

April 1, 1999

Mr. James Scarola, Vice President
Shearon Harris Nuclear Power Plant
Carolina Power & Light Company
Post Office Box 165, Mail Code: Zone 1
New Hill, North Carolina 27562-0165

SUBJECT: ISSUANCE OF AMENDMENT NO. 87 TO FACILITY OPERATING LICENSE NO. NPF-63 REGARDING CHANGES TO THE SURVEILLANCE REQUIREMENTS FOR THE AUXILIARY FEEDWATER SYSTEM - SHEARON HARRIS NUCLEAR POWER PLANT, UNIT NO. 1 (TAC NO. MA0434)

Dear Mr. Scarola:

The Nuclear Regulatory Commission has issued Amendment No. 87 to Facility Operating License No. NPF-63 for the Shearon Harris Nuclear Power Plant, Unit No. 1, in response to your request dated December 16, 1997, as supplemented by letters dated August 31, and December 7, 1998. This amendment changes Technical Specification (TS) 4.7.1.2.1.a.2.a, Auxiliary Feedwater (AFW) System Surveillance Requirements, by changing the differential pressure and flow requirements of the steam turbine-driven AFW pump to allow testing of the pump at a lower speed.

A copy of the related Safety Evaluation is enclosed. Notice of Issuance will be included in the Commission's regular bi-weekly Federal Register notice.

Sincerely,

Original signed by:

Richard J. Laufer, Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

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Docket No. 50-400

Enclosures:

- 1. Amendment No. 87 to NPF-63
- 2. Safety Evaluation

cc w/enclosures:

See next page

Distribution:

See next page

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*See previous concurrences

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DATE	<i>3/3/99</i>	<i>3/13/99</i>	03/30/99	3/24/99	<i>3/31/99</i>
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 1, 1999

Mr. James Scarola, Vice President
Shearon Harris Nuclear Power Plant
Carolina Power & Light Company
Post Office Box 165, Mail Code: Zone 1
New Hill, North Carolina 27562-0165

SUBJECT: ISSUANCE OF AMENDMENT NO. 87 TO FACILITY OPERATING LICENSE NO.
NPF-63 REGARDING CHANGES TO THE SURVEILLANCE REQUIREMENTS
FOR THE AUXILIARY FEEDWATER SYSTEM - SHEARON HARRIS NUCLEAR
POWER PLANT, UNIT NO. 1 (TAC NO. MA0434)

Dear Mr. Scarola:

The Nuclear Regulatory Commission has issued Amendment No. 87 to Facility Operating License No. NPF-63 for the Shearon Harris Nuclear Power Plant, Unit No. 1, in response to your request dated December 16, 1997, as supplemented by letters dated August 31, and December 7, 1998. This amendment changes Technical Specification (TS) 4.7.1.2.1.a.2.a, Auxiliary Feedwater (AFW) System Surveillance Requirements, by changing the differential pressure and flow requirements of the steam turbine-driven AFW pump to allow testing of the pump at a lower speed.

A copy of the related Safety Evaluation is enclosed. Notice of Issuance will be included in the Commission's regular bi-weekly Federal Register notice.

Sincerely,

A handwritten signature in cursive script that reads "Richard J. Laufer".

Richard J. Laufer, Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-400

Enclosures:

1. Amendment No. 87 to NPF-63
2. Safety Evaluation

cc w/enclosures:
See next page

AMENDMENT NO. 87 TO FACILITY OPERATING LICENSE NO. NPF-63 - HARRIS, UNIT 1

Docket File

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

CAROLINA POWER & LIGHT COMPANY, et al.

DOCKET NO. 50-400

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 87
License No. NPF-63

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by Carolina Power & Light Company, (the licensee), dated December 16, 1997, as supplemented by letters dated August 31, and December 7, 1998, 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 2.C.(2) of Facility Operating License No. NPF-63 is hereby amended to read as follows:

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(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, as revised through Amendment No. 87, are hereby incorporated into this license. Carolina Power & Light Company shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 60 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Sheri R. Peterson, Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: April 1, 1999

ATTACHMENT TO LICENSE AMENDMENT NO. 87

FACILITY OPERATING LICENSE NO. NPF-63

DOCKET NO. 50-400

Replace the following page of the Appendix A Technical Specifications with the enclosed page.
The revised area is indicated by a marginal line.

Remove Page

3/4 7-5

Insert Page

3/4 7-5

PLANT SYSTEMS

AUXILIARY FEEDWATER SYSTEM

SURVEILLANCE REQUIREMENTS (Continued)

- 2. Demonstrating that the steam turbine - driven pump satisfies performance requirements by either:

NOTE: The provisions of Specification 4.0.4 are not applicable for entry into MODE 3.

- a) Verifying the pump develops a differential pressure that (when temperature - compensated to 70°F) is greater than or equal to 1167 psid at a recirculation flow of greater than or equal to 81 gpm (40.5 KPPH) when the secondary steam supply pressure is greater than 210 psig, or
 - b) Verifying the pump develops a differential pressure that (when temperature - compensated to 70°F) is greater than or equal to 1400 psid at a flow rate of greater than or equal to 430 gpm (215 KPPH) when the secondary steam supply pressure is greater than 280 psig.
- 3. Verifying by flow or position check that each valve (manual, power operated, or automatic) in the flow path that is not locked, sealed, or otherwise secured in position is in its correct position; and
 - 4. Verifying that the isolation valves in the suction line from the CST are locked open.
- b. At least once per 18 months by:
 - 1. Verifying that each motor-driven auxiliary feedwater pump starts automatically, as designed, upon receipt of a test signal and that the respective pressure control valve for each motor-driven pump and each flow control valve with an auto-open feature respond as required;
 - 2. Verifying that the turbine-driven auxiliary feedwater pump starts automatically, as designed, upon receipt of a test signal. The provisions of Specification 4.0.4 are not applicable for entry into MODE 3; and
 - 3. Verifying that the motor-operated auxiliary feedwater isolation valves and flow control valves close as required upon receipt of an appropriate test signal for steamline differential pressure high coincident with main steam isolation.



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

CAROLINA POWER & LIGHT COMPANY

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1

DOCKET NO. 50-400

1.0 INTRODUCTION

By letter dated December 16, 1997, as supplemented by letters dated August 31, and December 7, 1998, Carolina Power and Light Company (the licensee) requested a revision to the Technical Specifications (TS) for the Shearon Harris Nuclear Power Plant. The licensee proposed to revise the surveillance requirements in TS 4.7.1.2.1.a.2.a to require that the turbine-driven auxiliary feedwater (TDAFW) pump be tested at 3700 revolutions per minute (rpm) instead of 4100 rpm. The corresponding pump differential pressure and flow acceptance requirements in the TS were revised to reflect the reduced turbine speed. The new acceptance criteria were calculated by application of the affinity rule for direct scaling with a change in pump speed.

The supplemental submittals dated August 31, and December 7, 1998, contained clarifying information only and did not change the initial no significant hazards consideration determination.

2.0 BACKGROUND

The AFW system at Shearon Harris supplies feedwater to the secondary side of the steam generators when the feedwater system is not available, either during plant conditions when it is not advantageous to run the feedwater system, or as an engineered safeguards system during plant transients when normal feedwater is interrupted. The AFW system includes three pumps: two redundant motor-driven pumps with a design rating of 450 gallons per minute (gpm) at 2940 feet of head; and one turbine-driven pump with a design rating of 900 gpm at 2940 feet of head at a turbine speed of 4100 rpm. The motor-driven AFW pumps are each 100% design capacity pumps and the TDAFW pump is sized for 200% of design capacity.

The current surveillance requirement for the TDAFW pump in TS 4.7.1.2.1.a.2.a requires verification of the pump differential pressure to be greater than or equal to 1433 psid at a recirculation flow of greater than or equal to 90 gpm when the secondary steam supply pressure is greater than or equal to 280 psig (pounds per square inch gage). The turbine speed is set at 4100 rpm to achieve this TS-required test point. The licensee states that the proposed change is necessitated by the pump experiencing elevated vibration levels at the current turbine speed setting. Supplemental testing by the licensee demonstrates that reducing the speed of the turbine from 4100 rpm to 3700 rpm reduces the overall pump vibration levels thereby implying that the bearing life should increase. It should be noted that both tests are performed through the AFW system pump minimum flow recirculation loop.

The licensee has proposed to reduce the differential pressure and flow requirements to 1167 psid (pounds per square inch differential) at 81 gpm respectively in TS 4.7.1.2.1.a.2.a. These numbers have been derived from application of the affinity rule for direct scaling to the previous technical specification values of 1433 psid and 90 gpm for a reduction in turbine speed from 4100 rpm to 3700 rpm. In addition, a 4% degradation of the differential pressure has been factored into the acceptance criteria.

3.0 EVALUATION

TS 4.7.1.2.1.a requires each AFW pump to be demonstrated operable every 31 days by either one of two tests. The first test is performed at low flow conditions during power operations; the second test is one at substantial flow conditions during cold shutdowns or refueling outages. The licensee has proposed to amend the acceptance criteria for the surveillance requirement of TS 4.7.1.2.1.a.2.a by reducing the differential pressure and flow requirements for the surveillance test of the TDAFW pump at low flow conditions.

3.1 TDAFW Pump Test at 3700 RPM

The licensee's request for a TS change results from problems with TDAFW pump bearings. Failures have been experienced that the licensee believes may be caused by higher than desired vibration levels resulting from operating the turbine at 4100 rpm while the system is aligned to pump through the minimum flow recirculation loop of the AFW system.

The licensee has proposed to alleviate the vibration problem by conducting the TS testing at 3700 rpm under these low flow conditions. The licensee stated in their August 31, 1998, submittal, that the current design of the Shearon Harris plant does not require the turbine to operate at 4100 rpm. The Final Safety Analysis Report states that the highest steam generator pressure that the AFW pumps are required to inject is 1205 psig. With the controller set to deliver AFW system flow at 28 psig above steam generator pressure, the licensee states that the corresponding flowrate would be approximately 55C gpm. During a main steam line break or feedwater line break, the turbine would go to a maximum speed of 4125 rpm for approximately 60 seconds. The only instance that the turbine would run over 3700 rpm would be at substantial flow conditions attributed to a main steam or feedwater line break, which is a less problematic operating point for the pump. Testing the pump at a turbine speed of 3700 rpm would include all significant pump operation points at substantial flow conditions. Reducing the pump speed during testing from 4100 rpm to 3700 rpm will reduce the elevated vibration levels without reducing the effectiveness of the TDAFW pump test.

3.2 Testing at Low Flow Conditions

3.2.1 Discussion

Many facilities are not designed to accommodate testing of certain safety-related pumps at full or substantial flow conditions during power operation. At several facilities, TS testing points for safety-related pumps tested during power operation reflect this impracticality. Many licensees apply the results from their inservice test to satisfy the requirement of their TS test. In addition,

the standard TS for all nuclear steam supply systems includes language that allows pumps to be tested in accordance with the inservice testing (IST) program. It should be noted that the inservice test and the TS test serve different functions. The inservice test is designed to determine pump degradation from a predetermined baseline test condition. TS surveillance tests, as defined in 10 CFR 50.36(c)(3), are requirements to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met.

The ASME Code edition currently incorporated by reference in 10 CFR 50.55a(b) for IST (the 1989 Edition of ASME Section XI) does not require pumps to be tested for degradation at specific operating points. The function of the ASME Code is to determine degradation and not to verify the design basis capability of a component. The Code requirement which usually determines the condition in which the pump is tested is that the test must be repeatable. However, a concern exists about the adequacy of testing pumps at low flow conditions. The 1995 Edition of the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code), which is currently being considered for endorsement by the NRC, requires that licensees test safety-related pumps within $\pm 20\%$ of the design basis flow of the pump, where practical, at least once every plant refueling outage cycle. This change to the Code acknowledges that the current testing requirements are in need of improvement to adequately determine the effect of degradation of safety-related pumps.

3.2.2 Evaluation

Currently, TS 4.7.1.2.1.a.2.a requires testing the TDAFW pump at a recirculation flow of greater than or equal to 90 gpm. The licensee has proposed reducing the required test flow to 81 gpm.

According to the manufacturer's pump curve, included in the licensee's December 16, 1997, submittal, the TS test flow rate of 90 gpm is 10% of the design flow rate of the TDAFW pump and approximately 5% of the maximum pump capacity as indicated on the manufacturer's pump curve. Therefore, the pump is being tested well below its best efficiency point. The performance point where the pump is being tested is such that it would take a substantial increase in flow to have a reliably detectable change in differential pressure.

A typical pump inservice test involves establishing operation of the pump at a fixed reference point while measuring other parameters. In the case of the TDAFW pump, the licensee establishes the turbine speed first, then pump flowrate. The pump differential pressure is then measured, and is used to determine degradation. Inability of the pump to establish the fixed reference value would constitute a failed test. A test would also be considered to fail if, once the fixed reference value were established, the "variable" reference value (in this case pump differential pressure) was not able to meet its acceptance criterion. For Shearon Harris, the current testing to meet the TS requirements is similar to the testing required by the IST program with the exception that the pump is tested at a turbine speed of 4100 rpm. Because the inservice test can be performed at any point, it is performed at a turbine speed of 3700 rpm. For both the TS test and the inservice test, the change in differential pressure is the acceptance criterion. (It should be noted that in the latest version of the standard TS, certain pump testing is allowed to be performed in accordance with the IST program.)

The staff's review of the pump manufacturer's performance curve (total developed head vs. pump flow) for a turbine speed of 4100 rpm, which was included in the licensee's submittal of December 16, 1997, indicates that at flow rates of approximately 90 gpm or less, the curve is essentially flat (i.e., there is little change in the total developed head as the pump flow changes). The licensee stated in a conference call on December 1, 1998, that at the point on the curve where the test was being conducted, it is difficult to set the flow at 90 gpm; therefore, the difference in using 81 gpm is negligible. At low flow rates for centrifugal pumps, flow instabilities are not uncommon and are usually dominated by recirculation at the inlet region of the pump. It is extremely difficult to determine any type of degradation at this performance point. In addition, because of the complex nature of the internal pump flows when operating at the low flow condition, an analytical determination cannot accurately be made about the performance of the pump at its design basis condition.

As part of the review of this TS change, the staff reviewed the licensee's response to Bulletin 88-04, "Safety-Related Pump Loss," for instances when this pump would be operated at low flow conditions for an extended period of time. The licensee's responses to the bulletin in submittals dated July 8, 1988, and November 1, 1988, did not cite any problems with operation of the TDAFW pump with regard to recirculation line capacity and mission time under low flow conditions. Based on these submittals, it appears that operation at low flow conditions for an extended period of time during accident conditions is not a concern. The response was not required to address testing at low flow conditions.

As discussed above, there are inherent problems with testing pumps at low flow conditions. However, in this case, based on the shape of the pump's performance curve, reducing the pump flow from the current TS requirement of 90 gpm to the proposed 81gpm will have a negligible effect on the test results. This flow reduction will also allow the pump to be tested at a lower speed, which will reduce the vibration levels as discussed earlier. The licensee has also proposed test acceptance criteria that are similar to the IST program, which is consistent with the latest version of the standard TS. Therefore, the licensee's proposal to test the TDAFW pump using an 81 gpm flowrate at a turbine speed of 3700 rpm is acceptable.

3.3 Use of Affinity Rule to Establish TS Acceptance Criteria

The licensee has proposed to apply an affinity rule to determine the pump acceptance criteria at a reduced turbine speed of 3700 rpm based on the current TS limits. Direct application of the affinity equation for differential pressure and flow as a function of turbine speed yielded the new acceptance criteria. The licensee has also factored in a 4% allowable degradation, which is described in their TS bases. This allowable degradation is more stringent than required in the ASME Code and is, therefore, acceptable.

The affinity rules are primarily used by pump designers to scale the performance of an existing pump to that of a theoretical pump. It gives the designer an initial iteration as to the effect of design changes on the performance characteristics of a pump. Once a prototype pump is developed from the affinity rules, it can be tested to determine the actual performance. The affinity rules are not derived from physical laws. Therefore, their results should be considered only as approximations subject to verification by testing.

The licensee did perform testing to validate its new acceptance criteria. Based on the licensee's submittal of August 31, 1998, this verification point is the reference point where the licensee conducts its inservice test on the TDAFW pump. The testing concluded that the proposed TS differential pressure was within 2% of the actual pump differential pressure. However, the test was conducted at a fixed reference value of 90 gpm. A more appropriate validation test would have been to establish the fixed reference value at 81 gpm and measure the resultant pump differential pressure. However, in reviewing the shape of the performance curve between 90 gpm and pump shutoff (no flow), the staff finds the difference in the test results negligible in light of the inherent inaccuracies in testing pumps at low flow conditions and the difficulty in extracting useful information from the test results. The lower reference flow rate is less conservative than the 90 gpm flow rate because the differential pressure is slightly higher. However, this effect is negligible and, from a practical standpoint, undetectable. Therefore, the acceptance criterion of 1167 psid at 81 gpm is acceptable.

3.5 SUMMARY

The staff finds the licensee's proposed TS change, which used a direct scaling of the previous acceptance criteria with the change in turbine speed, acceptable for the following reasons: (1) the reduction of the turbine speed from 4100 rpm to 3700 rpm eliminates elevated vibration levels and does not reduce the effectiveness of the test for the TDAFW pump; (2) testing at the proposed low flow conditions is similar to the testing allowed in the new standard TS; and (3) the differential pressure acceptance criterion derived from the use of the affinity rule has been verified by testing.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the State of North Carolina official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes surveillance requirements. The NRC staff has determined that the amendment involves 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 amendment involves no significant hazards consideration, and there has been no public comment on such finding (63 FR 6981). 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.

Principal Contributor: J. Colaccino

Date: April 1, 1999

Mr. James Scarola
Carolina Power & Light Company

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