

July 12, 2000

Mr. T. F. Plunkett  
President - Nuclear Division  
Florida Power and Light Company  
P.O. Box 14000  
Juno Beach, Florida 33408-0420

SUBJECT: SAFETY EVALUATION FOR THE RELIEF REQUEST TO USE ALTERNATIVE MATERIAL FOR THE REACTOR VESSEL HEAD PENETRATION ADAPTER PLUGS FOR TURKEY POINT NUCLEAR PLANT, UNITS 3 AND 4 (TAC NOS. MA8792 AND MA8793)

Dear Mr. Plunkett:

By letter dated May 1, 2000, the Florida Power and Light Company (FPL) requested relief from the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (the Code), Section III. The requested relief is to permit the use of alternative materials for the reactor vessel head adapter plugs in Turkey Point 3 and 4.

The U.S. Nuclear Regulatory Commission staff has reviewed the relief request. Based on the information provided by FPL, the staff concludes that the licensee's alternative to the requirements of the ASME Code would provide an acceptable level of quality and safety. Therefore, the proposed alternative is authorized pursuant to Title 10 of the *Code of Federal Regulations*, Part 50.55a(a)(3)(i).

The enclosure contains the staff's Safety Evaluation.

Sincerely,

**/RA/**

Richard P. Correia, Chief, Section 2  
Project Directorate II  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Docket Nos. 50-250 and 50-251

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR APPROVAL OF ALTERNATIVE MATERIAL FOR THE

REACTOR VESSEL HEAD PENETRATION ADAPTER PLUGS

FLORIDA POWER AND LIGHT COMPANY

TURKEY POINT NUCLEAR PLANT, UNITS 3 AND 4

DOCKET NOS. 50-250 AND 50-251

1.0 INTRODUCTION

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.55a requires that systems and components of nuclear power plants are designed and constructed in accordance with the rules provided in the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (hereinafter ASME Code) Section III, Division 1. Pursuant to 10 CFR 50.55a(3), proposed alternatives to the ASME Code requirements can be used when authorized by the NRC if the licensee demonstrates that: (1) the proposed alternative would provide an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Florida Power and Light Company (the licensee) was notified by a Westinghouse Nuclear Safety Advisory Letter (NSAL 98-008) of a potential material discrepancy for the vessel head adapter plugs at its Turkey Point Nuclear Plant, Units 3 and 4. The licensee has determined six adaptor plugs on Unit 3 and eight adaptor plugs on Unit 4 were fabricated from material ASTM A 276 Type 304 instead of ASME SA 182, Type 304 material as called out in Westinghouse drawing 883D194. Specifically, the reactor vessel head adapter plugs are required to meet the requirements of the ASME Code, Section III, 1965 Edition through the Summer 1966 Addenda (the design Code in effect). Table N-422 of the ASME Code lists the SA 182 Type 304 material (the specification is identical to ASTM A 182 Type 304), while material ASTM A 276 Type 304 is not referenced, and thus, the plugs do not meet the ASME Code requirements. In a letter dated May 1, 2000, the licensee requested that the NRC approve the use of ASTM A 276 Type 304 material as an alternative material for the reactor vessel head adapter plugs. Based on supplementary tests and comparison of the material requirements, the licensee has shown that the material installed is functionally equivalent to the ASME SA 182 Type 304 material approved by the ASME Code and called for in the construction drawing.

**Enclosure**

## 2.0 EVALUATION

The licensee submitted to the NRC a relief request to use alternative materials for the reactor vessel head adapter plugs in Turkey Point, Units 3 and 4. The information provided by the licensee in support of its request for relief has been evaluated and the bases for disposition are documented below.

### 2.1 Code Requirement

The ASME Code Section III, 1965 Edition through the Summer 1966 Addenda, Article N-310 states, "Any pressure-boundary material, or material welded thereto, except as provided in N-518.2, used under the rules of Subsection A shall conform to the requirements of one of the specifications for materials in Tables N-421, N-422, and N-423 and to all the special requirements of Article 3 which apply to the product form in which the material is used." Table N-422 lists requirements for material SA-182, Type 304 but does not include A 276 Type 304.

### 2.2 Licensee's Code Relief Request

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee requested relief from the ASME Code requirement to use material ASME SA 182 Type 304 for the reactor vessel head penetration adapter plugs and requested that the NRC approve the use of an alternate material, ASTM A 276, Type 304 instead.

### 2.3 Licensee's Basis for Requesting Relief:

"The head adapter plugs are currently installed (from original construction) on the reactor vessel and constitute part of the reactor vessel pressure boundary. The basis for this requested relief and proposed alternative is as follows:

- 1) The current material installed (ASTM A 276 Type 304) is considered to be functionally equivalent to the ASME Section III accepted code material of ASTM A 182 Type 304 [ASME SA 182 Type 304]. Comparison studies of the requirements for the Type 304 austenitic stainless steel by the two material specifications, A 276 and A 182 [SA 182], indicate that there is essentially no difference in terms of material chemistry and mechanical requirements. It was found that there were two other requirements that are different: a) minimum annealing temperature and b) macro-etch test.

The minimum annealing temperature required for the A 182 [SA 182] forging is 1900°F. Industry recommended practice for the annealing of austenitic stainless steel is from 1850°F to 2050°F. Based on the recommended temperature range there is about a 50°F difference in the minimum annealing temperature between A 276 and A 182 [SA182] specifications. The difference in minimum annealing temperature can make a difference in grain size, which in turn would impact the mechanical properties of the material. However, this is not considered significant since the comparison of the actual mechanical properties for the Turkey Point material heats show no indication of any difference.

The macro-etch required by A 182 [SA 182] specification of the 1965 Edition was intended for detecting evidence of laminations, cracks and segregation in case there is any dispute on the soundness of the forging manufactured under the specification. The head adapter plugs had an ultrasonic examination performed on the raw material prior to machining, to determine if any injurious laminations were present that would affect the remaining machined part, and a surface examination (liquid penetrant) after machining. These tests are considered adequate to satisfy the intent of the macro-etch test. A review of the fabrication records by Westinghouse confirmed these tests [UT and PT] were performed and the results were acceptable.

- 2) Tests were conducted on two spare adapter plugs fabricated from A 276 Type 304 (one was heat #57462, the same heat as that used for the Turkey Point 3 head adaptor plugs). The test results included chemical analysis that confirmed the equivalence in composition requirements for A 182 [SA 182] Type 304. The metallography and intergranular corrosion susceptibility evaluation was performed and results did not indicate any adverse microstructures or evidence of intergranular attack. These results indicate that the material is in the proper annealed condition. The A 276 Type 304 adapters meet the tensile requirements for A 182 [SA 182] Type 304. In conclusion, testing and metallographic analysis demonstrates the A 276 Type 304 material is functionally equivalent to A 182 [SA 182] Type 304.
- 3) The connection between the head adapter plug and the spare penetration is made by mechanical threads. A seal weld is made between the head adapter plug and the spare penetration to prevent leakage of water containing boron onto the reactor vessel head. The seal welding does not impact or affect any of the material properties of the pressure-retaining portion of the head adapter plug since it is below the mechanical threaded region.
- 4) Although not a basis for this requested relief, the replacement of the head adapter plugs would result in excessive radiation exposure to plant personnel. A replacement of four part-length control rod drives with head adapter plugs in 1997, on another Westinghouse designed reactor vessel head, using remotely operated tooling resulted in radiation exposure of 12 rem to personnel performing the job. Therefore, it is estimated that the exposure to replace the spare penetrations [is] 3 man-rem/adapter plug or a total of 52 man-rem to replace all fourteen head adapter plugs at Turkey Point, Units 3 and 4.

“Based on the above, the currently installed A 276 Type 304 head adapter plugs are considered functionally equivalent to the A 182 [SA 182] Type 304 material. Therefore, the proposed alternate material for the 14 installed head adapter plugs provides an equivalent and acceptable level of quality and safety.”

#### 2.4 Licensee's Proposed Alternative:

“The proposed alternative to the ASME Section III code requirement is to use ASTM material A 276 Type 304 for the 14 reactor vessel head adapter plugs that have been installed since original construction. This material is not listed in Tables N-421, N-422, or N-423.”

## 2.5 Staff Evaluation

The licensee was notified by a Westinghouse Nuclear Safety Advisory Letter (NSAL 98-008) of a potential material discrepancy for vessel head adapter plugs. As a result of this notification, the licensee has determined that eleven Turkey Point Units 3 and 4 vessel head adaptors were fabricated from ASTM A 276 Type 304 in lieu of ASME SA 182 Type 304, as called out in Westinghouse drawing 883D194. This material specification is not listed in Tables N-421, N-422, or N-423 as an approved pressure boundary material by the ASME Code, Section III, Subsection NB, 1965 Edition through the Summer 1966 Addenda, the design Code in effect for the plant.

The reactor vessel head adapter plugs are used to provide a Class I pressure boundary for CRDM vessel head penetrations that are inactive. The adapter plug is threaded onto spare head penetrations and seal welded to prevent any leakage past this connection. The pressure boundary is maintained by the threads. There are six head penetrations on Unit 3 and eight head penetrations on Unit 4.

The licensee has requested relief from Code requirements to use ASME SA 182 Type 304 material for the reactor vessel head adapter plugs based on supplementary tests and comparison of the material requirements that demonstrate that ASTM A 276 Type 304 is an acceptable alternate material. The licensee evaluated the suitability of the alternate material using tests that were conducted on spare adapter plugs fabricated of ASTM A 276 Type 304. The tests included chemical analysis, metallography, and intergranular corrosion susceptibility evaluation. The test results indicated that the material was in the proper annealed condition. The ASTM A 276 Type 304 adapters also meet the tensile requirements specified for ASME SA 182 Type 304 material. The licensee concluded that ASTM A 276 Type 304 material is functionally equivalent to ASME A 182 Type 304 material, and therefore, the material is acceptable for use as reactor vessel head adapter plugs. After comparing the specifications and reviewing the applicable ASME Code provisions, the NRC staff concludes that ASTM A 276 Type 304 material (with the supplementary tests conducted) is an acceptable alternative to ASTM A 182 Type 304 material because it would provide an acceptable level of quality and safety. The licensee has demonstrated that the material is functionally equivalent and has been properly solution-annealed, metallographically examined, and nondestructively examined prior to placement in service. Properly solution-annealed material is resistant to stress corrosion cracking and thus the integrity of the reactor vessel head adapter plugs is maintained in service.

## 3.0 CONCLUSION

The NRC staff concludes that the licensee has provided an acceptable alternative to the requirements of the ASME Code Section III, 1965 Edition through the Summer 1966 Addenda. The alternative will provide an acceptable level of quality and safety by using material that provides assurance of the integrity of the reactor vessel and adapter plugs. Thus, pursuant to 10 CFR 50.55a(a)(3)(i), the alternative is authorized.

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Date: July 12, 2000

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