

UNITED STATES OF AMERICA  
 NUCLEAR REGULATORY COMMISSION  
 OFFICE OF NUCLEAR REACTOR REGULATION

Frank J. Miraglia, Jr., Acting Director

In the Matter of

FLORIDA POWER & LIGHT CO.	)	Docket Nos. 50-335
	)	50-389
St. Lucie Plant, Units 1 and 2	)	License Nos. DPR-67
	)	NPF-16
	)	(10 CFR 2.206)

DIRECTOR'S DECISION UNDER 10 CFR 2.206

I. INTRODUCTION

On June 12, 1996, Mr. Thomas J. Saporito, Jr., on behalf of himself and the National Litigation Consultants (Petitioners), filed a Petition with the U.S. Nuclear Regulatory Commission (NRC or Commission) pursuant to 10 CFR 2.206. The Petitioners requested the Commission (1) to issue a confirmatory order requiring that the Florida Power & Light Company (FP&L or licensee) not operate St. Lucie Plant, Unit 1, above 50 percent of its power-level capacity, (2) to require the Licensee to specifically identify the "root cause" for the premature failure of the steam generator tubing, and (3) to require the licensee to specifically state what corrective measures will be implemented to prevent recurrence of steam generator tube failures in all the steam generators in Unit 1 and Unit 2.

The Petitioners' requests are based on assertions that (1) the licensee's Unit 1 steam generator tubes have degraded to the extent that more than 2,500 of the tubes have been plugged, (2) the licensee has not identified the root cause for the premature failure of the steam generator tubing,

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(3) the licensee will most likely experience similar tube ruptures on other steam generators at the station, and (4) the licensee's "FSAR's [Final Safety Analysis Reports] and the NRC's CFR's [*Code of Federal Regulations*] require that the integrity of the primary systems on Unit 1 and Unit 2 not be breached.

The Petition has been referred to my office pursuant to 10 CFR 2.206 of the Commission's regulations. By letter dated July 8, 1996, an acknowledgement of receipt of the Petition was sent to the Petitioners. In that letter, the Petitioners were informed that the NRC would take appropriate action within a reasonable time. I have completed my evaluation of the matters raised by the Petitioners and have determined that, for the reasons stated below, the Petition is denied.

## II. DISCUSSION

The NRC staff's evaluation of the Petitioners' requests follows.

- (a) Issue a confirmatory order requiring that the licensee not operate Unit 1 above 50 percent of its power-level capacity.

In a meeting held at NRC Headquarters on July 3, 1996, the licensee presented the inspection and repair history for the Unit 1 steam generator tubes.<sup>1</sup> The licensee has performed 15 inspections since commercial operation began in December 1976. For the most recent inspection, completed in

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<sup>1</sup>NRC Meeting Summary, Subject: "Steam Generator Inspection, Repair and Operating Issues - St. Lucie Unit 1," dated July 16, 1996.

June 1996, the licensee inspected the full length of all active tubes using a bobbin coil.<sup>2</sup> In addition, the licensee used a motorized rotating pancake coil<sup>3</sup> (MRPC) to inspect all expansion transition joints and drilled support intersections in the hot and cold legs, all free-span locations having bobbin coil indications,<sup>4</sup> and free-span tube regions in the upper two support areas in the hot legs. The inspection was based on the Electric Power Research Institute (EPRI) report "PWR Steam Generator Examination Guidelines," dated November 1992. Defective tubes having circumferential indications, axial indications, or volumetric indications<sup>5</sup> were plugged and removed from service.

Including tubes plugged during earlier outages, 2,159 of 8,519 tubes (25.3 percent) in the "A" steam generator and 1,834 of 8,519 tubes (21.5 percent) in the "B" steam generator have been plugged and removed from service. The licensee performed an evaluation that showed that the plant could be safely operated at full power with the reduced reactor coolant flow resulting from the increased number of plugged tubes.<sup>6</sup> The NRC reviewed the licensee's evaluation and concluded that it was acceptable and that the units

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<sup>2</sup> The bobbin coil is used for a general screening of tubes for indications of possible defects, while the motorized rotating pancake coil (MRPC) probe is used to further characterize bobbin coil indications. The MRPC is also used to inspect regions susceptible to circumferentially orientated degradation.

<sup>3</sup> See note 2.

<sup>4</sup> See note 2.

<sup>5</sup> Circumferential indications are crack-like indications orientated on the diameter of the tube. Axial indications are crack-like indications orientated on the long axis of the tube. Volumetric indications are areas of general reduction in tube wall thickness with no specific orientation.

<sup>6</sup> FP&L letter, "Thermal Margin and RCS Flow Limits," dated June 1, 1996.

could be operated at full power. The staff's evaluation is documented in a safety evaluation dated July 9, 1996.

In the meeting on July 3, 1996, the licensee presented a preliminary run-time analysis for Unit 1, which was used to determine the length of steam generator operation before the need for further tube inspections to ensure adequate tube integrity. The licensee stated that the preliminary results of its analysis support a tube inspection interval of 15 months for the current Unit 1 cycle that started in July 1996. The licensee also stated that in situ pressure testing of the steam generator tubes during the spring 1996 outage indicated that the most severely degraded tubes had adequate structural integrity and satisfied the safety margins in NRC's Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes." On the basis of the results of the in situ pressure tests, the staff concluded that adequate assurance of tube integrity existed to allow operation pending completion of the licensee's run-time analysis. The NRC is currently reviewing the licensee's analysis, which was submitted October 24, 1996.

The plant Technical Specifications for each of the units specify leakage limits for the reactor coolant pressure boundary, including steam generator tube leakage. If a tube leaks beyond the allowed limits, the unit must be shut down. The plant off-normal operating procedures for St. Lucie Units 1 and 2 also include criteria for shutdown based on EPRI TR-104788, "PWR Primary to Secondary Leak Guidelines," dated May 1995, which are more conservative than the limits in the plant Technical Specifications. Finally, if a tube fails, the plant's Emergency Operating Procedures contain the specific actions necessary for the operators to shut down and cool down the plant to mitigate the consequences of the event.

Thus, as required, the licensee has implemented measures for both units to protect public health and safety in the unlikely event that tube integrity is compromised. These measures include a primary-to-secondary leakage monitoring program and emergency operating procedures. The leakage monitoring program provides early warning of tube leakage. The steam generator blowdown monitor and condenser air ejector monitor at each of the units continuously monitors the radioactivity level in the main steamline. A significant increase in the instrument readings, which would result from a relatively small tube leak, will cause an alarm to alert the operators to the change in radioactivity levels and potential tube leakage.

On the basis of the information submitted, the NRC staff has concluded that the operation of the Unit 1 steam generators at full power poses no undue risk to public health and safety.

- (b) Require the licensee to specifically identify the "root cause" for the premature failure of the steam generator tubing.

It is not clear how the Petitioners define "premature failure"; however, since there have not been any steam generator tube ruptures at St. Lucie Units 1 or 2, it is assumed the reference is to tube degradation. Many of the tubes in the Unit 1 steam generators have degraded as a result of corrosion and/or mechanical conditions. The root cause of tube degradation in steam generators is the interaction of water chemistry, thermal-hydraulic design, materials selection, fabrication methods, and operating conditions. The causes of tube degradation are well understood by the industry and are documented in the public record. The root causes for the St. Lucie steam generator tube

degradations were presented to the NRC staff in a meeting on August 27, 1986.<sup>7</sup>

The licensee has identified to the NRC modes of degradation that have affected the steam generator tubes in both St. Lucie Units 1 and 2 in its response of June 23, 1995, to NRC Generic Letter 95-03, "Circumferential Cracking of Steam Generator Tubes," and in the meeting of July 3, 1996. The degradation modes identified include intergranular attack, stress-corrosion cracking, and denting. Intergranular attack refers to localized attack at and adjacent to grain boundaries of tube material, with relatively little corrosion of the grains. Intergranular stress-corrosion cracking refers to cracking caused by the simultaneous presence of stress and a specific corrosive medium. Denting is the accumulation of corrosion products at the tube-to-tube support plate that causes plastic deformation of the tube. The licensee has identified locations of these degradations in the tubes during the most recent steam generator inspection of St. Lucie Unit 1.<sup>8</sup> They include egg crate and drilled tube support plates, free spans, expansion transition regions, and sludge pile areas. In every case, the root cause of tube degradation can be attributed to material selection, water chemistry, fabrication methods, or residual stresses at the affected location.

The staff concludes that the licensee understands and has identified the root cause of tube degradation at St. Lucie Units 1 and 2.

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<sup>7</sup>NRC Meeting Summary, Subject: "Summary of August 27, 1986 Meeting with FP&L and NRC Staff Regarding Steam Generator Tube Degradation Mechanism," dated September 12, 1986.

<sup>8</sup> See note 1.

- (c) Require the licensee to specifically state what corrective measures will be implemented to prevent recurrence of steam generator tube failures in all the steam generators in Unit 1 and Unit 2.

As previously discussed, degradation of the steam generator tubing is caused by the interaction of water chemistry, thermal-hydraulic design, materials selection, fabrication methods, and operating conditions. The licensee has applied corrective measures in order to reduce the rate of tube degradation. For example, the rate of tube degradation may be reduced through improvements in water chemistry. The licensee follows industry guidelines<sup>9</sup> on secondary water chemistry for both units, and these guidelines represent a significant improvement over the guidelines followed when Unit 1 began operating. The guidelines have stringent requirements and limitations on specific types and amounts of chemicals in the primary and secondary water to mitigate corrosion. Replacement steam generators having improved design, for example, better material selection and tube support configuration, have had much better operating experience than the earlier steam generators, such as those at St. Lucie. The licensee plans to replace the Unit 1 steam generators in October 1997 with steam generators that incorporate these design improvements.

The NRC staff focuses on ensuring adequate tube integrity by requiring licensee compliance with applicable regulations and Technical Specification requirements. The staff uses its field inspections, meetings with the licensee, and licensing reviews to ensure that the licensee satisfies the

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<sup>9</sup> FP&L letter, "Generic Letter 95-03 Response," dated June 23, 1995.

regulations<sup>10</sup> and plant Technical Specifications as they apply to steam generator tube integrity and that appropriate inspection methods and repair criteria are used to address specific forms of degradation. Plant Technical Specifications define degraded and defective tubes, specify the scope of inspections and reporting requirements and set forth tube plugging criteria and limits for allowable leakage in the reactor coolant system. NRC regulations and plant Technical Specifications require that steam generator tube degradation be managed through a combination of inservice inspection, repair of tubes exceeding the plugging criteria in the plant Technical Specifications, primary-to-secondary leakage monitoring, and structural and run-time analyses to ensure that safety objectives are met. On the basis of the information provided by the licensee in the meeting on July 3, 1996, and the staff's onsite inspection, the staff has concluded that the licensee is in compliance with these requirements.

In summary, the licensee's corrective measures to reduce the rate of steam generator tube degradation and continued compliance with NRC regulations and plant Technical Specification requirements provide reasonable assurance that steam generator tube integrity at St. Lucie Units 1 and 2 will be maintained.

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<sup>10</sup> The NRC regulations that require steam generator tube integrity be maintained include 10 CFR Part 50, Appendix A, General Design Criteria for Nuclear Power Plants, Criterion 1 - Quality Standards and Records, Criterion 14 - Reactor Coolant Pressure Boundary, Criterion 30 - Quality of Reactor Coolant Pressure Boundary, Criterion 31 - Fracture Prevention of Reactor Coolant Pressure Boundary, and Criterion 32 - Inspection of Reactor Coolant Pressure Boundary; 10 CFR Part 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants; and 10 CFR Part 50.55a, which specifies codes and standards for nuclear power plants.



III. CONCLUSION

On the basis of the fact that (1) the licensee has performed adequate steam generator tube inspections that identified areas of degradation, (2) the licensee has completed analyses and repairs of degraded tubes, (3) the licensee's in situ pressure testing of degraded tubes indicated adequate structural integrity remains, (4) the licensee is monitoring primary-to-secondary leakage on a continuing basis, and (5) the licensee is complying with NRC regulations and plant Technical Specifications, I have concluded that a confirmatory order limiting St. Lucie Unit 1 to 50 percent of its power-level capacity is not warranted and that the licensee has identified the root cause of tube degradation and implemented adequate corrective measures to provide reasonable assurance that steam generator tube integrity will be maintained at St. Lucie Units 1 and 2.

For the reasons previously discussed, no basis exists for taking any further action in response to the Petition. As provided in 10 CFR 2.206(c), a copy of the Decision will be filed with the Secretary of the Commission for the Commission's review. This Decision will constitute the final action of the Commission 25 days after issuance unless the Commission, on its own motion, institutes a review of the Decision within that time.

Dated at Rockville, Maryland, this 18th day of November 1996.

FOR THE NUCLEAR REGULATORY COMMISSION



Frank J. Miraglia, Jr., Acting Director  
Office of Nuclear Reactor Regulation