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

April 28, 2015

Mr. Timothy S. Rausch
Senior Vice President and Chief Nuclear Officer
PPL Susquehanna, LLC
769 Salem Boulevard
Berwick, PA 18603-0467

SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2 - RELIEF REQUESTS 4RR-01: USE OF A RISK-INFORMED INSERVICE INSPECTION ALTERNATIVE FOR THE FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL (TAC NOS. MF5097 AND MF5098)

Dear Mr. Rausch:

By letter dated October 29, 2014, as supplemented by letter dated February 5, 2015, PPL Susquehanna, LLC (the licensee) requested authorization of a proposed alternative to the requirements of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code) Section XI for use of risk-informed Inservice Inspection (RI-ISI) programs at Susquehanna Steam Electric Station, Units 1 and 2 (SSES), for the remainder of the fourth 10-year ISI interval.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(i), the licensee submitted Relief Request 4RR-01 which proposes continued use of the current RI-ISI programs with updates relevant to certain non-destructive examination requirements associated with ASME Code, Class 1 and 2, Examination Category B-F, B-J, C-F-1, and C-F-2 piping welds. The licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. The Nuclear Regulatory Commission (NRC) staff authorized the previous Susquehanna RI-ISI program alternatives by letter dated July 28, 2005, for the previous ISI intervals.

The paragraph headings in 10 CFR 50.55a were changed by *Federal Register* notice dated November 5, 2014 (79 FR 65776), which became effective on December 5, 2014 (e.g., 10 CFR 50.55a(a)(3)(i) is now 50.55a(z)(1)). See the cross-reference tables, which are cited in the notice, at Agencywide Documents Accession and Management System (ADAMS) Accession No. ML14015A191 and ADAMS package Accession No. ML14211A050.

The NRC staff determines that the proposed alternative in Relief Request 4RR-01 for SSES provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes, as stated in the enclosed Safety Evaluation, that the licensee has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, pursuant to 10 CFR 50.55a(z)(1), the NRC staff authorizes the proposed alternative Relief Request 4RR-01 for the remainder of the fourth 10-year ISI interval at SSES, which began on June 1, 2014, and is currently scheduled to end on May 31, 2024.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the SSES Project Manager, Mr. Jeffrey A. Whited, at jeffrey.whited@nrc.gov or 301-415-4090.

Sincerely,

Douglas A. Broaddus, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-387 and 50-388

Enclosure:
Safety Evaluation

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING RELIEF REQUEST 4RR-01

ASSOCIATED WITH THE FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL

PPL SUSQUEHANNA, LLC

SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2

DOCKET NOS. 50-387 AND 50-388

## 1.0 INTRODUCTION

By letter dated October 29, 2014 (Reference 1), as supplemented by letter dated February 5, 2015 (Reference 2) PPL Susquehanna, LLC (the licensee) requested authorization of a proposed alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code (ASME Code) Section XI for use of risk-informed Inservice Inspection (RI-ISI) programs at Susquehanna Steam Electric Station, Units 1 and 2 (SSES) for the remainder of the fourth 10-year ISI interval.

Specifically, the licensee submitted Relief Request 4RR-01 which proposes continued use of the current RI-ISI programs with updates relevant to certain non-destructive examination requirements associated with ASME Code, Class 1 and 2, Examination Category B-F, B-J, C-F-1, and C-F-2 piping welds, 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 Nuclear Regulatory Commission (NRC) staff authorized the previous SSES RI-ISI program alternatives by letter dated July 28, 2005 (Reference 3), for the previous ISI intervals.

The paragraph headings in 10 CFR 50.55a were changed by *Federal Register* notice dated November 5, 2014 (79 FR 65776), which became effective on December 5, 2014 (e.g., 10 CFR 50.55a(a)(3)(i) is now 50.55a(z)(1)). See the cross-reference tables, which are cited in the notice, at Agencywide Documents Accession and Management System (ADAMS) Accession No. ML14015A191 and ADAMS package Accession No. ML14211A050.

## 2.0 REGULATORY EVALUATION

Section 50.55a(g) of 10 CFR 50 specifies that ISI of nuclear power plant components shall be performed in accordance with the requirements of the ASME Code, Section XI. The regulations in 10 CFR 50.55a(z) state, in part, that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used, when authorized by the NRC, if the licensee demonstrates: (1) that the proposed alternatives would provide an acceptable level of quality and safety; or (2) that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The NRC staff reviewed and evaluated the licensee's request pursuant to 10 CFR 50.55a(z)(1).

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the Commission to authorize the proposed alternative requested by the licensee.

## 3.0 TECHNICAL EVALUATION

### 3.1 Applicable Code Requirements

ASME Code Section XI, 2007 Edition through 2008 Addenda

IWB-2500, Examination and Pressure Test Requirements
Table IWB-2500-1, Examination Categories
Class 1 Piping Welds

> Category B-F, Pressure Retaining Dissimilar Metal Welds in Vessel Nozzles
> Category B-J, Pressure Retaining Welds in Piping

IWC-2500, Examination and Pressure Test Requirements
Table IWC-2500-1, Examination Categories
Class 2 Piping Welds

> Category C-F-1, Pressure Retaining Welds in Austenitic Stainless Steel or High Alloy Piping
> Category C-F-2, Pressure Retaining Welds in Low Alloy Steel Piping

The applicable Code of Record for the SSES fourth 10-year ISI interval, which began on June 1, 2014, and is currently scheduled to end on May 31, 2024, is the 2007 Edition through the 2008 Addenda of the ASME Code, Section XI.

### 3.2 Licensee's Proposed Alternative

The licensee proposed to update the RI-ISI program approved for the previous 10-year ISI interval and apply the updated program to the current 10-year ISI intervals. Other non-related portions of the ASME Code, Section XI are unaffected.

The proposed updated RI-ISI program is based on EPRI TR-112657, Rev B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure" (Reference 4), and Regulatory Guide (RG) 1.174, "An Approach For Using Probabilistic Risk Assessment in Risk-Informed Decisions On Plant Specific Changes To the Licensing Basis" (Reference 5) risk acceptance criteria. The licensee stated that the RI-ISI program has been updated consistent with the intent of Nuclear Energy Institute (NEI) 04-05, "Living Program Guidance to Maintain Risk-Informed Inservice Inspection Programs for Nuclear Plant Piping Systems." (Reference 6)

The licensee proposed to use ASME Code Case N-578-1, "Risk-Informed Requirements for Class 1, 2, or 3 Piping, Method B Section XI, Division 1," for the Risk-informed evaluation and inspection of Class 1 and Class 2 components at SSES. The use of Code Case N-578-1 has not been approved for use by the NRC staff per RG 1.193, "ASME Code Cases Not Approved for Use" (Reference 7), and the licensee was asked to clarify the use of Code Case N-578-1 by the NRC staff in a request for additional information (RAI). In Reference 2, the licensee stated that

portions of the request use Code Case N-578-1 for the development of the request, but the applicable requirements of the previously approved RI-ISI program at SSES from the third interval continues to be true in the fourth 10-year interval for the RI-SI program. The NRC Evaluation was based on the information provided in the relief request and not Code Case N-578-1.

3.3 NRC Staff's Evaluation

The licensee's previous RI-ISI program for Category B-F, B-J, C-F-1, and C-J-1 pressure retaining welds, as outlined in Reference 3, was developed in accordance with the methodology of EPRI TR-112657, which was reviewed and authorized by the NRC (Reference 4). In Reference 1, the licensee requested NRC authorization to extend the use of its RI-ISI programs to the current ISI interval. The scope of the SSES RI-ISI programs remains limited to Examination Category B-F, B-J, C-F-1, and C-F-2 piping welds.

An acceptable RI-ISI program plan is expected to meet the five key principles of RI decision making, discussed in RG 1.174 (Reference 5) and RG 1.178, "An Approach for Plant-Specific Risk-Informed Decision Making: Inservice Inspection of Piping," (Reference 8). These principles are:

1. The proposed change meets the current regulations unless it is explicitly related to a requested exemption.

2. The proposed change is consistent with the defense-in-depth philosophy.

3. The proposed change maintains sufficient safety margins.

4. When the proposed change results in an increase in core damage frequency (CDF) and/or large early release frequency (LERF), the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.

5. The impact of the proposed change should be monitored by using performance measurement strategies.

The first principle is met because an alternative ISI program may be authorized pursuant to 10 CFR 50.55a(z)(1) and, therefore, an exemption request is not required.

The second and third principles require assurance that the alternative program is consistent with the defense-in-depth philosophy and that sufficient safety margins are maintained. Assurance that the second principle is met is based on the application of the approved methodology and not on the particular inspection locations selected. The submittal stated that the methodology proposed for the fourth 10-year RI-ISI interval is the same as that approved for use for the third 10-year RI-ISI interval. In response to the NRC staff's RAI (Reference 2), the licensee stated, in part, that:

> There have been no indications of service induced degradation found during the third 10-year inspections interval for any welds within the scope of the RI-ISI program except for the vibration induced failure as discussed in EPNB RAI-02 [of Reference 2].

> [W]elds susceptible to high vibration were added to an augmented inspection program for a surface examination each outage. These six welds have each been inspected once since issuance of LER 2012-007-01 with no recordable indications found. These six locations have not been modified to minimize vibration response. The welds will continue to be inspected each outage or until modified to reduce the effects of vibration.

No changes to the design basis events were made as a result of the RI-ISI program. The safety margins, in the third principle, are maintained by retaining the existing augmented inspection programs and implementing the inspection protocol of EPRI TR-112657 which performs examinations of locations based on postulated degradation mechanisms. Therefore, the NRC staff finds that both the second and third principles, defense-in-depth and safety margins, are met.

The fourth principle requires an evaluation of the change in risk between the proposed RI program and the program the licensee would otherwise be required to implement. This principle also requires demonstration of the technical adequacy of the probabilistic risk assessment (PRA). As discussed in RGs 1.178 and 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities" (Reference 9), an acceptable change in risk evaluation (and risk-ranking evaluation used to identify the most risk significant locations) requires the use of a PRA of appropriate technical quality that models the as-built and as-operated plant. PRA peer-reviews of SSES were performed in 2003 and in 2012. The 2012 peer-review, which was performed using the process in NEI 05-04, "Process for Performing Internal Events PRA Peer Reviews Using the ASME/ANS PRA Standard," (Reference 10), the ASME PRA Standard (ASME/ANS RA-Sa-2009) (Reference 11), and RG 1.200, Revision 2, was a full-scope review of the technical elements of the internal events and internal flooding, at-power PRA. The licensee stated that the 2012 peer review resulted in 284 (89 percent) Supporting Requirements (SRs) meeting Capability Category (CC) II or higher, and 35 (11 percent) of the SRs not meeting CC II or higher. From 35 SRs not meeting CC II or higher, 24 were associated with the internal flooding technical element. In response to the NRC staff's RAIs (Reference 2), the licensee stated that the internal flooding PRA was not directly used for the consequence and the change-in-risk evaluations to support the relief request. The licensee further stated that impacts due to both direct and indirect effects of flooding were considered using the guidance provided in EPRI TR-112657, Revision B-A, which requires consideration of impacts of pipe breaks through plant walkdowns. In addition, EPRI Report 1021467-A, "Nondestructive Evaluation: Probabilistic Risk Assessment Technical Adequacy Guidance for Risk-Informed In-Service Inspection Programs" (Reference 12), which provides guidance regarding the capability categories for each supporting requirement that is applicable to RI-ISI applications, states that RI-ISI applications using the EPRI traditional RI-ISI approach do not use the internal flooding directly and, as such, internal flooding supporting requirements are not applicable. The licensee stated that after revising the peer-reviewed model and documentation, four of the remaining 11 SRs (i.e., HR-C3, DA-C6, DA-C12, and DA-C13) do not meet CC II or higher.

The NRC staff reviewed the licensee's resolution or impact of findings and observations (F&Os) related to those 11 SRs provided in Table 1 of Attachment 2 to the relief request and agrees that those F&Os have been resolved or have negligible impact on the relief request. The NRC staff recognizes that the EPRI method uses the quantitative results of the PRA as order-of-magnitude estimates for several risk and reliability parameters and to support the assignment of segments into three broad consequence categories. Inaccuracies in the models or in assumptions large enough to invalidate the broad categorizations developed to support RI-ISI or the change in risk estimates should have been identified during the licensee's evaluation of the gaps associated

with meeting ASME supporting requirements. Minor errors or inappropriate assumptions could potentially affect only the consequence categorization of a few segments and will not invalidate the general results or conclusions. Therefore, because the licensee has assessed the technical adequacy of its PRA using the appropriate version of RG 1.200, evaluated the findings developed during the reviews of its PRA, and addressed the findings, the NRC staff concludes the quality of the PRA is sufficient to support the proposed RI-ISI program.

The staff has previously determined that it is not necessary to develop a new deterministic ASME program for each new 10-year interval but, instead, it is acceptable to compare the new proposed RI-ISI program with the last deterministic ASME program. The licensee states that, as part of the RI-ISI living program update, the delta risk assessment was re-evaluated. The licensee provided results of the revised program delta risk assessment, in Reference 2, which represents a reduction of 4.2E-09 for Unit 1, and 3.9E-09 for Unit 2 with regards to CDF, and 9.0E-10 for Units 1 and 2 with regards to LERF. Results of the risk assessment provided in Tables 1 and 2 of Reference 2 satisfy the acceptance criteria of RG 1.174 and EPRI TR-112657, Revision B-A, when compared to the last deterministic Section XI inspection program for both the full plant and per system. Thus, the staff finds that the licensee's analysis provides assurance that the fourth key principle is met.

The fifth principle of RI decision-making states that the impact of the RI-ISI program should be monitored by performance measurement strategies. Monitoring of these programs encompasses many facets of feedback or corrective action, which includes periodic updates. As stated in Reference 1, the SSES RI-ISI program is a living program and the information has been updated and analyzed in accordance with NEI-04-05 and EPRI TR-112657, Revision B-A. Consistent with these topical reports, new information has been incorporated in the SSES RI-ISI analysis, as part of the living RI-ISI program. This includes revised consequences for pipe segments, revised failure probabilities for a limited number of segments based on industry and plant experience and plant modifications, and updated test intervals for a limited number of segments. The licensee further clarified, in Reference 2, that the implementation and monitoring program of the third 10-year interval RI-ISI program would continue during the proposed fourth 10-year interval with no changes. The NRC staff finds that the fifth principle of RI decision-making is met.

Based on the above discussion, the staff finds that the five key principles of risk-informed decision-making are ensured by the licensee's proposed fourth 10-year RI-ISI interval program and therefore, the proposed program for the fourth 10-year ISI satisfies the guidelines in RG 1.174.

## 4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative in Relief Request 4RR-01 for SSES provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, pursuant to 10 CFR 50.55a(z)(1), the NRC staff authorizes the proposed alternative, Relief Request 4RR-01, for the remainder of the fourth 10-year ISI interval, which began on June 1, 2014, and is currently scheduled to end on May 31, 2024. All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

## 5.0 REFERENCES


1. Letter dated October 29, 2014, "Requests to Continue Use of a Risk-Informed Inservice Inspection Alternative in a Proposed Relief Request No. 4RR-01 to the Fourth 10-Year Inservice Inspection Program For Susquehanna Units 1 and 2- PLA-7193" (ADAMS Accession No. ML14302A443).

2. Letter dated February 5, 2015, "Response to Request for Additional Information on Relief Request 4RR-01- PLA-7281 (TAC Nos. MF5097 and MF5092)" (ADAMS Accession No. ML15036A505).

3. Letter dated July 28, 2005, "Susquehanna Steam Electric Station, Units 1 and 2, Third 10-year Inservice Inspection (ISI) Interval Program Plan (TAC No. MC1181 and MC1182)" (ADAMS Accession No. ML051990330).

4. EPRI Topical Report TR-112657, letter dated February 10, 2000, "Safety Evaluation Report Related to EPRI Risk- Informed Inservice Inspection Evaluation Procedure (EPRI TR-112657, Revision B, July 1999)," (ADAMS Accession No. ML013470102).

5. NRC Regulatory Guide 1.174, Revision 2, "An Approach for using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," dated May 2011 (ADAMS Accession No. ML100910006).

6. NEI 04-05, "Living Program Guidance To Maintain Risk-Informed Inservice Inspection Programs For Nuclear Plant Piping Systems," April, 2004 (ADAMS Accession No. ML041480432).

7. NRC Regulatory Guide 1.193, Revision 4, "ASME Code Cases Not Approved for Use," dated August 2014 (ADAMS Accession No. ML13350A001).

8. NRC Regulatory Guide 1.178, Revision 1, "An Approach for Plant-Specific Risk-Informed Decision Making for Inservice Inspection of Piping," dated September 2003 (ADAMS Accession No. ML032510128).

9. NRC Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," dated March 1, 2009, (ADAMS Accession No. ML090410014).

10. NEI 05-04, "Process for Performing Internal Events PRA Peer Reviews Using the ASME/ANS PRA Standard," November 2008.

11. ASME/ANS RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008 Standard for Level I / Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," ASME, New York, New York and ANS, Chicago, Illinois.

12. EPRI TR-1021467, "Nondestructive Evaluation: Probabilistic Risk Assessment Technical Adequacy Guidance for Risk-Informed In-Service Inspection Programs," June 18, 2012.


Principal Contributors: Steven Vitto, NRR/DE
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Date: April 28, 2015

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the SSES Project Manager, Mr. Jeffrey A. Whited, at jeffrey.whited@nrc.gov or 301-415-4090.

Sincerely,

*/RA/*

Douglas A. Broaddus, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-387 and 50-388

Enclosure:
Safety Evaluation

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