September 29, 2006

Mr. Gene St. Pierre, Site Vice President
c/o James M. Peschel
Seabrook Station
FPL Energy Seabrook, LLC
PO Box 300
Seabrook, NH 03874

SUBJECT: SEABROOK STATION, UNIT NO. 1 - ISSUANCE OF AMENDMENT RE: LIMITED INSPECTION OF THE STEAM GENERATOR TUBE PORTION WITHIN THE TUBESHEET (TAC NO. MC8554)

Dear Mr. St. Pierre:

The Commission has issued the enclosed Amendment No. 112 to Facility Operating License (FOL) No. NPF-86 for the Seabrook Station, Unit No. 1. The amendment consist of a change to the FOL in response to your application dated September 29, 2005, as supplemented on August 8, September 18, and September 28, 2006.

The amendment revises the Seabrook Station, Unit No. 1 Technical Specifications to permit a one-time change in the steam generator tube inspection requirements to include a sampling of the bulges and over-expansions for portions of the steam generator tubes within the hot-leg tubesheet region. Originally, the amendment request proposed to implement the change as permanent. In the September 18, 2006, letter, the scope of the proposed change was narrowed to a one-time change. The August 8, the September 18, the September 28, 2006, supplements did not alter the validity of the Nuclear Regulatory Commission staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on November 8, 2005 (70 FR 67749).

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

Sincerely,

/RA/

G. Edward Miller, Project Manager
Plant Licensing Branch 1-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-443

Enclosures: 1. Amendment No. 112 to FOL No. NPF-86
2. Safety Evaluation

cc w/encls: See next page

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Sincerely,
/RA/
G. Edward Miller, Project Manager
Plant Licensing Branch 1-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-443

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cc w/encls: See next page

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FPL ENERGY SEABROOK, LLC, ET AL.*

DOCKET NO. 50-443

SEABROOK STATION, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 112
License No. NPF-86

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

   A. The application for amendment filed by FPL Energy Seabrook, LLC, et al. (the licensee), dated September 29, 2005, as supplemented on August 8, September 18, and September 28, 2006, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission 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.

*FPL Energy Seabrook, LLC (FPLE Seabrook), is authorized to act as agent for the following: Hudson Light & Power Department, Massachusetts Municipal Wholesale Electric Company, and Taunton Municipal Light Plant. FPLE Seabrook has exclusive responsibility and control over the physical construction, operation and maintenance of the facility.

2. Accordingly, the license is amended by changes to paragraph 2.J of Facility Operating License No. NPF-86 and is hereby amended to read as follows:

J. Additional Conditions

The Additional Conditions contained in Appendix C, as revised through Amendment No. 112 , are hereby incorporated into this license. FPLE Seabrook, LLC shall operate the facility in accordance with the Additional Conditions.

3. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-86 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 112 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

4. This license amendment is effective as of its date of issuance and shall be implemented within 90 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Brooke D. Poole, Acting Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment: Changes to the Operating License
and Technical Specifications

Date of Issuance: September 29, 2006

ATTACHMENT TO LICENSE AMENDMENT NO. 112

FACILITY OPERATING LICENSE NO. NPF-86

DOCKET NO. 50-443

Replace the following page of Facility Operating License No. NPF-86 with the attached revised page. The revised page is identified by amendment number and contains a marginal line indicating the area of change.

Remove	Insert
3	3
7	7

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

Remove	Insert
3/4 4-16	3/4 4-16
---	3/4 4-16a

Replace the following page of Appendix C, Additional Conditions, with the attached revised page as indicated. The revised page is identified by amendment number and contains marginal lines indicating the area of change.

Remove	Insert
Page 1	Page 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 112 TO FACILITY OPERATING LICENSE NO. NPF-86

FPL ENERGY SEABROOK, LLC

SEABROOK STATION, UNIT NO. 1

DOCKET NO. 50-443

1.0 INTRODUCTION

By letter dated September 29, 2005, as supplemented on August 8, September 18, and September 28, 2006, FPL Energy Seabrook, LLC (FPLE or the licensee) submitted a request for a change to the Operating License for Seabrook Station, Unit No. 1 (Seabrook). Specifically, the proposed amendment would implement a change to Technical Specifiction (TS) 3/4.4.5, "Steam Generators," regarding the required scope of steam generator (SG) tube inspections and plugging for Seabrook during Refueling Outage (RFO) 11 and the subsequent operating cycles until the next scheduled inspection. The proposed change modifies the inspection and plugging 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.

The supplements dated August 8 and September 28, 2006, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the Nuclear Regulatory Commission (NRC or the Commission) staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on November 8, 2005 (70 FR 67749). The supplement dated September 18, 2006, modified the requested amendment to request a one-time change in lieu of a permanent one. This narrowing of the scope did not alter the validity of the NRC staff's proposed no significant hazards consideration determination.

2.0 REGULATORY EVALUATION

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

Title 10 of the *Code of Federal Regulations* (10 CFR) establishes the fundamental regulatory requirements with respect to the integrity of the SG tubing. The General Design Criteria (GDC) in Appendix A to 10 CFR Part 50 provide, among other things, requirements for the RCPB.

Specifically, GDC 14, “Reactor Coolant Pressure Boundary,” states that:

> The [RCPB] shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, or rapidly propagating failure, and of gross rupture.

GDC 15, “Reactor Coolant System Design,” states that:

> The reactor coolant system and associated auxiliary, control, and protection systems shall be designed with sufficient margin to assure that the design conditions of the [RCPB] are not exceeded during any condition of normal operation, including anticipated operational occurrences.

GDC 30, “Quality of Reactor Coolant Pressure Boundary,” states that:

> Components which are part of the [RCPB] shall be designed, fabricated, erected, and tested to the highest quality standards practical. Means shall be provided for detecting and, to the extent practical, identifying the location of the source of reactor coolant leakage.

GDC 31, “Fracture Prevention of Reactor Coolant Pressure Boundary,” states that:

> The [RCPB] shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a nonbrittle manner and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the boundary material under operating, maintenance, testing, and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of irradiation on material properties, (3) residual, steady state and transient stresses, and (4) size of flaws.

GDC 32, “Inspection of Reactor Coolant Pressure Boundary,” states that:

> Components which are part of the [RCPB] shall be designed to permit (1) periodic inspection and testing of important areas and features to assess their structural and leaktight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel.

Section 50.55a of 10 CFR specifies that components which are part of the RCPB must meet the requirements for Class 1 components in Section III of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). Further, Section 50.55a requires, in part, that throughout the service life of a pressurized-water reactor (PWR) facility, Class 1 components meet the requirements, except design and access provisions and pre-service 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. 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 an SG tube rupture (SGTR) and main steamline break (MSLB). These analyses consider the primary-to-secondary leakage through the tubing which may occur during these events and must show that the offsite radiological consequences do not exceed the applicable limits of 10 CFR 50.67 for offsite doses, and the GDC 19 criteria for control room operator doses.

Under the plant TSs 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, “Steam Generators.”

The subject TS amendment request concerns the portions of the tubing which are subject to the TS SG tube surveillance requirements, including any necessary inspections or plugging. The amendment is applicable on a one-time basis to RFO 11 and the subsequent operating cycles until the next scheduled inspection. The regulatory standard by which the NRC staff has reviewed this request is that tube structural and leakage integrity must be maintained consistent with the design and licensing basis. The requested amendment is similar to one-time amendments approved for Byron 2, Braidwood 2, and Vogtle 2.

3.0 TECHNICAL EVALUATION

3.1 Background

Seabrook has four Model F SGs designed and fabricated by Westinghouse. There are 5626 tubes in each SG, each with an outside diameter of 0.688 inches and a nominal wall thickness of 0.040 inches. The tubes are hydraulically-expanded for the full depth of the tubesheet at each end and are welded to the tubesheet at the bottom of each expansion.

FPLE has been using bobbin probes for inspecting the length of tubing within the tubesheet. The bobbin probe, however, is not capable of reliably detecting stress corrosion cracks (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 3 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 not been any reported instances of SCC affecting the tubesheet region of thermally-treated alloy 600 tubing, either at Seabrook or elsewhere in the United States.

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 Seabrook, 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 (EFPYs) of service, slightly more than Seabrook at that point in time, with a slightly lower hot-leg operating temperature. 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 was 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.

The SG tube inspection scheduled for RFO 11 (currently scheduled for October 2006) at Seabrook is the first such inspection for Seabrook since the Catawba findings. FPLE believes that any flaws located at elevations more than 17 inches below the TTS (i.e., in the bottom 4 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. FPLE proposed a change to the TSs that would exclude the portion of tubing on the hot-leg side at elevations below 17 inches from the TTS from existing inspection and plugging requirements. The proposed change was supported by Westinghouse proprietary report LTR-CDME-05-170-P. In response to NRC staff questions, additional information supporting the proposed changes was provided on August 8, September 18, and September 28, 2006.

The requested changes are similar to changes the NRC staff has approved for other similar plants (Byron 2, Braidwood 2, and Vogtle 2) on a one-time basis (i.e., for one RFO inspection and subsequent operating cycle). Originally, the proposed amendment for Seabrook was for a permanent change to the TSs. Following discussions between FPLE and the NRC staff, it was identified that significant additional review was necessary to support permanent approval of the proposed changes. In order to support the upcoming SG tube inspection scheduled for RFO 11, FPLE submitted a revised amendment request by letter dated September 18, 2006, which would limit the applicability of the requested changes to only RFO 11 and the subsequent operating cycles to the next scheduled SG inspection.

3.2 Description of 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 and is equal to 40% of the nominal tube wall thickness;

The amendment request proposed to revise TS 4.4.5.4.a.6 to read as follows:

> Plugging Limit means the imperfection depth at or beyond which the tube shall be removed from service and is equal to 40% of the nominal tube wall thickness. During refueling outage 11 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. During Refueling Outage 11 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; and

The amendment request proposed to revise TS 4.4.5.4.a.8 to read 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. During Refueling Outage 11 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

3.3 Evaluation of Proposed Changes

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.

FPLE has proposed to exempt, during RFO 11 and the subsequent operating cycles until the next scheduled inspection, the lower 4 inches of the 21-inch deep tubesheet region from tube inspection, and to exempt tubes with flaw indications in the lower 4-inch zone from the need to plug. The latter part of this proposed amendment (i.e., to exempt tubes from plugging) is needed as a practical matter since the bobbin probe will be recording any signals produced in this zone, although rotating coil probe inspections will not be performed in this region. The proposed amendment, in effect, 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 inches of the tube or the tube-to-tubesheet weld in contributing to the structural or leakage integrity of the joint. The lower 4 inches of the tube and weld are assumed not to exist.

In its September 18, 2006, supplement, FPLE committed that if crack indications are found in any SG tube during refueling outage 11, then the next inspection for the SG containing the tube would not exceed the lesser of 24 effective full power months or one refueling outage. Pursuant to discussions with the licensee and consistent with the applicability of the one-cycle exclusion of the lower 4 inches of the tubesheet region, the NRC staff interprets this to include indications found during other potential SG inspections conducted during the subject operating cycle.

The NRC staff evaluated the proposed license amendment to determine whether the amended TSs would continue to ensure that tube integrity will be maintained. This included an evaluation of whether structural safety margins are maintained 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. In addition, the NRC staff evaluated whether the proposed change limits 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. It should be noted that this evaluation applies only to the contribution of the of the 4-inch exclusion zone and that there are other contributing factors to primary-to-secondary leakage included in the Seabrook licensing basis assumptions. Maintaining tube integrity in accordance with structural margin and leakage limits ensures that the plant is operated in compliance with all applicable regulations.

FPLE is also proposing, on a one-time basis, to plug all tubes found with degradation in the upper 17-inch region of the tubesheet (see proposed revision to TS 5.5.9d.1.f, "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. This definition is not limited to flaws which exceed the current TS 40% plugging limit. The NRC staff finds this proposed requirement acceptable since it is more conservative than the current TS 40% plugging limit and will provide added assurance that the length of tubing along the entire proposed 17-inch inspection zone will be effective in resisting tube pull-out under tube end cap pressure loads and in resisting primary-to-secondary leakage between the tube and tubesheet.

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 which 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. Westinghouse determined the required engagement distance on the basis of maintaining a factor of three against pullout under normal operating conditions and a factor of 1.4 against pullout under accident conditions. The NRC staff finds that these are adequate safety factors to apply to demonstrate structural integrity. As documented in detail in a safety evaluation 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 [Nuclear Energy Institute] 97-06, Steam Generator Program Guidelines," dated September 10, 2004; Agencywide Documents and Management System (ADAMS) Accession No. ML042570427), the staff had 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 about 3.0 to 8.6 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 NRC staff has not reviewed all aspects of the Westinghouse analyses in detail and, thus, has not reached a conclusion with respect to whether 3.0 to 8.6 inches of engagement (termed H* criterion by Westinghouse) is adequate to ensure that the necessary safety margins against pullout are maintained. FPLE, 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 3.0 to 8.6 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 8.6 inches to ensure the appropriate safety margins against pullout based on a no-slip criterion. This estimate is a mean minus one standard deviation estimate based on six pull 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 NRC staff notes that from a tube pull-out standpoint, the use of a “no-slip” criterion is conservative. Allowing slippage of about 0.2 to 0.3 inches decreases the necessary engagement distance to 5.1 inches, again ignoring 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 non-pressurized 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. Conceptually, 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 be such as 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 the neutral axis to be at approximately the axial mid-point of the tubesheet thickness (i.e., 10.5 inches below the top of the tubesheet), tubesheet bore dilation effects would be expected to further tighten the joint from 10 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 6.5-inch distance should be considerably higher than the contact pressure simulated in the above-mentioned pull-out tests. A similar logic applied to the periphery of the tubesheet leads the staff to conclude that at the top 10.5 inches of the tubesheet region, contact pressure should be considerably higher than the contact pressure simulated in the above-mentioned pull-out tests. Thus, the NRC 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 leak path between the primary-to-secondary is introduced between the hydraulically-expanded tubing and the tubesheet. In addition, not inspecting the tubing in the lower 4 inches of the tubesheet region may lead to an increased potential for 100% 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 do not create the potential for leakage during DBAs to exceed the accident values assumed in the plant licensing basis accident analyses. The licensee states that this is ensured by limiting primary-to-secondary leakage to 0.347 gallons per minute (gpm) in the faulted SG during a MSLB.

To support the previously-discussed H* criterion, Westinghouse developed a detailed leakage prediction model which considers the resistance to leakage from cracks located within the thickness of the tubesheet. The NRC staff has neither reviewed nor accepted this model as yet. 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 for operational primary-to-secondary leakage is 500 gallons per day (gpd) per SG and 1 gpm total for all SGs. The licensee has proposed to reduce these limits to 150 gpd per SG (thus limiting total leakage to 600 gpd) as part of Seabrook License Amendment Request 06-02, dated March 23, 2006. In its September 28, 2006, supplement, FPLE agreed to the imposition of a license condition which limits operational primary-to-secondary leakage to 150 gpd per SG. Thus, with 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, which is less than the 0.347 gpm assumed in the licensing basis accident analyses for MSLB.

The factor of two upper-bound for DBA primary-to-secondary leakage is based on the Darcy equation for flow through a porous media where leakage rate would be proportional to

differential pressure. Westinghouse considered normal operating pressure differentials between 1200 and 1400 psi and accident differential pressures on the order of 2560 to 2650 psi, essentially a factor of two difference. The factor of two 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 NRC staff considers the factor of two upper-bound to be reasonable, given the stated premise. Also, the NRC staff notes that the assumed linear relationship between leak rate and differential pressure is conservative relative to alternative models such as Bernoilli or orifice models which assume leak rate to be proportional to the square root of differential pressure.

The NRC 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 NRC 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 6.5-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 6.5-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 NRC 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 NRC 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 analyses show that there should be no significant reduction in leakage flow resistance when going from normal operating to accident conditions.

Finally, the NRC staff considered that undetected cracks in the lower 4 inches are unlikely to produce leakage rates during normal operation that would approach the operational leakage limit (150 gpd), thus providing additional confidence that such cracks will not result in leakage in excess of the values assumed in the Seabrook 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. Thus, 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 NRC staff concludes that there reasonable assurance that the proposed one-time exclusion of the lower 4 inches of the tubes in the tubesheet region from the tube inspection and plugging requirements will not impair the leakage integrity of the tube-to-tubesheet joint for RFO 11 and the subsequent operating cycles until the next scheduled inspection. Thus, with the proposed amendment, Seabrook will continue to meet regulatory criteria contained in the GDC, 10 CFR Parts 50.55a and 50.67.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the New Hampshire and Massachusetts State officials were notified of the proposed issuance of the amendment. The State officials had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

This amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluent that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has made a final finding that the amendment involves no significant hazards consideration. Accordingly, the amendment meets 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 amendment.

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 amendment will not be inimical to the common defense and security or to the health and safety of the public.

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