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

September 21, 2010

Mr. Michael J. Pacilio
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: THREE MILE ISLAND NUCLEAR STATION, UNIT 1 (TMI-1) - REQUEST TO EXTEND THE INSERVICE INSPECTION INTERVAL FOR REACTOR VESSEL WELD AND INTERNAL EXAMINATIONS, PROPOSED ALTERNATIVE REQUEST NOS. RR-09-01 AND RR-09-02 (TAC NOS. ME2483 AND ME2484)

Dear Mr. Pacilio:

By letter dated October 29, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML093020523), Exelon Generation Company, LLC (the licensee) submitted proposed alternative requests RR-09-01 and RR-09-02 for the use of alternatives to certain requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code*, Section XI, 1995 Edition through the 1996 Addenda, at Three Mile Island, Unit 1 (TMI-1).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 55a(a)(3)(i), proposed alternative request RR-09-01 would defer the scheduled examination of reactor vessel (RV) welds beyond the completion of the current inservice inspection (ISI) interval (scheduled for the fall of 2011) to the fall of 2015. This request was submitted on the basis that the proposed alternative provides an acceptable level of quality and safety. Proposed alternative request RR-09-02 was submitted pursuant to 10 CFR 50.55a(a)(3)(ii) on the basis that complying with the specified requirement would result in hardship or unusual difficulty. RR-09-02 would defer certain visual reactor internal visual examinations from the current ISI interval to the fall of 2015, so that they may be performed concurrently with the RV weld exams covered by RR-09-01.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the proposed alternatives as discussed in the enclosed safety evaluation. RR-09-01 is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the third 10-year interval ISI program at TMI-1 (fourth interval for two nozzle welds which have already received third interval inspections, as detailed in RR-09-01), and the licensee may defer the volumetric examinations of the subject RV welds until the fall 2015 refueling outage. The licensee will have to resubmit the requested alternative for future TMI-1 10-year ISI intervals after the results of the facility's 2015 inspection have been evaluated. Regarding RR-09-02, the staff concludes that compliance with the ASME Code, Section XI ISI interval requirements represents a hardship without a compensating increase in the level of quality and safety for the subject ASME Code, Section XI, Examination Category B-N-2 and B-N-3 components at TMI-1. Therefore, proposed alternative request RR-09-02 is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for the third 10-year interval ISI program at TMI-1, and the licensee may defer the visual examinations of the RV interior attachments and the removable core support structure until the fall 2015 refueling outage.

If you have any questions, please contact the TMI-1 Project Manager, Mr. Peter J. Bamford, at 301-415-2833.

Sincerely,

Harold K. Chernoff, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-289

Enclosure:
As stated

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVES REGARDING THE INSPECTION INTERVAL FOR

REACTOR VESSEL WELD AND INTERNALS EXAMINATIONS

REQUEST NOS. RR-09-01 AND RR-09-02

EXELON GENERATION COMPANY, LLC

THREE MILE ISLAND NUCLEAR STATION, UNIT 1

DOCKET NO. 50-289

1.0 INTRODUCTION

By letter dated October 29, 2009 (Agency Document Access and Management System (ADAMS) Accession Number ML093020523), Exelon Generation Company, LLC (the licensee) submitted proposed alternative requests RR-09-01 and RR-09-02 for Three Mile Island, Unit 1 (TMI-1). In RR-09-01, the licensee requested an alternative to the examination requirements of the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," for specified ASME Code Class 1, Examination Category B-A and B-D reactor vessel (RV) weld components. In RR-09-02, the licensee requested an alternative to the examination requirements of the ASME Code, Section XI, for specified ASME Code Class 1, Examination Category B-N-2 and B-N-3, RV internal components. The U.S. Nuclear Regulatory Commission (NRC) staff reviewed and evaluated RR-09-01 pursuant to the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i). The staff reviewed and evaluated RR-09-02 pursuant to the provisions of 10 CFR 50.55a(a)(3)(ii).

2.0 REGULATORY EVALUATION

2.1 General Requirements for Inservice Inspection

Inservice inspection (ISI) 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 10 CFR 50.55a(g), except where specific relief has been granted by the NRC pursuant to 10 CFR 50.55a(g)(6)(i). Paragraph 50.55a(a)(3) of 10 CFR states that alternatives to the requirements of 10 CFR 50.55a(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, 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) 12 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 third 10-year interval ISI program at TMI-1 is the 1995 Edition of the ASME Code, Section XI, with 1996 Addenda. The end date for the third 10-year interval ISI program at TMI-1 is scheduled for April 19, 2011, however TMI-1 intends to apply the provisions of ASME Section XI, IWA-2430(d)(1) to extend the third ISI interval through the fall 2011 refueling outage.

2.2 Applicable ASME Code, Section XI Requirements

ISI of ASME Code Class 1 components consists of volumetric examinations, surface examinations, and/or visual examinations to detect flaws in RV, RV attachment, core support structure, and reactor coolant pressure boundary components. The 1995 Edition and 1996 Addenda of the ASME Code, Section XI, Article IWB-2500 requires that ASME Code Class 1 components be examined and tested as specified in Table IWB-2500-1 of the ASME Code, Section XI. Table IWB-2500-1, Examination Category B-A defines the examination requirements for the RV shell welds, head welds, shell-to-flange welds, head-to-flange welds, and beltline region repair welds. Table IWB-2500-1, Examination Category B-D - Inspection Program B, defines the examination requirements for full penetration welded nozzles in RVs. Table IWB-2500-1, Examination Categories B-N-2 and B-N-3 define the examination requirements for RV interior attachments and removable core support structures, respectively.

The ASME Code, Section XI, Article IWA-2430(a) states that ISI examinations and system pressure tests required by subsections IWB, IWC, IWD, IWE, and ISI examinations and tests of subsection IWF shall be completed during each of the inspection intervals for the service life of the plant. IWA-2432 states that for plants inspected under Inspection Program B, the first ISI interval shall extend for 10 years following the initial start of plant service, and successive ISI intervals shall extend for 10 years following the previous inspection interval. Furthermore, IWB-2412, states that for plants inspected under Inspection Program B, the required examinations of each examination category in Table IWB-2500-1 shall be completed during each inspection interval. IWA-2430(d) and IWB-2412(b) allow for ISI intervals to be extended or decreased by as much as 1 year provided that successive ISI intervals are not altered by more than 1 year from the original pattern of intervals.

2.3 Summary of WCAP-16168-NP, Revision 2

By letter dated March 18, 2006, the Pressurized Water Reactor (PWR) Owners Group submitted Topical Report WCAP-16168-NP, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval," Revision (Rev.) 1, to the NRC in support of making a risk-informed assessment of extensions to the ISI intervals for ASME Code, Section XI, Examination Category B-A and B-D components. In the report, the PWR Owners Group took data associated with three different PWR plants (referred to as the pilot plants), one designed by each of the vendors for PWR nuclear power plants in the USA, and performed the necessary studies on each of the pilot plants required to justify the proposed extension of the ISI interval for Examination Category B-A and B-D components from 10 to 20 years.

The analyses in WCAP-16168-NP used probabilistic fracture mechanics tools and inputs from the work described in the NRC's pressurized thermal shock (PTS) risk re-evaluation. The PWR

Owners Group analyses incorporated the effects of fatigue crack growth and ISI data. Design basis transient data was used as an input for the fatigue crack growth evaluation. The effects of ISI data were modeled consistently with the previously-approved probabilistic fracture mechanics codes. These effects were input into evaluations performed with the "Fracture Analysis of Vessels-Oak Ridge" (FAVOR) code. All other inputs were identical to those used in the PTS risk re-evaluation.

The PWR Owners Group concluded, as a result of these studies, that the ASME Code, Section XI 10-year ISI interval for Examination Category B-A and B-D components in PWR RVs can be safely extended from 10 to 20 years. This conclusion, based on the results from the pilot plant analyses, was considered to apply to any plant designed by the three PWR vendors (Westinghouse, Combustion Engineering, and Babcock and Wilcox (B&W)) represented in the pilot plant study, as long as certain critical plant-specific criteria are bounded by the analysis for the applicable pilot plant.

2.4 NRC Safety Evaluation (SE) of WCAP-16168-NP, Revision 2

In its final SE for WCAP-16168-NP, Rev. 2, dated May 8, 2008, the NRC staff concluded that the methodology of the WCAP-16168-NP is consistent with the guidance provided in Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," November 2002. The staff also concluded that the methodology of the WCAP-16168-NP is acceptable for referencing as a risk-informed basis by individual PWR licensees in requests submitted under 10 CFR 50.55a to implement alternatives to the ASME Code, Section XI, requirements for extending the ISI intervals for Examination Category B-A and B-D components, provided that licensees meet the limitations and conditions specified in the SE. Therefore, the final approved version of the WCAP-16168, incorporating the staff's final SE and designated WCAP-16168-NP-A, Rev. 2 (the WCAP), was issued on June 13, 2008.

In order to obtain authorization for alternatives to ASME Code, Section XI requirements to allow extension of the ISI interval for Examination Category B-A and B-D components, individual PWR licensees must demonstrate in their requests that their plants are bounded by the pilot plant analyses in the WCAP. The criteria approved by the staff for demonstrating that that this pilot plant analysis is bounding on a plant-specific basis are summarized below.

1. In its request for an alternative, the licensee shall identify the year during which future inspections of the Examination Category B-A and B-D welds will be performed. The future inspection date for the proposed extended ISI interval should be within plus or minus one refueling cycle of the date specified for the subject plant in the WCAP implementation plan, OG-06-356, "Plan for Plant Specific Implementation of Extended Inservice Inspection Interval per WCAP-16168-NP, Revision 1, 'Risk-Informed Extension of the Reactor Vessel Inservice Inspection Interval,' MUHP 5097-99, Task 2059," October 31, 2006 (ADAMS Accession No. ML082210245). Any deviations from the implementation plan should be discussed in detail in the request for an alternative ISI interval. The maximum allowable ISI interval for plants requesting these extensions is 20 years.

2. In its request for an alternative, the licensee must report the number of past inspections of the Examination Category B-A and B-D RV welds, the results of the prior ISI of the RV welds, and the methodology used for performing these inspections.

3. The licensee must demonstrate in its request that the embrittlement of its RV is within the envelope used in the supporting analyses for the WCAP. The licensees must provide the 95th percentile total through-wall cracking frequency for the RV ($TWCF_{TOTAL}$) and its supporting material properties for the end of the licensed operating period in order to extend the inspection interval from 10 to 20 years. The 95th percentile $TWCF_{TOTAL}$ must be calculated using the methodology in NUREG-1874, "Recommended Screening Limits for Pressurize Thermal Shock (PTS)," March 1, 2007 (ADAMS Accession No. ML070860156). The supporting material properties are the maximum nil-ductility reference temperature (RT_{MAX-X}) and the shift in the Charpy V-notch test transition temperature produced by irradiation defined at the 30 foot-pound energy level (ΔT_{30}). The RT_{MAX-X} and ΔT_{30} values must be calculated using the latest approved methodology documented in Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials," or other NRC-approved methodology for the limiting axial weld, circumferential weld, plate and forging in the RV beltline region. The request for an alternative ISI interval must demonstrate that the 95th percentile $TWCF_{TOTAL}$ value for the RV at the subject plant is bounded by the corresponding value for the pilot plant analysis from the WCAP. This analysis should address all materials in the beltline region of the RV for the subject plant, with at least three surveillance data points.

4. If the subject plant is Babcock & Wilcox (B&W) plant (such as TMI-1):

   a. The licensee must verify that the WCAP pilot plant basis fatigue crack growth for 12 heat-up/cool-down transients per year bound the fatigue crack growth for all of the subject plant's design basis transients.

   b. The licensee must identify the design basis transients that contribute to significant fatigue crack growth

5. If the subject plant has RV forgings that are susceptible to underclad cracking and the RV has such forgings with RT_{MAX_FO} values exceeding 240 degrees Fahrenheit (°F), then the WCAP analyses are not applicable, and the licensee must submit a plant-specific evaluation for any extension to the 10-year ISI interval for the ASME Code, Section XI, Examination Category B-A and B-D RV welds.

6. The requirements for reporting the results of ISIs found in the voluntary PTS rule apply in all cases. Licensees that do not implement the voluntary PTS rule must amend its licenses to require that the information and analyses requested in the voluntary PTS rule be submitted for NRC staff review and approval. The amendment to the license shall be submitted at the same time as the request for alternative ISI interval.

3.0 EVALUATION

3.1 Component Identification

Request RR-09-01

Request RR-09-01 addresses the following ASME Code, Section XI examination categories and item numbers covering examinations of ASME Code Class 1 components (the subject RV weld components) primarily for the third 10-year interval ISI program at TMI-1. The following examination categories and item numbers are from Table IWB-2500-1 of the 1995 Edition and 1996 Addenda of the ASME Code, Section XI.

ASME Code Class	Examination Category	Item Number(s)	Component Description
1	B-A	B1.11 B1.12 B1.21 B1.30 B1.51	Circumferential Shell Welds Longitudinal Shell Welds Circumferential Head Welds Shell-to-Flange Weld Beltline Region Repair Weld
1	B-D*	B3.90 B3.100	RV Nozzle-to-Vessel Welds RV Nozzle Inside Radius Section

* Components RCT0001RV0002N and RCT0001RV0005N were inspected in 2001 and credited as third interval inspections, whereas the inspections of the other welds in this category, also conducted in 2001, were credited as second interval inspections.

Request RR-09-02

Request RR-09-02 addresses the following ASME Code, Section XI, examination categories and item numbers covering examinations of ASME Code Class 1 components (the subject RV interior components) for the third 10-year interval ISI program at TMI-1. The following examination categories and item numbers are from Table IWB-2500-1 of the 1995 Edition and 1996 Addenda of the ASME Code, Section XI.

ASME Code Class	Examination Category	Item Number(s)	Component Description
1	B-N-2 and B-N-3	B13.50 and B13.70	RV Interior Attachments Within the Beltline Region Core Support Structure

3.2 Summary Description of Information Provided in Requests RR-09-01 and RR-09-02

Request RR-09-01

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee submitted proposed alternative RR-09-01 in order to obtain authorization for an alternative to the ISI requirements of the ASME Code, Section XI for the Examination Category B-A RV welds and Examination Category B-D RV-to-nozzle welds at TMI-1. The ASME Code, Section XI requires volumetric examinations of these welds during each 10-year inspection interval. The ASME Code, Section XI, IWB-2412 states that for plants inspected under Inspection Program B, the required examinations of each Examination Category in Table IWB-2500-1 shall be completed during each 10-year inspection interval. The latest possible end date for the third 10-year interval ISI program at TMI-1 is April 19, 2012, counting the 1-year ISI interval extension permitted by the ASME Code, Section XI, IWA-2430(d). TMI-1 plans to extend the third ISI interval through the fall of 2011 refueling outage.

The licensee requested authorization to extend the inspection interval for the subject RV welds so that the volumetric examinations for these components can be deferred until the fall 2015 refueling outage at TMI-1. The licensee stated that this deferral is necessary in order to align

these examinations with other in-vessel examinations that will occur during that time. Specifically, the deferral is needed so that TMI-1 license renewal commitments to perform inspections of the RV internals can be satisfied while minimizing the number of times that removal of the RV core support structure is required. The licensee stated that the ISI interval extension for the subject RV welds is requested on the basis that deferring the subject examinations will result in a negligible change in risk by satisfying the risk-informed criteria specified in RG 1.174.

The methodology used to demonstrate the acceptability of extending the inspection interval for Examination Category B-A and B-D welds based on a negligible change in risk is contained in WCAP-16168-NP-A, Rev. 2. This methodology was used to develop a pilot plant analysis for Westinghouse, Combustion Engineering, and B&W RV designs and is an extension of the work that was performed as part of the NRC's PTS Risk Re-Evaluation. The WCAP criteria for demonstrating that this pilot plant analysis is applicable on a plant-specific basis were identified by the licensee in Tables 1 and 2 of its submittal for RR-09-01. The licensee stated that by demonstrating that TMI-1 is bounded by the B&W pilot plant analysis from the WCAP, with respect to these criteria, the application of the WCAP methods to TMI-1 is acceptable for use as a risk-informed basis for extending the ISI interval for the subject RV welds.

The licensee provided information necessary to demonstrate whether TMI-1 is bounded by the B&W pilot plant analysis from the WCAP, with respect to the criteria identified above in Section 2.4 of this SE. Information pertaining to previous inspections of the subject RV welds, as well as the proposed schedule for future inspections of the subject welds was provided in Table 2 of RR-09-01. The licensee provided details concerning the 95th percentile $TWCF_{TOTAL}$ calculations for the TMI-1 RV in Table 3 of RR-09-01. Table 3 of RR-09-01 includes information necessary to demonstrate whether the embrittlement of the TMI-1 RV is within the envelope used in the applicable pilot plant analysis from the WCAP. Appendix A of RR-09-01 includes information necessary to demonstrate whether the fatigue crack growth for the TMI-1 design basis transients is bounded by the fatigue crack growth for 12 heat-up/cool-down cycles per year from the B&W pilot plant analysis. Appendix A also provides information identifying the design basis transients that contribute to significant fatigue crack growth for the TMI-1 RV.

The NRC staff reviewed and evaluated the information provided in RR-09-01 to determine whether the licensee had adequately demonstrated that the risk-informed criteria of the WCAP are applicable on a plant-specific basis to TMI-1, thereby justifying the extension of the ISI interval for the subject RV welds based on a negligible change in risk. The details concerning the staff's evaluation of this information is provided below in Section 3.3 of this SE.

Request RR-09-02

Pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee submitted proposed alternative RR-09-02, in order to obtain authorization for an alternative to the ISI requirements of the ASME Code, Section XI for the Examination Category B-N-2 and B-N-3 RV interior components at TMI-1. The ASME Code, Section XI, requires a visual test level 3 (VT-3) examination of all accessible welds for the RV interior attachments and all accessible surfaces for the removable core support structure components once each 10-year inspection interval. As with RR-09-01, TMI-1 plans to extend the third ISI interval through the fall of 2011 refueling outage as permitted by the ASME Code, Section XI, IWA-2430(d).

The licensee requested approval to increase the interval for performing the required VT-3 examinations of these components at TMI-1 because, according to the licensee, compliance

with the ASME Code, Section XI requirements for completing these examinations during the scheduled third 10-year interval ISI program for TMI-1 would result in hardship without a compensating increase in the level of quality and safety. The licensee proposed to defer the VT-3 examinations for these Examination Category B-N-2 and B-N-3 components until the fall 2015 refueling outage at TMI-1. The VT-3 examinations for these components were last performed in 2001.

The licensee stated that the increased inspection interval proposed for these components is needed to align the VT-3 examinations of these components with the proposed volumetric examinations of the Examination Category B-A and B-D RV welds. The proposed schedule for the examinations of the Examination Category B-A and B-D RV welds was discussed in RR-09-01.

The licensee stated that there is a license renewal commitment for TMI-1 to develop and implement a plant-specific RV internals enhanced inspection program (relative to ASME Code requirements), and that the RV internals enhanced inspection program must be submitted to the NRC 2 years prior to the beginning of the 20-year extended license term for TMI-1, in accordance with the provisions in the SE for the TMI-1 license renewal (NUREG-1928, "Safety Evaluation Report Related to the License Renewal of Three Mile Island Nuclear Station, Unit 1," ADAMS Accession Nos. ML092950449 and ML092950450). The licensee may elect to perform the enhanced RV internals examinations for this program coincident with the normal VT-3 examinations required for the Examination Category B-N-2 and B-N-3 components, because both examinations would require a complete core offload and removal of all the internal components.

The licensee stated that the VT-3 examinations of the RV interior attachments and the core support structure require that the fuel and core barrel be removed from the RV. The licensee also stated that the volumetric examinations of the Examination Category B-A and B-D RV welds require that the core support structure be removed to facilitate performance of these examinations. Therefore, according to the licensee, the VT-3 examinations of the RV interior attachments and core support structure have historically been performed during the same refueling outage as the volumetric examinations for the RV welds. The licensee stated that performing the visual examinations of the RV interior attachments and core support structure during the same refueling outage as the RV weld volumetric examinations will result in a significant reduction in radiation exposure because the RV internals will only be removed once to accommodate both examinations. According to the licensee, an unnecessary risk is created by the removal of the fuel and core barrel more than once within an inspection interval for the sole purpose of performing a visual examination of these internal components. Furthermore, according to the licensee, the radiation exposure resulting from the performance of the visual examinations for these components would essentially double if the subject examinations did not occur during the same refueling outage as the volumetric examinations for the RV welds.

The licensee stated that the visual examinations of the RV interior attachments beyond the beltline region and core support structure have been performed several times at TMI-1 with no relevant indications noted during the examinations. These visual examinations were last performed during the 2001 refueling outage, with acceptable results. According to the licensee a review of industry operating experience reveals that these examinations have been performed many times by the industry with no significant findings.

3.3 Staff Evaluation

Request RR-09-01

The NRC staff reviewed the information provided in RR-09-01 to determine whether the licensee had adequately demonstrated that the risk-informed criteria of the WCAP are applicable on a plant-specific basis to TMI-1. This determination was made by verifying that the licensee had demonstrated that TMI-1 (a B&W plant) is bounded by the B&W pilot plant analysis from the WCAP, with respect to the five technical criteria discussed above in Section 2.4. By demonstrating that TMI-1 is bounded by the B&W pilot plant analysis from the WCAP, with respect to these five technical criteria, the licensee would have sufficient technical basis for applying the risk-informed provisions of the WCAP to the TMI-1 RV, and the Examination Category B-A and B-D RV weld examinations could be deferred, in accordance with the provisions of the WCAP and the implementation plan given in OG-06-356.

For the first criterion specified for plant-specific application of the WCAP methodologies, the staff reviewed the licensee's submittal to determine whether the RV weld deferred examination dates identified in RR-09-01 were within plus or minus one refueling cycle of the dates identified in the WCAP implementation plan, OG-06-356, or whether any deviations from the implementation plan were clearly discussed in the submittal. In its submittal, the licensee stated that the subject RV weld examinations for the third 10-year interval ISI program (fourth interval for the two nozzle welds which have already received third interval inspections, as discussed in section 3.1), are currently scheduled to occur during the 2011 refueling outage at TMI-1, in accordance with ASME Code, Section XI requirements. OG-06-356 states that if the licensee for TMI-1 receives NRC authorization for an alternative to defer the subject RV weld examinations per the criteria of the WCAP, then the subject RV weld examination would be deferred until the 2021 refueling outage. However, the licensee stated in RR-09-01 that if the proposed alternative is authorized, the subject examinations will be performed during the fall 2015 refueling outage. The 2015 refueling outage is 6 years earlier than the implementation date provided to the staff in OG-06-356 and is a deviation from the implementation plan. The licensee discussed this deviation in its submittal for RR-09-01. Specifically, the licensee stated that this deviation for performing the subject RV weld examinations is required so that TMI-1 can satisfy its license renewal commitment to implement industry programs for managing the effects of aging on the RV internal components by performing enhanced examinations (beyond ASME Code, Section XI requirements) of the RV internals in 2015, concurrently with the subject RV weld examinations. The licensee stated that performance of the subject RV weld examinations in 2015 will minimize the number of times for which removal of the RV internals is required. The staff reviewed the TMI-1 license renewal commitments and verified that the licensee has committed to implementing industry programs for enhanced ISI of the RV internals. The staff agreed with the licensee's determination that the RV internals examinations should occur during the same refueling outage as the subject RV weld examinations, because both examinations require the removal of the core support structure. The staff also notes that the fall 2015 date will provide inspection results sooner than would be obtained if the full interval extension to 20 years, as justified in the WCAP, were utilized. Furthermore, the licensee's proposal is consistent with a revised inspection plan submitted by the Pressurized Water Reactor Owners Group in letter OG-09-454, dated December 1, 2009. This revised inspection plan is currently under staff review. Therefore, the staff found that the licensee had satisfied the first criterion for plant-specific application of the WCAP methodologies.

For the second criterion specified for plant-specific application of the WCAP methodologies, the staff reviewed the licensee's submittal in RR-09-01 to determine whether the licensee reported

the number of past inspections of the RV welds, the results of the previous ISI for the RV welds, and the methodology used for performing these inspections. The staff also reviewed the licensee's submittal in RR-09-01 to determine whether any recordable indications discovered during the previous ISI are bounded by the limits set in the voluntary PTS rule. The licensee provided detailed information concerning the inspection methodology, the number past inspections, and the results of the previous ISI for the TMI-1 RV in Table 2 of RR-09-01. In Table 2 of RR-09-01 the licensee stated that two ISI examinations have performed to date on the Examination Category B-A and B-D welds, with the exception that three examinations were completed for two of the RV nozzles identified in the request. The most recent volumetric examinations of the subject welds were completed during the 2001 refueling outage at TMI-1. The licensee stated in the table that past ISI interval inspections have been performed in accordance with RG 1.150, Rev. 1, "Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations," February 1983, and the applicable edition of the ASME Code, Section XI. Table 2 further states that the RV beltline welds have been previously inspected in accordance with the requirements of the ASME Code, Section XI, Appendix VIII and future volumetric inspections will be performed in accordance with these requirements. Based on this information, the staff determined that the licensee had adequately reported the number of past RV weld inspections and the methodology used for performing past and future inspections. In Table 2 of RR-09-01, the licensee stated that 26 recordable indications were detected in the RV beltline region during volumetric examinations conducted during the most recent ISI interval at TMI-1. All indications were screened using the ASME Code, Section XI, IWB-3500 acceptance standards, and all were found to be acceptable for continued service in accordance with the Table IWB-3510-1 acceptance criteria. According to the licensee, only one of these indications was located in the inner 1 inch of the RV wall thickness. This indication was detected in an RV plate and had a through-wall extent of 0.14 inch. Table 3 of the voluntary PTS rule, 10 CFR 50.61a, specifies the allowable number of flaws in the inner 1 inch thickness of RV plates and forgings, based on through-wall extent. According to Table 3 of 10 CFR 50.61a, as many as 3.15 flaws of this size are acceptable per 1000 square inches of RV plate inside surface area in the examination volume. The licensee stated that based on the area of the RV plate inspected, 42 flaws of this size would be acceptable in accordance with the 10 CFR 50.61a criteria. The staff reviewed this information and determined that the licensee had adequately reported the results of its previous ISI examination. Furthermore, the staff noted that the indication found in the inner one inch thickness of the RV plate discussed above is acceptable in accordance with criteria specified in Table 3 of the voluntary PTS rule, and all of the recordable indications are acceptable for continued service in accordance with the ASME Code, Section XI, Table IWB-3510-1 acceptance criteria. Therefore, the staff found that the licensee had satisfied the second criterion for plant-specific application of the WCAP methodologies.

For the third criterion specified for plant-specific application of the WCAP methodologies, the staff reviewed the licensee's submittal in RR-09-01 to determine whether the licensee adequately demonstrated that the 95th percentile $TWCF_{TOTAL}$ value for the TMI-1 RV is bounded by the corresponding value from the B&W pilot plant analysis in the WCAP. The licensee calculated ΔT_{30} and RT_{MAX-X} values for the TMI-1 RV limiting beltline axial weld, circumferential weld, plate, and forging materials at the end 60-year license operating period using the NRC-approved methods described in Regulatory Guide (RG) 1.99, Revision 2. The staff verified that the licensee had accurately calculated the ΔT_{30} and RT_{MAX-X} values for these TMI-1 RV limiting beltline materials and that all RT_{MAX-X} values are less than 240 °F. The staff verified that the 95th percentile $TWCF_{TOTAL}$ value for the TMI- 1 RV was calculated using the methodology in NUREG-1874. The bounding value for the 95th percentile $TWCF_{TOTAL}$ value from the B&W pilot plant analysis is 4.42 x 10^{-7} events per operating year. The 95th percentile $TWCF_{TOTAL}$ value for the

TMI 1 RV is 1.81 x 10^{-12} events per operating year and is therefore bounded by the B&W pilot plant analysis. Therefore, the staff found that the licensee had satisfied the third criterion for plant-specific application of the WCAP methodologies.

For the fourth criterion specified for plant-specific application of the WCAP methodologies, the staff reviewed the licensee's submittal in RR-09-01 to determine: (1) whether the licensee adequately demonstrated that the B&W pilot plant basis fatigue crack growth for 12 heat-up/cool-down transients per year bound the fatigue crack growth for the TMI-1 design basis transients; and (2) that the licensee identified the design basis transients that contribute to significant fatigue crack growth at TMI-1. The licensee provided an assessment of the design basis transients for TMI-1 in Appendix A of its submittal for RR-09-01. A listing of the TMI-1 design basis transients was provided in Table A-1 in Appendix A of RR-09-01. In accordance with part (2) of the fourth criterion specified above, the licensee identified the design basis transients that contribute to fatigue crack growth at TMI-1. These transients are:

- Cooldown from 8% power
- Rapid depressurization
- Power changes between 0% and 15% power
- Power loading and unloading between 8% and 100% power
- Loss of feedwater to one steam generator
- Rod withdrawal accident
- Control rod drop

In accordance with part (1) of the fourth criterion specified above, the licensee provided the results of an analysis demonstrating that the fatigue crack growth for the TMI-1 design basis transients is bounded by the B&W pilot plant fatigue crack growth for 12 heat-up/cool-down transients per year. In this analysis, the licensee compared the surface breaking flaw density from the B&W pilot plant analysis with the surface breaking flaw density calculated based on the TMI-1 design basis transients identified above. The fatigue crack growth analysis was evaluated for 80 years of plant operation. The staff verified that the licensee's fatigue analysis for TMI-1 is consistent with the methods described in the WCAP. The results of this analysis were provided in Table A-2 of Appendix A in RR-09-01, which summarizes the comparison of the total average surface breaking flaw density distribution for TMI-1 with that from the B&W pilot plant fatigue analysis. This table demonstrates that the TMI-1 surface breaking flaw density distributions are bounded by the values in the B&W pilot plant analysis for all percentage flaw growth values and flaw aspect ratios. The staff reviewed this information and determined that the licensee had demonstrated that the TMI-1 RV fatigue crack growth for the TMI-1 design basis transients are bounded by the fatigue crack growth for 12 heat-up/cool-down transients per year used in the B&W pilot plant analysis. Furthermore, the staff determined that the licensee had adequately identified the design basis transients that contribute to fatigue crack growth at TMI-1. Therefore, the staff found that the licensee had satisfied the fourth criterion for plant-specific application of the WCAP methodologies.

For the fifth criterion specified for plant-specific application of the WCAP methodologies, the staff reviewed the licensee's submittal in RR-09-01 to determine whether TMI-1 has RV forgings that are susceptible to underclad cracking and whether those RV forgings have RT_{MAX_FO} values exceeding 240 °F. As stated in the staff SE for the WCAP, the WCAP analyses are not applicable if the subject plant meets both of these conditions, and the licensee for the plant must submit a plant-specific evaluation for any extension to the 10-year ISI interval for ASME Code, Section XI, Examination Category B-A and B-D RV welds. The staff verified that the RT_{MAX_FO} value for the limiting TMI-1 RV forging is approximately 64.5 °F. Hence, the RT_{MAX_FO} values for

all TMI-1 forgings are less than 240 °F. Therefore, the staff found that the licensee had satisfied the fifth criterion for plant-specific application of the WCAP methodologies.

Regarding the sixth criterion in Section 2.4 of this SE, at the time of issuance of the safety evaluation for WCAP-16168, it was the NRC staff's intent to establish a process by which licensees could receive approval to implement 20 year ISI intervals for the subject component examinations through the end of its facility's current operating license. This objective led to the provision, as discussed in Section 4 of the SE for WCAP-16168, that licensees submit a license condition which would require the licensee to evaluate future volumetric ISI data in accordance with the criteria in the draft and/or final alternative PTS Rule, 10 CFR 50.61a. The NRC staff has since determined that the appropriate process for requesting further extensions of the ISI interval, beyond this proposed alternative, is through 10 CFR 50.55a for each subsequent ISI Interval. Accordingly, the NRC staff considers that such a license condition as discussed above is not necessary and that requirements for future evaluation of ISI data will be addressed as a part of the review of further requests for extension of the ISI Interval for the subject components.

Based on this philosophy, the NRC staff will grant ISI interval extensions for the subject components on an interval-by-interval basis, i.e., only a facility's current ISI interval will be extended for up to 20 years. Licensees will have to submit subsequent requested alternatives, for NRC review and approval, to extend each following ISI interval from 10 years to 20 years, as needed. Based on this new NRC position, the requirement in the staff's SE on WCAP-16168-NP for a license condition to address the evaluation of future ISI data is no longer necessary, as identified in the cover letter of the licensee's October 29, 2009, submittal. However, subsequent requested alternatives which seek to extend additional ISI intervals from 10 to 20 years for the subject component examinations should include the evaluation of a facility's most recent ISI data in accordance with the criteria in the final alternative PTS Rule, 10 CFR 50.61a, in order to obtain NRC staff approval. In addition, for purposes of technical and regulatory consistency, the WCAP-16168-NP SE will be revised, in the future, to reflect these changes in NRC position regarding the implementation of ISI interval extensions based on WCAP-16168-NP.

Based on its review of RR-09-01, the staff found that the licensee had satisfied all five of the technical criteria for demonstrating that TMI-1 is bounded by the B&W pilot plant analysis from the WCAP and the sixth criterion (license condition) is not applicable. Therefore, the staff found that the licensee has sufficient technical basis for applying the risk-informed provisions of the WCAP to the TMI-1 RV. Accordingly, the staff determined that there is no significant additional risk associated with extending the ISI interval for the Examination Category B-A and B-D components, and the licensee's request to defer the volumetric examinations of these components until 2015 would provide an acceptable level of quality and safety.

RR-09-02

The NRC staff reviewed and evaluated the information provided in RR-09-02 to determine whether the licensee had adequately demonstrated that compliance with the specified requirements for completing the VT-3 examinations of the subject components before the end date for the third 10-year interval ISI program at TMI-1 would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The end date for the third 10-year interval ISI program at TMI-1 is planned to extend through the fall 2011 outage and could be as late as April 19, 2012, counting the 1-year ISI interval extension permitted by the ASME Code, Section XI, IWA-2430(d). The licensee would defer the VT-3 examinations of the RV interior attachments within the beltline region (Examination Category B-N-2) and removable core support structure (Examination Category B-N-3) at TMI-1 until the fall 2015 refueling

outage. The VT-3 examinations for these components were last performed in 2001, with acceptable results.

The staff reviewed the licensee's justification for deferring the subject VT-3 examinations and agreed with the licensee's determination that the deferral proposed in RR-09-02 is necessary in order align the VT-3 examinations of the subject components with the schedule for deferred volumetric examinations of the Examination Category B-A and B-D RV welds, as proposed in RR-09-01. The staff verified that the licensee had submitted an acceptable request in RR-09-01 for an alternative to the ASME Code, Section XI examination requirements to defer the volumetric examinations of the Examination Category B-A and B-D RV welds until the fall 2015 refueling outage for TMI-1. The staff's review of the RR-09-01 is addressed above in Section 3.3 of this SE.

The staff also acknowledged that the licensee has committed to the development and implementation of a plant-specific RV internals enhanced inspection program (relative to ASME Code requirements) and submittal of the RV internals inspection program plan to the NRC 2 years prior to the beginning of the 20-year extended license term for TMI-1, in accordance with the provisions in the safety evaluation report for the TMI-1 license renewal. The period of extended operation will begin on April 20, 2014, at TMI-1. The licensee may elect to perform the enhanced RV internals examinations for this program coincident with the normal VT-3 examinations required for the Examination Category B-N-2 and B-N-3 components because the performance of the enhanced RV internals examinations would require a complete core offload and removal of all the internal components.

The staff agreed with the licensee's determination that performing VT-3 examinations of the RV internal attachments and core support structure so that the timing of these examinations would meet the ISI interval and schedule requirements of the ASME Code, Section XI represents a hardship without a compensating increase in the level of quality and safety. The staff agreed with this determination because: (1) an unnecessary risk is created by the removal of the fuel and core support barrel from the RV for the exclusive purpose of performing these VT-3 examinations; and (2) the radiation exposure resulting from the performance of these VT-3 examinations would increase if these examinations were performed at a time different from the RV weld volumetric examinations, because the performance of the Examination Category B-A and B-D RV weld examinations requires the removal of the core support structure. The staff also noted that no other nuclear power plant performs these VT-3 examinations on a different interval schedule than that for the Examination Category B-A and B-D RV welds. All of the previous examinations of the Examination Category B-N-2 and B-N-3 components at TMI-1 have shown no indications of cracking or service-induced degradation.

Based on the above considerations, the staff determined that performing the VT-3 examinations of the RV interior attachments (Examination Category B-N-2) and the removable core support structure (Examination Category B-N-3) in order to meet the ISI schedule requirements of the ASME Code, Section XI represents a hardship without a compensating increase in the level of quality and safety for TMI-1. Therefore, the staff finds that the licensee's request to defer the subject examinations until the fall 2015 refueling outage at TMI-1 is acceptable.

4.0 CONCLUSION

Based on the above evaluation of proposed alternative request RR-09-01, the staff concludes that extending the ISI interval for the ASME Code, Section XI, Examination Category B-A and B-D components at TMI-1 in order to allow for the deferral of the volumetric examinations of these

components until the fall 2015 refueling outage will result in no significant increase in risk. This conclusion is based on the fact that the plant-specific information provided by the licensee is bounded by the applicable pilot plant analysis from WCAP-16168-NP-A, Rev. 2, and the licensee's request meets all the conditions described in the WCAP. Therefore, proposed alternative request RR-09-01 is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the third 10-year interval ISI program at TMI-1 (fourth interval for two nozzle welds which have already received third interval inspections, as detailed in Section 3.1), and the licensee may defer the volumetric examinations of the subject RV welds until the fall 2015 refueling outage.

Based on the above evaluation of proposed alternative request RR-09-02, the staff concludes that compliance with the ASME Code, Section XI ISI interval requirements represents a hardship without a compensating increase in the level of quality and safety for the subject ASME Code, Section XI, Examination Category B-N-2 and B-N-3 components at TMI-1. Therefore, proposed alternative request RR-09-02 is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for the third 10-year interval ISI program at TMI-1, and the licensee may defer the VT-3 examinations of the RV interior attachments and the removable core support structure until the fall 2015 refueling outage.

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 Contributors: C. Sydnor
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Date: September 21, 2010

If you have any questions, please contact the TMI-1 Project Manager, Mr. Peter J. Bamford, at 301-415-2833.

Sincerely,

/ra/

Harold K. Chernoff, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-289

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