February 27, 2008

Mr. Charles G. Pardee
Chief Nuclear Officer
and Senior Vice President
AmerGen Energy Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BYRON STATION, UNIT NOS. 1 AND 2 – INSERVICE INSPECTION PROGRAM SECOND INTERVAL RELIEF REQUEST I2R-21 (TAC NOS. MD4097 AND MD4098)

Dear Mr. Pardee:

By letter dated January 12, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070120246), as supplemented by letters dated September 17, 2007 (ADAMS Accession No. ML072610587), and January 31, 2008 (ADAMS Accession No. ML080310561), Exelon Generation Company, LLC (the licensee), submitted Relief Requests (RRs) I2R-21, I2R-22, I2R-23, I2R-25, and I2R-53 for the second 10-year inservice inspection interval (ISI) at Byron Station, Unit Nos. 1 and 2 (Byron). These RRs were submitted due to the impracticality of satisfying the relevant requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, for the specified ASME Code Class 1 and 2 components.

The Nuclear Regulatory Commission (NRC) has reviewed the licensee's analysis in support of its requests for relief. For RR I2R-21, the NRC determined that the relevant ASME Code, Section XI examination requirement is impractical for Byron and that the licensee's alternative examination of the subject Class 1 components provides reasonable assurance of structural integrity. Therefore, RR I2R-21 is granted pursuant to 10 CFR 50.55a(g)(6)(i). However, although this request for relief is granted, the RR granted is retroactive for Bryon's second 10-year ISI interval, which ended January 15, 2006.

The NRC staff had previously reviewed RRs I2R-22, I2R-23, I2R-25, and I2R-53, which were also provided by the licensee in its letter dated January 12, 2007. These RRs were approved by letter dated January 15, 2008 (ADAMS Accession No. ML073230312).

Granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and approved, remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Sincerely,

/RA/

Russell Gibbs, Chief
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-454 and STN 50-455

Enclosure: Safety Evaluation

cc w/encl: See next page

Granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and approved, remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

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Docket Nos. STN 50-454 and STN 50-455

Enclosure: Safety Evaluation

cc w/encl: See next page

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Byron Station, Unit Nos. 1 and 2

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST I2R-21 FOR THE

SECOND 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

EXELON GENERATION COMPANY, LLC

BYRON STATION, UNIT NOS. 1 AND 2

DOCKET NOS. 50-454 AND 50-455

1.0 INTRODUCTION

By letter dated January 12, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070120246), as supplemented by letters dated September 17, 2007 (ADAMS Accession No. ML072610587), and January 31, 2008 (ADAMS Accession No. ML080310561), Exelon Generation Company, LLC (EGC, the licensee), submitted Relief Requests (RRs) I2R-21, I2R-22, I2R-23, I2R-25, and I2R-53 for the second 10-year inservice inspection interval (ISI) at Byron Station, Unit Nos. 1 and 2 (Byron). In its submittal, the licensee requested relief from certain examination requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, for several ASME Code Class 1 and 2 components.

The Nuclear Regulatory Commission (NRC) staff had previously reviewed RRs I2R-22, I2R-23, I2R-25, and I2R-53, which were also provided by the licensee in its letter dated January 12, 2007. These RRs were approved by letter dated January 15, 2008 (ADAMS Accession No. ML073230312). This evaluation addresses RR I2R-21.

2.0 REGULATORY EVALUATION

Inservice Inspection of ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g), except where specific relief has been granted by the NRC 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.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” to the extent practical within the limitations of design, geometry, and materials of construction of the components. The

regulation requires 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) twelve months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The applicable Code of Record for the second 10-year interval ISI program at Byron is the 1989 Edition of the ASME Code, Section XI, without addenda. The second 10-year interval ISI program at Byron ended on January 15, 2006.

3.0 TECHNICAL EVALUATION

3.0.1 Component Identification

In RR I2R-21, the licensee requested relief from the ASME Code, Section XI examination requirements for Pressurizer Seismic Lug Welds PSL-1, PSL-2, PSL-3, and PSL-4 at Byron.

3.0.2 ASME Code, Section XI Requirements

The pressurizer seismic lug welds are Class 1 integrally welded attachments and are subject to the examination requirements of the ASME Code, Section XI, Table IWB-2500-1, Examination Category B-K, Item Number B10.10. The 1989 Edition of the ASME Code, Section XI, Table IWB-2500-1, Examination Category B-K, Item Number B10.10, requires surface examinations for all welded attachments to the pressurizer. The required examination area is specified in Figure IWB-2500-15.

3.0.3 Licensee's Code RR

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code, Section XI requirements for performing a full surface examination of the area specified in Figure IWB-2500-15 of the ASME Code, Section XI, for pressurizer seismic lug welds PSL-1, PSL-2, PSL-3, and PSL-4 at Byron. Relief was requested for the second ISI interval at Byron.

3.0.4 NRC Staff Evaluation

The ASME Code, Section XI requires that the subject Class 1 pressurizer seismic lug welds receive a 100 percent surface examination each inspection interval. The required examination area is specified in Figure IWB-2500-15. The figures provided by the licensee in RR I2R-21 demonstrate that a large portion of the examination surface area for these seismic lug welds is inaccessible due to the seismic lug restraints, pressurizer shell insulation, and the configuration of the pressurizer coffin. In order for access to be obtained to perform the required full surface examinations, the seismic lug restraints and pressurizer shell insulation would need to be removed and major modifications to the pressurizer coffin would be required. This would result in a significant burden on the licensee.

The licensee was able to perform a liquid penetrant (PT) surface examination of all accessible portions of the seismic lug welds and adjacent ½ inch of base metal. The figures provided by the licensee indicate that the average surface examination coverage achieved for the four seismic lug welds was 21.4 percent of the examination surface area required by the ASME Code, Section XI, for Byron, Unit No. 1 and 27.7 percent for Byron, Unit No. 2.

The table below shows the actual surface examination coverage that was achieved for each of the four seismic lug welds.

Seismic Lug Weld ID	Unit 1 Percentage Examined	Unit 2 Percentage Examined
PSL-1	21.4%	25%
PSL-2	42.9%	0%
PSL-3	21.4%	42.9%
PSL-4	0%	42.9%
Average Weld Coverage	21.4%	27.7%

In addition to the limited surface examination coverage of these seismic lug welds, the licensee has performed periodic VT-2 visual examinations in accordance with the requirements of the ASME Code, Section XI, Examination Category B-P. The licensee indicated that these examinations along with technical specification requirements for reactor coolant system leakage monitoring provide reasonable assurance of continued structural integrity of the pressurizer shell and seismic lug welds.

The NRC staff noted that RR I2R-21 did not indicate whether the limited scope surface examination of the seismic lug welds provided any indication of the presence of unacceptable flaws or conditions in accordance with the acceptance criteria of the ASME Code, Section XI, Article IWB-3000. The NRC staff requested clarification of this and other issues in a request for additional information (RAI) issued by letter dated August 17, 2007 (ADAMS Accession No. ML072270701). In RAI question 1 on I2R-21 (RAI I2R-21-1), the NRC staff requested that the licensee discuss whether the limited scope surface examination of the seismic lug welds provided any indication of the presence of flaws or other relevant conditions that were determined to be unacceptable according to the acceptance criteria of the ASME Code, Section XI, Article IWB-3000.

In its September 17, 2007, RAI response, the licensee stated that the examination of pressurizer seismic lug weld PSL-1 at Byron, Unit No. 2 during the fall 2005 refueling outage revealed two aligned linear flaws near the toe of the weld closest to the pressurizer vessel. According to the licensee, the lengths of the two flaws were 0.2 inch and 0.8 inch, with a separation distance of 0.9 inch between the flaws. These two flaws did not require grouping into a single flaw, based on Subarticle IWA-3400 of the ASME Code, Section XI. Using the acceptance standard in Table IWB-3510-3 for allowable linear flaws, the 0.2 inch linear flaw was determined to be acceptable. However, for the 0.8 inch linear flaw, the length divided by the nominal pressurizer vessel thickness (i.e. the linear flaw(*l*) / nominal pressurizer vessel thickness (t)) was calculated to be 20 percent, and this exceeded the 10.4 percent acceptance standard in Table IWB-3510-3. The licensee also stated that the flaws detected in pressurizer seismic lug weld PSL-1 at Byron, Unit No. 2 were determined to be fabrication defects and not service-induced. The licensee stated that both flaws were analytically evaluated in accordance with the requirements of the ASME Code, Section XI, Subarticle IWB-3600. The licensee submitted its flaw evaluation report to the NRC staff in a letter dated January 11, 2006 (ADAMS Accession No. ML080580263), pursuant to the requirements of the ASME Code, Section XI, Subparagraph IWB-3134(b).

In RAI I2R-21-2, the NRC staff requested that the licensee discuss the extent to which the seismic lug welds were examined during the first ISI interval and the preservice examination, including the percentage of credible surface examination coverage that was achieved during these previous examinations. The NRC staff also requested that the licensee discuss any relevant conditions that were found during these previous examinations. In its response to RAI I2R-21-2, the licensee indicated that the preservice inspection program at Byron was based on the 1977 Edition through the Summer 1978 Addenda of the ASME Code, Section XI. Under these ASME Code requirements, it was determined that a preservice examination was not applicable to the pressurizer seismic lug welds. During the first ISI interval, the PT surface examination achieved an estimated 21 percent average coverage for the pressurizer seismic lug welds at Byron, Unit No. 1 and 20 percent average coverage for these welds at Byron, Unit No. 2. The licensee stated that none of these limited PT surface examinations resulted in any recordable indications. The fabrication examination method was magnetic particle testing (MT) using the prod technique, which also did not detect these shallow surface flaws. The NRC staff found that this response resolved RAI I2R-21-2 because the licensee provided the requested information regarding the examination history of the pressurizer seismic lug welds.

In its January 11, 2006, flaw evaluation report, the licensee stated that there is no known evidence that the flaws detected in weld PSL-1 at Byron, Unit No. 2 are service induced, despite the fact that these flaws were not detected during the first ISI interval and fabrication acceptance examinations. This finding was based, in part, on the fact that there is no known mechanism that can cause crack initiation in the affected region of weld PSL-1 since the maximum design fatigue usage factor calculated for the seismic lug region is 0.37 compared to the ASME Code-allowable value of 1.0. Furthermore, according to the licensee, no seismic events have occurred at Byron, Unit No. 2. Therefore, there is essentially no cumulative fatigue usage factor to date because the seismic restraint lugs are structurally active only under earthquake and pipe rupture loadings.

The seismic restraint lugs were welded to the outside diameter of the pressurizer shell with two longitudinal full penetration welds for each of the four lugs. The lugs were installed on the pressurizer in January 1975. In its flaw evaluation report, the licensee reviewed the seismic restraint lug installation sequence based on the available drawings and records in order to ascertain the root cause of the suspected fabrication defects. Prior to the installation and welding of the seismic restraint lugs, MT and ultrasonic (UT) examinations of the pressurizer shell revealed no recordable indications in the regions where the lugs were to be welded into place. Back gouging and MT testing were performed throughout the full penetration welding sequence. After the full penetration welds were completed, filet welds were added to all sides of the lugs and the lugs received a post-weld heat treatment. Based on a review of this welding sequence and the location and orientation of the two flaws, the licensee determined that the flaws are fabrication defects in a portion of the filet weld that is not required for any pressurizer structural support purpose.

The root cause of the fabrication defects, according to the licensee, was a lack of fusion between the fillet weld beads. The licensee stated that these defects are not likely to extend any further beyond the fillet weld into the full penetration weld or into the reactor coolant pressure boundary region of the pressurizer shell because the original ASME Code acceptance MT inspection of the full penetration welds showed no indications, and the pressurizer shell base metal is not susceptible to stress corrosion cracking in a primary water environment. The NRC staff agreed with the licensee's determination that the detected flaws are fabrication

defects because (1) the seismic lug installation sequence indicates that the flaws probably originated during the fillet welding process and, (2) the relatively minor loadings on the pressurizer seismic restraint lugs are highly unlikely to induce and propagate flaws of this nature.

The NRC staff reviewed the licensee's analytical flaw evaluation in order to determine whether the licensee conservatively evaluated the two flaws in accordance with the ASME Code, Section XI, Subarticle IWB-3600 flaw evaluation guidelines. The licensee developed flaw evaluation charts for both outside axial and circumferential surface flaws to determine their acceptability. These flaw evaluation charts were based on the IWB-3600 flaw acceptance criteria for continued service without repair. The development of the flaw evaluation charts required that the depths of the detected flaws be known in order to ascertain a flaw shape factor (flaw depth (*a*) / flaw length (*l*)). The length of the largest flaw was 0.8 inch. However, given that the flaws were detected using PT surface examination techniques, the depths were not known and had to be conservatively ascertained, based on an assumed semicircular flaw shape, with a shape factor (*a/l*) of 0.5. This is the maximum flaw shape factor allowed by the ASME Code, Section XI, and it therefore yields the maximum flaw depth. This shape factor resulted in a flaw depth of 0.4 inch. The licensee performed a confirmatory best estimate UT examination to validate the conservatism of the 0.4 inch flaw depth assumption used in the flaw evaluation. This UT examination interrogated the weld material volume below the flaws to a depth from 0.10 inch to 0.50 inch. The transducer was unable to examine the weld metal volume less than 0.10 below the flaws due to physical restrictions. However, no indications were detected within the 0.10 to 0.50 inch depth range. Therefore, the flaw depth assumption was determined to be conservative.

Moreover, the UT examination confirmed that the flaws were confined to the actual weld region only, and they do not extend into the pressurizer wall. Flaw evaluations were performed based on the above flaw shape factor, assuming both axial and circumferential orientations, with respect to the pressurizer axis. The flaw evaluation charts demonstrated that, given a conservative flaw depth of 0.4 inch (one-half the length of the largest flaw), the maximum allowable initial length for the flaw is 2.6 inches for assumed fatigue growth over an operational period of 30 years. This allowable flaw length was based on an axial flaw orientation, which yielded the most conservative results. The actual surface length of the largest detected flaw was 0.8 inch. Therefore, the flaw evaluation charts conclusively demonstrated that ample safety margin exists for both of the detected flaws and no repair is necessary for an operational period of at least 30 years, based on a conservative fatigue crack growth analysis performed in accordance with the methodology suggested by the ASME Code, Section XI. Based on the above considerations, the NRC staff determined that the licensee's flaw evaluation report demonstrated that both flaws satisfied the flaw evaluation acceptance criteria of the ASME Code, Section XI, Subarticle IWB-3600.

The NRC staff noted that a similar RR was granted for Braidwood Station, Units 1 and 2 on January 6, 2000 (ADAMS Accession No. ML003676803). However, the authorization for this request was granted with the understanding that the licensee would perform a VT-1 visual examination of the accessible areas in the vicinity of the seismic lug welds during the next ISI interval. Therefore, in RAI I2R-21-3, the NRC staff requested that the licensee indicate whether

a VT-1 visual examination has been, or will be, performed for the accessible areas of the seismic lug welds. In its response to RAI I2R-21-3, the licensee indicated that both a VT-1 visual examination and a best effort surface examination will be performed on the accessible regions of the seismic lug welds during the third ISI interval when the separable portions of the pressurizer shell insulation panels are removed. The NRC staff found that this response resolved RAI I2R-21-3 because the licensee stated that a VT-1 visual examination of the accessible regions of the pressurizer seismic lug welds will be performed during the third ISI interval at Byron.

Given the limited coverage that was obtained for the pressurizer seismic lug welds at Byron and specifically the detection of flaws in the limited coverage area for one of these welds at Byron, Unit No. 2, the NRC staff determined that the licensee should provide additional assurance that the VT-1 visual examination and best effort surface examination will be performed on the accessible regions of the seismic lug welds during the third ISI interval. Therefore, in a telephone conference with the licensee on January 11, 2008, the NRC staff requested that the licensee provide a formal regulatory commitment to perform these examinations during the third ISI interval. This commitment was provided to the NRC staff in a supplemental letter dated January 31, 2008, and reads as follows:

> For the third inservice inspection (ISI) interval, EGC will perform a best effort surface examination (i.e., liquid penetrant [PT]) on those portions of the seismic lug welds that are inspectable when the removable insulation panels are removed. In addition, in conjunction with this surface examination, EGC will perform a VT-1 visual examination of the upper surfaces of the three accessible lugs.

Based on the above considerations, the NRC staff determined that the ASME Code, Section XI, requirement to perform surface examinations of the subject pressurizer seismic lug welds, with essentially 100 percent coverage of the examination surface specified in Figure IWB-2500-15 of the ASME Code, Section XI, is impractical for Byron. The licensee provided a formal regulatory commitment to perform a VT-1 visual and a best effort surface examination of the accessible regions of the pressurizer seismic lug welds during the third ISI interval at Byron. Therefore, based on the limited scope surface examinations and VT-2 visual examinations already performed during the second ISI interval, the NRC staff's review and acceptance of the licensee's flaw evaluation report, and the commitment to perform VT-1 visual and surface examinations during the third ISI interval, it can be concluded that reasonable assurance of structural integrity will be maintained for pressurizer seismic lug welds PSL-1, PSL-2, PSL-3, and PSL-4, at Byron.

4.0 CONCLUSION

Based on the above evaluation of RR I2R-21, the NRC staff concludes that the applicable ASME Code, Section XI requirements is impractical for Byron. Furthermore, the NRC staff concludes that the licensee's alternative examination provides reasonable assurance of structural integrity for the subject Class 1 components. Therefore, RR I2-21 is granted pursuant to 10 CFR 50.55a(g)(6)(i). However, although this request for relief is granted, the RR granted is retroactive for Bryon's second 10-year ISI interval, which ended January 15, 2006.

Granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and approved, remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: C. Syndor, NRR

Date: February 27, 2008