From:	Richard Guzman
To:	Loomis, Thomas R:(Constellation Nuclear)
Cc:	Reynolds, Ronnie J:(Constellation Nuclear); Hipo Gonzalez
Subject:	Nine Mile Point, Unit 1 - REQUEST FOR ADDITIONAL INFORMATION - Proposed Alternative Associated with a Weld Overlay Repair to the Torus [EPID: L-2022-LLR-0085]
Date:	Thursday, March 02, 2023 9:16:51 AM

Tom,

On February 17, 2023, the U.S. Nuclear Regulatory Commission (NRC) staff sent Constellation Energy Generation, LLC (CEG, the licensee) the subject Request for Additional Information (RAI) as a draft e-mail. This RAI is in regard to the licensee's December 8, 2022, proposed alternative request (ADAMS Accession No. ML22342B229), to perform one or more weld overlays on the exterior of the torus to restore wall thickness due to internal degradation of the torus shell in lieu of repairing the torus as required by American Society of Mechanical Engineers (ASME) Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plants," at Nine Mile Point Nuclear Station, Unit No. 1 (NMP1). The request also included an alternative to the pneumatic leakage test requirements of IWE-5221 following the installation of a weld overlay repair performed on the torus. The alternative request applies to the third ten-year containment inservice inspection (CISI) interval, which began on August 23, 2019, for NMP1.

On March 1, 2023, the NRC staff and CEG held a conference call to discuss clarifications on the draft RAI. Updated below is the official (final) RAI. As agreed on the call, please provide a response to these questions as soon as possible and no later than April 3, 2023, which is approximately 30 days from the date of this e-mail communication. A publicly available version of this message will be placed in ADAMS, the NRC's official document repository system. Please contact me if you have any questions concerning this request.

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==========FINAL==========

REQUEST FOR ADDITIONAL INFORMATION
REQUEST FOR ALTERNATIVE TO ASME CODE REPAIR REQUIRED BY IWA-4000 and IWE-5000
FOR PRIMARY CONTAINMENT VESSEL TORUS SHELL REPAIR
CONSTELLATION ENERGY GENERATION, LCC
NINE MILE POINT NUCLEAR STATION, UNIT 1
DOCKET NO. 50-220
EPID L-2022-LLR-0085

By letter dated December 8, 2022 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22342B229), Constellation Energy Generation, LLC (the licensee) requested U.S. Nuclear Regulatory Commission (NRC) authorization of a proposed alternative, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), to perform one or more weld overlays on the exterior of the torus to restore wall thickness due to internal degradation of the torus shell in lieu of repairing the torus as required by American Society of Mechanical Engineers (ASME) Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plants," at Nine Mile Point Nuclear Station, Unit No. 1 (NMP1) The request also included an alternative to the pneumatic leakage test requirements of IWE-5221 following the installation of a weld overlay repair performed on the torus. The alternative request applies to the third ten-year containment inservice inspection (CISI) interval, which began on August 23, 2019, for NMP1. The NRC staff has determined that additional information is needed to complete its review, as described in the request for additional information (RAI) shown below.

Regulatory Basis: Regarding proposed alternative to code requirements, the regulation in 10 CFR 50.55a(z)(1) requires that the licensee must demonstrate that the proposed alternative would provide an acceptable level of quality and safety.

RAI-1

The licensee's proposed alternative is based on ASME Code Case N-561-3, *Alternative Requirements for Wall Thickness Restoration of Class 2 and High Energy Class 3 Carbon Steel Piping Section XI, Division 1*; however, it is not clear which portions of the code case will be followed. In addition, limited justification for applying the code case, which is applicable for localized wall thickness restoration of Class 2 and high energy Class 3 piping, has been provided for its application to wall thickness restoration of the Class MC, NMP1 torus. It should also be noted that NRC approval of the code case in Regulatory Guide (RG) 1.147, Revision 20, *Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1*, requires that when it is used for localized wall restoration of Class 2 and high energy Class 3 carbon steel piping, it must be used in its entirety.

Provide a detailed description of which portions of Code Case N-561-3 are and are not being used in the proposed alternative for the Class MC NMP1 torus, and provide a technical justification for the code case sections being used and an explanation/justification for those sections that are excluded.

RAI-2

NRC Inspection Report 05000220/2021002 for NMP1 dated August 10, 2021 (ADAMS Accession No. ML21222A021) states in part, that "during [the 2019 refueling outage (1RFO25)] underwater examination of the Unit 1 torus, divers identified a band of corrosion, described as "tiger stripe"-like corrosion on the interior surface of the wetted areas that started just below the torus water surface and extended an additional 4-6 feet down." It is the NRC staff's understanding that there were several areas in the torus that exhibited "tiger-stripe" like corrosion and that is the likely degradation that the licensee may use the proposed alternative to repair. An important aspect of using a weld overlay to restore wall thickness in any component is to have a good understanding of all active degradation mechanisms that are contributing to wall loss. This consideration is also reflected in Sections 2 and 7 of Code Case N-561-3 referenced as the basis for the proposed alternative request.

Provide background information, including the history and extent of condition, of the observed degradation and active degradation mechanisms that may require torus shell restoration via weld overlay. In addition, discuss the projected impact of residual stress as a result of weld overlays on potential corrosion rates which could significantly increase compared to degradation rate projections based on wall loss so far. Note that any assumption that the inside diameter of the torus will be in compression after the application of a weld overlay would need to be verified by a detailed analysis such as those that have been performed as part of several industry sponsored studies related to weld overlays using mechanized gas tungsten arc welding (GTAW).

RAI-3

Section 5.1.2(a) of the submittal states that "…Unless otherwise established by theoretical analysis, the full thickness of the weld overlay shall extend a distance of at least *s* [as shown in Figure 1 of Code Case N-516-3] in each direction beyond the area predicted, over the design life of the overlay to infringe upon the required thickness prescribed by the Construction Code…"

Explain, in detail, the process that will be used to conduct a theoretical analysis, if one is performed.

RAI-4

Section 5.1.2(c) of the submittal states, in part, that "the [weld] overlay surface finish may be as-welded or smoother."

Given that the licensee has specified the use of shielded metal arc welding (SMAW), which will most likely be applied in a vertical-up progression, potentially resulting in a rough surface, provide a basis for permitting an as-welded surface which could impact the accuracy of any ultrasonic testing (UT) thickness measurements.

RAI-5

Section 5.1.3 of the submittal states that "…The design of weld overlays not prequalified by 5.1.4 shall be in accordance with the applicable requirements of the Construction Code or NE-3000 and shall consider the weld overlay as an integral portion of the torus shell plate upon which it is applied (not as a weld)…"

Explain the differences between the prequalified design and the requirements of the Construction Code or NE-3000 (whichever will be used) and provide a justification for the use of a prequalified design.

RAI-6

Section 5.1.5(a) of the submittal, related to temper bead welding technique, states:

> In lieu of the requirement of IWA-4681(b) [2017 Edition], the maximum area of an individual weld based on the finished surface over the ferritic material shall be 1,300 in^2, except as specified in 5.1.4(c)(5) [prequalified design], and the thickness of the weld overlay *W* shall not be greater than the ferritic base metal nominal thickness."

The NRC staff notes that the limiting weld size in IWA-4681 is 500 in^2 and is applicable to SMAW which the licensee has specified for any repairs when using the proposed alternative. Section 5.3.8 of the submittal also states:

> The justification for the alternative to IWA-4681(b), allowing an individual weld area not greater than 1,300 in^2 is supported by Electric Power Research Institute Report, Justification for Extension of Temper Bead Limit to 1,000 Square Inches for WOL of P1 and P3 Materials, EPRI, Palo Alto, CA: 2010, 1021073." This report provided a basis for increasing the allowable size of a temper bead weld overlay from 500 in^2 to 1,000 in^2, but the report also concluded that, "increasing the area of the temper bead WOL area over the ferritic material does indeed improve the ID residual stresses…" and the report concluded that the investigation, "produced no unexpected or unacceptable results that would preclude the use of the temper bead process for weld overlays up to and beyond 1,000 in^2."

The NRC staff notes that the above referenced report is based on weld overlays performed with mechanized GTAW which is a tightly controlled process and typically performed circumferentially around the entire diameter of a pipe and the referenced report was not based on the type of SMAW weld overlays to be used in the licensee's proposed alternative. Further, based on the EPRI report, the NRC staff noted that it included among its conclusions that the ASME Code and industry should provide an

option to users to justify repairs beyond 1,000 in^2 by additional analysis and evaluation of the type presented in the report, if required.

Provide a technical basis for weld overlays greater than 500 in^2 using the SMAW process.

RAI-7

Section 5.1.4, "Prequalified Design," of the submittal states: "Application of weld overlays on the torus shell plate need not comply with the requirements of 5.1.3, provided all of the following conditions are met: …"

The Code Case was developed for weld overlay on piping; provide a justification for the use of prequalified joint design requirements in the Code Case on the torus.

RAI-8

Section 5.1.4(c)(5), related to prequalified designs, of the proposed alternative states: "The maximum area of the weld overlay excluding tapered edges shall not exceed 576 in^2 which includes *s*." The NRC staff notes that the licensee calculated A_{max} = 146 in^2.

Explain how this limit was derived and provide a technical basis for the weld overlay area limit of 576 in^2, which is significantly more than the maximum permissible weld area per the Code Case for a prequalified design.

RAI-9

Section 5.1.8 of the submittal states that "…Each weld overlay shall be examined using an ultrasonic thickness measurement method during each of the two subsequent fuel cycles following installation to establish the expected life of the weld overlay repair. Subsequent examinations shall be scheduled prior to exceeding ½ of the expected life of the repair."

Discuss (a) the expected life of the repair; (b) whether and at what frequency the repaired location will be examined during each containment inservice inspection (ISI) interval; (c) whether the acceptance criteria of the inspection results will follow the provisions of IWE-3000; (d) how future ISI of the repaired area will meet examination requirements in Table IWE-2500-1 and Subsection IWE of the ASME Code, Section XI.

RAI-10

Section 5.3.8 of submittal states: "CEG has determined that a weld overlay of as large as 1,300 in^2 could be required for some torus repairs." The NRC staff notes that this is greater than the 1,000 in^2 for which analytical basis was provided in the cited EPRI report 1021073, "Justification for Extension of Temper Bead Limit to 1,000 Square Inches for WOL of P1 and P3 Materials," dated June 2010. The licensee's submittal references EPRI Report 1021073 as a technical basis for the alternative request. The staff notes that the referenced EPRI report study is based on a configuration representative of a typical large bore, thick wall pressurized water reactor (PWR) pipe. It is not clear to the staff how the configuration studied in the report is representative of and applicable to a significantly larger diameter (27 ft inside diameter (ID)), relatively thin wall (0.46 in nominal thickness), and significantly more flexible (based on D/t) cross-sectional configuration of the NMP1 torus shell. It is also not clear what the effects of residual stress and shrinkage/distortion effects of the proposed weld overlay repair and potential differences in thermal expansion coefficients would be on the structural integrity of the of the torus shell configuration.

Discuss how the effects of residual stress, shrinkage/distortion and potential expansion coefficient differences, from weld overlay repair, on the structural integrity of the torus shell configuration was or will be evaluated/assessed. Explain how the proposed (up to 1,300 in^2) repair area was determined.

RAI-11

Section 5.3.7 of the submittal states, in part: "There are no specific requirements in the Construction Code or ASME Section III, Subsection NE for the design and installation of weld overlays, so use of an approved alternative, based on requirements in an NRC approved ASME Code Case, is desired…" The NRC approved Code Case being referenced for this proposed alternative is N-561-3, which explicitly applies to Class 2 and high-energy Class 3 carbon steel piping systems (not Class MC pressure vessel components such as the torus) that has experienced internal wall thinning from localized erosion, corrosion, and cavitation or pitting.

a. To enable the NRC staff to verify that the proposed alternative remains consistent with the current licensing basis of the torus, explain with technical basis the impact(s), if any, of implementing the proposed alternative exterior weld overlay repair method on the licensing design basis of the NMP1 torus, which is a Class MC component. If it is determined that there is no change in the licensing design basis, provide the basis for that determination.

b. Explain the criteria that will be used to establish that the area being repaired has internal wall thinning from erosion, corrosion, and cavitation or potting that is localized**,** for applicability of the Code Case. Provide a summary characterization of the degradation(s) of the NMP1 torus shell and the basis of why the degraded condition of the NMP1 torus would be considered localized (and not a gross discontinuity) for Code Case N-561-3 to be applicable. Also, state in the response the required minimum wall thickness in the current licensing basis for the torus wall.

RAI-12

Section 5.1.2(f) of the submittal states, "The effects of the weld overlay on the dynamic analysis of the torus shall be addressed in the weld overlay design." It is not clear how this will be accomplished. Section 5.3.8 of the submittal states in part, "CEG has determined that an overlay of up to 1,300 in^2 will not affect the containment design basis loads or the dynamic analysis of the torus." It is not clear how this determination was made, nor whether and how multiple 1,300 in^2 repairs were accounted.

a. Explain the methodology that will be used in overlay design to address the effects of the weld overlay on the dynamic analysis of the torus.

b. Describe the evaluation that was performed to make the determination that an overlay of up to 1,300 in^2 will not affect the containment design basis loads or the dynamic analysis of the torus. Also explain how multiple 1,300 in^2 overlay repairs that may be made per the proposed alternative request were accounted for and provide a summary of the results.

RAI-13

The ASME Code, Section XI condition in 10 CFR 50.55a(b)(2)(ix)(J), which applies to IWE-5000 of Subsection IWE of the ASME Code, Section XI, 2013 Edition, states:

> *Metal containment examinations: Tenth provision*. In general, a repair/replacement activity such as replacing a large containment penetration, cutting a large construction opening in the containment pressure boundary to replace steam generators, reactor vessel heads, pressurizers, or other major equipment; or other similar modification is considered a major containment modification. When applying IWE–5000 to Class MC pressure-retaining components, any major containment modification or repair/replacement must be followed by a Type A test to provide assurance of both containment structural integrity and leak-tight integrity prior to returning to service, in accordance with appendix J to this part, Option A or Option B, on which the applicant's

> or licensee's Containment Leak-Rate Testing Program is based. When applying IWE–5000, if a Type A, B, or C Test is performed, the test pressure and acceptance standard for the test must be in accordance with appendix J to this part.

Section 5.1 of the submittal states, in part, "CEG proposes an alternative to perform one or more weld overlay repairs on the exterior surface of the containment torus…." Section 5.1.5(a) of the submittal states, in part, "….the maximum area of an individual weld based on the finished surface over the ferritic material shall be 1300 in^2 …" The NRC staff notes that multiple (more than 1) 1,300 in^2 weld overlay repairs that may be performed per the proposed alternative request could result in a repair that may constitute a major containment modification. However, the condition in 50.55a(b)(ix)(J), which is applicable to IWE-5000 of the ASME code-of-record of the 3rd CISI interval for the NMP1 torus, is not addressed in the licensee's submittal. Further, the justification provided in Section 5.4 for the proposed alternative to IWE-5221 (Section 5.2) of the submittal does not appear to provide a discussion of how the leak-tight integrity of the repaired area or component is assured following the repair.

a. Discuss your evaluation of the condition in 10 CFR 50.55a(b)(2)(ix)(J) in the context of the proposed alternative for the NMP1 torus in the submittal. If it is determined that the repairs in the proposed alternative would not constitute a major containment modification, discuss your basis for that determination and how it is incorporated and assured in the proposed alternative request.

b. Describe how leak-tight integrity of the area or component repaired in accordance with the proposed alternative request is assured following the repair.

RAI-14

Section 5.1.2(c) of the submittal states the thickness of the overlay shall be sufficient to maintain the required thickness for the predicted life of the overlay. Due to lack of clarity in the submittal,

a. explain how the minimum required thickness for the weld overlay repair for the torus will be determined in the proposed alternative and provide the analysis that was performed to determine the torus minimum wall thickness and maximum weld overlay size.

b. explain how the proposed alternative will meet the limitation on thickness in code case paragraph 1(c) for applicability of the Code Case N-561-3.

==========FINAL==========

From: Richard Guzman
Sent: Friday, February 17, 2023 2:00 PM
To: Loomis, Thomas R:(Constellation Nuclear) <thomas.loomis@constellation.com>
Cc: Reynolds, Ronnie J:(Constellation Nuclear) <Ronnie.Reynolds@constellation.com>
Subject: Nine Mile Point, Unit 1 - DRAFT Request for Additional Information re: Proposed Alternative Associated with a Weld Overlay Repair to the Torus [EPID: L-2022-LLR-0085]

Hello Tom,

By letter dated December 8, 2022 (ADAMS Accession No. ML22342B229), Constellation Energy Generation, LLC (CEG, the licensee) submitted Relief Request I5R-10, associated with a weld overlay contingency repair to the Nine Mile Point Nuclear Station, Unit No. 1 (NMP1) torus. The proposed alternative in Relief Request I5R-10 would allow weld overlay repairs to be performed on the exterior surface of the torus in lieu of performing underwater weld repairs or draining the torus to allow access to perform weld repairs on the interior surface of the torus. This request also includes an alternative to the pneumatic leakage test requirements of IWE-5221 following the installation of a weld overlay repair performed on the torus.

The NRC staff has determined that additional information is needed to complete its review, as described in the request for additional information (RAI) shown below. This RAI is identified as DRAFT at this time to confirm your understanding of the information needed by the NRC staff to complete its evaluation. Please let me know if a clarification call is needed, and I will coordinate availabilities w/the NRC technical staff. I would like to hold the call within the next two weeks, if needed, as I plan to issue the questions as an official RAI no later than March 3rd.

Thanks,

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