are confirmed by surface or volumetric examination to be non-surface-connected.

(f) Flaws exceeding the applicable acceptance standards and analytical evaluation have not been performed for acceptance, shall be reduced to an acceptable size or removed and repaired, and the location of the repair shall be reexamined using the same ultrasonic examination procedure that detected the flaw.

(g) The ultrasonic examination shall be performed using encoded UT technology that produces an electronic record of the ultrasonic responses indexed to the probe position, permitting off-line analysis of images built from the combined data. Where component configuration does not allow for effective examination for transverse flaws (e.g., pipe-to-valve, tapered weld transition, weld shrinkage), use of non-encoded UT technology may be used for transverse flaws. The basis for the non-encoded examination shall be documented.

(h) A written ultrasonic examination procedure qualified by performance demonstration shall be used. The qualification shall be applicable to the scope of the procedure, e.g., flaw detection or sizing (length or through-wall height), encoded or non-encoded, single or dual-side access. The procedure shall:

(1) 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)

(2) specify which parameters are considered essential variables, and a single value, a range of values or criteria for selecting each of the essential variables

(3) list the examination equipment, including manufacturer and model or series

(4) define the scanning requirements, such as beam angles, scan patterns, beam direction, maximum scan speed, extent of scanning, and access

(5) contain a description of the calibration method (i.e., actions required to ensure 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)

(6) describe the method and criteria for discrimination of indications (e.g., geometric indications versus indications of flaws and surface versus subsurface indications)

(7) describe the surface preparation requirements

(i) Performance demonstration specimens shall conform to the following requirements:

(1) The specimens shall be fabricated from ferritic or austenitic material, similar to the material being examined. Ferritic specimens shall be fabricated with the same inside surface cladding process, if applicable, with the following exceptions:

(-a) Demonstration with shielded metal arc weld (SMAW) single-wire cladding is transferable to multiple-wire or strip-clad processes.

(-b) Demonstration with a multiple-wire or strip-clad process is considered equivalent but is not transferable to SMAW type cladding processes.

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

(3) The demonstration set shall include specimens not thicker than 0.1 in. (2.5 mm) more than the minimum thickness, nor thinner than 0.5 in. (13 mm) less than the maximum thickness for which the examination procedure is applicable. The demonstration set shall include the minimum, within 1/2 of the nominal outside diameter (OD), and maximum pipe diameters for which the examination procedure is applicable. If the procedure is applicable to piping of 24 in. (600 mm) OD or larger, the specimen set must include at least one specimen 24 in. (600 mm) OD or larger but need not include the maximum diameter.

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

(5) The demonstration specimen set shall include geometric conditions that require discrimination from flaws (e.g., counterbore, weld root conditions, weld crowns) and limited scanning surface conditions for single-side access, when applicable.

(6) The demonstration specimens shall include both planar and volumetric fabrication flaws (e.g., lack of fusion, crack, incomplete penetration, slag inclusions) representative welding process or processes of the welds to be examined. The flaws shall be distributed throughout the examination

volume.

(7) Specimens shall be divided into flawed and unflawed grading units as follows:

(-a) Flawed grading units shall be the actual flaw length, plus a minimum of 0.25 in. (6 mm) on each end of the flaw. Unflawed grading units shall be at least 1 in. (25 mm).

(-b) The number of unflawed grading units shall be at least $1^1/_2$ times the number of flawed grading units.

(8) Demonstration specimen set flaw distribution shall be as follows:

(-a) For thickness greater than 0.50 in. (13 mm); at least 20% of the flaws shall be distributed in the outer third of the specimen wall thickness, at least 20% of the flaws shall be distributed in the middle third of the specimen wall thickness, and at least 40% of the flaws shall be distributed in the inner third of the specimen wall thickness. For thickness 0.50 in. (13 mm) and less, at least 20% of the flaws shall be distributed in the outer half of the specimen wall thickness, and at least 40% of the flaws shall be distributed in the inner half of the specimen wall thickness.

(-b) At least 30% of the flaws shall be classified as surface planar flaws in accordance with IWA-3310. At least 40% of the flaws shall be classified as subsurface planar flaws in accordance with IWA-3320.

(-c) At least 50% of the flaws shall be planar flaws, such as lack of fusion, incomplete penetration, or cracks. At least 20% of the flaws shall be volumetric flaws, such as slag inclusions.

(-d) The flaw through-wall heights shall be based on the applicable acceptance standards for volumetric examination in accordance with IWB-3400, IWC-3400, or Article IWD-3000, as applicable. At least 30% of the flaws shall be classified as acceptable planar flaws, with the smallest flaws being at least 50% of the maximum allowable size based on the applicable a/ℓ aspect ratio for the flaw. Additional smaller flaws may be included in the specimens to assist in establishing a detection threshold, but shall not be counted as a missed detection if not detected. At least 30% of the flaws shall be classified as unacceptable in accordance with the applicable acceptance standards. Welding fabrication flaws are typically confined to a height of a single weld pass. Flaw through-wall height distribution shall range from approximately one to four weld pass thicknesses, based on the welding process used.

(-e) If applicable, at least two flaws, but no more than 30% of the flaws, shall be oriented perpendicular to the weld fusion line, and the remaining flaws shall be circumferentially-oriented.

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

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

(1) The procedure shall be demonstrated using either a blind or a non-blind demonstration.

(2) The non-blind performance demonstration is used to assist in optimizing the examination procedure. When applying the non-blind performance demonstration process, personnel have access to limited knowledge of specimen flaw information during the demonstration process. The non-blind performance demonstration process consists of an initial demonstration without any flaw information, an assessment of the results, and feedback of the performance provided to the qualifying candidate. After an assessment of the initial demonstration results, limited flaw information may be shared with the candidate, as part of the feedback process, to assist in enhancing the examination procedure to improve the procedure performance. To maintain the integrity of the specimens for blind personnel demonstrations, only generalities of the flaw information may be provided to the candidate. Procedure modifications or enhancements made to the procedure, based on the feedback process, shall be applied to all applicable specimens, based on the scope of the changes.

(3) Objective evidence of a flaw's detection, length, and through-wall height sizing, in accordance with the procedure requirements, shall be provided to the organization administering the performance demonstration.

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

(5) The demonstration set shall include specimens to represent the minimum and maximum diameter and thickness covered by the procedure. If the procedure spans a range of diameters and thicknesses, additional specimens shall be included in the set to demonstrate the effectiveness of the procedure throughout the entire range.

(6) The procedure demonstration specimen set shall include at least 30 flaws and shall meet the requirements of (i) above.

(7) Procedure performance demonstration acceptance criteria:

(-a) To be qualified for flaw detection, all flaws in the demonstration set that are not less than 50% of the maximum allowable size, based on the applicable a/ℓ aspect ratio for the flaw, shall be detected. In addition, when performing blind procedure demonstrations, no more than 20% of the non-flawed grading units may contain a false call. Any non-flaw condition (e.g., geometry) reported as a flaw shall be considered a false call.

(-b) To be qualified for flaw length sizing, the root mean square (RMS) error of the flaw lengths estimated by ultrasonics, as compared with the true lengths, shall not exceed 0.25 in. (6 mm) for NPS 6 (DN 150) and smaller, and 0.75 in. (18 mm) for larger than NPS 6 (DN 150).

(-c) To be qualified for flaw through-wall height sizing, the RMS error of the flaw through-wall heights estimated by ultrasonics, as compared with the true through-wall heights, shall not exceed 0.125 in. (3 mm).

(-d) RMS error shall be calculated as follows:

$$RMS = \left[\frac{\sum_{n}^{i=1} (m_i - t_i)^{1/2}}{n} \right]$$

Where:

m_i = measured flaw size

n = number of flaws measured

t_i = true flaw size

(8) Essential variables may be changed during successive personnel performance demonstrations. Each examiner need not demonstrate qualification over the entire range of every essential variable.

(9) Expansion of a procedure, demonstrated in accordance with (j), to include an additional material type (i.e. ferritic or austenitic) shall meet the following:

(-a) The procedure expansion may be performed during successive personnel performance demonstrations, performed in accordance with (k)(1), with the exception that all flaws must be detected.

(-b) The examination technique is the same, e.g. wave modes, angles, V-path, access, etc. Any changes to the examination technique shall be performed in accordance with (j).

(-c) The demonstration set must include the minimum and maximum diameter and thickness range of the new material being demonstrated.

(-d) Personnel using the expanded procedure shall demonstrate the additional material type in accordance with (k).

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

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

(2) The demonstration specimen set shall contain at least 10 flaws and shall meet the flaw distribution requirements of (i)(8) above, with the exception of (i)(8)(-e). When applicable, at least one flaw, but no more than 20% of the flaws, shall be oriented perpendicular to the weld fusion line, and the remaining flaws shall be circumferentially oriented.

(3) Personnel performance demonstration acceptance criteria:

(-a) To be qualified for flaw detection, at least 80% of the flaws in the demonstration set shall be detected and no more than 20% of the grading units shall contain a false call. Any non-flaw condition (e.g., geometry) reported as a flaw shall be considered a false call.

(-b) To be qualified for flaw length sizing, the RMS error of the flaw lengths estimated by ultrasonics, as compared with the true lengths, shall not exceed 0.25 in. (6 mm) for NPS 6 (DN 150) and smaller, and 0.75 in. (18 mm) for larger than NPS 6 (DN 150).

(-c) To be qualified for flaw through-wall height sizing, the RMS error of the flaw through-wall heights estimated by ultrasonics, as compared with the true through-wall heights, shall not exceed 0.125 in. (3 mm).

(l) Dominion Energy is responsible for reviewing the procedure and demonstration results to validate that the ranges of the essential variables in the procedure were included in the demonstration.

(m) Documentation of the qualifications of procedures and personnel shall be maintained by Dominion Energy. Documentation shall include identification of personnel, NDE procedures, equipment, and specimens used during qualification, and results of the performance demonstration.

5.2 Basis for Use

The basis for this proposed alternative is that encoded PAUT is equivalent or superior to RT for detecting and sizing critical (planar) flaws. 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. The examination procedure and personnel performing examinations are qualified using representative piping conditions and flaws that demonstrate the ability to detect and size flaws that are both acceptable and unacceptable to the defined acceptance standards. The demonstrated ability of the examination procedure and personnel to appropriately detect and size flaws provides an acceptable level of quality and safety alternative as allowed by 10 CFR 50.55a(z)(1).

6. Duration of Proposed Alternative

This alternative request will be applied for the duration of the fifth 10-year ISI interval at MPS2 which begins on April 1, 2020 and ends on March 31, 2030.

7. Precedents

7.1 Oconee Request for Relief No. 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 request 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. (ML061210495)

7.2 Wolf Creek 10 CFR 50.55a 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 request was based on the acceptability of the proposed ultrasonic examination alternative process, radiation exposure reduction, outage costs and duration, and radiography exposure risk. (ML062500093)

7.3 Palo Verde Nuclear Generating Station Relief Request 48, dated August 1, 2012 (ML12229A046). NRC approval dated April 12, 2013 (ML13091A177).

7.4 Millstone Power Station Unit 2 Alternative Request RR-04-16, dated August 1, 2013 (ML13220A019). NRC approval dated April 4, 2014 (ML14091A973).

7.5 Millstone Power Station Unit 2 Alternative Request RR-04-21, dated October 6, 2014 (ML14283A128). NRC approval dated September 21, 2015 (ML15257A005).

7.6 Millstone Power Station Unit 3 Alternative Request IR-3-25, dated October 6, 2014 (ML14283A128). NRC approval dated September 21, 2015 (ML15257A005).

7.7 Millstone Power Station Unit 2 Alternative Request RR-04-023, dated April 11, 2016 (ML16106A105). NRC approval dated January 23, 2017 (ML16363A089).

7.8 Millstone Power Station Unit 3 Alternative Request IR-3-28, dated April 11, 2016 (ML16106A105). NRC approval dated January 23, 2017 (ML16363A089).

7.9 Millstone Power Station, Units 2 and 3; North Anna Power Station, Units 1 and 2; and Surry Power Station, Units 1 and 2; Proposed Alternative for the Use of Encoded Phased Array Ultrasonic Examination, dated June 29, 2017 (ML17188A379). NRC approval dated January 24, 2018 (ML18019A195).

7.10 Millstone Power Station Units 2 (RR-04-27) and 3 (IR-3-38), dated February 28, 2018 (ML18066A522). NRC approval dated September 17, 2018 (ML18252A003)

8. References

8.1. ASME Section III Code Case N-659-2, "Use of Ultrasonic Examination in Lieu of Radiography for Weld Examination Section III, Divisions 1 and 3," dated June 9, 2008.

8.2. 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.

8.3. ASME B31.1, Case 168, "Use of Ultrasonic Examination in Lieu of Radiography for B31. 1 Application," dated June 1997.

8.4. ASME Section XI, 2013 Edition, No Addenda.

8.5. ASME Section III, Code Case N-818, "Use of Analytical Evaluation Approach for Acceptance of Full Penetration Butt Welds in Lieu of Weld Repair," dated December 6, 2011.

8.6. ASME Code Case 2235-9, 2005; "Use of Ultrasonic Examination in Lieu of Radiography Section I, Section VIII, Divisions 1 and 2, and Section XII," dated October 11, 2005.

8.7. 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.

8.8. ASME Code Case 2326, "Ultrasonic Examination in Lieu of Radiographic Examination for Welder Qualification Test Coupons Section IX," dated January 20, 2000.

8.9. ASME Code Case 2541, "Use of Manual Phased Array Ultrasonic Examination Section V," dated January 19, 2006.

8.10. ASME Code Case 2558, "Use of Manual Phased Array E-Scan Ultrasonic Examination Per Article 4 Section V", dated December 30, 2006.

8.11. ASME Code Case 2599, "Use of Linear Phased Array E-Scan Ultrasonic Examination Per Article 4 Section V," dated January 29, 2008.

8.12. ASME Code Case 2600, "Use of Linear Phased Array S-Scan Ultrasonic Examination Per Article 4 Section V," dated January 29, 2008.

8.13. ASME Section XI, Code Case N-713, "Ultrasonic Examination in Lieu of Radiography," dated November 10, 2008.

8.14. ASME Section XI, Code Case N-831, "Ultrasonic Examination in Lieu of Radiography for Welds in Ferritic Pipe," dated October 20, 2016.

8.15. US NRC, NUREG/CR-7204, "Applying Ultrasonic Testing in Lieu of Radiography for Volumetric Examination of Carbon Steel Piping" (ML15253A674).

8.16. Technical Basis for Substituting Ultrasonic Testing for Radiographic Testing for New, Repaired, and Replacement Welds for ASME Section XI, Division 1, Stainless Steel Piping. EPRI, Palo Alto, CA: 2017. 3002010297.