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

April 21, 2010

Mr. Charles G. Pardee
President and Chief Nuclear Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: CLINTON POWER STATION, UNIT NO. 1 – RELIEF REQUEST NO. 1203 FOR PROPOSED ALTERNATIVE TO POST WELD HEAT TREATMENT (PWHT) FOR REACTOR WATER CLEANUP SYSTEM PIPING (TAC NO. ME1878)

Dear Mr. Pardee:

By letter dated May 5, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML091260459), as supplemented by letters dated October 22, 2009 (ADAMS Accession No. ML092960499), and March 12, 2010 (ADAMS Accession No. ML100710476). Exelon Generation Company, LLC (the licensee) requested to use an alternative to the requirements of the 2004 Edition of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section XI, Article IWA-4000, for the repair and replacement of certain reactor water cleanup (RT) system piping at Clinton Power Station (CPS), Unit 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(i), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. The licensee proposed to use Table NB-4622.7(b)-1, "Exemptions to Mandatory [post weld heat treatment] PWHT," of the 2006 Addenda to the 2004 Edition of Section III to the ASME Boiler and Pressure Vessel Code, Subsection NB as an alternative for the RT system piping to be installed during the 13th refueling outage.

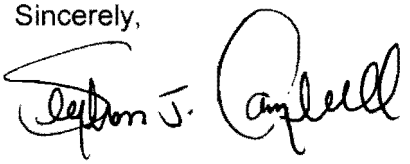
The Nuclear Regulatory Commission (NRC) staff has reviewed the licensee's submittal and concluded that the proposed request to use a portion of a later ASME Code edition and addenda provides an acceptable level of quality and safety for the specified repair/replacement activities and is acceptable and authorizes the use of Table NB-4622.7(b)-1 of the 2006 Addenda to the 2004 Edition of Section XI of the ASME Code, Section XI for the duration of the project to install the RT system piping with ASME Code, Section IX P5A material without the use of PWHT during the January 2012, refueling outage at CPS, or until such time as the NRC incorporates the use of the 2006 Addenda of the ASME Code, Section XI, Subsection NB by reference in 10 CFR 50.55a(b).

This authorization does not exempt the licensee from the requirements of 10 CFR 50.55a(g)(4)(i), clarified in Regulatory Information Summary 2004-16, "Use of Later Editions and Addenda to ASME Code Section XI for Repair/Replacement Activities," or when and if the NRC incorporates the use of the 2006 Addenda of the ASME, Section XI, Subsection NB Code in 10 CFR 50.55a(b). This authorization does not exempt the replacement valve which is specified as SA-217, Grade WC9, with a maximum chromium content of 2.75 percent and an allowable carbon content of 0.18 percent from PWHT. PWHT shall be applied to welds associated with this valve.

A copy of the Safety Evaluation is enclosed. All other ASME Code, Sections III and XI, requirements 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 Project Manager, Nicholas DiFrancesco, at 301-415-1115.

Sincerely,



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

Docket No. 50-461

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NO. 1203 REGARDING USE OF ALTERNATIVE

TO POST WELD HEAT TREATMENT REQUIREMENTS FOR PIPING REPLACEMENTS

EXELON GENERATION COMPANY, LLC

CLINTON POWER STATION, UNIT NO. 1

DOCKET NO. 50-461

1.0 INTRODUCTION

By letter dated May 5, 2009, as supplemented by letters dated October 22, 2009, and March 12, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML091260459, ML092960499 and ML100710476, respectively), Exelon Generation Company, LLC (EGC, the licensee), requested to use an alternative to the requirements of the 2004 Edition of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," Article IWA-4000, "Repair / Replacement Activities," for the repair and replacement of certain reactor water cleanup (RT) system piping at Clinton Power Station (CPS), Unit No. 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(i), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. The licensee proposed to use Table NB-4622.7(b)-1, "Exemptions to Mandatory [post weld heat treatment] PWHT," of the 2006 Addenda to the 2004 Edition of Section III to the ASME Boiler and Pressure Vessel Code, Subsection NB as an alternative for the RT system piping to be installed during the 13th refueling outage. Table NB-4622.7(b)-1, provides exemption criteria from mandatory PWHT.

2.0 REGULATORY REQUIREMENTS

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(4), ASME Code Class 1, 2 and 3 components (including supports) will meet the requirements, except the design and access provisions and the 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. Paragraph IWA-4170(b) of the 2004 Edition of ASME, Section XI requires that repairs and installation of replacement items shall be performed in accordance with the Owner's Design Specification and the original code of construction of the component or system. Later editions and addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and ASME Code Cases may be used. The Code of Construction for the subject piping is ASME Code, Section III, Subsection NB, 1974 Edition through Summer 1974 Addenda. Paragraph 50.55a(g)(4) of 10 CFR states, in part, that

inservice examination of components and system pressure tests may meet the requirements set forth in subsequent editions and addenda of the ASME Code provided that they are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed in 10 CFR 50.55a(b), and subject to Commission approval. Portions of editions or addenda may be used provided that all related requirements of the respective editions or addenda are met. Currently, 10 CFR 50.55a(b)(1) incorporates by reference the ASME Code, Section III from the 1970 Edition through the 1976 Winter Addenda, and the 1977 Edition through the 2004 Addenda.

Paragraph 50.55a(a)(3) of 10 CFR states, in part, that the Director of the Office of Nuclear Reactor Regulation may authorize an alternative to the requirements of 10 CFR 50.55a(g). For an alternative to be authorized, as per 10 CFR 50.55a(a)(3)(i), the licensee must demonstrate that the proposed alternative would provide an acceptable level of quality and safety; per 10 CFR 50.55a(a)(3)(ii), the licensee must show that following the ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

3.0 LICENSEE'S REQUEST TO USE LATER EDITION AND ADDENDA TO ASME CODE, SECTION III

3.1 ASME Code Components Affected

ASME Code Class 1, Reactor Water Cleanup (RT) System Piping Line Component Numbers 1RT01 AA-4", 1RT01AB-4", 1RT01 EC-4", 1RT01 ED-4".

3.2 Applicable Code Edition and Addenda

The letter dated March 12, 2010, the licensee, requested relief from the ASME code requirements for the 13th refueling outage scheduled for January, 2012, which will occur within the third Inservice Inspection Program interval. The code of record for this request is the 2004 Edition of Section XI of the ASME Boiler and Pressure Vessel Code.

3.3 Background

In its letter dated May 5, 2009, the licensee states:

> During the [13th] refueling outage [...], CPS intends to replace a portion of the RT system piping with [ASME Code, Section IX P-Number 5A] P5A material versus the originally installed [ASME Code, Section IX P-Number 1] P1 material. A literal interpretation of Table NB-4622.7(b)-1, "Exemptions to Mandatory PWHT," of up to and including the 2004 Edition of the ASME Code, Section III, Subsection NB, would preclude [nominal pipe size] NPS 4-inch piping with an outside diameter (OD) of 4.5 inches from being exempt from PWHT. However, Table NB-4622.7(b)-1 of the 2006 Addenda of ASME, Section III, Subsection NB was revised to clarify and correct the inconsistencies between older versions of the piping codes. Specifically, this table was revised to correct the references to piping with a nominal OD of 4 inches. The table was revised to include NPS 4-inch piping with a nominal OD of 4.5 inches.

The piping within the scope of this request is being replaced in [CPS's 13th refueling outage]. The welds that will be made in support of the piping replacement meet the exemption requirements of the 2006 Addenda of the ASME Code, Section III, Subsection NB, Table NB-4622.7(b)-1. Due to the location of the piping in the CPS drywell and the number of field welds that are required due to space limitations, there would be a significant radiological dose savings (i.e., approximately 2 rem) by not having to set up and remove equipment for post weld heat treatment of the affected welds.

3.4 Applicable ASME Code Requirement (as stated by the licensee)

Repair and replacement activities [at CPS] are governed by Articles IWA-4000, IWB-4000, IWA-7000 and IWB-7000 of Section XI of the ASME Boiler and Pressure Vessel Code. These articles make reference to the code of construction, which for the subject piping is ASME, Section III, Subsection NB, 1974 Edition through summer 1974 Addenda. The code of construction required CPS to perform [PWHT] of the subject piping welds due to the piping OD being 4.5 inches. These articles also allow using later Editions and Addenda of ASME Code, Section III, either in their entirety or portions thereof, provided they have been approved by the regulatory authorities. The version of Section III ASME Boiler and Pressure Vessel Code incorporated by reference in 10 CFR 50.55a is the 2004 Edition.

CPS is planning to replace portions of the RT system piping with [ASME Code, Section IX] P5A material. ASME Code Section III, Subsection NB, Article NB-4000, Table NB-4622.7(b)-1, "Exemptions to Mandatory PWHT," provides exemption criteria from mandatory PWHT. Up to and including the 2004 Edition of the ASME Code, Section III, Subsection NB, Table NB-4622.7(b)-1, P5A material with an OD of 4 inches or less is exempt from PWHT. The current installation at CPS consists of [NPS] 4-inch piping with an OD of 4.5 inches, which requires PWHT after welding.

3.5 Proposed Subsequent ASME Code Edition and Addenda and Basis for Use (as stated by the licensee)

CPS proposes to use ASME Section III, Subsection NB, Table NB-4622.7(b)-1, as provided in the 2006 Addenda [to the 2004 Edition of] ASME Code,[Section XI,] to utilize an alternative to the requirement for a PWHT of the replacement piping. This table was revised in the 2006 Addenda to clarify the referenced sizes for pipes and tube OD's. In particular, this table was revised to correct the references to piping with a nominal OD of 4 inches. The table was revised to include NPS 4-inch piping with a nominal OD of 4.5 inches, as long as the piping wall thickness did not exceed 0.5 inches and carbon content did not exceed 0.15 percent. This revision was documented in a change to the 2006 Addenda of the ASME Code, Section III, Subsection NB, under record number BC-05-489. This change recognizes that piping normally produced by piping manufacturers is based on nominal pipe sizes.

The components within the scope of this relief request are the circumferential butt welds associated with replacement piping on the reactor water cleanup system piping system. The affected lines are NPS 4-inch (4.5 inch [OD]), schedule 120 piping (0.437 inch wall thickness). The material of the piping is SA-335, Grade P22, with a maximum chromium

content of 2.6 percent and a maximum carbon content of 0.15 percent. The material of the fittings is SA-234, Grade WP22 Class 1, with a maximum chromium content of 2.6 percent and a maximum carbon content of 0.15 percent. [...]

The licensee plans on replacing a valve as part of the piping replacement covered by this relief request. The replacement valve has been specified as SA-217, Grade WC9, with a maximum chromium content of 2.75 percent and an allowable carbon content of 0.18 percent. Welds on this material must be post weld heat treated. All of the above materials, except for the valve body material, meet the requirements of ASME, Section III, Subsection NB for Table NB-4622.7(b)-1 as revised by the 2006 Addenda.

3.6 Duration of Proposed Request

This request will remain in effect for the duration of the project to replace a portion of the RT system piping with ASME Code, Section IX P5A material during the January 2012 refueling outage at CPS or until such time as the Nuclear Regulatory Commission (NRC) incorporates the use of the 2006 Addenda of the ASME Code, Section XI, Subsection NB by reference.

4.0 STAFF EVALUATION

The NRC staff evaluated the licensee's request to use a later ASME Code edition and addenda using the criteria contained in 10 CFR 50.55a(a)(3)(i), since the proposed alternative provides an acceptable level of quality and safety. In its Relief Request No. 1203, the licensee proposes to use the requirements of Table NB-4622.7(b)-1, "Exemptions to Mandatory PWHT," of the 2006 Addenda to ASME Code, Section III, Subsection NB for the repair/replacement of certain RT system piping. This table was revised in the 2006 Addenda to the 2004 Edition of ASME Code, Section III to include NPS 4-inch piping with a nominal diameter of 4.5 inches, as long as the piping wall thickness did not exceed 0.5 inches and carbon content did not exceed 0.15 percent. This revision was documented in a change to the 2006 Addenda of the ASME Code, Section III, Subsection NB Code. Use of this addenda to the ASME Code would allow the licensee to install the RT system piping with ASME Code, Section IX P5A material without the use of a PWHT. The latest version of the ASME Code, Section III, incorporated by reference in 10 CFR 50.55a is the 2004 Edition; therefore, the licensee must seek relief to use this later edition of the ASME Code.

In response to an NRC request for additional Information, the licensee submitted a letter dated October 22, 2009. This letter detailed certain methods to be used in the welding. The methods detailed included:

1. All welds will be preheated to 400°F minimum using inductive or resistive heating methods.

2. Preheat will be maintained from the start of welding until the completion of welding.

3. Preheat and interpass temperatures will be verified using temperature indicating crayons, contact pyrometers, magnetic thermometers, or thermocouples.

4. Electrode and filler metal control and storage to be used for this welding will be in accordance with the following:

   a). The gas tungsten arc welding filler material will be locked in a designated rod storage area and will be issued to qualified welders per a rod issue ticket. The issue ticket will specify the type of rod required, the work order number, and the welder that is qualified to perform the weld.

   b). The shielded metal arc welding electrodes will be locked in a rod storage area until the sealed containers are opened. Once the electrode containers are opened, the rod will be placed in locked rod ovens and maintained at a temperature between 250°F and 400°F. The electrodes will only be issued to qualified welders in accordance with a rod issue ticket that will specify the type of rod that is required, the work order number, and the welder that is qualified to perform the weld. Once issued to the qualified welder, the electrodes will be maintained in portable heated rod caddies. A copy of the rod issue ticket must be kept with the weld filler material at all times after the filler material is removed from the rod issue area until it is used or disposed of.

The primary concern for this welding activity is cold cracking in the weld's heat affected zone and adjacent base metal. Two of the cold cracking mechanisms applicable in the welding of this material are hydrogen cracking and restraint cracking.

Cold restraint cracking generally occurs during cooling at temperatures approaching ambient temperature. As stresses build under a high degree of restraint, cracking may occur at defect locations. Brittle microstructures with low ductility are subject to cold restraint cracking. Preheating slows down the cooling rate resulting in a ductile, less brittle microstructure thereby lowering susceptibility to cold cracking.

Hydrogen cracking is also a form of cold cracking. It is produced by the action of internal tensile stresses acting on brittle microstructures. The internal stresses are produced from localized build-ups of monatomic hydrogen. Monatomic hydrogen forms when moisture or hydrocarbons interact with the welding arc and molten weld pool. The monatomic hydrogen can be entrapped during weld solidification and tends to migrate to transformation boundaries or other microstructure defect locations. As concentrations build, the monatomic hydrogen will recombine to form molecular hydrogen, thus generating localized internal stresses at these internal defect locations. If these stresses exceed the resistance of the material, hydrogen induced cracking will occur. This form of cracking requires the presence of hydrogen and a brittle microstructure. It is manifested by intergranular cracking of susceptible materials and normally occurs within 48 hours of welding.

Both of these mechanisms occur at ambient temperature. Preheating at 400°F significantly slows down the cooling rate resulting in a less brittle microstructure thereby lowering susceptibility to cold cracking. Preheat also increases the diffusion rate of monatomic hydrogen that may have been trapped in the weld during solidification. A preheat of 400°F minimizes the amount of hydrogen in the immediate area since all moisture is vaporized before welding commences. Proper electrode control minimizes the amount of hydrogen sources, such as, grease, oil, dirt, and moisture in the weld area.

The licensee has already stated that this revision was documented in a change to the 2006 Addenda of the ASME Code, Section III, Subsection NB and is part of that edition of the ASME Code. NRC has not yet accepted that edition and addenda of the ASME Code and thus this request addresses the technical effects of the use of the specific relief. The specific request is to weld on a pipe which is 0.5 inch larger in diameter than the diameter which is exempted by the earlier, NRC-accepted ASME Code Edition. The preheat required by both the 2004 edition and the 2006 Addenda of the ASME Code, Section III is 300°F whereas the licensee will use a preheat of 400°F, thus decreasing the cooling rate and increasing the rate of hydrogen diffusion. The licensee will also comply with the thickness, carbon content and chromium content requirements of Table NB-4622.7(b)-1 of both the 2004 edition and the 2006 Addenda of the of ASME Code, Section III. In their letter dated October 22, 2009, Exelon Generation Company deleted their request to include the replacement valve which is specified as SA-217, Grade WC9, with a maximum chromium content of 2.75 percent and an allowable carbon content of 0.18 percent from their request to exempt this material from PWHT and stated that they will apply PWHT to welds associated with this valve. Therefore, based on the above, the NRC staff finds that the proposed request provides an acceptable level of quality and safety for the specified repair/replacement activities and is acceptable.

5.0 CONCLUSION

Pursuant to 10 CFR 50.55a(a)(3)(i), and on the basis of evaluating the information submitted, the NRC staff concludes that the proposed request to use a portion of a later ASME Code edition and addenda provides an acceptable level of quality and safety for the specified repair/replacement activities and is acceptable and authorizes the use of Table NB-4622.7(b)-1 of the 2006 Addenda to the 2004 Edition of Section XI of the ASME Code, Section XI for the duration of the project to install the RTsystem piping with ASME Code, Section IX P5A material without the use of a PWHT during the January 2012, refueling outage at CPS or until such time as the NRC incorporates the use of the 2006 Addenda of the ASME Code, Section XI, Subsection NB by reference in 10 CFR 50.55a(b).

This authorization does not exempt the licensee from the requirements of 10 CFR 50.55a(g)(4)(i), clarified in Regulatory Information Summary 2004-16, or when and if the NRC incorporates the use of the 2006 Addenda of the ASME, Section XI, Subsection NB Code in 10 CFR 50.55a(b). This authorization also does not exempt the replacement valve which is specified as SA-217, Grade WC9, with a maximum chromium content of 2.75 percent and an allowable carbon content of 0.18 percent from PWHT. PWHT shall be applied to welds associated with this valve.

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.

Principal Contributor: E. Andruszkiewicz

Date: April 21, 2010

A copy of the Safety Evaluation is enclosed. All other ASME Code, Sections III and XI, requirements 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 Project Manager, Nicholas DiFrancesco, at 301-415-1115.

Sincerely,

/RA/

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

Docket No. 50-461

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

DISTRIBUTION:

PUBLIC	LPL3-2 R/F	RidsNrrDorlLpl3-2 Resource
RidsNrrPMClinton Resource	RidsNrrLATHarris Resource	RidsOgcRp Resource
RidsRgn3MailCenter Resource		RidsNrrDorlDpr Resource
RidsAcrsAcnw_MailCenter Resource		SBagley, EDO RIII

ADAMS Accession No ML100880126 NRR-028

OFFICE	LPL3-2/PM	LPL3-2/LA	LPL3-2/BC
NAME	NDifrancesco	THarris	SCampbell
DATE	4/19/10	4/8/10	4/21/10

OFFICIAL RECORD COPY