

March 21, 2005

Mr. Mark E. Warner, Site Vice President
c/o James M. Peschel
Seabrook Station
FPL Energy Seabrook, LLC
PO Box 300
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SUBJECT: SEABROOK STATION, UNIT NO. 1 - EVALUATION OF RELIEF REQUEST
PR 04-01, REPAIR OF CONTROL ROD DRIVE MECHANISM CANOPY SEAL
WELDS (TAC NO. MC5091)

Dear Mr. Warner:

By letter dated November 9, 2004, FPL Energy Seabrook, LLC submitted a proposed alternative to the requirements of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section III, paragraph NB-5271 and ASME Code, Section XI, paragraph IWA-4611 for Seabrook Station, Unit No. 1. The proposed alternative was submitted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(a)(3)(ii) on the basis that compliance with the ASME Code would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety.

The Nuclear Regulatory Commission staff has concluded that, considering the proposed alternative, compliance with the ASME Code would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety. Therefore, based on the enclosed Safety Evaluation, the proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(ii), for the second 10-year inservice testing interval. All other ASME Code requirements for which relief were not specifically requested and approved in this review remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact Victor Nerses, at 301-415-1484.

Sincerely,

/RA/

Darrell J. Roberts, Chief, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-443

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST PR 04-01

FPL ENERGY SEABROOK, LLC

SEABROOK STATION, UNIT NO. 1

DOCKET NO. 50-443

1.0 INTRODUCTION

By letter dated November 9, 2004 (see Agencywide Documents Access Mangement System accession number ML043240019), FPL Energy Seabrook, LLC, (FPLE or the licensee) requested, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(ii), an alternative to certain requirements of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section III and Section XI for the repair of control drive rod mechanism (CRDM) canopy seal welds for Seabrook Staton, Unit No. 1 (Seabrook). Specifically, the canopy seal weld is an ASME Code Section III seal weld and, per paragraph NB-5271, requires examination by either magnetic particle or liquid penetrant method. The licensee is proposing to examine the repair welds using a remote 8X magnification visual inspection method. Also, ASME Code, Section XI, 1995 Edition with 1996 Addenda, paragraph IWA-4611 requires that defects be removed or reduced in size such that the resultant section thickness created by the cavity is at least the minimum design thickness. The licensee proposed to repair the welds by using corrosion-resistant Alloy 52 weld overlay material utilizing a remote automatic welding process.

ASME Code Section XI specifies that repair and replacement activities must meet the construction code to which the original item was constructed. The original CRDMs were constructed to ASME Code, Section III, 1974 Edition through the summer 1974 Addenda. The applicable ASME Code of record for the Seabrook, second 10-year inservice inspection (ISI) interval, is ASME Code, Section XI, 1995 Edition with 1996 Addenda.

2.0 LICENSEE'S EVALUATION

The following is a summary of FPLE's description and justification of the proposed alternative.

2.1 ASME Code Components Affected

The components affected by this relief request are the Seabrook reactor pressure vessel CRDM canopy seal welds for 22 penetrations in the reactor pressure vessel closure head (Figure 1 of FPLE's November 9, 2004 submittal). The reactor pressure vessel CRDMs are ASME Code Class 1 components that are mechanically attached to the reactor vessel closure head penetrations by a threaded connection (Figure 2 of FPLE's November 9, 2004 submittal).

The reactor vessel closure head penetrations and the CRDMs are ASME Code pressure boundary components. The threaded connection between these two components carries the structural loads and establishes the ASME Code pressure boundary. The canopy seal weld (Figure 2 of FPLE's November 9, 2004 submittal) is not a structural load-carrying weld nor a pressure-retaining weld but provides a membrane seal to contain any leakage through the threaded connection between the CRDMs and the reactor pressure vessel closure head penetrations.

2.2 Applicable ASME Code Edition and Addenda

ASME Code Section III, "Nuclear Power Plant Components," Subsection NB, 1974 Edition through summer 1974 Addenda is the original code of construction for the Seabrook CRDMs. ASME Code Section III, Subsection NB, 1971 Edition through winter 1972 Addenda is the original code of construction for the Seabrook reactor pressure vessel. ASME Code Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1995 Edition with 1996 Addenda is the applicable ASME Code of record for the Seabrook second 10-year ISI interval.

2.3 Applicable ASME Code Requirement For Which Relief Is Requested

The ASME Code, Section XI, 1995 Edition with 1996 Addenda, paragraph IWA-4221, requires that repairs meet the Owner's Requirements and the applicable construction code to which the original item was constructed or different editions and addenda of the construction code or of Section III. The canopy seal weld is an ASME Code, Section III seal weld as described in paragraph NB-3227 of Section III, and, per paragraph NB-5271, requires examination by either a magnetic particle or a liquid penetrant method. Pursuant to 10 CFR 50.55a(a)(3)(ii), FPLE proposed an alternative to the surface examination requirements of the ASME Code, 1974 Edition through summer 1974 Addenda, Section III Subsection NB, paragraph NB-5271, "Welds of Specially Designed Seals," which states that welds of this type be examined by either the magnetic particle or liquid penetrant method.

Additionally, pursuant to 10 CFR 50.55a(a)(3)(ii), FPLE proposed an alternative to the ASME Code, Section XI, 1995 Edition with 1996 Addenda, paragraph IWA-4611 "Metal Removal," which states that defects shall be removed or reduced in size such that the resultant section thickness created by the cavity is at least the minimum design thickness.

2.4 Reason for Request

FPLE proposed an alternative, in accordance with 10 CFR 50.55a(a)(3)(ii), to the ASME Code Section III required surface examination of the canopy seal welds (NB-5271) on the basis that compliance with this ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety. FPLE also requested relief in accordance with 10 CFR 50.55a(a)(3)(ii) from the ASME Code Section XI requirement (IWA-4611) to remove the defect or reduce the size of the defect to at least the minimum design thickness on the same basis, that compliance with this ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety.

During refueling outage (RFO) number 9, the CRDM canopy seal welds on reactor pressure vessel closure head penetration No. 20 and No. 26 showed signs of leakage. Penetration

No. 20 has a full-length, active CRDM installed and penetration No. 26 has a dummy can assembly bolted on the top of the penetration. In lieu of an ASME Code weld repair, the CRDM canopy seal welds on these two penetrations were repaired by the installation of a canopy seal clamp assembly (CSCA) that was designed and provided by the nuclear steam system supplier. The CSCA provided a non-welded, mechanical method of stopping leakage in the CRDM canopy seal welds. The CSCA seals the leaking weld by the introduction of a compressive load into the canopy seal weld, which closes the leak path and prevents crack propagation.

During RFO10, FPLE intends to remove the two CSCAs and repair the CRDM canopy seal welds using a weld overlay technique (Figure 3 of FPLE's November 9, 2004 submittal). As a conservative initiative to minimize the possibility of future leakage in spare CRDM canopy seal welds, FPLE intends to provide weld overlays to the CRDM canopy seal welds on the remaining 20 spare penetrations in the reactor pressure vessel closure head. Industry experience has shown that the spare CRDM penetrations are more susceptible to leakage. No repairs to the remaining 56 penetrations that have a full-length, active CRDM installed are planned for this outage.

The CRDM canopy seal welds are located above the reactor pressure vessel closure head in a highly congested area and subjected to high radiation levels. An ASME Code weld repair to penetration No. 20 and No. 26 would involve excavation of the defects and restoration of the weld to the original configuration. The ASME Code weld repair would require manual excavation of the defects and manual repair welding which has a high risk of failure due to the difficulty of making a quality weld on the canopy seal accompanied by the required cleaning. In addition to the difficulty and time required to remove the defect and manually re-weld the canopy seal, a similar level of difficulty and resultant time is required for a liquid penetrant (LP) examination of the repair welds. The high radiological dose associated with strict compliance with these repair requirements would be contrary to the intent of the as low as reasonably achievable radiological control program. During RFO9, dose rates were recorded at 600 - 800 mR/hr in the CRDM canopy seal area. Installation of temporary radiation shielding is not feasible in this area, as it would interfere with the welding process and LP examination process. Based on an estimated total time of 2 hours per seal weld to perform the LP examination, the occupational exposure from the required LP examination will add approximately 1.6 rem to the total repair dose for each repair which results in a total additional dose of approximately 35.2 rem.

2.5 Proposed Alternative and Basis for Use

FPLE proposed an alternative to the requirements of the ASME Code, Section III, Subsection NB paragraph NB-5271 and the ASME Code, Section XI, paragraph IWA-4611 in accordance with 10 CFR 50.55a(a)(3)(ii) by proposing an alternative method of repair and alternative surface examination due to hardship and unusual difficulty without a compensating increase in quality or safety.

ASME Code Case N-504-2, "Alternate Rules for Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping," Section XI, Division 1, March 1997, will be used as guidance for repair by weld overlay which increases the weld thickness to establish the acceptability of the defect in accordance with IWB-3640. In addition, alloy 52 nickel-based weld repair material will be used rather than austenitic stainless steel as required by ASME Code Case N-504-2. In lieu of performing LP examinations of CRDM canopy seal weld repairs or weld overlays as required by

NB-5271, an enhanced 8X visual examination (VT-1) will be performed after welding is completed.

The alternative method of repair and the alternative surface examination are requested to facilitate the weld repairs to the two canopy seal welds and the weld overlays for 20 additional CRDM canopy seal welds planned during RFO10 and if required, for future weld repairs and weld overlays during the second 10-year ISI interval.

Industry experience with failure analysis performed on leaking canopy seal welds removed from service at other plants has determined that, in a majority of the cases, the CRDM canopy seal welds developed cracks as the result of transgranular stress corrosion cracking (TGSCC). The size of the opening where leakage occurs has been extremely small, normally a few thousandths of an inch. The crack orientations vary, but often radiate outward such that a pinhole appears on the surface as opposed to a long crack. The TGSCC results from exposure of a susceptible material with residual stress which is often concentrated by weld discontinuities, and to a corrosive environment such as borated water trapped in the cavity behind the canopy seal weld that is combined with air initially in the cavity, resulting in higher oxygen content than is in the bulk primary system coolant.

As permitted by ASME Code Case N-504-2, the CRDM canopy seal weld flaws will not be removed, but an analysis of the repaired weldment has been performed by Westinghouse using paragraph (g) of the ASME Code Case as guidance to ensure that the remaining flaw will not propagate unacceptably. This analysis established the critical flaw size used to qualify the VT-1 examination method to assure capability of detecting a flaw sufficiently small to assure an adequate margin of safety is maintained. The canopy seal weld is not a structural load-carrying weld nor a pressure-retaining weld but provides a membrane seal to contain any leakage through the threaded connection between the CRDMs and the reactor pressure vessel closure head penetrations. A remote viewing system will also be used during the welding process to monitor the quality of the welds. By use of the remote viewing system, potential flaws resulting from contamination of the weld deposit, burn-through, or blowback can be seen as soon as they occur and welding can be stopped to permit correction of problems immediately. After each weld bead is deposited in one direction, the remote viewing camera is rotated back in the reverse direction to permit viewing of the entire as-deposited weld bead, including weld overlaps.

The alternative CRDM canopy seal weld repairs and weld overlays will consist of a minimum of two weld layers and will use a gas tungsten arc welding (GTAW) process and VT-1 examinations both controlled remotely. The VT-1 examinations will use a video camera within several inches of the weld with 8X magnification. The examiner will be qualified to assure identification of a flaw significantly smaller than the analyzed critical flaw size. Based on the capability of the remote visual examination system to resolve flaws of a size 0.001-inch in width, reasonable assurance of the weld integrity will be provided. The examination technique will be demonstrated to resolve a 0.001- inch thick wire against the surface of the weld. The proposed alternative is an enhanced visual examination technique with resolution and consistency much greater than that provided by the requirements of an ASME Code (visually unaided) VT-1 and comparable to flaw sizes detectable by using a liquid penetrant method.

The alloy 52 nickel-based weld repair material will be used rather than austenitic stainless steel as required ASME Code Case N-504-2. Alloy 52 nickel-based weld repair material was

selected rather than austenitic stainless steel as required by the ASME Code Case N-504-2, paragraph (b) because Alloy 52 is highly resistant to stress corrosion cracking. Thus, the ferrite requirements of ASME Code Case N-504-2, paragraph (e) do not apply. The weld repairs and weld overlays will be documented on the appropriate forms, reviewed by the Authorized Nuclear Inservice Inspector and maintained in accordance with the plants archival records system.

The GTAW weld repairs, weld overlays and VT-1 surface examination method would result in significantly lower radiation exposure because the equipment is remotely operated after setup. The use of remote visual examination will assure weld quality and integrity for the multiple layer, canopy seal weld repairs and weld overlays. The radiation exposure associated with the performance of an ASME Code repair and ASME Code-required surface examinations would not result in a compensating increase in the level of quality and safety.

2.6 Duration of Proposed Relief Request

FPLE, requests this relief for the second 10-year ISI interval of the plant.

3.0 STAFF EVALUATION

The Nuclear Regulatory Commission (NRC) staff reviewed the information provided by the licensee in support of its request for relief from certain requirements of ASME Code requirements that are applicable to the repair of CRDM canopy seal welds at Seabrook. The staff evaluation of the request follows.

According to the licensee, the weld repairs and weld overlays will consist of a minimum of two weld layers and will use a GTAW process and VT-1 examinations, both controlled remotely. The VT-1 examinations will use a video camera within several inches of the weld with 8X magnification. The examiner will be qualified to assure identification of a flaw significantly smaller than the analyzed critical flaw size. Based on the capability of the remote visual examination system to resolve flaws of a size 0.001-inch in width, reasonable assurance of the weld integrity will be provided. The examination technique will be demonstrated to resolve a 0.001-inch thick wire against the surface of the weld. The proposed alternative is an enhanced visual examination technique with resolution and consistency much greater than that provided by the requirements of an ASME Code VT-1 and comparable to flaw sizes detectable using liquid penetrant method. In addition, analysis of the repaired weldment has been performed by Westinghouse using paragraph (g) of the ASME Code Case N-504-2 as guidance to assure that the remaining flaw will not propagate unacceptably. This analysis established the critical flaw size that was used to qualify the VT-1 examination method. Furthermore, the canopy seal weld serves only to seal leakage from the CRDM, and does not serve as the structural pressure retaining boundary. This approach would ensure that the VT-1 examination method is capable of detecting a flaw sufficiently small to ensure that an adequate margin of safety is maintained.

The NRC staff finds proposed remote weld overlay and weld visual examination acceptable because the weld overlay would be accomplished utilizing a remote GTAW process which has been approved by the NRC staff for use at other nuclear power plant facilities under equivalent conditions and for similar applications. Further, the licensee would remotely visually examine the completed welds using a video camera that has been qualified to identify 0.001-inch thick wire against the surface of the weld. This would ensure that unacceptable weld defects, if present, would be identified, evaluated and repaired by the licensee prior to placing the unit in

service. In addition, the proposed weld overlay material to be deposited over existing CRDM canopy seal weld repairs or weld overlays is Alloy 52. Alloy 52 is identified as F-No. 43 Grouping for Ni-Cr-Fe, classification UNS N06052 filler metal and has been previously approved by the NRC staff. Alloy 52 is a nickel-based alloy that contains about 30% chromium which provides excellent corrosion resistance in a reactor coolant environment.

As stated by the licensee, the CRDM canopy seal welds are located above the reactor pressure vessel closure head in a highly-congested area and subjected to high radiation levels. An ASME Code weld repair to two penetrations (Nos. 20 and 26) and weld overlay of 20 CRDM canopy seal welds would involve manual excavation of the defects and manual weld repair of the weld to the original configuration, which has a high risk of failure because of fabrication difficulty associated with making a quality canopy seal weld followed by the required cleaning. In addition to the difficulty and time required to remove the defect and manually re-weld the canopy seal, a similar level of difficulty and resultant time is required for an LP examination of the repair welds. The high radiological dose associated with strict compliance with these repair requirements was estimated by the licensee to be approximately 35.2 rem.

The NRC staff finds that the licensee has demonstrated that performing an ASME Code repair in accordance with the ASME Code would result in hardship and unusual difficulty without a compensating increase in quality or safety. This finding is based on the fact that the CRDM canopy seal welds are located in a highly congested area and are subjected to high radiation levels and do not serve as the structural pressure boundary of the CRDM assembly. Therefore, requiring the licensee to comply with the ASME Code requirements in this case is not a reasonable requirement, taking into consideration the fact that the licensee has proposed an acceptable alternative which would provide reasonable assurance of structural integrity of the repaired CRDM canopy seal welds.

4.0 CONCLUSION

Based on the information provided in the licensee's submittal, the NRC staff concludes that the licensee has provided an acceptable alternative to the requirements of ASME Code, Sections III and XI for the proposed weld overlay repair of CRDM canopy seal welds at Seabrook. Therefore, the proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for Seabrook. All other ASME Code, Section III or XI, requirements for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: G. Georgiev

Date: March 21, 2005