November 1, 2006

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, UNITS 3 AND 4 - ISSUANCE OF AMENDMENTS REGARDING STEAM GENERATOR ALTERNATE REPAIR CRITERIA (TAC NOS. MD1380 AND MD1381)

Dear Mr. Stall:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 231 to Renewed Facility Operating License No. DPR-31 and Amendment No. 226 to Renewed Facility Operating License No. DPR-41 for the Turkey Point Plant, Units Nos. 3 and 4, respectively. The amendments consist of changes to the Technical Specifications in response to your application dated April 27, 2006, as supplemented October 3, 2006.

A copy of the Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Brendan T. Moroney, Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-250 and 50-251

Enclosures: 1. Amendment No. 231 to DPR-31
2. Amendment No. 226 to DPR-41
3. Safety Evaluation

cc w/enclosures: See next page

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FLORIDA POWER AND LIGHT COMPANY

DOCKET NO. 50-250

TURKEY POINT PLANT, UNIT NO. 3

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 231
Renewed License No. DPR-31

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Florida Power and Light Company (the licensee) dated April 27, 2006, as supplemented October 3, 2006, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 3.B of Renewed Facility Operating License No. DPR-31 is hereby amended to read as follows:

   (B) Technical Specifications and Environmental Protection Plan

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 231, are hereby incorporated in the license. The Environmental Protection Plan contained in Appendix B is hereby incorporated into the license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of its date of issuance and shall be implemented within 30 days.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA by LOlshan for/

Evangelos C. Marinos, Acting Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the License
and Technical Specifications

Date of Issuance: November 1, 2006

FLORIDA POWER AND LIGHT COMPANY

DOCKET NO. 50-251

TURKEY POINT PLANT, UNIT NO. 4

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 226
Renewed License No. DPR-41

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Florida Power and Light Company (the licensee) dated April 27, 2006, as supplemented October 3, 2006, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 3.B of Renewed Facility Operating License No. DPR-41 is hereby amended to read as follows:

(B) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 226, are hereby incorporated in the license. The Environmental Protection Plan contained in Appendix B is hereby incorporated into the license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(C) This license amendment is effective as of its date of issuance and shall be implemented within 30 days.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA by LOlshan for/

Evangelos C. Marinos, Acting Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the License
and Technical Specifications

Date of Issuance: November 1, 2006

ATTACHMENT TO LICENSE AMENDMENT

AMENDMENT NO. 231 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-31

AMENDMENT NO. 226 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-41

DOCKET NOS. 50-250 AND 50-251

Replace Page 3 of Renewed Facility Operating License DPR-31 with the attached Page 3.

Replace Page 3 of Renewed Facility Operating License DPR-41 with the attached Page 3.

Replace the following pages of the Appendix A Technical Specifications with the attached pages. The revised pages are identified by amendment number and contain marginal lines indicating the area of change.

Remove pages	Insert pages
3/4 4-14	3/4 4-14
3/4 4-19	3/4 4-19

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO

AMENDMENT NO. 231 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-31 AND

AMENDMENT NO. 226 TO RENEWED FACILITY OPERATING LICENSE NO. DPR-41

FLORIDA POWER AND LIGHT COMPANY

TURKEY POINT PLANT, UNIT NOS. 3 AND 4

DOCKET NOS. 50-250 AND 50-251

1.0 INTRODUCTION

By letter dated April 27, 2006 (Agencywide Document Access and Management System Accession Number ML061310089), as supplemented by letter dated October 3, 2006 (ML062920100), the Florida Power and Light Company (FPL, the licensee) proposed an amendment to the Technical Specifications (TSs) for Turkey Point Plant, Units 3 and 4. The proposed change modifies the inspection and plugging requirements in TS 3/4.4.5, Steam Generator (SG) Surveillance Requirements, for portions of the SG tubing within the hot leg tubesheet region to make these requirements applicable only to the portion of tubing within the upper 17 inches of the tubesheet thickness for Refueling Outage 23 and the subsequent operating cycles until the next scheduled inspection. The proposed changes would also permanently revise the limit for primary-to-secondary leakage in TS 3/4.4.6, Reactor Coolant System Leakage.

The licensee's supplementary submittal dated October 3, 2006, revised the request to a one-time change for TS 3/4.4.5 rather than a permanent change, but did not otherwise change the scope of the proposed amendment as described in the original notice of proposed action published in the *Federal Register* and did not change the initial proposed no significant hazards determination.

2.0 REGULATORY EVALUATION

SG tubes function as an integral part of the reactor coolant pressure boundary (RCPB) and, in addition, serve to isolate radiological fission products in the primary coolant from the secondary coolant and the environment. For the purposes of this safety evaluation (SE), tube integrity means that the tubes are capable of performing these functions in accordance with the plant design and licensing bases.

Title 10 of the *Code of Federal Regulations* (10 CFR) establishes the fundamental regulatory requirements with respect to the integrity of the SG tubing. Specifically, the General Design Criteria (GDC) in Appendix A to 10 CFR Part 50 state that the RCPB shall have "an extremely

low probability of abnormal leakage . . . and gross rupture" (GDC 14), "shall be designed with sufficient margin" (GDC 15 and 31), shall be of "the highest quality standards possible" (GDC 30), and shall be designed to permit "periodic inspection and testing . . . to assess . . . structural and leak tight integrity" (GDC 32). To this end, 10 CFR 50.55a specifies that components that are part of the RCPB must meet the requirements for Class 1 components in Section III of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code). Section 50.55a further requires, in part, that throughout the service life of a pressurized-water reactor (PWR) facility, ASME Code Class 1 components meet the requirements, except design and access provisions and preservice examination requirements, in Section XI, "Rules for Inservice Inspection [ISI] of Nuclear Power Plant Components," of the ASME Code, to the extent practical. This requirement includes the inspection and repair criteria of Section XI of the ASME Code. Section XI requirements pertaining to ISI of SG tubing are augmented by additional SG tube surveillance requirements in the TSs.

As part of the plant licensing basis, applicants for PWR licenses are required to analyze the consequences of postulated design-basis accidents (DBAs), such as a SG tube rupture and main steamline break (MSLB). These analyses consider the primary-to-secondary leakage through the tubing that may occur during these events and must show that the offsite radiological consequences do not exceed the limits of 10 CFR Part 100, GDC 19 and 10 CFR 50.67, as applicable, or some fraction thereof, as appropriate to the accident.

Under the plant TS SG surveillance program requirements, the licensee is required to monitor the condition of the SG tubing and to plug tubes as necessary. Specifically, the licensee is required to perform periodic inspections of and to remove from service by plugging all tubes found to contain flaws with sizes exceeding the acceptance limit, termed "plugging limit." The tube plugging limits were developed with the intent of ensuring that degraded tubes (1) maintain factors of safety against gross rupture consistent with the plant design basis (i.e., consistent with the stress limits of the ASME Code, Section III) and (2) maintain leakage integrity consistent with the plant licensing basis while, at the same time, allowing for potential flaw size measurement error and flaw growth between SG inspections. The required frequency and scope of tubing examinations and the tube plugging limits are specified in TS 3/4.4.5, "SGs."

The proposed license amendment (applicable during Refueling Outage 23 for Units 3 and 4, and the subsequent operating cycles) would limit the required inspections and any resulting plugging on the hot leg side of the approximately 22-inch thick tubesheet region to the upper 17 inches of the tubesheet region. The regulatory standard used by the staff to review the requested changes to the TS is that tube structural and leakage integrity must be maintained consistent with the design and licensing bases. The requested amendment is similar to one-time amendments approved for Byron Unit 2, Braidwood Unit 2, Vogtle Unit 2, Seabrook, and Wolf Creek.

3.0 TECHNICAL EVALUATION

3.1 Background

Turkey Point Units 3 and 4 each have three Westinghouse Model 44F SGs. The SGs utilize a hydraulic tubesheet expansion method and have stainless steel tube support plates with

broached quatrefoil holes. The SGs for Units 3 and 4 began operation in 1982 and 1983, respectively, and each has thermally-treated Alloy 600 tubing.

The licensee has been using bobbin probes for inspecting the length of tubing within the tubesheet. However, the bobbin probe is not capable of reliably detecting stress corrosion cracking (SCC) in the tubesheet region should such cracks be present. For this reason, the licensee has been supplementing the bobbin probe inspections with rotating coil probes in a region extending from 3 inches above the top of the tubesheet (TTS) to 2 inches below the TTS. This zone includes the tube expansion transition zone located at the TTS. The expansion transition contains significant residual stress and was considered a likely location for SCC should it ever develop. Until the fall of 2004, there had been no reported instances of SCC affecting the tubesheet region of thermally-treated Alloy 600 tubing, either at Turkey Point or elsewhere in the U.S.

In the fall of 2004, crack-like indications were found in tubes in the tubesheet region of Catawba Unit 2, which has Westinghouse model D5 SGs. Like Turkey Point, the Catawba SGs employ thermally-treated Alloy 600 tubing that is hydraulically expanded against the tubesheet. Catawba had accumulated 14.7 effective full-power years service at the time cracking was discovered. Although Turkey Point has operated longer than Catawba, the operating hot-leg temperature at Turkey Point is lower than Catawba. The crack-like indications at Catawba were found in bulges (or over-expansions) in the tubesheet region, in the tack roll region, and in the tube-to-tubesheet weld. (The tack expansion is an initial 0.7-inch long expansion at each tube end and is formed prior to the hydraulic expansion over the full tubesheet depth. Its purpose is to facilitate performing the tube-to-tubesheet weld.) Crack-like indications were found in a bulge in one tube and in the tack expansion in nine tubes. Approximately 6 of the 196 tube-to-tubesheet weld indications extended into the parent tube.

As a result of the Catawba Unit 2 findings, the licensee plans to expand the scope of previous rotating coil inspections to address the potential for cracks within the thickness of the tubesheet down to 17 inches below the TTS. However, the licensee believes that any flaws located greater than 17 inches below the TTS (i.e., in the bottom 4.8 inches of the tubesheet region, including the tack expansion region and the tubing in the vicinity of the welds) have no potential to impair tube integrity and, thus, do not pose a safety concern. To avoid the unnecessary plugging of tubes that would be required by the TSs should inspection reveal cracks in this region, the licensee is proposing, on a one-time basis, to revise the TSs such that tubes found to contain flaws in the lower 4.8 inches of the tubesheet region need not be plugged and that the lower 4.8-inch region be excluded from current inspection requirements. In addition, the licensee proposed new requirements that all tubes found with degradation in the upper region of the tubesheet be plugged.

The requested changes are similar to changes the staff has approved for other similar plants (Byron 2, Braidwood 2, and Vogtle 2) on a one-time basis (i.e., for one refueling outage inspection and subsequent operating cycle). Originally, the proposed amendment for Turkey Point was for a permanent change to the TSs. Following discussions between the licensee and the NRC staff, it was identified that significant additional review was necessary to support approval on a permanent basis. In order to support the upcoming SG tube inspections scheduled for Refueling Outage 23, the licensee submitted a revised amendment request by letter dated October 3, 2006, which would limit the applicability of the requested changes to

only Refueling Outage 23 and the subsequent operating cycles to the next scheduled SG inspection.

3.2 Proposed Changes

- TS 4.4.5.4.a.6 currently states:

  Plugging Limit means the imperfection depth at or beyond which the tube shall be removed from service because it may become unserviceable prior to the next inspection and is equal to 40% of the nominal tube wall thickness.

  This would be revised as follows:

  Plugging Limit means the imperfection depth at or beyond which the tube shall be removed from service because it may become unserviceable prior to the next inspection and is equal to 40% of the nominal tube wall thickness. For Unit 3 during Refueling Outage 23 and the subsequent operating cycles until the next scheduled inspection, and for Unit 4 during Refueling Outage 23 and the subsequent operating cycles until the next scheduled inspection, this criterion does not apply to degradation identified in the portion of the tube below 17 inches from the top of the hot leg tubesheet. Degradation found in the portion of the tube below 17 inches from the top of the hot leg tubesheet does not require plugging. For Unit 3 during Refueling Outage 23 and the subsequent operating cycles until the next scheduled inspection, and for Unit 4 during Refueling Outage 23 and the subsequent operating cycles until the next scheduled inspection, all tubes with degradation identified in the portion of the tube within the region from the top of the hot leg tubesheet to 17 inches below the top of the tubesheet shall be removed from service;

- TS 4.4.5.4.a.8 currently states:

  Tube Inspection means an inspection of the steam generator tube from the point of entry (hot leg side) completely around the U-bend to the top support of the cold leg, or from the point of entry (cold leg side) completely around the U-bend and to the bottom of the hot leg; and

  This would be revised as follows:

  Tube Inspection means an inspection of the steam generator tube from the point of entry (hot leg side) completely around the U-bend to the top support of the cold leg, or from the point of entry (cold leg side) completely around the U-bend and to the bottom of the hot leg. For Unit 3 during Refueling Outage 23 and the subsequent operating cycles until the next scheduled inspection, and for Unit 4 during Refueling Outage 23 and the subsequent operating cycles until the next scheduled inspection, the portion of the tube below 17 inches from the top of the hot leg tubesheet is excluded; and

- TS 3.4.6.2.c currently states:

  1 GPM total primary-to-secondary leakage through all steam generators and 500 gallons per day through any one steam generator,

  This would be revised as follows:

  150 gallons per day primary-to-secondary leakage through any one steam generator (SG),

3.3 NRC Staff Evaluation

The tube-to-tubesheet joint consists of the tube, which is hydraulically expanded against the bore of the tubesheet, the tube-to-tubesheet weld located at the tube end, and the tubesheet. The joint was designed as a welded joint in accordance with the ASME Code, Section III, not as a friction or expansion joint. The weld itself was designed as a pressure boundary element in accordance with the ASME Code, Section III. It was designed to transmit the entire end cap pressure load, during normal and DBA conditions, from the tube to the tubesheet with no credit taken for the friction developed between the hydraulically-expanded tube and the tubesheet. In addition, the weld serves to make the joint leak tight.

The licensee is proposing to exempt, during Refueling Outage 23 and the subsequent operating cycles for Units 3 and 4, the lower 4.8 inches of the approximately 22-inch deep tubesheet region from a tube inspection and to exempt tubes with flaw indications in the lower 4.8-inch zone from the need to plug. The latter part of this proposal (i.e., to exempt tubes from plugging) is needed as a practical matter since, while rotating coil probe inspections will not be performed in this region, the bobbin probe will necessarily be recording any signals produced in this region. This proposal redefines the pressure boundary at the tube-to-tubesheet joint as consisting of a friction or expansion joint with the tube hydraulically expanded against the tubesheet over the top 17 inches of the tubesheet region. Under this proposal, no credit is taken for the lower 4.8 inches of the tube or the tube-to-tubesheet weld in contributing to the structural or leakage integrity of the joint. In other words, the scope of inspections in the proposed change would assume that the lower 4.8 inches of the tube and weld do not exist.

In its letter dated October 3, 2006, the licensee made the following commitments for the period that this one-time license amendment remains in effect:

1) If crack indications are found in any SG tube at Turkey Point Unit 3 during refueling outage 23 or Turkey Point Unit 4 during refueling outage 23, then the next inspection for each SG in the affected unit for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever is less). If definitive information of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

2) For Unit 3 during refueling outage 23 and Unit 4 during refueling outage 23, SG tubes that are not fully expanded within the hot leg tubesheet will be included in the scheduled inspections at each unit, and the 17 inch tubesheet inspection limitation will not be applied to these tubes.

The first commitment is consistent with a requirement contained in TS Task Force (TSTF) Standard TS Change Traveler, TSTF-449, "Steam Generator Tube Integrity," and is acceptable to the staff for this one-time amendment request. The staff's model SE of TSTF-449 was published in the *Federal Register* on March 2, 2005 (70 FR 10298). The "Notice of Availability of Model Application Concerning Technical Specification; Improvement To Modify Requirements Regarding Steam Generator Tube Integrity; Using the Consolidated Line Item Improvement Process," was published in the *Federal Register* on May 6, 2005 (70 FR 24126), which made the model SE available for licensees to reference. In a separate submittal (ML061300597), also dated April 27, 2006, the licensee proposed to incorporate the TSTF-449 changes into the Turkey Point TSs. That amendment request is under NRC staff review. Pursuant to discussions with the licensee and consistent with the applicability of the one-time exclusion of the lower 4.8 inches of the tubesheet region, the NRC staff interprets this commitment to include indications found during other potential SG inspections conducted during the subject operating cycle.

With respect to the second commitment, the licensee indicated that there are a total of nine tubes in the Turkey Point Unit 3 SGs and nine tubes in the Turkey Point Unit 4 SGs that are not fully expanded within the tubesheets. The structural and leakage integrity of these tubes are ensured by FPL SG Program Implementation Procedures that require a full tubesheet examination. This commitment is acceptable to the staff for this one-time amendment request since it ensures the pressure retaining boundary is inspected.

The regulatory standard by which the staff has evaluated the proposed license amendment is that the amended TSs should continue to ensure that tube integrity will be maintained. This includes maintaining structural safety margins consistent with the plant design basis as embodied in the stress limit criteria of the ASME Code, Section III, as discussed in Section 3.3.1 below. In addition, this includes limiting the potential for accident-induced primary-to-secondary leakage to values not exceeding those assumed in the licensing basis accident analyses, as discussed in Section 3.3.2 below. It should be noted that this evaluation applies only to the contribution of the 4.8-inch exclusion zone and that there may be other contributors to the primary-to-secondary leakage rate during DBAs. Maintaining tube integrity in accordance with structural margins and leakage limits ensures that the plant is operated in compliance with all applicable regulations.

The licensee is proposing, on a one-time basis, to plug all tubes with degradation in the upper 17-inch region of the tubesheet region of the tubes, irrespective of whether the flaw exceeds the TS 40-percent plugging limit. "Degradation" is defined in the TSs to mean service-induced cracking, wastage, wear or general corrosion occurring on either the inside or outside of a tube. The staff finds this acceptable since it is more conservative than the current TS 40-percent plugging limit and it provides assurance that the length of tubing along the entire proposed 17-inch inspection zone will be effective in resisting tube pullout under tube end cap pressure loads and in resisting primary-to-secondary leakage between the tube and tubesheet.

Nondegraded tubing in the upper 17-inch zone is also consistent with the technical basis supporting this request.

In addition, the licensee is proposing to modify TS 3.4.6.2.c by limiting primary-to-secondary leakage through any one SG to less than or equal to 150 gallons per day (gpd). This is consistent with TSTF-449, "Steam Generator Tube Integrity," which the staff has generically approved, and, therefore, it is acceptable to the staff. The 150 gpd operational leakage limit is based on operating experience and the operational leakage performance criterion in Nuclear Energy Institute publication NEI 97-06, "Steam Generator Program Guidelines," and it is more conservative than the previous operational leakage limit of 1 gallon per minute (gpm) and 500 gpd through any one SG. This limit on normal operating primary-to-secondary leakage rate through any one SG is less than that assumed in the safety analysis. However, since the leakage rate observed during operation may increase during a DBA, it may be necessary to ensure that the operational leak rate is kept well below the operational leak rate limit in order to meet both the operational leakage limit and the accident-induced leakage limit. This increase in leak rate can be a result of either: (1) the higher differential pressure between the primary coolant system and the secondary system associated with a DBA causing the leak rate from flaws leaking during normal operation to leak at higher rates; or (2) the higher loadings associated with a DBA causing a flaw that was not leaking during normal operation to leak during the accident.

3.3.1 Joint Structural Integrity

Westinghouse has conducted analysis and testing to establish the engagement (embedment) length of hydraulically-expanded tubing inside the tubesheet that is necessary to resist pullout under normal operating and DBA conditions. Pullout is the structural failure mode of interest since the tubes are radially constrained against axial fishmouth rupture by the presence of the tubesheet. The axial force that could produce pullout derives from the pressure end cap loads due to the primary-to-secondary pressure differentials associated with normal operating and DBA conditions. The licensee's contractor, Westinghouse, determined the required engagement distance on the basis of maintaining a factor of 3 against pullout under normal operating conditions and a factor of 1.4 against pullout under accident conditions. The staff concurs that these are the appropriate safety factors to apply to demonstrate structural integrity. As documented in detail in an SE accompanying the staff's approval of new performance-based SG TSs for Farley Units 1 and 2 (Reference: Letter, Sean Peters, NRC, to L. M. Stinson, Vice President, Southern Nuclear Operating Company, "Joseph M. Farley Nuclear Plant, Units 1 and 2, re: Issuance of Amendments to Facilitate Implementation of Industry Initiative NEI 97-06, Steam Generator Program Guidelines," dated September 10, 2004 (ML042570427)), the staff concluded that these safety factor criteria are consistent with the design basis; namely the stress limit criteria in the ASME Code, Section III.

The resistance to pullout is the axial friction force developed between the expanded tube and the tubesheet over the engagement distance. The friction force is a function of the radial contact pressure between the expanded tube and the tubesheet. The radial contact pressure derives from several contributors including (1) the contact pressure associated directly with the hydraulic expansion process itself, (2) additional contact pressure due to differential radial thermal expansion between the tube and tubesheet under hot operating conditions, (3) additional contact pressure caused by the primary pressure inside the tube, and (4) additional or reduced contact pressure associated with tubesheet bore dilation (distortion)

caused by tubesheet bow (deflection) as a result of the primary-to-secondary pressure load acting on the tubesheet. Westinghouse employed a combination of pullout tests and analyses, including finite element analyses, to evaluate these contributors. Based on these analyses and tests, Westinghouse concludes that the required engagement distances to ensure the safety factor criteria against pullout are achieved vary from 4.78 to 8.04 inches depending on the radial location of the tube within the tube bundle, with the largest engagement distances needed toward the center of the bundle.

The staff has not reviewed the Westinghouse analyses in detail and, thus, has not reached a conclusion with respect to whether 4.78 to 8.04 inches of engagement (termed H* criterion by Westinghouse) is adequate to ensure that the necessary safety margins against pullout are maintained. The licensee, therefore, is proposing to inspect the tubes in the tubesheet region such as to ensure a minimum of 17-inches of effective engagement, well in excess of the 4.78 to 8.04 inches that the Westinghouse analyses indicate are needed. Based on the following considerations, the staff concludes the proposed 17-inch engagement length is acceptable to ensure the structural integrity of the tubesheet joint:

- The NRC staff estimates that based on the Westinghouse pullout tests, the radial contact pressure produced by the hydraulic expansion and differential radial thermal expansion is such as to require an engagement distance of approximately 7 inches to ensure the appropriate safety margins against pullout are met. This estimate is a mean minus one standard deviation estimate based on three pullout tests. This estimate ignores the effect on needed engagement distance from internal primary pressure in the tube and tubesheet bore dilations associated with tubesheet bow.

- The internal primary pressure inside the tube under normal operating and accident conditions also acts to tighten the joint relative to nonpressurized conditions, thus reducing the necessary engagement distance.

- Tubesheet bore dilations caused by tubesheet bow under primary-to-secondary pressure can increase or decrease contact pressure depending on the tube location within the bundle and on location along the length of the tube in the tubesheet region. Basically, the tubesheet acts as a flat, circular plate under an upward acting net pressure load. The tubesheet is supported axially around its periphery with a partial restraint against tubesheet rotation provided by the SG shell and channel head. The SG divider plate provides a spring support against upward displacement along a diametral mid-line. Over most of the tubesheet away from the periphery, the bending moment resulting from the applied primary-to-secondary pressure load can be expected to put the tubesheet into tension at the top and compression at the bottom. Thus, the resulting distortion of the tubesheet bore (tubesheet bore dilation) tends to loosen the tube-to-tubesheet joint at the top of the tubesheet and to tighten the joint at the bottom of the tubesheet. The amount of dilation and resulting change in joint contact pressure would be expected to vary in a linear fashion from top to bottom of the tubesheet. Given that the neutral axis is at approximately the axial mid-point of the tubesheet thickness (i.e., 10.9 inches below the top of the tubesheet), tubesheet bore dilation effects would be expected to further tighten the joint from 11 inches below the TTS to 17 inches below the TTS which would be the lower limit of the proposed tubesheet region inspection zone. Combined with the effects of the joint tightening associated with the primary pressure inside the tube, contact pressure over at least a 6-inch distance should be

considerably higher than the contact pressure simulated in the above mentioned pullout tests. A similar logic applied to the periphery of the tubesheet leads the staff to conclude that at the top 11 inches of the tubesheet region, contact pressure should be considerably higher than the contact pressure simulated in the above mentioned pullout tests. Thus, the staff concludes that the proposed 17-inch engagement distance (or inspection zone) is acceptable to ensure the structural integrity of the tubesheet joint.

3.3.2 Joint Leakage Integrity

If no credit is to be taken for the presence of the tube-to-tubesheet weld, a potential primary-to-secondary leak path is introduced between the hydraulically-expanded tubing and the tubesheet. In addition, not inspecting the tubing in the lower 4.8 inches of the tubesheet region may lead to an increased potential for 100-percent through-wall flaws in this zone and the potential for leakage of primary coolant through the crack and up between the hydraulically-expanded tubes and tubesheet to the secondary system. Operational leakage integrity is assured by monitoring primary-to-secondary leakage relative to the applicable TS Limiting Condition for Operation (LCO) limits. However, it must also be demonstrated that the proposed TS changes for degradation in the lower region of the tubesheet do not create the potential for leakage during DBAs that exceeds the accident values assumed in the plant licensing basis accident analyses. This is ensured by limiting the primary-to-secondary leakage from all sources to 1 gpm through all SGs and 0.347 gpm through any one SG during an MSLB.

To support the previously discussed H* criterion, Westinghouse developed a detailed leakage prediction model that considers the resistance to leakage from cracks located within the thickness of the tubesheet. The NRC staff has neither reviewed nor accepted this model. For the proposed 17-inch inspection zone, Westinghouse cited a number of qualitative arguments supporting a conclusion that a minimum 17-inch engagement length ensures that leakage during MSLB will not exceed two times the observed leakage during normal operation. Westinghouse refers to this as the “bellwether approach.” Currently, the TS LCO limit for operational primary-to-secondary leakage is 500 gpd per SG and 1 gpm total for all SGs. The licensee has proposed to reduce these limits to 150 gpd per SG. Thus, for an SG leaking at the limit of 150 gpd (or 0.104 gpm) under normal operating conditions, Westinghouse estimates that leakage would not be expected to exceed 0.208 gpm if all the leakage is from flaws within the tubesheet region, which is less than the 0.347 gpm assumed in the licensing basis accident analyses for MSLB for any one SG.

The factor of two upper bound for DBA primary-to-secondary leakage is based on the Darcy equation for flow through a porous medium where leakage rate would be proportional to differential pressure. Westinghouse considered normal operating pressure differentials between 1200 and 1400 pounds per square inch (psi) and accident differential pressures on the order of 2560 to 2650 psi, essentially a factor of 2 difference. The factor of 2 as an upper bound is based on a premise that the flow resistance between the tube and tubesheet remains unchanged. Westinghouse states that the flow resistance varies as a log normal linear function of joint contact pressure. The staff concurs that the factor of 2 upper bound is reasonable, given the stated premise. The staff notes that the assumed linear relationship between leak rate and differential pressure is conservative relative to alternative models, such as Bernoulli or orifice models, that assume leak rate to be proportional to the square root of differential pressure.

The staff reviewed the arguments developed by Westinghouse regarding the conservatism of the aforementioned premise; namely the conservatism of assuming that flow resistance between the expanded tubing and the tubesheet does not decrease under the most limiting accident relative to normal operating conditions. Most of the Westinghouse observations are based on insights derived from the finite element analyses performed to assess joint contact pressures and from test data relating leak flow resistance to joint contact pressure, neither of which has been reviewed by the staff in detail. Among the Westinghouse observations is that for all tubes, there is at least an 11-inch zone in the upper 17-inches of the tubesheet where there is an increase in joint contact pressure, and, thus, leak flow resistance, due to higher primary pressure inside the tube and changes in tubesheet bore dilation along the length of the tubes. In Section 3.3.1 above, the staff observed that there is at least a 6-inch zone over which changes in tubesheet bore dilations when going from unpressurized to pressured conditions should result in an increase in joint contact pressure. The contact pressure due to changes in tubesheet bore dilation should increase further over this 6-inch zone under the increased pressure loading on the tubesheet during accident conditions. Considering the higher pressure loading in the tube when going from normal operating to accident conditions, the Westinghouse estimates appear reasonable to the staff.

Although joint contact pressures and leak flow resistance decrease over other portions of the tube length, Westinghouse expects a net increase in total leak flow resistance on the basis of its insights from leakage test data. This data shows that leak flow resistance is more sensitive to changes in joint contact pressure as contact pressure increases due to the linear log normal nature of the relationship. The staff's review did not evaluate this aspect of the Westinghouse assessment. However, the NRC staff finds that the insights derived from the finite element analysis show that there should be no significant reduction in leakage flow resistance when going from normal operating to accident conditions.

Finally, the staff has considered that undetected cracks in the lower 4.8 inches are unlikely to produce leakage rates during normal operation that would approach the TS LCO operational leakage limits, thus providing additional confidence that such cracks will not result in leakage in excess of the values assumed in the accident analyses. Any axial cracks will be tightly clamped by the tubesheet, limiting the opening of the crack faces. In addition, little of the end cap pressure load should remain in the tube below 17 inches and, thus, any circumferential cracks would be expected to remain tight. Therefore, irrespective of the flow resistance in the upper 17 inches of the tubesheet between the tube and tubesheet, the tightness of the cracks themselves should limit leakage to very small values.

Based on the above, the staff concludes that there is reasonable assurance that the proposed one-time exclusion of the lower 4.8 inches of the tubes in the tubesheet region from the tube inspection and plugging and repair requirements will not impair the leakage integrity of the tube-to-tubesheet joint for Refueling Outage 23 and the subsequent operating cycles until the next scheduled inspections at Turkey Point, Units 3 and 4.

4.0 STATE CONSULTATION

Based upon a letter dated May 2, 2003, from Michael N. Stephens of the Florida Department of Health, Bureau of Radiation Control, to Brenda L. Mozafari, Senior Project Manager, U.S. Nuclear Regulatory Commission, the State of Florida does not desire notification of issuance of license amendments.

5.0 ENVIRONMENTAL CONSIDERATION

These amendments involve a change in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and changes surveillance requirements. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding (71 FR 43532). Accordingly, these amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

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