October 5, 2001

Mr. J. A. Stall
Senior Vice President, Nuclear and
Chief Nuclear Officer
Florida Power and Light Company
P.O. Box 14000
Juno Beach, Florida 33408-0420

SUBJECT: TURKEY POINT PLANT, UNIT 3 - SAFETY EVALUATION FOR RELIEF REQUEST NO. 28 FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE REGARDING REPAIR OF THE REACTOR VESSEL HEAD PENETRATIONS (TAC NO. MB2884)

Dear Mr. Stall:

By letter dated September 12, 2001, which was superseded by letter dated September 24, 2001, Florida Power and Light Company (the licensee), submitted a request for relief (RR) No. 28, from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) for Turkey Point Plant, Unit 3. The objective of the RR is to allow the use of the automatic or machine gas tungsten arc welding temper bead technique without the specified preheat or post weld heat treatment required by the ASME Code in order to perform the repair of the J-groove attachment welds of the reactor vessel head penetrations, which may be required at Turkey Point Unit 3 following inspection during the current refueling outage.

Based on the discussion in the enclosed safety evaluation, the U.S. Nuclear Regulatory Commission staff finds the licensee's RR 28 acceptable. If you have any comments regarding this matter, please contact Kahtan Jabbour at 301-415-1496.

Sincerely,

/RA by Ronald Hernan for/
Richard P. Correia, Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-250

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST TO USE ALTERNATIVE WELD REPAIR TECHNIQUES

FOR REACTOR VESSEL HEAD CONTROL ROD DRIVE MECHANISM PENETRATION REPAIRS

TURKEY POINT PLANT, UNIT 3

FLORIDA POWER AND LIGHT COMPANY

DOCKET NUMBER 50-250

1.0 INTRODUCTION

By letter dated September 12, 2001, which was superseded by letter dated September 24, 2001, Florida Power and Light Company (FPL or the licensee), submitted a request for relief (RR) No. 28 from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) for Turkey Point Plant, Unit 3. The objective of the RR is to allow the use of the automatic or machine gas tungsten arc welding (GTAW) temper bead technique without the specified preheat or post weld heat treatment required by the ASME Code in order to perform the repair of the J-groove attachment welds of the reactor vessel closure head (RVCH) penetrations, which may be required at Turkey Point Unit 3 following inspection during the current refueling outage.

The repairs may be required when 1/8-inch or less of non-ferritic weld deposit exists above the original fusion line, at Turkey Point Unit 3. The objective of RR No. 28 is to allow the use of the automatic or machine GTAW temper bead technique without the specified preheat or post weld heat treatment required by the ASME Code as an alternative to the temper bead welding process described in ASME Section XI, 1989 edition, provided the requirements of Paragraph IV of RR 28, and all other requirements of ASME Section XI and the original Construction Code are met.

There have been several recent instances of cracking in RVCH penetrations constructed of Alloy 600 welds in pressurized water reactor nuclear power plants. In response to the reactor vessel penetration cracking concerns and U.S. Nuclear Regulatory Commission (NRC) Bulletin 2001-01, "Circumferential Cracking of Reactor Vessel Head Penetration Nozzles," dated August 3, 2001, FPL will be performing inspections of the reactor vessel head penetrations during the current fall refueling outage for Turkey Point Unit 3. In the event that repairs are required as a result of these inspections, FPL is requesting the use of alternative repair techniques, instead of the current 1989 ASME Code repair requirements, pursuant to Title 10, *Code of Federal Regulations* (10 CFR), Section 50.55a(a)(3)(i).

Enclosure

2.0 EVALUATION

The NRC staff has reviewed the information regarding RR 28 provided by FPL in its submittal dated September 24, 2001. The staff evaluation and conclusion are presented below.

Code Requirements

Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, 1989 Edition, Examination Category B-O, “Pressure Retaining Welds in Control Rod Housings,” code item B14.10.

System/Component for which relief is requested

Turkey Point Unit 3
Reactor Vessel Closure Head (RVCH) Penetrations, Class 1
FPL Drawing No. 5610-M-400-57 Rev. 1

Licensee’s Code Relief Request (as stated)

> Pursuant to 10 CFR 50.55a(a)(3)(i), FPL requests relief to use an ambient temperature temper bead method of repair as an alternative to the requirements of ASME Section XI, Rules for inservice inspection of Nuclear Power Plant Components, 1989 Edition.
>
> FPL is proposing to perform the repair with a remotely operated weld tool, using the machine Gas Tungsten-Arc Welding (GTAW) process and the ambient temperature temper bead method, with 50°F minimum preheat temperature and no post weld heat treatment.

Licensee's Basis for RR 28

FPL will perform visual examinations of the RVCH penetration nozzles during Turkey Point Unit 3 refueling outage in the fall of 2001. If the examinations identify any flaws that require repair, FPL is planning to use the methods described in RR 28.

RR 28 proposes performing the repair with a remotely operated weld tool, using the machine GTAW process and the ambient temperature temper bead method, with 50°F minimum preheat temperature and no post weld heat treatment.

The repair process will remove the portion of the nozzle that extends below the inner surface of the head. A new weld application surface will be prepared at a point above the heat-affected zone of the original pressure boundary weld, within the bore through which the nozzle is installed. A new nozzle-to-head weld will be installed within the head bore by remote machine welding. The original weld is not part of the new pressure boundary weld. The original weld will be left in place at the junction of the head nozzle bore to head inside surface, and analyzed for acceptability.

Quality temper bead welds, without preheat and postheat, can be made based on welding procedure qualification test data derived from machine GTAW ambient temperature temper bead welding process. The proposed alternative repair technique proposed by FPL has been demonstrated as an acceptable method for performing reactor pressure vessel repairs. The ambient temperature temper bead technique has been approved by the NRC as having an acceptable level of quality and safety and was successfully used at several plants (i.e., Duane Arnold, Nine Mile Point, and FitzPatrick). Results of procedure qualification work performed to date, indicate that the process produces sound and tough welds.

As shown in Framatome-ANP Procedure Qualification Record (FRA-ANP PQR 7164), which was used to qualify the proposed machine GTAW ambient temperature temper bead weld process when using P-No. 3, Group No. 3 base materials, the heat-affected zone (HAZ) exhibited improved Charpy V-notch properties from both absorbed energy and lateral expansion perspectives, compared to the unaffected base material. The absorbed energy, lateral expansion, and percent shear were significantly greater for the HAZ than the unaffected base material at both test temperatures. It is clear from these results that the GTAW temper bead process has the capability of producing acceptable repair welds.

In lieu of using thermocouples for interpass temperature measurements, calculations show that the maximum interpass temperature (350°F) will not be exceeded based on a maximum allowable low welding heat input, weld bead placement, travel speed, and conservative preheat temperature assumptions. The calculations support the conclusion that using the maximum allowable low welding heat input through the third layer of the weld, the interpass temperature returns to near ambient temperature. Heat input beyond the third layer will not have a metallurgical effect on the low alloy steel HAZ.

The calculation is based on a typical inter-bead time interval of 5 minutes. The 5-minute inter-bead interval is based on: (1) the time required to explore the previous weld deposit with the two remote cameras housed in the weld head, (2) time to shift the starting location of the next weld bead circumferentially away from the end of the previous weld-bead, and (3) time to shift the starting location of the next bead axially to insure a 50% weld bead overlap required to properly execute the temper bead technique.

A welding mockup on the full size Midland RVCH, which is similar to the Turkey Point Unit 3 RVCH, was used to demonstrate the welding technique described herein. During the mockup, thermocouples were placed to monitor the temperature of the head during welding. Thermocouples were placed on the outside surface of the closure head within a 5-inch band surrounding the control rod driven mechanism (CRDM) nozzle. Three other thermocouples were placed on the closure head inside surface. One of the three thermocouples was placed 1-1/2 inches from the CRDM nozzle penetration, on the lower hillside. The other inside surface thermocouples were placed at the edge of the 5-inch band surrounding the CRDM nozzle, one on the lower hillside, the second on the upper hillside. During the mockup, all thermocouples fluctuated less than 15°F throughout the welding cycle. Based on past experience, it is believed that the temperature fluctuation was due more to the resistance heating temperature variations than the low heat input from the welding process. For the Midland RVCH mockup application, 300°F minimum preheat temperature was used. Therefore, for ambient temperature conditions used for this repair, maintenance of the 350°F maximum interpass temperature will not be a concern.

The automated repair method described above leaves a band of ferritic low alloy steel exposed to the primary coolant. The effect of corrosion on the exposed area, both reduction in reactor pressure vessel head thickness and primary coolant Iron (Fe) release rates, has been evaluated by Framatome-ANP (FRA-ANP). The results of this evaluation concluded that the total corrosion would be insignificant when compared to the thickness of the RVCH. FRA-ANP has estimated that the total estimated Fe release from a total of 69 repaired CRDM nozzles would be significantly less than the total Fe release from all other sources. Since Turkey Point has only 65 CRDM nozzles, this estimate is bounding.

Based on FRA-ANP prior welding procedure qualification test data using machine GTAW ambient temperature temper bead welding, quality temper bead welds can be performed with 50°F minimum preheat and no post heat treatment. Additional FRA-ANP qualifications were performed at room temperature with cooling water to limit the maximum interpass temperature to a maximum of 100°F. The qualifications were performed on the same P-3 Group-3 base material using the same filler material (Alloy 52 AWS Class ERNiCrFe-7), with similar low heat input controls as will be used in the repairs. Also, the qualifications did not include a post weld heat soak. The qualification of the ambient temperature temper bead welding process demonstrates that the proposed alternative provides an acceptable level of quality and safety.

Recent experience gained from the performance of manual repairs on CRDM nozzles at other plants indicates that remote automated repair methods are needed to reduce radiation dose to repair personnel and to provide an acceptable level of quality and safety. Because FPL recognizes the importance of as low as reasonably achievable principles, proposed remote repair method has been developed for the possibility of leaking nozzles at Turkey Point Unit 3. This approach for repair of leaking CRDM nozzles will significantly reduce radiation dose to repair personnel while still maintaining an acceptable level of quality and safety. The total radiation dose for one nozzle using the proposed remote repair method is projected to be approximately 7.5 Rem. In contrast, using manual repair methods for Turkey Point Unit 3 would result in a total radiation dose of approximately 32 Rem.

Therefore, based on the discussion above, FPL has determined, pursuant to 10 CFR 50.55a (a)(3)(i), that the proposed alternative provides an acceptable level of quality and safety.

EVALUATION

The staff has evaluated the licensee's request and supporting information regarding the proposed method to perform repairs to the RVCH penetration J-groove attachment welds at the Turkey Point Unit 3, and concluded that it provides an acceptable alterative method of weld repair.

This conclusion is based on the data from the welding procedure qualification tests using the machine GTAW ambient temperature temper bead welding. The data demonstrate that quality temper bead welds can be performed with a 50°F minimum preheat and no postheat treatment. The data that resulted from FRA-ANP PQR 7164 show that, when using P-No. 3, Group No. 3 base materials, the HAZ exhibited improved Charpy V-notch properties from both absorbed energy and lateral expansion perspectives, compared to the unaffected base material. The absorbed energy, lateral expansion, and percent shear were significantly greater for the HAZ than the unaffected base material at both test temperatures used in the tests on FRA-ANP PQR 7164. A welding mockup on the full size Midland RVCH, which is similar to the Turkey Point Unit 3 RVCH, was used to demonstrate the welding technique described herein. For this test application a 300°F minimum preheat temperature was used. Therefore, for the ambient temperature conditions used for this repair, maintenance of the 350°F maximum interpass temperature will not be a concern. Also, a calculation was performed to show that the maximum interpass temperature will not be exceeded based on a maximum allowable low welding heat input, weld bead placement, travel speed, and conservative preheat temperature assumptions.

The repair plan seeks to significantly reduce radiation exposures by instituting these machine remote processes for nozzle repair. These processes are similar to those used at Oconee Nuclear Station Unit 2 (ONS-2). Based on the ONS-2 experience of repairing manually, versus repairing with machine remote processes, FPL estimates radiological dose savings of greater than 24 Rem for each CRDM nozzle repaired. There are 65 CRDM nozzles on the Unit 3 reactor vessel head.

Based on the discussion above, the staff finds that the licensee's proposed alternative provides an acceptable level of quality and safety.

3. CONCLUSION

The staff concludes that, pursuant to 10CFR 50.55a(a)(3)(i), the relief request is authorized because the licensee has demonstrated that the proposed alternative provides an acceptable level of quality and safety.

Principal Contributor: Edward Andruszkiewicz, NRR

Date: October 5, 2001

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TURKEY POINT PLANT

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