

May 5, 2008

Mr. Keith J. Polson
Vice President Nine Mile Point
Nine Mile Point Nuclear Station, LLC
P.O. Box 63
Lycoming, NY 13093

SUBJECT: NINE MILE POINT NUCLEAR STATION, UNIT NO. 1 – USE OF THE 1995
ASME CODE AND PERFORM FLAW EVALUATION OF RECIRCULATION
INLET NOZZLE-TO-SAFE END WELD (TAC NOS. MD5700 AND MD5709)

Dear Mr. Polson:

By letter dated May 10, 2007, as supplemented by letters dated May 25, 2007, and February 21, 2008, Nine Mile Point Nuclear Station, LLC (NMPNS) submitted for the Nuclear Regulatory Commission (NRC) staff review (1) a request for using Subarticle IWB-3640, "Evaluation Procedures and Acceptance Criteria for Austenitic Piping," of Section XI of the 1995 Edition through 1997 Addenda of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) in a flaw evaluation and (2) the associated flaw evaluation report for the reactor pressure vessel (RPV) recirculation inlet nozzle-to-safe end weld 32-WD-164 indication for Nine Mile Point, Unit 1 (NMP-1). The flaw indication was detected by ultrasonic examination as required by the alternative risk-informed inservice inspection program during the unit's 19th refueling outage. The licensee intended to demonstrate through a flaw evaluation in accordance with Section XI of the 1995 Edition through 1997 Addenda of the ASME Code that the unit can be operated without repair of the subject RPV recirculation inlet nozzle-to-safe end weld for an additional operating cycle (approximately 2 years).

The NRC staff finds NMPNS's request acceptable and approves the use of Section XI of the 1995 Edition through 1997 Addenda of the ASME Code in this application for NMP-1. The NRC staff also finds that the flaw evaluation of the detected crack in the recirculation inlet nozzle-to-safe end weld meets the ASME Code requirements. Hence, the NRC staff concludes that NMP-1 can be operated without repair of the subject nozzle connection for an additional operating cycle.

The NRC staff's safety evaluation is enclosed. If you have any questions, please contact Richard Guzman, at (301) 415-1030.

Sincerely,

/RA/

Mark G. Kowal, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-220

Enclosure:
Safety Evaluation

cc w/encl: See next page

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Accession No. ML081200001

* SE provided by memo. No substantial changes made.

OFFICE	LPL1-1/PM	LPL1-1/LA	CVIB/BC	OGC	LPL1-1/BC
NAME	RGuzman	SLittle	MMtichell	CChandler	MKowal
DATE	4/30/08	4/30/08	3/4/08 SE DTD*	5/5/08	5/005/08

DATED: May 5, 2008

NINE MILE POINT NUCLEAR STATION, UNIT NO. 1 – USE OF THE 1995 ASME CODE AND PERFORM FLAW EVALUATION OF THE RECIRCULATION INLET NOZZLE-TO-SAFE END WELD (TAC NOS. MD5700 AND MD5709)

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MMitchell

RidsNrrDciCvib

ACRS

RidsNrrAcrcAcnw&mMailCenter

GDentel, RI

RidsRgn1MailCenter

SSheng

cc: Plant Service list

Nine Mile Point Nuclear Station, Unit No. 1

cc:

Mr. Michael J. Wallace, Chairman and CEO
Constellation Energy Nuclear Group, LLC
750 East Pratt Street, 18th Floor
Baltimore, MD 21202

Mr. Henry B. Barron, Chief Nuclear Officer
Constellation Energy Nuclear Group, LLC
111 Market Place
Baltimore, MD 21202

Mr. Terry F. Syrell
Director, Licensing
Nine Mile Point Nuclear Station
P.O. Box 63
Lycoming, NY 13093

Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Resident Inspector
U.S. Nuclear Regulatory Commission
P.O. Box 126
Lycoming, NY 13093

Supervisor
Town of Scriba
Route 8, Box 382
Oswego, NY 13126

Charles Donaldson, Esquire
Assistant Attorney General
New York Department of Law
120 Broadway
New York, NY 10271

Mr. Paul D. Eddy
New York State Department of
Public Service
3 Empire State Plaza, 10th Floor
Albany, NY 12223

Mark J. Wetterhahn, Esquire
Winston & Strawn
1700 K Street, NW
Washington, DC 20006

Carey W. Fleming, Esquire
Sr. Counsel - Nuclear Generation
Constellation Energy Nuclear Group, LLC
750 East Pratt Street, 17th Floor
Baltimore, MD 21202

Mr. John P. Spath
New York State Energy, Research, and
Development Authority
17 Columbia Circle
Albany, NY 12203-6399

Mr. Paul Tonko
President and CEO
New York State Energy, Research, and
Development Authority
17 Columbia Circle
Albany, NY 12203-6399

Mr. James R. Evans
LIPA
P.O. Box 129
Lycoming, NY 10393

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO THE USE OF LATER ASME CODE SECTION XI FOR
THIRD 10-YEAR INSERVICE INSPECTION INTERVAL AND
RECIRCULATION NOZZLE-TO-SAFE END WELD 32-WD-164 FLAW EVALUATION
NINE MILE POINT NUCLEAR STATION, LLC
NINE MILE POINT NUCLEAR STATION, UNIT NO. 1
DOCKET NUMBER 50-220

1.0 INTRODUCTION

By letter dated May 10, 2007 (Agencywide Documents Access and Management Systems (ADAMS) Accession No. ML071370230), as supplemented by letters dated May 25, 2007 (ML071510144), and February 21, 2008 (ML080530088), Nine Mile Point Nuclear Station (NMPNS), LLC (the licensee) submitted a request to use Subarticle IWB-3640, "Evaluation Procedures and Acceptance Criteria for Austenitic Piping," of Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the 1995 Edition through 1997 Addenda of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) for analyzing inservice inspection (ISI) results for Nine Mile Point Nuclear Station, Unit 1 (NMP-1). Subarticle IWB-3640 provides, in lieu of repair/replacement, requirements for analytical evaluation and acceptance of flaws in a component during the ISI activities.

The licensee submitted this request in accordance with Nuclear Regulatory Commission (NRC) Regulatory Issue Summary (RIS) 2004-12, "Clarification on use of later Editions and Addenda to the ASME OM Code and Section XI," dated July 28, 2004. RIS 2004-12 states "[I]licensees must request approval to use later Code editions and addenda via a letter to the NRC; they may not just update their IST or ISI program." Prior NRC approval is required by Section 50.55a(g)(4)(iv) of Title 10 of the *Code of Federal Regulations* (10 CFR).

In its letter dated, May 10, 2007, the licensee also submitted for NRC staff review an evaluation of a flaw indication in the N2D reactor pressure vessel (RPV) recirculation nozzle-to-safe end weld 32-WD-164 for NMP-1. The flaw indication was detected by ultrasonic (UT) examination as required by the alternative risk-informed ISI program during the unit's 19th refueling outage. The licensee intended to demonstrate through a flaw evaluation provided in its May 10, 2007, submittal that the unit can be operated without repair of the subject RPV recirculation inlet nozzle-to-safe end weld for an additional operating cycle.

2.0 REGULATORY REQUIREMENTS

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. Section 10 CFR 50.55a(g)(4)(ii) requires that ISI examination of components and system pressure tests conducted during successive 120-month inspection intervals must 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 repair, replacement, and modification of plant components are not explicitly mentioned in 10 CFR 50.55a(g)(4) and associated subparagraphs. However, these activities are specifically mentioned in the ASME Code, Section XI. The NRC staff maintains that these activities are not separate and distinct from, but are included under, inservice examinations. Therefore, the requirements of 10 CFR 50.55a(g)(4)(iv) are applicable to repair/replacement activities. Similarly, flaw evaluation, in lieu of repair/replacement, is also considered to be under inservice examinations.

Section 10 CFR 50.55a(g)(4)(iv) states that inservice examination of components and system pressure tests may meet the requirements set forth in subsequent editions and addenda of the ASME Code provided that they are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed in 10 CFR 50.55a(b), and subject to Commission approval. Portions of editions or addenda may be used provided that all related requirements of the respective editions or addenda are met. Currently, 10 CFR 50.55a(b)(2) incorporates by reference the ASME Code, Section XI from the 1970 Edition through the 1976 Winter Addenda, and the 1977 Edition through the 2003 Addenda.

The ISI of the ASME Code Class 1, Class 2, and Class 3 components shall be performed in accordance with Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the ASME Code and applicable editions and addenda as required by 10 CFR 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i).

When flaws are detected by volumetric examinations, acceptance of them by supplemental examination, repairs, replacement, or analytical evaluation shall be in accordance with Subarticle IWB-3130, "Inservice Volumetric and Surface Examinations." In this application, Subarticle IWB-3600, "Analytical Evaluation of Flaws," specified in Subarticle IWB-3132.3, "Acceptance by Analytical Evaluation," was applied by the licensee to demonstrate that the unit can be operated for an additional operating cycle without repair of the RPV recirculation nozzle-to-safe end weld.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected

RPV recirculation inlet nozzle N2D nozzle-to-safe end weld 32-WD-164.

3.2 Applicable Code Edition and Addenda

The applicable ASME Code edition for the third ISI interval at NMP-1 is the 1989 Edition of the ASME Code, Section XI with no Addenda. However, the flaw evaluation was performed in accordance with the 1995 Edition through 1997 Addenda of the ASME Code. The NRC staff's

evaluation for the relief request to use this later edition and addenda of the ASME Code is provided in Section 3.5.1 of this safety evaluation.

3.3 Proposed Subsequent Code Edition and Addenda (or Portion)

3.3.1 Background

The licensee performed ISI for NMP-1 during its 19th refueling outage in accordance with the alternative risk-informed ISI program and Section XI of the 1989 Edition of the ASME Code with no Addenda. The UT examination detected a flaw in the RPV recirculation inlet nozzle N2D nozzle-to-safe end weld 32-WD-164. The licensee intended to demonstrate through a flaw evaluation that the unit can be operated without repair of the subject weld for an additional operating cycle (Attachment 2 to the May 10, 2007, submittal). However, IWB-3400 in the 1989 Edition sets the limit for the allowable flaw depth at 60% of the nozzle wall for flaws in welds fabricated by certain welding processes. As modified in its letter dated February 21, 2008, the licensee requested to use the 1995 Edition through the 1997 Addenda of the ASME Code, Section XI, which revised the limit for the allowable flaw depth to 75% of the nozzle wall for all types of welds (Attachment 1 to the submittal). The duration of this request is for the remainder of the third ISI interval (April 5, 2008 to April 4, 2018), which covers the additional operating cycle supported by the flaw evaluation.

3.3.2 Proposed Subsequent Code Edition and Addenda

As permitted by 10 CFR 50.55a(g)(4)(iv), the licensee requested to use Subarticle IWB-3400 in the 1995 Edition through the 1997 Addenda of the ASME Code, Section XI to evaluate the ISI results. Subarticle IWB-3400 provides rules for evaluating flaws in austenitic piping. The NRC approved the use of the 1995 Edition through the 1997 Addenda as documented in 10 CFR 50.55a(b)(2) with no limitations, conditions, or modifications on Subarticle IWB-3400.

3.3.3 Related Requirements

The proposed use of Subarticle IWB-3640 in the 1995 Edition through 1997 Addenda of the ASME Code for flaw evaluation does not affect other parts of the ASME Code. Therefore, there are no related requirements to be applied as a result of this request.

3.4 Duration of Proposed Request

NMP-1 is currently in the unit's third ISI interval. The duration of this request will be effective from the date of the NRC approval to the end of the third ISI interval (April 4, 2018).

3.5 NRC Staff Evaluation

3.5.1 Licensee's Use of 1995 Edition through 1997 Addenda of the ASME Code, Section XI

The NRC staff evaluated the licensee's request for use of a later Edition to the ASME Code, Section XI using the criteria contained in 10 CFR 50.55a(g)(4)(iv), which states that inservice examination of components and system pressure tests may meet the requirements set forth in subsequent editions and addenda of the ASME Code provided certain criteria are satisfied.

The first criterion is that the edition and addenda of the ASME Code, Section XI that will be used in the proposed request is incorporated by reference in 10 CFR 50.55a(b). Currently, Section 50.55a(b)(2) incorporates by reference the ASME Code, Section XI from the 1970 Edition through the 1976 Winter Addenda, and the 1977 Edition (Division 1) through the 2003 Addenda (Division 1), which includes the 1995 Edition through the 1997 Addenda of the ASME Code, Section XI (the edition and addenda proposed by the licensee for use in this application). Therefore, the NRC staff finds that the first criterion has been satisfied.

The second criterion is that the limitations and modifications listed in 10 CFR 50.55a(b) are satisfied for the specific use of the proposed subsequent edition and addenda of the ASME Code, Section XI. Section 10 CFR 50.55a(b) sets no limitations and modifications on Subarticle IWB-3640 of the 1995 Edition through the 1997 Addenda of the ASME Code, Section XI. Therefore, the NRC staff finds that the second criterion has been satisfied.

The third criterion is that if portions of subsequent editions or addenda of the ASME Code, Section XI are used, all related requirements of the respective editions or addenda must be met. The licensee stated that there are no related requirements to be applied as a result of using Subarticle IWB-3640 in the 1995 Edition through the 1997 Addenda of the ASME Code, Section XI. The NRC staff has verified this statement and, therefore, finds that the third criterion has been satisfied.

Based on the above, the NRC staff finds that the criteria of 10 CFR 50.55a(g)(4)(iv) are satisfied and that the licensee's request to use the 1995 Edition through the 1997 Addenda of the ASME Code, Section XI for this flaw evaluation is acceptable.

3.5.2 Flaw Evaluation: RPV N2D Nozzle-to-safe end weld 32-WD-164

A typical flaw evaluation for detected flaws includes: (1) flaw sizing, (2) a crack growth evaluation based on applied stress intensity factors (K_{applied}), (3) an estimation of the final flaw size, (4) an estimation of the allowable flaw size based on the failure resistance considering degradation, and (5) a stability evaluation using NRC-approved acceptance criteria. The five elements of the licensee's flaw evaluation are provided below.

The flaw indication was detected by UT examination as required by the alternative risk-informed ISI program during the unit's 19th refueling outage. The licensee's UT examination and flaw sizing was performed by WesDyne International and was documented in Attachment 4 to the submittal. Attachment 3 to the submittal contained an independent evaluation of the UT examination results by Electric Power Research Institute, which confirmed the licensee's conclusion that N2D nozzle-to-safe end weld contains a planar, circumferential flaw of 1.59 inch in length (17% of the pipe circumference) and 0.27 inch in depth (16% of the pipe wall thickness). The licensee's flaw sizing was appropriate considering that the UT results were independently verified by another organization and that the licensee conservatively assumed that the initial flaw depth was 0.3 inch, adding 0.03 inch to the depth as additional margin.

The licensee calculated crack growth of the detected flaw due to two degradation mechanisms: (1) the intergranular stress-corrosion cracking (IGSCC) and (2) fatigue crack growth. The IGSCC growth rate was based on BWRVIP-59A, "BWR [Boiling Water Reactor] Vessels and Internals Project: Evaluation of Crack Growth in BWR Nickel Base Austenitic Alloys in RPV

Internals (BWRVIP-59).” BWRVIP-59A allows use of the bounding IGSCC crack growth rates so that calculation of K_{applied} becomes unnecessary. The licensee used the bounding rates for both normal water chemistry (NWC) and hydrogen water chemistry (HWC) to study the worst-case scenario of this flaw evaluation. The NRC staff considered the use of the bounding rates appropriate for estimating the crack growth due to IGSCC in Alloy 82/182 materials because BWRVIP-59A was developed specifically for (1) Alloy 82/182 weld materials and (2) Alloy 600 types of nickel-based austenitic materials in a BWR environment. For the fatigue crack growth calculation, the licensee used 10 times the ASME Code, Section XI, crack growth law for an air environment as the rate for a BWR environment. It also used a constant $\Delta K_{\text{applied}}$ of 50 thousand pounds per square inch (ksi/inch). This was more conservative than a typical industry approach that was approved by the NRC in the past and is, therefore, acceptable.

The calculated flaw depth after one fuel cycle (2 years) of IGSCC growth under the NWC condition was 1.18 inch (69.6% of the wall). The calculated flaw growth rate under fatigue (startup and shutdown cycles) was 2×10^{-4} inch/cycle. Assuming 10 startup and shutdown cycles in one operating cycle to cover other possible transients for fatigue crack growth and adding it to the growth due to IGSCC, the NRC staff arrived at the final flaw depth of 1.182 inches, or 70% of the wall. The NRC staff concluded that this estimation of the final flaw depth was appropriate because (1) the IGSCC growth based on bounding growth rates was acceptable and (2) the fatigue crack growth based on 10 times the ASME Code, Section XI, crack growth rate for an air environment in addition to 10 startup and shutdown cycles in one operating cycle was conservative.

For the flaw stability evaluation, the ASME Code, Section XI provides two approaches: one based on comparing driving force to failure resistance and the other based on comparing predicted flaw size at the end of the requested period of operation to the allowable flaw size. The licensee chose the latter and utilized ASME Code, Section XI, Table IWB-3641-1 (based on the limit load analysis methodology), which lists allowable flaw sizes as a function of stress ratio (defined as the ratio of the applied stress to the weld flow stress). This simplified the licensee’s effort to calculate the allowable flaw size. The NRC staff determined that use of ASME Code, Section XI, Table IWB-3641-1 for austenitic piping in this application was justified, considering that Alloy 82/182 is very ductile and the rather conservative acceptance criterion of limiting a short flaw to 75% of the wall can accommodate use of the limit load analysis as opposed to an elastic-plastic fracture mechanics analysis.

After applying the stability criterion, the licensee found that the subject flaw will not grow to 75% of the nozzle wall at the end of an additional operating cycle. Therefore, the licensee concluded that the flaw meets the ASME Code, Section XI, IWB-3640 requirements. The NRC staff concurred on this finding based on the NRC staff’s evaluation of each element of the licensee’s flaw evaluation.

4.0 CONCLUSION

On the basis of evaluating the information submitted, the NRC staff concludes that the proposed request is acceptable and authorizes the use of Subarticle IWB-3640 of the 1995 Edition through the 1997 Addenda of the ASME Code, Section XI in the licensee’s flaw evaluation of the indication in the RPV recirculation inlet nozzle N2D nozzle-to-safe end weld 32-WD-164 for the remainder of the third 10-year ISI interval at NMP-1.

All other requirements of the ASME Code, Sections III and XI for which relief has not been specifically requested and approved remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

The NRC staff also concludes that the licensee's flaw evaluation meets the rules in the 1995 Edition through 1997 Addenda of Section XI of the ASME Code. Since the projected flaw size with 2 years of crack growth is bounded by the allowable flaw size, the NRC staff concludes that NMP-1 can be operated without repair of the subject RPV recirculation inlet nozzle-to-safe end weld for an additional operating cycle.

Principal Contributor: Simon Sheng

Date: May 5, 2008