Exelon Generation®

200 Exelon Way
Kennett Square, PA 19348

www.exeloncorp.com

10 CFR 50.55a

April 15, 2019

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Calvert Cliffs Nuclear Power Plant, Units 1 and 2
Facility Operating License Nos. DPR-53 and DPR-69
NRC Docket Nos. 50-317 and 50-318

Subject: Submittal of Relief Requests Associated with the Fifth Inservice Inspection (ISI) Interval

Reference: 1) Letter from J. Barstow (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "Submittal of Relief Requests Associated with the Fifth Inservice Inspection (ISI) Interval," dated December 19, 2018

In the Reference 1 letter, Exelon Generation Company, LLC (Exelon) submitted for review and approval relief requests associated with the fifth Inservice Inspection (ISI) interval for the Calvert Cliffs Nuclear Power Plant, Units 1 and 2. Relief Request I5-04 is being resubmitted with a correction to the "Performance Demonstration Detection Test Acceptance Criteria" contained on page 8 of 10.

There are no regulatory commitments in this letter.

If you have any questions concerning this letter, please contact Tom Loomis at (610) 765-5510.

Respectfully,

James Barstow
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Attachment: Revised Relief Request I5R-04

cc: Regional Administrator, Region I, USNRC
USNRC Senior Resident Inspector, CCNPP
Project Manager [CCNPP] USNRC
D. A. Tancabel, State of Maryland

Attachment
Revised Relief Request I5R-04

Request for Relief for Use of Encoded Phased Array Ultrasonic Examination Techniques in Lieu of Radiography in Accordance with 10 CFR 50.55a(z)(1)
--Alternative Provides Acceptable Level of Quality or Safety--

1. ASME Code Component(s) Affected

All American Society of Mechanical Engineers (ASME), Boiler & Pressure Vessel (BPV) Code, Section XI, ISI ferritic piping butt welds requiring radiography during repair/replacement activities.

2. Applicable Code Edition and Addenda

The fifth 10-year interval of the Calvert Cliffs Nuclear Power Plant, Units 1 and 2, Inservice Inspection (ISI) Program is based on the ASME BPV Code, Section XI, 2013 Edition.

3. Applicable Code Requirement

10 CFR 50.55a(b)(2)(xx)(B) requires that "The NDE provision in IWA–4540(a)(2) of the 2002 Addenda of Section XI must be applied when performing system leakage tests after repair and replacement activities performed by welding or brazing on a pressure retaining boundary using the 2003 Addenda through the latest edition and addenda incorporated by reference in paragraph (a)(1)(ii) of this section." IWA-4540(a)(2) of the 2002 Addenda of ASME Section XI requires that the nondestructive examination method and acceptance criteria of the 1992 Edition or later of ASME Section III be met prior to return to service in order to perform a system leakage test in lieu of a system hydrostatic test. The examination requirements for ASME Section III, circumferential butt welds are contained in the ASME Code, Section III, Subarticles NB-5200, NC-5200 and ND-5200. The acceptance standards for radiographic examination are specified in ASME Section III, Subarticles NB-5300, NC-5300 and ND-5300.

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

In accordance with 10 CFR 50.55a(z)(1), relief is requested on the basis that the proposed alternative will provide an acceptable level of quality and safety.

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 the planned exposure and the potential for accidental personnel exposure. PAUT minimizes the impact on other outage activities normally involved with performing RT such as limited access to work locations and the need to control system fill status because RT would require a line to remain fluid empty in order to obtain adequate examination sensitivity and resolution. In addition, encoded PAUT has been demonstrated to be adequate for detecting and sizing critical flaws.

Exelon Generation Company, LLC (Exelon) requests approval of this proposed alternative to support anticipated piping repair and replacement activities for Calvert Cliffs Nuclear Power Plant, Units 1 and 2, during the fifth ISI interval.

5. Proposed Alternative and Basis for Use

Calvert Cliffs Nuclear Power Plant, Units 1 and 2, is proposing the use of encoded PAUT in lieu of the Code-required RT examinations for ISI Class 1 and 2 ferritic piping repair/replacement welds. Similar techniques are being used throughout the nuclear industry for examination of dissimilar metal welds and overlaid welds, as well as other applications including ASME B31.1 piping replacements. This proposed alternative request includes requirements that provide an acceptable level of quality and safety that satisfy the requirements of 10 CFR 50.55a(z)(1). The examinations will be performed using personnel and procedures qualified with the requirements of Section 5.1 below.

The electronic data files for the PAUT examinations will be stored as part of the archival-quality records. In addition, hard copy prints of the data will also be included as part of the PAUT examination records to allow viewing without the use of hardware or software.

5.1 Proposed Alternative

Calvert Cliffs Nuclear Power Plant, Units 1 and 2, 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.

(2) 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.

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

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

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

(b) 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.

(c) 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 portion of the procedure, is required to be qualified in accordance with ASME Section V, Article 4 and may be performed using non-encoded techniques.

(5) All detected flaw indications from (4)(a) and (4)(b) above shall be considered planar flaws and compared to the preservice acceptance standards for volumetric examination in accordance with IWB-3000, IWC-3000 or IWD-3000. Preservice acceptance standards shall be applied. 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.

(6) Flaws exceeding the applicable acceptance standards and when analytical evaluation has 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.

(7) 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.

(a) Where component configuration does not allow for effective examination for transverse flaws, (e.g., pipe-to-valve, tapered weld transition, weld shrinkage, etc.) the use of non-encoded UT technology may be used for transverse flaws. The basis for the non-encoded examination shall be documented.

(8) 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 and/or sizing (length or through-wall height), encoded or non-encoded, single and/or dual side access, etc. The 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, and a single value, a range of values or criteria for selecting each of 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;

(e) 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);

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

(g) describe the surface preparation requirements.

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

(a) The specimens shall be fabricated from ferritic material with the same inside surface cladding process, if applicable, with the following exceptions:

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

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

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

(c) 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 ½ inch of the nominal pipe size (NPS), and maximum pipe diameters for which the examination procedure is applicable. If the procedure is applicable to outside diameter (O.D.) piping of 24 in. (600 mm) or larger, the specimen set must include at least one specimen 24 in. O.D. (600 mm) or larger but need not include the maximum diameter.

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

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

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

(g) Specimens shall be divided into flawed and unflawed grading units.

(i) 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).

(ii) The number of unflawed grading units shall be at least 1-1/2 times the number of flawed grading units.

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

(i) 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.

(ii) 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.

(iii) 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.

(iv) The flaw through-wall heights shall be based on the applicable acceptance standards for volumetric examination in accordance with IWB-3400, IWC-3400 or IWD-3400. 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.

(v) 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.

(vi) 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.

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

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

(b) 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 on 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. In order 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.

(c) 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.

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

(e) 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.

(f) The procedure demonstration specimen set shall include at least 30 flaws and shall meet the requirements of (9) above.

(g) Procedure performance demonstration acceptance criteria

(i) 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.

(ii) 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 diameters of NPS 6.0 in. (DN150) and smaller, and 0.75 in. (18 mm) for diameters greater than NPS 6.0 in. (DN150).

(iii) 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).

(iv) RMS error shall be calculated as follows:

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

where:
m_i = measured flaw size
n = number of flaws measured
t_i = true flaw size

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

(11) 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:

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

(i) The demonstration specimen set shall contain at least 10 flaws and shall meet the flaw distribution requirements of (9)(h) above, with the exception of (9)(h)(v). 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.

(b) Personnel performance demonstration acceptance criteria:

(i) To be qualified for flaw detection, personnel performance demonstration shall meet the requirements of the following table for both detection and false calls. Any non-flaw condition (e.g., geometry) reported as a flaw shall be considered a false call.

Performance Demonstration Detection Test Acceptance Criteria			
Detection Test Acceptance Criteria		**False Call Test Acceptance Criteria**	
No. of Flawed Grading Units	**Minimum Detection Criteria**	**No. of Unflawed Grading Units**	**Maximum Number of False Calls**
10	8	15	2
11	9	17	3
12	9	18	3
13	10	20	3
14	10	21	3
15	11	23	3
16	12	24	4
17	12	26	4
18	13	27	4
19	13	29	4
20	14	30	5
Note 1: Flaws $\geq$ 50% of the maximum allowable size, based on the applicable a/ℓ aspect ratio for the flaw.			

(ii) 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 6.0 in. (DN150) and smaller, and 0.75 in. (18 mm) for diameters larger than NPS 6.0 in. (DN150).

(iii) 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).

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

(13) The pre-service examinations will be performed per ASME Section XI (Reference 1).

5.2 Basis for Use

The overall 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. It has been shown that PAUT provides an equally effective examination for identifying the presence of fabrication flaws in carbon steel welds compared to RT (Reference 5). 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).

The requirements in this relief request are based upon ASME Section XI Code Case N-831 (N-831) (Reference 4) and will apply to ISI ferritic piping butt welds requiring radiography during repair/replacement activities. N-831 was approved by ASME Board on Nuclear Codes and Standards on October 20, 2016; however, it has not been incorporated into NRC Regulatory Guide 1.147, "Inservice Inspection Code Case Applicability, ASME Section XI, Division 1," and thus, is not available for application at nuclear power plants without specific NRC approval.

6. Duration of Proposed Alternative

Relief is requested for the fifth ISI interval and the remainder of the plant life for Calvert Cliffs Nuclear Power Plant, Units 1 and 2, or until the NRC approves N-831, or a later revision, in Regulatory Guide 1.147 or other document during the interval.

7. Precedents

- Calvert Cliffs Nuclear Power Plant, Units 1 and 2, fourth ISI interval relief request was authorized by NRC Safety Evaluation (SE) dated June 5, 2017 (Reference 2). This Calvert Cliffs Nuclear Power Plant, Units 1 and 2, relief request was part of an Exelon fleet-wide submittal, and the use of encoded phased array ultrasonic examination techniques in lieu of radiography was authorized for various stations. This relief request for the Calvert Cliffs Nuclear Power Plant, Units 1 and 2, fifth ISI interval, utilizes a similar approach to the previously approved relief request.

- Relief request was authorized for Millstone Power Station, Units 1 and 2, and Surry Power Station, Units 1 and 2 by NRC SE dated January 24, 2018 (Reference 3).

8. References

1. ASME Boiler and Pressure Vessel Code, Section XI, Division 1, "Inservice Inspection of Nuclear Power Plant Components," 2013 Edition.

2. Letter from D. J. Wrona (NRC) to B. C. Hanson (Exelon Generation Company, LLC), Proposed Alternative to Use Encoded Phased Array Ultrasonic Examination Techniques (CAC Nos. MF8763-MF8782 and MF9395), dated June 5, 2017 (ADAMS Accession No. ML17150A091).

3. Letter from Michael T. Markley (NRC) to Daniel G. Stoddard (Dominion Energy), "Millstone Power Station, Units 1 and 2; 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 (CAC Nos. MF9923, MF9924, MF9925, MF9926, MF9927, and MF9928; EPID L-2017-LLR-0060)," dated January 24, 2018 (ADAMS Accession No. ML18019A195).

4. ASME Section XI Code Case N-831, "Ultrasonic Examination in Lieu of Radiography for Welds in Ferritic Pipe Section XI, Division 1," ASME Approval Date: October 20, 2016.

5. US NRC, NUREG/CR-7204, "Applying Ultrasonic Testing in Lieu of Radiography for Volumetric Examination of Carbon Steel Piping" (ADAMS Accession No. ML15253A674).