



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

August 15, 2012

Mr. Anthony Vitale
Vice President, Operations
Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530

SUBJECT: PALISADES NUCLEAR PLANT SAFETY EVALUATION OF COMMITMENT
SUBMITTAL FOR LICENSE RENEWAL REGARDING THE ALLOY 600
PROGRAM (TAC NO. ME7125)

Dear Mr. Vitale:

By letter dated March 13, 2008, Entergy (the licensee) submitted information to fulfill a commitment for license renewal regarding its proposed Nickel Alloy Program. The licensee's commitment is specified in Commitment no. 6 in Appendix A of NUREG-1871, "Safety Evaluation Report Related to the License Renewal of Palisades Nuclear Plant," dated January 2007. Commitment no. 6 states that the licensee "...will revise the Alloy 600 Program to update the PWSCC corrosion rate assessments and inspection program consistent with the latest NRC requirements and industry commitments ... The updated program will be submitted for NRC review and approval..."

The NRC staff reviewed the information in the licensee's letter and the response dated May 31, 2012, to the staff's request for additional information. The staff determined that the licensee has fulfilled Commitment no. 6 for license renewal. The licensee demonstrated that the Nickel Alloy Program will adequately manage the aging effects of primary system pressure boundary components that are made of nickel-based alloy material.

Sincerely,

A handwritten signature in black ink, appearing to read "Heather Jones".

Heather M. Jones, Project Manager
Subsequent Renewal, Guidance,
and Operations Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure:
Safety Evaluation of Commitment

cc w/encl: Listserv

OFFICE OF NUCLEAR REACTOR REGULATION
SAFETY EVALUATION OF COMMITMENT FOR LICENSE RENEWAL
ALLOY 600 PROGRAM PALISADES NUCLEAR PLANT
DOCKET NO. 50-255

1.0 INTRODUCTION

By letter dated March 22, 2005, Nuclear Management Company, LLC (the former license holder) requested renewal of the operating license in accordance with Title 10, Part 54, *Code of Federal Regulations* (10 CFR Part 54) for the Palisades Nuclear Plant (PNP) for a period of 20 years beyond the current expiration date of March 24, 2011. The application contained a commitment to submit for U.S. Nuclear Regulatory Commission (NRC) review and approval, the revised Alloy 600 (i.e., nickel-based alloy) aging management program (AMP). The NRC's review of the license renewal application is contained in NUREG-1871, *Safety Evaluation Report Related to the License Renewal of Palisades Nuclear Plant*, September 2006 (Agencywide Documents Access Management System [ADAMS] Accession No. ML062710074). The NRC issued the renewed license for PNP on January 17, 2007 (ADAMS Accession No. ML070100449).

By letter dated March 13, 2008 (ADAMS Accession No. ML080770454), the current license holder, Entergy Nuclear Operations, Inc. (ENO), submitted for NRC review and approval the Nickel Alloy Program, EM-09-22, to satisfy a commitment made in a letter dated April 26, 2006 (ADAMS Accession No. ML061170214), as part of its license renewal application for PNP.

By letter dated April 2, 2012 (ADAMS Accession No. ML12068A388), the NRC requested additional information. By letter dated May 31, 2012 (ADAMS Accession No. ML12153A114), ENO provided additional information and submitted the revised Nickel Alloy Program, SEP-A600-PLP-001, Revision 0, which superseded EM-09-22.

2.0 REGULATORY EVALUATION

Commitment no. 6 states:

"NMC will revise the Alloy 600 Program to update the PWSCC [primary water stress corrosion cracking] corrosion rate assessments and inspection program consistent with the latest NRC requirements and inspection program consistent with the latest NRC requirements and industry commitments (e.g., EPRI [Electric Power Research Institute] Report 1010087 'Materials Reliability Program [MRP]: Primary System Piping System Butt Weld Inspection and Evaluation Guidelines [MRP-139],' August 2005). The updated program will be submitted for NRC review and approval by March 24, 2008."

10 CFR Part 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants*, provides requirements for the license renewal application. Paragraph 10 CFR 54.21(a)(3) requires that "...[f]or each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the [current licensing basis] CLB for the period of extended operation..."

ENCLOSURE

To ensure the revised Nickel Alloy Program satisfies Commitment no. 6, the NRC staff used the following documents for its review:

- Section A1.2.3 of NUREG-1800, Revision 2, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," (SRP-LR), provides guidance on the contents of aging management programs.
- The Generic Aging Lessons Learned (GALL) Report, AMP XI.M11, Nickel-Alloy Nozzles and Penetrations, provides guidance for the nickel alloy AMP. However, some of guidance in the original GALL Report, which was published in 2001, is no longer relevant in light of augmented inspections required in 10 CFR 50.55a.
- The GALL Report, Revision 1, issued in September 2005, deleted AMP XI.M11 and does not contain an Alloy 600 AMP.
- The GALL Report, Revision 2, issued in December 2010, contains a new AMP, XI.M11B, *Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (PWRs Only).* AMP XI.M11B expands the scope of the original AMP XI.M11 to include aging management of all pressure boundary components that are fabricated with nickel alloy material and incorporates the latest requirements from the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. The NRC staff notes that the guidance in AMP XI.M11B in the GALL Report, Revision 2, is also not current with respect to the inspection requirements of Alloy 600 components in 10 CFR 50.55a.

The NRC staff finds that by submitting a revised Nickel Alloy Program, ENO has satisfied the regulatory aspect of Commitment no. 6 in the license renewal application. The technical aspect of the commitment is evaluated below.

3.0 STAFF EVALUATION

Section 3.0.3.1.1 of NUREG-1871 documents the NRC staff's safety evaluation of the original Alloy 600 AMP in the PNP license renewal application. However, as a result of the new inspection requirements mandated in 10 CFR 50.55a, the guidance in the original GALL Report for the Alloy 600 AMP and the Alloy 600 AMP in the license renewal application are no longer applicable. ENO has submitted a revised Nickel Alloy Program, and the NRC staff reviewed the revised program in its entirety.

Program Description

Title 10 CFR 50.55a requires the use of three ASME Code Cases that are related to the examination of nickel-alloy components.

- Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds, Section XI, Division 1," is incorporated with conditions in 10 CFR 50.55a (g)(6)(ii)(D).

- Code Case N-722-1, "Additional Examinations for PWR Pressure Retaining Welds in Class 1 Components Fabricated with Alloy 600/82/182 Materials, Section XI, Division 1," is incorporated with conditions in 10 CFR 50.55a(g)(6)(ii)(E).
- Code Case N-770-1, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated With UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities, Section XI, Division 1," is incorporated with conditions in 10 CFR 50.55a(g)(6)(ii)(F).

The NRC staff questioned ENO as to why the Nickel Alloy Program, EM-09-22, did not reference these three code cases or corresponding conditions in 10 CFR 50.55a. By letter dated May 31, 2012, ENO submitted the revised Nickel Alloy Program, SEP-A600-PLP-001, which referenced the three ASME Code Cases and associated 10 CFR 50.55a paragraphs. Specifically, SEP-A600-PLP-001, Subsection 5.3.1, "Examination Methods and Frequency," stated that:

"...[t]he type and frequency of examinations will be dependent upon the component being examined. The examination methods and frequencies for the 251 nickel-alloy components within the scope of the program are maintained in the Palisades Inservice Inspection (ISI) Master Plan. Examination methods and frequencies are prescribed in the following mandatory ASME Code Cases, with conditions prescribed in 10 CFR 50.55a: N-722-1 (visual examinations), N-729-1 (reactor head examinations), and N-770-1 (butt weld examinations)."

The NRC staff finds that SEP-A600-PLP-001, Revision 0, will follow the three ASME Code Cases and associated 10 CFR 50.55a paragraphs. Therefore, the revised Nickel Alloy Program, SEP-A600-PLP-001, Revision 0, satisfies 10 CFR 50.55a; the program description of AMP XI.M11B in the GALL Report, Revision 2; and Section A.1.2.3 of SRP-LR.

Program Element No. 1, Scope of the Program

Section 2.1.3 of the Nickel Alloy Program, EM-09-22, lists 251 components that are made of nickel-alloy material. By letter dated May 31, 2012, ENO clarified that the welds joining the safe ends to the safety injection, shutdown cooling outlet and surge line nozzles in the primary coolant piping; the welds joining the safe ends to the pressurizer spray and surge line piping; and the welds joining the relief valve flanges to the pressurizer vessel nozzles are made of Alloy 82/182 material. The safe ends at the safety injection, shutdown cooling outlet, surge line nozzles, and pressurizer spray line nozzle; and the relief valve flanges are made of Alloy 600 material.

The NRC staff finds that SEP-A600-PLP-001, Revision 0, satisfies Program Element No. 1 in the GALL Report, Revision 2, AMP XI.M11B; and SRP-LR, Section A.1.2.3.1, because the program identifies the scope, and provides a comprehensive list of components that are fabricated with nickel-alloy material.

Program Element No. 2, Preventive Actions

Section 5.2.3 of the Nickel Alloy Program, EM-09-22, discussed mitigation methods to reduce PWSCC susceptibility in nickel-alloy components. The NRC staff asked ENO to provide the

details of its preventive actions. By letter dated May 31, 2012, ENO stated that it applied a mechanical stress improvement process to the following three components that were fabricated with nickel alloy:

- (1) PCS-12-PSL-1H1-2, Alloy 82/182 weld attaching the Alloy 600 safe end of the pressurizer surge outlet nozzle to stainless steel surge line upper elbow;
- (2) PCS-12-PSL-1H1-7, Alloy 82/182 weld attaching the Alloy 600 safe end of the hot leg nozzle to the stainless steel surge line lower elbow; and
- (3) PCS-12-SDC-2H1-2, Alloy 82/182 weld attaching the Alloy 600 safe end of the hot leg shutdown cooling outlet nozzle to stainless steel piping elbow.

In 1995, ENO replaced the Alloy 600 safe end of the power operated relief valve (PORV) by a stainless steel safe end attached with Alloy 52/152 weld filler material. A small amount of original Alloy 82/182 butter and weld were left on the end of the carbon steel pressurizer nozzle, but that material was encapsulated by an onlay on the inside diameter with Alloy 52/152 weld metal prior to attaching the stainless steel safe end. This configuration isolates the remnant Alloy 82/182 butter from the primary water environment to reduce the potential for primary water stress corrosion cracking (PWSCC). This weld is included, for inspection, in the Code Case N-770-1 population.

ENO stated that other mitigation methods such as weld overlay or inlay have not been applied at PNP.

In 1993, ENO discovered PWSCC in the weld joining the Alloy 600 safe end of the PORV to stainless steel pipe. ENO removed the leaking segment and replaced it with a stainless steel safe end in 1995. Also, in 1993, two J-[groove] welded Alloy 600 pressurizer temperature element nozzles leaked and were repaired with pad welds.

In 2004, ENO found indications in two reactor head control rod drive mechanism nozzles based on volumetric examination, but no leakage. ENO repaired the control rod drive mechanism nozzles with temper bead welding.

The NRC staff finds that SEP-A600-PLP-001, Revision 0, satisfies Program Element No. 2 in the GALL Report, Revision 2, AMP XI.M11B; and SRP-LR, Section A.1.2.3.1, because ENO has performed preventive actions to reduce PWSCC susceptibility of nickel-alloy components.

Program Element No. 3, Parameters Monitored or Inspected

Section 5.3 of the revised Nickel Alloy Program specifies examination requirements including parameters inspected. By letter dated May 31, 2012, ENO explained that it examined Alloy 600 components in the 2012 refueling outage, and met the requirements of 10 CFR 50.55a, with the exception of seven Code Case N-770-1 baseline volumetric inspections that could not be performed due to piping configuration. By letter dated April 26, 2012, ENO submitted a relief request for NRC review and approval, entitled "Relief Request - Proposed Alternative - Use of Alternate ASME Code Case N-770-1 Baseline Examination" (ADAMS Accession No. ML121118A144). On May 2, 2012, the NRC verbally approved the relief request to defer those inspections until the 2013 refueling outage (ADAMS Accession No. ML12130A357).

ENO explained that examination frequencies within these ASME Code Cases, and within the additional conditions imposed by 10 CFR 50.55a, are largely based upon corrosion rate assessments that will allow for the timely detection and correction of PWSCC. Therefore, these ASME code cases largely supersede component-by-component corrosion rate assessments that were needed prior to the establishment of common standards.

ENO stated that specific corrosion rate assessments may still be used within the structure of ASME Section XI to evaluate acceptability of specific conditions. For example, ENO recently performed a corrosion rate assessment in preparation of the relief request related to Code Case N-770-1 baseline inspection requirements, as discussed in its letter dated April 26, 2012.

The NRC staff finds that SEP-A600-PLP-001, Revision 0, satisfies Program Element No. 3 in the GALL Report, Revision 2, AMP XI.M11B; and SRP-LR, Section A.1.2.3.1, because ENO performed inspections based on the parameters required by the ASME Code Cases N-722-1, N-729-1, and N-770-1 with associated conditions in 10 CFR 50.55a.

Program Element No. 4, Detection of Aging Effects

Section 5.3 of SEP-A600-PLP-001, Revision 0, specifies periodic examinations of the nickel-alloy components in accordance with ASME Code Cases N-722-1, N-729-1 and N-770-1 as conditioned in 10 CFR 50.55a. The periodic examinations will detect aging effects of the nickel-alloy components. Therefore, the NRC staff finds that SEP-A600-PLP-001, Revision 0, satisfies Program Element No. 4 in the GALL Report, Revision 2, AMP XI.M11B; and SRP-LR, Section A.1.2.3.1.

Program Element No. 5, Monitoring and Trending

Section 5.3 of SEP-A600-PLP-001, Revision 0, specifies monitoring and trending of the nickel-alloy components, and evaluation of detected indications in accordance with ASME Code Cases N-722-1, N-729-1 and N-770-1 as conditioned in 10 CFR 50.55a. The NRC staff finds that periodic examinations including the evaluation of inspection results serve the purpose of monitoring and trending. Therefore, the NRC finds that SEP-A600-PLP-001, Revision 0, satisfies Program Element No. 5 in the GALL Report, Revision 2, AMP XI.M11B; and SRP-LR, Section A.1.2.3.1.

Program Element No. 6, Acceptance Criteria

Section 5.3.6 of SEP-A600-PLP-001, Revision 0, specifies that any indications that exceed acceptance criteria and cannot be resolved as non-relevant will be documented. Section 5.3.7 specifies that relevant flaw indications be evaluated in accordance with ASME Code, XI, Table IWB-2500-1. Section 5.3.8 specifies disposition of reportable indications. The NRC staff finds that the revised Nickel Alloy Program identifies the acceptance criteria and provides adequate procedures for the use of the acceptance criteria. Therefore, the NRC staff finds that SEP-A600 PLP-001, Revision 0, satisfies Program Element No. 6 in the GALL Report, Revision 2, AMP XI.M11B; and SRP-LR, Section A.1.2.3.1.

Program Element No. 7, Corrective Actions

Section 5.2.5 of SEP-A600-PLP-001, Revision 0, specifies that repair and replacement procedures will comply with the ASME Code, Section XI, and applicable ASME code cases as invoked in accordance with 10 CFR 50.55a. Section 5.2.5 also states that alternative repair/replacement activities will be submitted to the NRC for approval in lieu of the ASME code requirements. The NRC staff finds that the revised Nickel Alloy Program provides adequate procedures for corrective actions. The NRC staff finds that SEP-A600-PLP-001, Revision 0, satisfies Program Element No. 7 in the GALL Report, Revision 2, AMP XI.M11B; and SRP-LR, Section A.1.2.3.1.

Program Element No. 8, Confirmation Process

AMP XI.11B of GALL Report, Revision 2, specifies that site quality assurance procedures and review and approval processes are implemented in accordance with 10 CFR Part 50, Appendix B. Although the revised Nickel Alloy Program does not specifically reference 10 CFR Part 50, Appendix B, the NRC staff finds that the program provides sufficient procedures that will ensure quality assurance as required in 10 CFR Part 50, Appendix B.

Section A.1.2.3.8 of SRP-LR, Revision 2, specifies that:

- (1) The confirmation process should be described. The process ensures preventive actions are adequate, and appropriate corrective actions have been completed and are effective.
- (2) The effectiveness of prevention and mitigation programs should be verified periodically.
- (3) When corrective actions are necessary, there should be follow-up activities to confirm that the corrective actions have been completed, a root cause determination was performed, and recurrence will be prevented.

The NRC staff finds that by following the ASME Code Cases N-722-1, 729-1, and N-770-1 and ASME Code Section XI, ENO has satisfied Section A.1.2.3.8 of SRP-LR, Revision 2. Therefore, the NRC staff finds that SEP-A600-PLP-001, Revision 0, satisfies Program Element No. 8 in the GALL Report, Revision 2, AMP XI.M11B; and SRP-LR, Section A.1.2.3.1.

Program Element No. 9, Administrative Controls

The NRC staff asked ENO how the revised Nickel Alloy Program will be maintained current from present to the end of the period of extended operation. By letter dated May 31, 2012, ENO responded that the Nickel Alloy Program requirements will continue to meet the 10 CFR 50.55a requirements and conditions for ASME Code Cases N-722-1, N-729-1 and N-770-1.

ENO stated that Section 4 of SEP-A600-PLP-001 specifies responsibilities and requirements to maintain the Nickel Alloy Program current. The procedure in Section 4 describes the program engineering responsibilities and the program requirements that will ensure program maintenance and updates to the ISI Master Plan. The NRC staff finds that SEP-A600-PLP-001, Revision 0, contains administrative controls that satisfy Program Element No. 9 in the GALL Report, Revision 2, AMP XI.M11B; and SRP-LR, Section A.1.2.3.1.

Program Element No. 10, Operating Experience

The NRC staff asked ENO to discuss any industry and plant-specific operating experience that has occurred in nickel-alloy components since the issuance of NUREG-1871 in January 2007, whether a record of operating experience has been maintained, and how industry and plant-specific operating experience will be addressed under the Nickel Alloy Program.

By letter dated May 31, 2012, ENO responded that at the time NUREG-1871 was issued, the industry nickel-alloy programs were in flux, and licensees prepared their programs from a combination of available data, projections from that data, and interim instructions from the NRC. Since then, industry operating experience has led to the development of ASME Code Cases N-722-1, N-729-1, and N-770-1. ENO explained that this industry experience has been applied in the PNP Nickel Alloy Program, and the original PNP Alloy 600 Program has been revised to satisfy the latest NRC requirements.

ENO explained that it did not identify any evidence of PWSCC at Alloy 600 locations during any refueling outage since January 2007 (2007, 2009, 2010, and 2012). The only evidence of PWSCC prior to 2007 was identified in 1993 and 2004. ENO stated that during the recent 2012 refueling outage, nine Alloy 600 locations were inspected for the first time, due to their inclusion under Code Case N-770-1. Seven locations could not be fully examined to Code Case N-770-1 requirements for which the NRC has verbally approved the relief request to defer inspection until the fall 2013 refueling outage. Dye penetrant examinations at all nine locations and limited ultrasonic examinations at the seven locations did not reveal any evidence of PWSCC.

ENO further stated that industry and plant-specific operating experience related to the Nickel Alloy Program are maintained per SEP-A600-PLP-001, Revision 0, Section 4.1, *Program Engineering*. Section 4.1 specifies that the program engineering department maintains the AMP. Responsibilities include, but are not limited to:

- (1) serving as the Palisades contact for outside technical communications;
- (2) participating in industry owners groups; and
- (3) providing analysis and response to significant industry events. SEP-A600-PLP-001, Section 4.5, *Plant and Industry Experience*, specifies that "...[t]he ISI Technical Lead shall identify any additional nickel-alloy components based upon industry experience that may be applicable to Palisades. These components shall be included as required in the examination scope..."

ENO clarified that Alloy 600 examination results are retained in inservice inspection reports prepared after every refueling outage. Adverse findings are also documented and maintained as records in the corrective action process. Such records are maintained in accordance with the Entergy Quality Assurance Program Manual and ENO procedures.

Based on the operating experience provided, the NRC staff finds that SEP-A600-PLP-001, Revision 0, satisfies Program Element No. 10 in the GALL Report, Revision 2, AMP XI.M11B and SRP-LR, Section A.1.2.3.1.

4.0 CONCLUSION

On the basis of its review, the NRC staff finds that the Nickel Alloy Program, SEP-A600-PLP-001, Revision 0, satisfies the requirements of GALL Report, Revision 2, AMP XI.M11B; SRPLR, Section A.1.2.3.1; and 10 CFR 50.55a for primary system pressure boundary components that are made of nickel-based alloy.

Pursuant to 10 CFR 54.21(a)(3), the NRC staff finds that the Nickel-Alloy Program, SEP-A600--PLP-001, Revision 0, is acceptable because ENO has demonstrated that the subject program will adequately manage the aging effects of primary system pressure boundary components that are made of nickel-based alloy material so that the intended functions of the components will be maintained, consistent with the current licensing basis for the period of extended operation at PNP. Therefore, the NRC staff concludes that ENO has satisfied the requirements of Commitment no. 6 in its license renewal application.

Primary Contributor: John Tsao NRR/DE

Date: July 6, 2012

August 15, 2012

Mr. Anthony Vitale
Vice President, Operations
Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530

SUBJECT: PALISADES NUCLEAR PLANT SAFETY EVALUATION OF COMMITMENT
SUBMITTAL FOR LICENSE RENEWAL REGARDING THE ALLOY 600
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The NRC staff reviewed the information in the licensee's letter and the response dated May 31, 2012, to the staff's request for additional information. The staff determined that the licensee has fulfilled Commitment no. 6 for license renewal. The licensee demonstrated that the Nickel Alloy Program will adequately manage the aging effects of primary system pressure boundary components that are made of nickel-based alloy material.

Sincerely,
/RA/

Heather M. Jones, Project Manager
Subsequent Renewal, Guidance,
and Operations Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure:
Safety Evaluation of Commitment

cc w/encl: Listserv

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Letter to A. Vitale from H. Jones dated August 15, 2012

SUBJECT: PALISADES NUCLEAR PLANT SAFETY EVALUATION OF COMMITMENT
SUBMITTAL FOR LICENSE RENEWAL REGARDING THE ALLOY 600
PROGRAM (TAC NO. ME7125)

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