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

August 24, 2009

Mr. Charles Pardee
President and Chief Nuclear Office
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: CLINTON POWER STATION, UNIT NO. 1 - PROPOSED ALTERNATIVE TO 10 CFR 50.55a EXAMINATION REQUIREMENTS FOR REACTOR PRESSURE VESSEL WELD INSPECTIONS (TAC NO. ME0218)

Dear Mr. Pardee:

By letter to the Nuclear Regulatory Commission (NRC) dated December 3, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML083380762), AmerGen, the licensee for Clinton Power Station, Unit No. 1 (CPS), submitted a proposed alternative, RS-08-156, in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a, paragraph (a)(3)(i). In RS-08-156, the licensee requested NRC approval of a proposed alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI inspection requirements regarding examination of certain reactor pressure vessel nozzle-to-vessel welds and nozzle inner radii at CPS. Specifically, AmerGen has proposed an alternative in accordance with ASME Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds."

At the time of the application, AmerGen was the licensee for CPS. AmerGen was a wholly-owned subsidiary of Exelon Generation Company, LLC (EGC). On January 8, 2009, EGC elirminated AmerGen and transferred the operating licenses of the AmerGen reactor plants to EGC. By letter dated January 9, 2009 (ADAMS Accession No. ML090120538), EGC adopted and endorsed docketed submittals that requested specific licensing actions that were made by AmerGen, and requested that the NRC staff continue to process those pending actions on the schedules previously agreed to by AmerGen.

The NRC staff has completed its review of RS-08-156. The details of the NRC staff's review are included in the enclosed safety evaluation. Use of Code Case N-702 is authorized until such time as the Code Case is published in a revision to Regulatory Guide 1.147. At that time, if the licensee intends to continue to implement the Code Case, the licensee must follow all provisions in Code Case N-702 with limitations issued in Regulatory Guide 1.147, if any. Accordingly, RS-08-156, is authorized pursuant to Title 10 CFR Section 50.55a(a)(3)(i) based on the NRC staff's determination that an acceptable level of quality and safety will be maintained.

All other requirements of the ASME Code, Sections III and XI, for which relief has not been specifically requested and approved remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the Clinton Project Manager, Mrs. Cameron Goodwin, at 301-415-3719.

Sincerely,

Stephen J. Campbell, Chief
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-461

Enclosure:
As stated

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE TO 10 CFR 50.55a EXAMINATION REQUIREMENTS FOR

REACTOR PRESSURE VESSEL WELD INSPECTIONS

EXELON GENERATION COMPANY, LLC

CLINTON POWER STATION, UNIT NO. 1

DOCKET NO. 50-461

1.0 INTRODUCTION

By letter to the Nuclear Regulatory Commission (NRC) dated December 3, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML083380762), AmerGen, the licensee for Clinton Power Station, Unit No. 1 (CPS), submitted a proposed alternative, RS-08-156, in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50.55a, paragraph (a)(3)(i). In RS-08-156, the licensee requested NRC approval of a proposed alternative to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI inspection requirements regarding examination of certain reactor pressure vessel (RPV) nozzle-to-vessel welds and nozzle inner radii at CPS. Specifically, AmerGen has proposed an alternative in accordance with ASME Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds."

The technical basis for ASME Code Case N-702 was documented in an Electric Power Research Institute (EPRI) report for the Boiling-Water Reactor Vessel and Internals Project (BWRVIP), "BWRVIP-108: BWR Vessel and Internals Project, Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Inner Radii," which was approved by the NRC in a safety evaluation (SE) dated December 19, 2007 (ADAMS Accession No. ML073600374).

The December 19, 2007, SE for the BWRVIP-108 report specified plant-specific requirements which must be met by applicants proposing to use this alternative. The licensee has provided information in its submittal, RS-08-156, to demonstrate that the relevant CPS RPV nozzle-to-vessel welds and their inner radii meet these plant-specific requirements so that the proposed alternative can be authorized.

At the time of the application, AmerGen was the licensee for CPS. AmerGen was a wholly-owned subsidiary of Exelon Generation Company, LLC (EGC). On January 8, 2009, EGC eliminated AmerGen and transferred the operating licenses of the AmerGen reactor plants to EGC. By letter dated January 9, 2009 (ADAMS Accession No. ML090120538), EGC adopted and endorsed docketed submittals that requested specific licensing actions that were made by

AmerGen, and requested that the NRC staff continue to process those pending actions on the schedules previously agreed to by AmerGen.

2.0 REGULATORY EVALUATION

Inservice inspection (ISI) of the 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 granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 50.55a(a)(3) of 10 CFR states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if: (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.

The regulation at 10 CFR 50.55a(g)(4) further states that ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except design and access provisions and preservice examination requirements, set forth in the ASME Code, Section XI 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 applicable ISI Code of Record for the second 10-year ISI interval for CPS is the 1989 Edition of ASME Code, Section XI. In addition, for ultrasonic examinations, Section XI, Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," of the 1995 Edition, with the 1996 Addenda, is implemented as required and modified by 10 CFR 50.55a(b)(2)(xv).

For all RPV nozzle-to-vessel shell welds and nozzle inner radii, ASME Code, Section XI requires 100 percent inspection during each 10-year ISI interval. However, ASME Code Case N-702 proposes an alternative which reduces the inspection of RPV nozzle-to-vessel shell welds and nozzle inner radius areas from 100 percent to 25 percent of the nozzles for each nozzle type during each 10-year interval. As mentioned earlier, the NRC has approved the BWRVIP-108 report, the underlying technical basis document for ASME Code Case N-702. However, each licensee should demonstrate the plant-specific applicability of the BWRVIP-108 report to their units when requesting to use the proposed alternative of ASME Code Case N-702, by showing that all the following general and nozzle-specific criteria are satisfied:

(1) The maximum RPV heatup/cooldown rate is limited to less than 115 °F/hour;

For the recirculation inlet nozzles

(2) $(pr/t)/C_{RPV} < 1.15$
p = RPV normal operating pressure,
r = RPV inner radius,
t = RPV wall thickness, and
C_{RPV} = 19332 (i.e., 1000 psi x 110 inch/5.69 inch, based on the BWRVIP-108 recirculation inlet nozzle/RPV finite element model);

(3) $[p(r_O^2 + r_I^2)/ (r_O^2 - r_I^2)]/ C_{NOZZLE} < 1.15$
p = RPV normal operating pressure,
r_O = nozzle outer radius,
r_I = nozzle inner radius, and
C_{NOZZLE} = 1637 [i.e., 1000 psi x(13.98822 + 6.87522)/ (13.98822 - 6.87522)], based on the BWRVIP-108 recirculation inlet nozzle/RPV finite element model];

For the recirculation outlet nozzles

(4) $(pr/t)/C_{RPV} < 1.15$
p = RPV normal operating pressure,
r = RPV inner radius,
t = RPV wall thickness, and
C_{RPV} = 16171 (i.e., 1000 psi x 113.2 inch/7.0 inch, based on the BWRVIP-108 recirculation outlet nozzle/RPV finite element model); and

(5) $[p(r_O^2 + r_I^2)/ (r_O^2 - r_I^2)]/ C_{NOZZLE} < 1.15$
p = RPV normal operating pressure,
r_O = nozzle outer radius,
r_I = nozzle inner radius, and
C_{NOZZLE} = 1977 [i.e., 1000 psi x(22.312+ 12.782)/ (22.312 – 12.782)], based on the BWRVIP-108 recirculation outlet nozzle/RPV finite element model];

This plant-specific information was required by the NRC staff to ensure that the probabilistic fracture mechanics (PFM) analysis documented in the BWRVIP-108 report applies to the RPV of the applicant's plant.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Requirement for which Relief is Requested

The licensee requested relief from the following requirements of ASME Code, Section XI, 1989 Edition:

> ASME Code Class 1 nozzle-to-vessel weld and nozzle inner radii examination requirements are given in Subsection IWB, Table IWB-2500-1, "Examination Category B-D Full Penetration Welds of Nozzles in Vessels - Inspection Program B," Item Numbers B3.90 and B3.100, respectively. The method of examination is volumetric. For the extent of examination, all nozzles with full penetration welds to the vessel shell (or head) and integrally cast nozzles must be examined each interval.

3.2 Component(s) for which Relief is Requested

Code Class:	1
Component Numbers:	N1, N2, N3, N5, N6, N7, N8, N9, and N16 [note that each "Nx" category may have multiple individual nozzles]
Examination Category:	B-D
Item Number:	B3.90 and B3.100

3.3 Licensee's Proposed Alternative to the ASME Code (As stated)

Pursuant to 10 CFR 50.55a(a)(3)(i), relief is requested from performing the required examinations on 100% of the identified nozzle assemblies. Alternatively, in accordance with Code Case N-702, Clinton, Unit 1 proposes to examine a minimum of 25% of the nozzle inner radii and nozzle-to-shell welds, including at least one nozzle from each system and nominal pipe size. For each of the identified nozzle assemblies, both the inner radius and the nozzle-to-shell weld would be examined. As a minimum, the following nozzles would be selected for examination: one of the two 20" recirculation outlet nozzles (i.e., N1); three of the ten 10" recirculation inlet nozzles (i.e., N2); one of the four 24" main steam nozzles (i.e., N3); one of the two 12" core spray nozzles (i.e., N5); one of the three 10" low pressure coolant injection nozzles (i.e., N6); one of the two 6" head spray nozzles (i.e., N7 and N8); one of the two 4" jet pump instrumentation nozzles (i.e., N9); and the vibration instrumentation nozzle (i.e., N16).

3.4 Licensee's Bases for Alternative

The EPRI Technical Report 1003557, "BWRVIP-108: BWR Vessel and Internals Project, Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii," provides the basis for ASME Code Case N-702. The evaluation found that failure probabilities due to a Low Temperature Overpressure event at the nozzle blend radius region and nozzle-to-vessel shell weld are very low (i.e., <1 x 10-6 for 40 years) with or without ISI. The report concludes that inspection of 25 percent of each nozzle type is technically justified.

On December 19, 2007, the NRC issued a SE approving the use of the BWRVIP-108 evaluation as a basis for using ASME Code Case N-702. Within Section 5 of the SE, it states that each licensee should demonstrate the plant-specific applicability of the BWRVIP-108 evaluation to their units in the request for alternative by meeting the criteria discussed in Section 5 of the SE.

Criterion 1: The maximum RPV heatup/cooldown rate is less than 115° F/hour.

The licensee states that this criterion is met by adherence to CPS technical specification 3.4.11, "Reactor Coolant System Pressure/Temperature Limits" and surveillance requirement 3.4.11.1, which requires verification that the Reactor Coolant System Heatup and Cooldown rates are limited to less than or equal to 100 °F in any 1 hour period and, less than or equal to 20 °F in any 1 hour period during RPV pressure testing.

Criterion 2: For recirculation inlet nozzles, $(pr/t)/C_{RPV} < 1.15$

$[(1025 \times 110.19) \div 6.1] \div 19332 < 1.15$

CPS result: $(pr/t)/C_{RPV} = 0.96 < 1.15$

Criterion 3: For recirculation inlet nozzles, $[p(r_O^2 + r_I^2)/(r_O^2 - r_I^2)]/C_{NOZZLE} < 1.15$

$[1025 \times (11.69^2 + 5.81^2) \div (11.69^2 - 5.81^2)] \div 1637 < 1.15$

CPS result: $[p(r_O^2 + r_I^2)/(r_O^2 - r_I^2)]/C_{NOZZLE} = 1.14 < 1.15$

Criterion 4: For recirculation outlet nozzles, $(pr/t)/C_{RPV}$ <1.15
[(1025 x 110.19) ÷ 6.1] ÷ 16171 < 1.15

CPS result: $(pr/t)/C_{RPV}$ = 0.97 < 1.15

Criterion 5: For recirculation outlet nozzles, $[p(r_O^2 + r_I^2)/(r_O^2 - r_I^2)]/C_{NOZZLE}$ <1.15

$[1025 \times (16.3125^2 + 9.0^2)\ (16.3125^2 - 9.0^2)] \div 1977 < 1.15$

CPS result: $[p(r_O^2 + r_I^2)/(r_O^2 - r_I^2)]/C_{NOZZLE}$ = 1.04 < 1.15

The results of the above equations demonstrate the applicability of the BWRVIP-108 evaluation to CPS by showing that the criteria within Section 5 of the NRC issued SE, dated December 19, 2007, are met. Therefore, the basis for using ASME Code Case N-702 is demonstrated for CPS.

3.5 Staff Evaluation

Criteria for Applying the BWRVIP-108 Report

The December 19, 2007, SE on the BWRVIP-108 report specified five plant-specific criteria that licensees must meet to demonstrate that the BWRVIP-108 report results apply to their plants. The five criteria are related to the driving force of the PFM analyses for the recirculation inlet and outlet nozzles. It was stated in the December 19, 2007, SE that the nozzle material fracture toughness-related RT_{NDT} values used in the PFM analyses were based on data from the entire fleet of BWR RPVs. Therefore, the BWRVIP-108 report PFM analyses are bounding with respect to fracture resistance, and only the driving force of the underlying PFM analyses needs to be evaluated. It was also stated in the December 19, 2007, SE that, except for the RPV heatup/cooldown rate, the plant-specific criteria are for the recirculation inlet and outlet nozzles only because the probabilities of failure, P(F|E)s, for other nozzles are an order of magnitude lower.

In the request for alternative submittal, RS-08-156, the licensee provided the CPS plant-specific data and its evaluation of the five driving force factors, or ratios, against the criteria established in the December 19, 2007, SE. The licensee's evaluation indicated that all five criteria are satisfied.

Evaluation of the Proposed ISI

The licensee states that for each of the identified nozzle assemblies, both the inner radius and the nozzle-to-shell weld would be examined. As a minimum, the following nozzles would be selected for examination: one of the two 20" recirculation outlet nozzles (i.e., N1); three of the ten 10" recirculation inlet nozzles (i.e., N2); one of the four 24" main steam nozzles (i.e., N3); one of the two 12" core spray nozzles (i.e., N5); one of the three 10" low pressure coolant injection nozzles (i.e., N6); one of the two 6" head spray nozzles (i.e., N7 and N8); one of the two 4" jet pump instrumentation nozzles (i.e., N9); and the vibration instrumentation nozzle (i.e., N16).

For the examination of the inner radii, ASME Code Case N-702 proposes that visual examination may be used in lieu of volumetric examination. However, the licensee states in their submittal that CPS is not currently using ASME Code Case N-648-1, "Alternative Requirements for Inner Radius Examinations of Class 1 Reactor Vessel Nozzles," on enhanced magnification visual examination and has no plans of using ASME Code Case N-648-1 in the future. The licensee further states that CPS will continue to perform volumetric examinations of all required nozzle inner radii. The NRC staff finds the licensee's continued use of volumetric examination of required nozzle inner radii to be consistent with current regulatory guidance.

4.0 CONCLUSION

The staff has reviewed the submittal and finds that the CPS RPV meets all five plant-specific criteria specified in the December 19, 2007, SE on the BWRVIP-108 report, which provides the technical bases for use of ASME Code Case N-702. Use of Code Case N-702 is authorized until such time as the Code Case is published in a revision to Regulatory Guide 1.147. At that time, if the licensee intends to continue to implement the Code Case, the licensee must follow all provisions in Code Case N-702 with limitations issued in Regulatory Guide 1.147, if any. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the request for a proposed alternative, RS-08-156, is authorized through the end of the second 10-year ISI interval from the requirements of Table IWB-2500-1 (Inspection Program B) of ASME Code, Section XI, pertaining to inspection of the RPV nozzle-to-vessel shell welds and inner radii for the nozzles specified in Attachment 2 of the licensee's submittal based on the use of ASME Code Case N-702 because an acceptable level of quality and safety will be maintained.

All other requirements of the ASME Code, Section XI, not specifically included in the request for the alternative RS-08-156, submitted by the licensee in letter dated December 3, 2008, remain in effect.

Principal Contributor: AShaikh, NRR

Date: August 24, 2009

If you have any questions, please contact the Clinton Project Manager, Mrs. Cameron Goodwin, at 301-415-3719.

Sincerely,

/RA/

Stephen J. Campbell, Chief
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-461

Enclosure:
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