CENG
a joint venture of
Constellation Energy · eDF

NINE MILE POINT
NUCLEAR STATION

P.O. Box 63
Lycoming, NY 13093

September 29, 2011

U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

ATTENTION: Document Control Desk

SUBJECT: Nine Mile Point Nuclear Station
Unit No. 1; Docket No. 50-220

Request to Utilize an Alternative to the Requirements of 10 CFR 50.55a(g) for the Repair of Control Rod Drive Housing Penetrations – Response to NRC Request for Additional Information (TAC No. ME5789)

REFERENCES:

(a) Letter from J. E. Pacher (NMPNS) to Document Control Desk (NRC), dated March 25, 2011, Request to Utilize an Alternative to the Requirements of 10 CFR 50.55a(g) for the Repair of Control Rod Drive Housing Penetrations for the Remainder of the License Renewal Period of Extended Operation

(b) Letter from R. V. Guzman (NRC) to S. L. Belcher (NMPNS), dated August 11, 2011, Request for Additional Information Regarding Nine Mile Point Nuclear Station, Unit No. 1 - Relief Request No. 1ISI-004 (TAC No. ME5789)

Nine Mile Point Nuclear Station, LLC (NMPNS) hereby transmits supplemental information requested by the NRC in support of a previously submitted request for alternative (No. 1ISI-004) under the provision of 10 CFR 50.55a(a)(3). This 10 CFR 50.55a request, submitted in Reference (a), describes an alternative repair strategy for Nine Mile Point Unit 1 Control Rod Drive (CRD) housing penetrations that includes a variation of the CRD housing penetration welded repair geometry specified in Boiling Water Reactor Vessel and Internals Project (BWRVIP) report BWRVIP-58-A and variations from the requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI, and ASME Code Case N-606-1. The supplemental information, provided in the Attachment to this letter, responds to the request for additional information (RAI) documented in the NRC's letter dated August 11, 2011 (Reference b). This letter contains no new regulatory commitments.

A047
NRR

Should you have any questions regarding the information in this submittal, please contact John J. Dosa, Licensing Director, at (315) 349-5219.

Very truly yours,

M. [signature] for P Swift

Paul M. Swift
Manager Engineering Services

PMS/DEV

Attachment: Nine Mile Point Unit 1 – Response to NRC Request for Additional Information Regarding 10 CFR 50.55a Request Number 1ISI-004

cc: Regional Administrator, Region I, NRC
Project Manager, NRC
Resident Inspector, NRC

ATTACHMENT

NINE MILE POINT UNIT 1

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

REGARDING 10 CFR 50.55a REQUEST NUMBER 1ISI-004

Nine Mile Point Nuclear Station, LLC
September 29, 2011

ATTACHMENT

NINE MILE POINT UNIT 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
REGARDING 10 CFR 50.55a REQUEST NUMBER 1ISI-004

By letter dated March 25, 2011, Nine Mile Point Nuclear Station, LLC (NMPNS) submitted 10 CFR 50.55a request number 1ISI-004 pursuant to 10 CFR 50.55a(a)(3). This 10 CFR 50.55a request describes an alternative repair strategy for Nine Mile Point Unit 1 (NMP1) Control Rod Drive (CRD) housing penetrations that includes a variation of the CRD housing penetration welded repair geometry specified in Boiling Water Reactor Vessel and Internals Project (BWRVIP) report BWRVIP-58-A and variations from the requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI, and ASME Code Case N-606-1. This attachment provides supplemental information in response to the request for additional information (RAI) documented in the NRC's letter dated August 11, 2011. Each individual NRC request is repeated (in italics), followed by the NMPNS response.

RAI - 1

American Society of Mechanical Engineers (ASME) Code, Section XI, 2004 Edition, no Addenda, IWA-4610(a) requires the use of thermocouples and recording instruments to monitor process temperatures. In Paragraph 5A of Relief Request No. 1ISI-004, the licensee requests relief from using thermocouples for interpass temperature monitoring as specified in IWA-4610(a). In lieu of using thermocouples to monitor and verify process temperatures, the licensee proposes in Paragraph 5B of the relief request to verify maximum interpass temperature by performing heat transfer calculations or by performing temperature measurement on a test coupon that is no thicker than the bottom head and control rod drive (CRD) housing wall thickness. The test coupon welding would use the maximum heat input permitted by the applicable welding procedure specification.

The measurement of interpass temperature in this application is critical for at least two reasons. Maintaining a maximum interpass temperature is critical to maintaining the corrosion resistance of the stainless steel filler metal and base metal, and it is also critical in maintaining the notch toughness of the low alloy steel reactor vessel material. Therefore, maintaining a maximum interpass temperature is absolutely necessary; and since this cannot be done by direct measurement, all effort must be concentrated on maintaining a correct maximum interpass temperature, and the use of both methods of maximum interpass temperature determination shown in Paragraph 5B of the relief request is imperative.

In response to this question, please indicate if the licensee will modify its relief request to require both heat transfer calculations and temperature measurement on a test coupon that is no thicker than the bottom head and CRD housing wall thickness to be performed. If both methods are not performed or direct measurement of interpass temperature measurement is not made, please describe how an acceptable level of quality and safety can be maintained in this repair.

Response

As stated in 10 CFR 50.55a Request Number 1ISI-004, submitted by NMPNS letter dated March 25, 2011, direct interpass temperature measurement is impractical to perform during welding operations from inside the CRD housing penetration bore. Interpass temperature measurements cannot be accomplished due to the physical configuration and the inaccessibility of the weld region during welding. The alternative proposed by NMPNS is to either perform heat flow calculations or measure the maximum interpass temperature on a representative test coupon, but not both. This approach is consistent with the associated requirements specified in ASME Code Case N-638-4, which the NRC has determined to be conditionally acceptable in Regulatory Guide (RG) 1.147, Revision 16. RG 1.147, Revision 16 has been incorporated into the NRC's regulations at 10 CFR 50.55a(b). The RG specifically states that if it is impractical to perform interpass temperature measurements, then the provisions of 3(e)(2) [heat flow calculations] or 3(e)(3) [measurement of maximum interpass temperature on a test coupon] may be used. For the NMP1 CRD housing internal weld repair, AREVA has prepared heat transfer calculations in accordance with 3(e)(2) of Code Case N-638-4.

Analyses have been performed by AREVA that compare the heat transfer calculation method with the representative test coupon/mockup interpass temperature measurement method. AREVA has successfully performed numerous inside diameter temper bead weld modifications on Control Rod Drive Mechanism (CRDM) nozzle penetrations in pressurized water reactor (PWR) closure heads. Determination of interpass temperature for these modifications involved either heat transfer calculations or mockup temperature measurements, but not both. AREVA has also successfully performed PWR pressurizer heater nozzle sleeve inside diameter temper bead weld modifications. For these modifications, heat transfer calculations were performed according to the guidelines of Code Case N-638, and mockup interpass temperature measurements were performed both with and without water backing. The results of these analyses, which were recently presented to the ASME Welding Subcommittee, demonstrate that both methods are suitable and conservative for ensuring that welding interpass temperature limits are not exceeded.

Of the prior PWR work performed by AREVA, the CRDM nozzle penetration modifications represent a similar configuration to the NMP1 reactor vessel bottom head CRD housing internal weld repair, with the following differences:

- The NMP1 bottom head thickness is greater than a PWR reactor closure head thickness by approximately one (1) inch, which provides a larger heat sink.
- The NMP1 bottom head is filled with reactor coolant at the time of the repair, whereas the welding on the PWR closure heads is performed without water backing. The NMP1 heat transfer calculations conservatively ignore the beneficial cooling effects of the water backing.

Consideration of the above differences provides additional margin to the maximum allowable interpass temperature as determined in the NMP1 heat transfer calculations.

NMPNS agrees that maintaining the maximum interpass temperature below 350°F is critical in maintaining the notch toughness in the reactor vessel low alloy steel material. When maintaining the notch toughness of the low alloy steel, the focus of concern is elevated temperatures while performing the actual temper bead welding (i.e., during the first 3 layers of welding over P-No. 3 materials). Mockups and calculations show that the temperature remains low during the first three layers of welding because the area surrounding the weld remains at low temperature until significant additional balance welding of the joint (i.e., the non-temper bead region) is completed. The welding procedure qualification was performed using the same tooling used in the field mockup, and demonstrated that notch toughness could not only be maintained, but improved.

NMPNS also agrees that maintaining the maximum interpass temperature below 350°F is critical for corrosion resistance of the stainless steel filler metal and base metal. In addition to the conservative nature of the interpass temperature calculation, the following features contribute to maintaining the corrosion resistance of the stainless steel filler material:

- Only "L" grade filler materials are being utilized for the repair. This significantly reduces the likelihood of chromium carbides, the primary mechanism for sensitization.
- The ambient temperature temper bead process uses low heat input techniques, minimizing times that the material is at the sensitization temperature.
- The exposed stainless steel weld material will be subjected to rotary peening, which has proven to impose compressive residual stresses on the surface.

Welded and peened surfaces of fabricated sample coupons and full scale mockup samples have undergone testing in accordance with American Society for Testing and Materials (ASTM) Standard G36 to validate corrosion resistance.

Based on the above discussion, an acceptable level of quality and safety can be maintained in the proposed repair by incorporating the heat transfer calculation inputs into the applicable process control documents, which will ensure that the maximum interpass temperature is not exceeded.

RAI - 2

ASME Code Case N-606-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique for BWR [Boiling Water Reactor] CRD Housing Stub Tube Repairs, Section XI, Division 1," Paragraph 1(f) prohibits peening of the final weld layer. The licensee requests relief from this restriction to allow portions of the final weld surface and the heat affected zone in the lower CRD housing to be rotary peened after acceptance nondestructive evaluation (NDE) has been performed.

Peening is a mechanical process which can crack or otherwise damage welds. It can also mask NDE methods from identifying defects in a weld. If peening is performed on a weld, the potential for creating or masking defects exists and identification of defects in a weld is imperative. Therefore, NDE of the final weld surface, both before peening and after peening, is the best method to identify defects in a weld.

It is understood from the relief request that NDE will be performed prior to implementation of the rotary peening process. Please indicate if NDE will be performed after peening. If so, please describe what type of NDE will be performed to identify defects which may result from the peening process.

Response

Non-destructive examination (NDE), consisting of a remote ASME Code Section XI equivalent visual (VT-1) inspection, will be performed after completion of the rotary peening.

The purpose of the peening is to induce a compressive stress in the new CRD housing weld and weld heat affected zone (HAZ) of the CRD housing base metal. The rotary peening tool used in this application consists of a standard commercial roto-peening flapper driven by a belt driven electric motor. The flapper has embedded tungsten balls that perform the peening. This peening process is not capable of material removal, as demonstrated in the rotary peening developmental testing. Liquid penetrant (PT) examinations have been performed on the mockup used during the NMP1 repair development, qualification, and demonstrations, both before and after the rotary peening. No surface defects were identified. Data from other AREVA repair projects also demonstrates that rotary peening does not produce surface indications.

PT and ultrasonic (UT) examinations are performed after final machining and weld crown removal but prior to rotary peening. The PT area includes the area to be rotary peened. The PT examination ensures that any relevant surface indications are identified prior to rotary peening. Relevant PT indications would be evaluated for repair and PT examined again subsequent to making any repairs. Therefore, a PT examination and subsequent repairs (if necessary) will have already been performed prior to rotary peening such that the potential to mask defects is not a concern.

The final step of the repair process requires post-rotary peening cleaning and visual inspection. AREVA has developed a remote ASME Code Section XI equivalent visual (VT-1) inspection method for surface inspection of post-peened surfaces. This inspection will further validate that peening has not damaged the weld surface. The mockup qualification and demonstration on the entire area of interest was discernable to VT-1 inspection quality standards. Various weld ripples and other landmarks were highly visible.

Based on the above discussion, NMPNS concludes that visual inspection is an acceptable approach to verify that the final rotary peened surface is absent of defects, and that the repair process does not need to include a final PT examination of the rotary peened surface. An additional benefit is the personnel dose savings (estimated to be 1.5 Rem) that is realized by not having to install the PT tool into the CRD housing, perform the PT examination, and remove the PT tool.

RAI - 3

In the second paragraph on page 1 of Attachment 2 to Relief Request No. 1ISI-004, it states, in part, "In the event that roll expansion does not seal the [Control Rod Drive Housing] penetration and stop the leak, a repair shall be performed based on BWR Vessel and Internals Project (BWRVIP)-58-A as depicted in Figure 1 with variations thereto as discussed and justified herein." Section 3 of BWRVIP-58-A, "BWR Vessel and Internals Project, CRD Internal Access Weld Repair," discusses repair of CRD welds. Section 3.3 of BWRVIP-58-A discusses making a weld repair if water is leaking through a crack and states that, "The welding is performed at a pressure (~60 psi) that would prevent leakage of water into the cavity during the welding process. The pressure in the cavity is maintained during the welding process by sealing at the CRD housing flange and at the nozzle bore plug. This hyperbaric-chamber environment must be maintained during an initial drying cycle when any residual moisture from the AWJ [Abrasive water jet] process or leakage is removed, and during the first three layers of welding to insure the leak path is sealed."

If this process or any other similar process is performed, then this weld is a dry underwater weld and as such the rules of ASME Code, Section XI, IWA-4660, "Underwater Welding," apply. The rules of Title 10 of the Code of Federal Regulations (10 CFR), Section 50.55a(b)(2)(xii) also apply, in which case, permission to perform underwater welding must be sought from the NRC.

If the licensee intends to implement the approach identified in Section 3.3 of BWRVIP-58-A, please provide a request, as identified above, consistent with 10 CFR 50.55a(b)(2)(xii) and indicate how the welding process will be performed consistent with ASME Code, Section XI, IWA-4660.

Response

The relief request proposes to use ASME Code Case N-606-1 to implement the CRD housing inside diameter temper bead weld repair. This code case, which specifically addresses BWR CRD housing/stub tube repairs, requires all other requirements of IWA-4000, 1989 Edition with 1990 Addenda to be met. The ASME Code Section XI, 1989 Edition with 1990 Addenda, did not cover machine temper bead welding or underwater welding. The NRC's conditional approval of Code Case N-606-1 that is documented in RG 1.147, Revision 16, also does not impose any conditions related to underwater welding.

Code Case N-606-1, Paragraph 2.1(b), states: "Consideration shall be given to the effects of welding in a pressurized environment. If they exist, they shall be duplicated in the test assembly." The NMP1 procedure qualification record (PQR) and repair test assembly were both designed to address welding in a pressurized environment. In addition, Tables 3-1 and 3-2 below summarize how the welding process will be performed consistent with ASME Code Section XI, IWA-4660 for dry underwater welding. Table 3-1 addresses the procedure qualification additional essential variables listed in IWA-4662.1, and Table 3-2 addresses the performance qualification variables listed in IWA-4662.2. These tables demonstrate that the NMP1 PQR meets all of the applicable technical requirements of IWA-4660 by following the procedure qualification instructions found in Code Case N-606-1.

The RAI states that the rules of 10 CFR 50.55a(b)(2)(xii) also apply, in which case permission to perform underwater welding must be sought from the NRC. This regulation states:

> "The provisions in IWA–4660, "Underwater Welding," of Section XI, 1997 Addenda through the latest edition and addenda incorporated by reference in paragraph (b)(2) of this section, are not approved for use on irradiated material".

The BWRVIP has produced several documents pertaining to welding underwater on irradiated components. Specifically, BWRVIP-97-A, "Guidelines for Performing Weld Repairs to Irradiated BWR Internals," establishes a generic weldability boundary within which the effects of irradiation are benign. Within this boundary, BWRVIP-97-A states that the standard ASME Section IX weld procedure specification (WPS) and PQR for non-irradiated material can be used. The NMP1 CRD housings are at the bottom of the reactor vessel and are well within the generic weldability boundary. NRC acceptance of BWRVIP-97-A is documented in the NRC safety evaluation transmitted to the BWRVIP by NRC letter dated June 30, 2008.

Based on the BWRVIP-97-A guidance, NMPNS concludes that the NMP1 CRD housings may be considered non-irradiated material for the purpose of the proposed weld repair, and that a request for relief from the requirements of 10 CFR 50.55a(b)(2)(xii) is not required.

Table 3-1

Assessment of Additional Essential Variables for Dry Underwater Welding Procedure Qualification

Essential Additional Variable (IWA-4662.1)	PQR	NMP1 CRD Housing Internal Repair
Welding procedure specifications for dry underwater welding shall be qualified in accordance with the requirements of Section IX for groove welds.	Addressed – WPS/PQR meet the ASME Section IX requirements for groove welds.	Addressed – The field Operation Instructions invoke the applicable WPS.
(1) A change in the method for underwater transport and storage of filler material (e.g., from sealed packages to exposed).	Not Applicable – There is no underwater transport of filler material involved. The exposed filler material is contained outside the pressurized chamber at all times in a dry environment below the repair location.	Not Applicable – There is no underwater transport of filler material involved. The exposed filler material is contained outside the pressurized chamber at all times in a dry environment below the repair location.
(2) Addition or deletion of waterproof or supplementary coatings for the filler metal or a change in the type of any waterproof or supplementary coatings.	Not Applicable– No supplementary coatings necessary or included.	Not Applicable – Standard bare wire with no supplementary coatings utilized.
(3) A change in depth beyond that qualified in accordance with Table IWA-4662.1-1.	Addressed – Although the word "depth" is used, the technical concern that is addressed by IWA-4660 is the pressure induced in order to make dry underwater welding possible. Depth translates into a specified repair pressure of 60 psi (±14 psi) used for the entire welding process.	Addressed – Although the word "depth" is used, the technical concern that is addressed by IWA-4660 is the pressure induced in order to make dry underwater welding possible. Depth translates into a specified repair pressure of 60 psi (±14 psi) used for the entire welding process.
(4) A change in the nominal background gas composition.	Addressed – Argon used as background gas.	Addressed - Argon used as background gas.
(5) For SMAW [Shielded Metal Arc Welding] and FCAW [Flux-Cored Arc Welding], use of a larger diameter electrode than that used in qualification.	Not Applicable – GTAW (Gas Tungsten Arc Welding) utilized.	Not Applicable – GTAW utilized.
(6) For P-No. 1 material, a decrease in the minimum distance from the point of welding to the wetted surface in any direction, when the minimum distance is less than 6 in. (150 mm).	Not Applicable – P-No. 3 material to P-No. 8 material used.	Not Applicable – P-No. 3 material to P-No. 8 material used.
(7) For P-No.1 material, the supplementary essential variables of Section XI apply to non-impact-tested base metal when the minimum distance from the point of welding to the wetted surface in any direction is less than 6 in. (150 mm).	Not Applicable – P-No. 3 material to P-No. 8 material used.	Not Applicable – P-No. 3 material to P-No. 8 material used.

Table 3-2

Assessment of Variables for Dry Underwater Welding Performance Qualification

Variable (IWA-4662.2)	Welding Operator Qualification	NMP1 CRD Housing Internal Repair
(a) A change in welding mode (i.e., dry chamber, dry spot, or habitat).	Dry chamber welding used.	Dry chamber welding used.
(b) A change in the SFA specification AWS [American Welding Society] filler metal classification, or if not conforming to an AWS filler metal classification, a change in the manufacturer's trade name for the electrode or filler metal.	ASME SFA 5.9 classification ER309L materials used.	ASME SFA 5.9 classification ER309L materials used.
(c) Addition or deletion of supplementary coatings for the filler metal or a change in the type of any supplementary coatings.	N/A – Supplementary coatings are not used.	N/A – Supplementary coatings are not used.
(d) A change in depth beyond that qualified in accordance with Table IWA-4662.1-1.	Addressed – Although the word "depth" is used, the technical concern that is addressed by IWA-4660 is the pressure induced in order to make dry underwater welding possible. Depth translates into a specified repair pressure of 60 psi (±14 psi) used for the entire welding process.	Addressed – Although the word "depth" is used, the technical concern that is addressed by IWA-4660 is the pressure induced in order to make dry underwater welding possible. Depth translates into a specified repair pressure of 60 psi (±14 psi) used for the entire welding process.
(e) For SMAW and GMAW [Gas Metal Arc Welding], use of a larger diameter electrode than that used during performance qualification.	N/A – These processes are not used.	N/A – These processes are not used.