

December 27, 2001

Mr. Harold W. Keiser  
Chief Nuclear Officer & President  
PSEG Nuclear LLC - X04  
Post Office Box 236  
Hancocks Bridge, NJ 08038

SUBJECT: SALEM NUCLEAR GENERATING STATION, UNIT NO. 1, ISSUANCE OF  
AMENDMENT RE: EMERGENCY REQUEST FOR CHANGE TO TECHNICAL  
SPECIFICATION (TS) 3/4.7.4, SERVICE WATER SYSTEM (TAC NO. MB3528)

Dear Mr. Keiser:

The Commission has issued the enclosed Amendment No. 248 to Facility Operating License No. DPR-70 for the Salem Nuclear Generating Station, Unit No. 1 (Salem). This amendment consists of changes to the Technical Specifications (TSs) in response to your application dated December 10, 2001, as supplemented on December 21 and 24, 2001.

This amendment allows a one-time change to TS Limiting Condition for Operation 3/4.7.4, "Service Water System," to increase the Allowed Outage Time (AOT) from 72 hours to 10 days. The increase in the TS 3/4.7.4 AOT is necessary in order to allow repairs to a portion of the 12 Service Water System piping, located near the Salem intake structure, while remaining at power.

A copy of our safety evaluation is also enclosed. Notice of Issuance will be included in the Commission's biweekly Federal Register notice.

Sincerely,

**/RA R. Ennis for/**

Robert J. Fretz, Project Manager, Section 2  
Project Directorate I  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Docket No. 50-272

Enclosures: 1. Amendment No. 248 to  
License No. DPR-70  
2. Safety Evaluation

cc w/encls: See next page

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PSEG NUCLEAR LLC  
EXELON GENERATION COMPANY, LLC  
DOCKET NO. 50-272  
SALEM NUCLEAR GENERATING STATION, UNIT NO. 1  
AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 248  
License No. DPR-70

1. The Nuclear Regulatory Commission (the Commission or the NRC) has found that:
  - A. The application for amendment filed by the PSEG Nuclear LLC and Exelon Generation Company, LLC (the licensees) dated December 10, 2001, as supplemented on December 21 and 24, 2001, 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 set forth in 10 CFR Chapter I;
  - 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. DPR-70 is hereby amended to read as follows:

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 248, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

**/RA/**

James W. Clifford, Chief, Section 2  
Project Directorate I  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical  
Specifications

Date of Issuance: December 27, 2001

ATTACHMENT TO LICENSE AMENDMENT NO. 248

FACILITY OPERATING LICENSE NO. DPR-70

DOCKET NO. 50-272

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

Remove Pages

3/4 7-16

Insert Pages

3/4 7-16

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO AMENDMENT NO. 248 TO FACILITY OPERATING LICENSE NO. DPR-70

PSEG NUCLEAR LLC

EXELON GENERATION COMPANY, LLC

SALEM NUCLEAR GENERATING STATION, UNIT NO. 1

DOCKET NO. 50-272

## 1.0 INTRODUCTION

By letter dated December 10, 2001, as supplemented on December 21 and 24, 2001, PSEG Nuclear LLC (PSEG or the licensee) submitted a request for changes to the Salem Nuclear Generating Station, Unit No. 1 (Salem) Technical Specifications (TSs). The requested changes would provide a one-time change to the Allowed Outage Time (AOT) for TS 3/4.7.4, "Service Water System." The AOT for TS 3/4.7.4 would be increased from 72 hours to 10 days. This change was requested by PSEG in order to support repairs to the 12 Service Water System (SWS) header while operating in Mode 1. The December 21, 2001, letter provided clarifying information that did not change the scope of the initial proposed no significant hazards consideration determination. The December 24, 2001, letter requested that the proposed TS change be approved under emergency conditions, in accordance with Title 10 of the *Code of Federal Regulations* Section 50.91(a)(5), in lieu being approved under exigent circumstances as originally requested in the licensee's letter dated December 10, 2001, and as discussed in the notice of consideration of issuance of amendment as published in the Federal Register on December 17, 2001 (66 FR 64996).

## 2.0 BACKGROUND

According to Salem's Updated Final Safety Analysis Report (UFSAR), the SWS at Salem provides a heat sink for the removal of process and operating heat from safety-related components during a design basis accident (DBA) or transient. During normal operation, and normal shutdown, the SWS also provides this function for various safety-related and non-safety-related components. The SWS consists of two separate, 100% capacity, safety related, cooling water trains. Each train is equipped with three vertical turbine-type pumps that provide strained Delaware River Water to the plant before discharging via the circulating water system outlet piping. Cooling water flow is divided into two portions, servicing various nuclear area and turbine generator area heat loads, including the following:

- Reactor containment fan cooler units
- Component cooling water (CCW) heat exchangers
- Diesel generators
- Chiller condensers
- Auxiliary equipment lube oil coolers
- Auxiliary equipment room coolers

- Steam generator feed pump coolers
- Station air compressor units
- Turbine lube oil coolers
- Turbine auxiliary cooling water heat exchangers
- Other Intake Structure heating loads

The design basis of the SWS is for one SWS train, in conjunction with the CCW System and a 100% capacity containment cooling system, to remove core decay heat following a design-basis loss-of-coolant accident (LOCA) as discussed in UFSAR Section 9.2.1. The SWS is designed to keep the containment sump fluid from increasing in temperature during the recirculation phase following a LOCA, and provides for a gradual reduction in the temperature of this fluid as it is supplied to the Reactor Coolant System (RCS) by the emergency core cooling system (ECCS) pumps. The SWS is designed to perform its function with a single failure of any active component, assuming the loss of offsite power (LOOP).

#### *Request For One-Time Change to AOT*

On November 30, 2001, PSEG discovered water rising up through the gravel surface in front of the service water intake structure. The water was located approximately 5 feet from the structure and 7 feet from the north side stairs. The 12 Service Water nuclear header is located below the location where the water was observed, and the licensee initially considered this to be a likely source of the leak.

A subsequent investigation and troubleshooting by PSEG personnel determined that the leak was associated with the 12 Service Water nuclear supply header. This determination was partially based on the use of a dye test. PSEG believes that the leak may be associated with an underground mechanical joint or mechanical connection associated with the buried portion of the 12 Service Water nuclear supply header located near the Service Water structure. PSEG performed an operability evaluation, and determined that the system remained operable.

PSEG requested in its December 10, 2001, application that the TS change be approved under exigent circumstances. As previously noted, an operability determination concluded that the SWS remained operable at the leak rate measured at that time. In a phone call with the licensee on December 12, 2001, PSEG reported that the estimated leak rate was 20 to 25 gallons per minute (GPM). However, by letter dated December 24, 2001, the licensee stated that, on December 22, 2001, the 12 Service Water nuclear header leakage had increased to approximately 110 GPM. The licensee added that the current leak rate remains less than the limiting leak rate of 200 GPM as determined by in the licensee's operability determination. In the December 24, 2001, letter, PSEG also stated that it believes that, due to the increased leakage, an emergency situation exists per 10 CFR 50.91(a)(5), in that the failure to promptly act on the proposed TS change would result in the shutdown of Salem Unit No. 1.

### 3.0 EVALUATION

LCO 3/4.7.4 requires that two SWS trains be operable in Modes 1, 2, 3, and 4 to provide the required redundancy to ensure that the system functions to remove post-accident heat loads, assuming the worst-case single active failure occurs coincident with the LOOP. An SWS train is considered to be operable when the pump is operable, and the associated piping, valves,

heat exchanger, and instrumentation and controls required to perform the safety function are operable.

During the proposed extended AOT, the 12 Service Water nuclear header will be taken out of service for repairs. PSEG stated in its December 10, 2001, application that during the time that the system is initially taken out of service and a blind flange installed to isolate the affected 12 SWS piping, as well as when the system is being restored following repairs, it will provide a dedicated operator who will be available to initiate service water cooling via the Salem Unit No. 2 cross-connect piping. The Salem Unit No. 2 cross-connect is intended to serve as a back up source of cooling water during these periods only. The NRC staff independently reviewed drawings of the SWS provided in the Salem UFSAR to confirm whether PSEG's use of the 14, 15, and 16 service water pumps as back up pumps for the 11 Service Water nuclear header was feasible. Based on this review, the staff finds the licensee's approach to be acceptable.

### 3.1 No. 11 Service Water Nuclear Header Pipe Integrity

Since the section of the 12 Service Water nuclear header piping will be taken out of service between the intake structure and the auxiliary building for an extended period, it will be necessary for the licensee to assure adequate cooling through the 11 Service Water nuclear header during the proposed AOT. As previously stated, all 6 service water pumps will have the ability to supply the necessary cooling water through the 11 Service Water nuclear header except during the times that the blind flange is installed and removed. In addition, the operation of the SWS beyond the affected piping in the auxiliary and containment buildings will be unaffected by the proposed TS change. Therefore, the section of piping between the intake structure and the auxiliary building will be the critical component necessary to maintain service water flow during the extended AOT since there will be no other redundant supply header available.

In its December 10 and 21, 2001, letters, PSEG provided the following information to justify why it believes that the design function provided by the 11 Service Water nuclear header will remain unimpaired during the proposed extended AOT:

- The SWS is designed for Class I (seismic) conditions except for the turbine area service water piping outside the intake structure.
- Degradation of the tendons in the prestressed concrete pipe (PCCP) is the bounding credible failure mechanism for structural integrity. In this situation, corrosion originates from the exterior of the pipe due to a breakdown in the protective properties of the outer cement mortar coating. This loss of protection allows corrosion to initiate on the prestressed tendon wires. Wire deterioration can then be caused by galvanic corrosion, stray-current corrosion or hydrogen embrittlement (a form of stress corrosion cracking). However, deterioration of the reinforcing wires would not cause immediate catastrophic failure due to the existence of a 10 gauge steel liner. This liner is thick enough to retain the service water line pressure.
- The PCCP's bell and spigot joints are designed to flex, and the seismic capability of the piping system is derived from the engineered soils, which provide passive resistance to the piping.

- There is no evidence that the leakage from the 12 SWS header has challenged the surrounding soil bearing capability.
- The 11 header piping was last inspected during the most recent Salem Unit No. 1 refueling outage in April 2001. The results of this inspection showed that no repairs were necessary.

The NRC staff reviewed the description of the SWS in the Salem UFSAR. The section of piping between the intake structure and auxiliary building is predominantly reinforced concrete pipe, otherwise referred to as PCCP. Since the SWS is classified as a moderate energy piping system, system pressures and temperatures are low enough that it is highly improbable that the PCCP will catastrophically fail without warning. Extensive experience with this type of piping has shown that corrosion of the reinforcing tendons and 10 gauge steel liner would result in noticeable water leakage prior to rupture. Consequently, it is very unlikely that a piping failure would result in a total loss of service water before the licensee could initiate a controlled shutdown of the plant. Furthermore, according to the Salem UFSAR and the licensee's December 21, 2001, letter, the piping is buried underground and is surrounded by engineered soils suitable for this type of field application. The PCCP and engineered backfill/soils, as a system, provides sufficient structural stability that would serve to limit any credible leak from a crack that could realistically develop in this type of piping. The staff notes that the recent observations associated with the leaking, but currently operable, 12 Service Water nuclear header are consistent with PCCP experience. Therefore, based on its review, the staff concurs with the licensee's engineering evaluation that a total loss of service water due to a catastrophic failure of the redundant 11 Service Water nuclear header is highly unlikely during the proposed extended AOT.

### 3.2 Risk Assessment

The licensee evaluated the potential risk impacts of continuing power operation for up to 10 days with the 12 Service Water nuclear header out of service, and normal operating and accident service water flow requirements being provided by the 11 nuclear header only. During most of the extended AOT, the 11 nuclear header will have up to 6 pumps that are powered from redundant vital buses. As previously stated, a dedicated operator will be available during the other periods to perform the necessary actions to initiate service water cooling flow through the Salem Unit No. 2 cross-tie connection.

According to the licensee's December 10 and 21, 2001, letters, the Salem probabilistic safety assessment (PSA) model baseline core damage frequency is  $4.995\text{E-}05$  per year, and the baseline large early release frequency is  $9.87\text{E-}06$  per year. The incremental conditional core damage probability (ICCDP) for the extended AOT is estimated to be less than  $2.89\text{E-}08$ . In addition, the incremental conditional large early release probability (ICLERP) is estimated to be less than  $3.92\text{E-}09$ . The ICCDP value of  $2.89\text{E-}08$  is below the Regulatory Guide (RG) 1.177 threshold of  $5.0\text{E-}07$  that is considered small for a single TS AOT change. The ICLERP of  $3.92\text{E-}09$  is also below the RG 1.177 threshold of  $5.0\text{E-}08$  for a single TS AOT change. The staff notes that, although RGs 1.177 and 1.174 are normally applicable only to permanent (as opposed to temporary, or "one time") changes to TS requirements, PSEG has demonstrated that the proposed TS AOT change has only a small quantitative impact on plant risk.

PSEG has considered appropriate restrictions on dominant risk-significant configurations associated with the change. For example, in its December 21, 2001, letter PSEG stated that it gained valuable insights from a simulator exercise and qualitative assessment of the Salem PSA model. This evaluation showed the importance of maintaining reactor coolant pump (RCP) seal integrity as well as other reactor coolant system inventory and cooling concerns in the event of a total loss of service water. If there would be a total loss of service water, PSEG plans on implementing various coping strategies, such as securing letdown flow, minimizing charging flow, and isolating RCP thermal barrier cooling in order to further minimize component cooling system heat up.

Additionally, the licensee has implemented a risk-informed plant configuration control program in accordance with 10 CFR 50.65(a)(4). In its December 21, 2001, supplement, PSEG stated that there are no planned outages for the power operated relief valve (PORV) block valves and auxiliary feedwater (AFW) trains during the proposed AOT. However, if maintenance was required on the PORV block valves or an AFW train during the extended AOT, the licensee would evaluate the impacts to plant risk according to 10 CFR 50.65(a)(4).

Therefore, since PSEG has addressed risk concerns by demonstrating that the proposed one-time AOT change will result in a small quantitative impact on plant risk, that dominant risk-significant configurations were considered, and has implemented a risk-informed configuration control program, the staff finds this acceptable.

### 3.3 Compensatory Actions

The licensee will take further actions to minimize the chances of a complete loss of service water during the repair process. Prior to cross-connecting the 14, 15, and 16 service water pumps to augment the 11, 12, and 13 service water pumps which normally serve the 11 Service Water nuclear header, PSEG stated in its December 21, 2001, letter that a service water header outage contingency plan will be in effect. The plan will include: (1) provisions to use the Salem Unit No. 2 service water cross-tie, if required; (2) pre-staged equipment for restoration of the 12 Service Water nuclear supply header; and (3) additional maintenance and engineering staffing during the repairs. The licensee added that existing plant procedures direct a rapid shutdown to Mode 3 in the event of a loss of service water. The plant would be maintained with decay heat removal provided by the auxiliary feedwater system and the steam generator atmospheric relief valves. Water inventory would be sufficient to provide for decay heat removal until restoration of a service water nuclear header. Salem's procedures also address the resulting loss of ventilation and spent fuel pool cooling by cross connecting the affected systems to Salem Unit No. 2, and by establishing alternate ventilation paths. PSEG also stated that spent fuel pool temperatures would not reach the design temperature limit for greater than 200 hours, based upon current spent fuel decay heat loads. Salem's procedures provide for cross connecting to the Salem Unit No. 2 spent fuel pool cooling system before design limits would be exceeded.

As previously stated, the licensee conducted simulator exercises involving a total loss of service water scenario. This action served to validate that PSEG's compensatory measures were adequate. The exercises included briefing the crew on plant conditions for the 12 SWS header outage, discussion of potential coping strategies, and review of existing plant procedures. These procedures include the necessary actions to diagnose plant conditions, and perform steps to mitigate the loss of service water, such as tripping the plant, securing RCPs, ensuring

the plant was stabilized, securing letdown, minimizing charging flow, isolating the RCP thermal barriers to minimize component cooling system heat up, and progressing to plant cooldown. During the simulator exercise scenario, the licensee monitored charging pump operation, component cooling system and containment temperatures to evaluate system response.

Therefore, because the licensee has prepared for various possible contingencies by using risk insights, the staff finds that the compensatory measures to be taken by PSEG during the proposed extended AOT are acceptable.

### 3.4 Staff Conclusions

Based on its review, the NRC staff finds that since: (1) the total loss of service water due to a catastrophic failure of the redundant 11 Service Water nuclear header will be highly unlikely during the proposed extended AOT; (2) the proposed one-time AOT change will result in only a small quantitative impact on plant risk; and (3) the dominant risk-significant configurations will be addressed by appropriate compensatory measures, the proposed one-time TS change is acceptable.

## 4.0 STATEMENT OF EMERGENCY CIRCUMSTANCES

In its original December 10, 2001, application, PSEG requested an exigent TS change to TS 3/4.7.4 to allow repairs to, and testing of, the 12 Service Water nuclear supply header while remaining at power. However, by letter dated December 24, 2001, PSEG requested that the proposed TS amendment be treated under emergency circumstances pursuant to 10 CFR 50.91(a)(5). As previously noted, the licensee requested this change in treatment following a significant increase in leakage observed to be coming from the 12 Service Water nuclear header on December 22, 2001.

PSEG determined that an internal inspection and repair of the affected piping would require approximately 10 days to perform. Since this is greater than the current LCO AOT of 3 days, a one-time TS change would be necessary in order to avoid shutting down or otherwise derating the plant. The licensee stated that it could not have foreseen the need for a TS amendment prior to the indication of the leakage. The SWS nuclear supply headers are inspected every 3 years, with one header inspected every refueling outage on a staggered basis. The licensee last inspected the 12 Service Water nuclear supply header in the fall of 1999, and did not note any deficiencies that would require repairs.

The staff concurs with the licensee's assessment that, although the 12 Service Water nuclear supply header may be operable, repairs will likely be required within a matter of days, and are almost certainly probable before the next refueling outage scheduled for the fall of 2002. Accordingly, the staff considers it prudent to repair the leaking header in a timely manner. Prompt action would allow the licensee to take advantage of more desirable weather and river water temperature conditions. The staff also notes that the SWS chlorination system is currently out of service due to environmental concerns associated with the leak. If the chlorination system remains out of service for extended periods, or does not operate during warmer weather, there will likely be a significant increase in heat exchanger bio-fouling, as well as an increased chance of microbiologically induced corrosion (MIC) effects within the SWS. Therefore, based on its review, the NRC staff finds that emergency circumstances exist as

defined by 10 CFR 50.91(a)(5), and that this situation was not the result of actions taken, or the failure to take actions, by the licensee.

## 5.0 FINAL NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

The Commission's regulations in 10 CFR 50.92 state that the Commission may make a final determination that a license amendment involves no significant hazards consideration if operation of the facility, in accordance with the amendment, would not (1) involve a significant increase in the probability or consequences of an accident previously evaluated, or (2) create the possibility of a new or different kind of accident from any accident previously evaluated, or (3) involve a significant reduction in a margin of safety. As required by 10 CFR 50.91(a), the licensee has provided its analysis of the issue of no significant hazards consideration, which is presented below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No

The Service Water System (SWS) will remain capable of performing its required safety function. The proposed change results in an insignificant increase in the incremental conditional core damage probability and so does not involve a significant increase in the probability of an accident. The proposed change to extend the allowed outage time from 72 hours to 10 days does not significantly increase consequences of an accident previously evaluated, since the capability of SWS is maintained.

Therefore, the proposed change will not significantly increase the probability or consequences of any accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously analyzed?

Response: No

The completion of the maintenance activity, the post maintenance testing, and the surveillance testing associated with demonstrating OPERABILITY of 12 service water nuclear header will not result in the plant being operated in a manner that will create the possibility of a new or different kind of accident from any previously evaluated. While repair to the buried portion of the 12 service water nuclear header is in progress, the service water system will be operated as described in the Updated Final Safety Analysis Report. This configuration does not create a new failure mechanism, malfunction or accident initiator.

Therefore, the proposed change will not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No

The 11 service water nuclear header will remain operational and capable of performing its required safety functions. Sufficient safety-related equipment and systems will remain available to ensure that the consequences of design basis transients and accidents are mitigated as assumed in the Salem UFSAR. Preventive maintenance activities that could adversely affect the reliability of the Unit 1 service water system, Emergency Diesel Generators, 4kv vital buses or offsite A.C. electrical power sources will be controlled during the extended allowed outage time.

Based on the preceding considerations, the NRC staff concludes that the amendment meets the three standards of 10 CFR 50.92(c). Therefore, the NRC staff has made a final determination that the proposed amendment request involves a no significant hazards consideration.

#### 6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the New Jersey State official was notified of the proposed issuance of the amendment. The State official provided no comments.

#### 7.0 ENVIRONMENTAL CONSIDERATION

The 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 effluents 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.

#### 8.0 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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Date: December 27, 2001

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