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Company

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United States Nuclear Regulatory Commission
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Ladies and Gentlemen:

**REQUEST FOR ADDITIONAL INFORMATION REGARDING
SPENT FUEL POOL COOLING SYSTEM
SALEM GENERATING STATION UNIT NOS. 1 AND 2
FACILITY OPERATING LICENSES DPR-70 AND DPR-75
DOCKET NOS. 50-272 AND 50-311**

On March 12, 1998, the NRC issued a request for additional information in regards to letter LR-N980008 submitted by Public Service Electric and Gas (PSE&G) on January 19, 1998. In letter LR-N980008, PSE&G committed to seismically qualify the Spent Fuel Pool Cooling System. Responses to the NRC's questions are contained in Attachment 1 of this letter.

If you have any questions concerning the above information, please do not hesitate to contact us.

Sincerely,

E C Simpson

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NRC Question 1:

Since the spent fuel pool (SFP) liner analysis will not be revised for boiling conditions, what is the design temperature of the SFP liner?

PSE&G Response:

The spent fuel pool (SFP) liner analysis has a design temperature of 180 °F for the SFP liner. For postulated events that do not credit liner integrity, the SFP's seismic class I structure and anti-siphon piping will support and maintain the pool integrity. The liner drain lines will be provided with isolation valves or capped to limit the leakage during the seismic upgrade of the SFPCS. The maximum SFP water temperature limit is controlled by procedures to 149 °F during normal operation and 180°F for a completely defueled reactor.

NRC Question 2a:

Has an evaluation of all initiating events within the Salem design basis that could lead to an elevated coolant temperature in the SFP been performed?

PSE&G Response:

The temperature rise rates of the SFPs have been evaluated with various irradiated fuel loading. Boiling is not a concern with the current spent fuel inventory in the SFPs even if the Spent Fuel Pool Cooling System (SFPCS) is lost indefinitely. For the upgraded (seismically qualified) SFPCS which will be in place before the next scheduled refueling outage for each Salem Unit, cooling will be maintained to limit fuel pool temperatures to 180 °F for planned refueling outages up to and including a full core off-load. The evaluation of the decay heat associated with a full core off-load incorporates a delay time before fuel transfer of 168 hours. The initiating events evaluated are the Seismic, loss of offsite power (LOOP), loss of coolant accident (LOCA), and loss of SFPCS.

The loss of SFPCS is addressed by an abnormal operating procedure to mitigate the event. Currently, in the event of a complete loss of SFP cooling at the instant when peak pool temperature occurs at the end of plant life, the time to boil is 4.61 hours during a batch refueling discharge (88 assemblies), 1.28 hours for the full core off-load, and would be 1.38 hours after a full core discharge 30 days after a refueling discharge of 68 assemblies as stated in UFSAR, Section 9.1.3.3. While boiling in the SFP establishes a case that exceeds the maximum liner design temperature, any liner leakage would be contained by the pool's seismic class I structure and anti-siphon piping. The liner drain lines will be provided with isolation valves or capped to limit the leakage during the seismic upgrade of the SFPCS.

NRC Question 2b:

Describe the redundancy, qualification, and train separation (mechanical and electrical) of the SFP cooling system (SFPCS) and any support systems that are necessary to prevent an elevated SFP coolant temperature (e.g., service water to the SFPCS heat exchangers). Consider normal, abnormal, and accident conditions within the design basis.

PSE&G Response:

The SFPCS will be seismically qualified with portions of the SFPCS being safety related. Each Unit's SFPCS has two 100% capacity non-safety related pumps and one safety related heat exchanger for each spent fuel pool. Each pump is powered from separate Class 1E vital buses. The SFPCS heat exchangers are cooled by the safety related Component Cooling Water System which transfers heat to the Service Water System. The Service Water System transfers heat to the ultimate heat sink, the Delaware River. There are four redundant makeup water sources available to the spent fuel pool, including the Refueling Water Storage Tank which is seismic category I. The other three sources, which are not seismic category I, are the Demineralized Water Storage Tanks, the Primary Water Storage Tank, and the Chemical and Volume Control System Holdup Tanks. Piping and valves are provided which allow the Unit 1 and Unit 2 heat exchangers to be cross connected. The cross-connect can be used to alternatively cool both pools when one heat exchanger is out of service and could be used in the future to minimize the temperature rise in one of the pools by connecting the heat exchangers in parallel.

During a loss of offsite power (LOOP) event the Component Cooling Water (CCW) pumps are automatically loaded onto their respective vital buses in Modes 1 through 4 and the SFPCS pumps are manually started. Therefore during a LOOP event SFP cooling capability is maintained. In Modes 5 and 6, the CCW pumps and SFPCS pumps are manually loaded on to the emergency diesel generators.

During a LOCA coincident with a LOOP, the CCW pumps are not automatically sequenced to supply cooling to the SFPCS. The operator restores cooling manually by starting CCW pumps and SFPCS pumps as directed by procedures. Since a LOCA is not coincident with a full core off-load (LOCA is only postulated to occur in Modes 1 through 4), the SFP decay heat generation is less compared to the maximum SFP design heat generation rate which includes a full core off-load.

The system description of the SFPCS outlining the details of the system redundancy, qualification, and train separation will be documented in the upgrade of the seismic qualification of the SFPCS.

NRC Question 3a:

Is the SFPCS designed to operate immediately following a loss of coolant accident?

PSE&G Response:

No. As stated above the SFPCS must be re-established by manual operator action following a LOCA as addressed by an abnormal operations procedure.

NRC Question 3b:

If, not, when would cooling be restored to the spent fuel pool and, under design conditions, what would be the maximum bulk SFP temperature?

PSE&G Response

After a LOCA the fuel pool would not contain a full core off-load. A LOCA is only postulated to occur when in Modes 1 through 4. The maximum heat load in the SFP would occur in Mode 4 after the refueling has been completed since the spent fuel just off-loaded from the core would have its maximum heat generation. As stated in UFSAR Section 9.1.3.3, the time-to-boil after loss of cooling would be 4.61 hours during a batch refueling discharge (88 assemblies). The 4.61 hours is calculated for a core offload at the end of plant life after waiting 168 hours before moving fuel. This calculation provides a conservative number with respect to the actual time available before SFP boiling would occur if the LOCA were to occur upon entry into Mode 4 following the core reload. The available time to take action to restore the SFPCS would be longer. This time will be determined during the seismic upgrade of the SFPCS.

NRC Question 4a:

Considering PSE&G's decision to qualify the SFPCS to seismic Category I requirements, what measures have been taken to prevent pool boiling until both trains of the SFPCS are seismically qualified?

PSE&G Response:

Sufficient decay time has elapsed with the current SFP fuel load such that boiling is not a concern even if the Spent Fuel Pool Cooling System (SFPCS) is lost indefinitely. SFP temperatures would remain below 180 °F for the Salem Unit 1 and 2 SFPs should the cooling systems become unavailable. A potential for SFP boiling is not credible until such time as freshly irradiated fuel is transferred to the SFP. Seismic qualification of the SFPCS will be completed prior to the next scheduled refueling outages for each Salem Unit. Additionally a Decay Heat Load Management Program is being established to address decay heat removal. As discussed in PSE&G letter LR-N96218, dated August 2, 1996, the Decay Heat Load Management Program will include the establishment of appropriate controls on the addition of newly irradiated fuel to the spent fuel pool to assure that spent fuel cooling requirements are satisfied. The Decay Heat Load Management Program will also establish appropriate controls over heat exchanger operation in the cross connected mode of operation to assure that both spent fuel storage pools are adequately cooled.

NRC Question 4b:

In addition, provide (a) an evaluation of the consequences of a loss of SFP cooling, (b) an estimate of the maximum leakage through the liner should a loss of cooling occur, and (c) a description of how the leakage would be stopped or controlled since there are no liner leakoff isolation valves.

PSE&G Response:

a. As stated above SFP temperatures would remain below 180 °F for the present spent fuel loading in the Salem Unit 1 and 2 SFPs should the cooling systems become unavailable.

b & c. For the present condition with no transfer of freshly irradiated fuel into the SFP, the temperature increases that potentially could cause liner failures are precluded. The present condition of the Unit 1 and 2 liners is good such that only a few liner drains show any leakage and the maximum leakage rate is in the order of a few drops a minute.

NRC Question 5:

Discuss the capability of the SFP liner leakoff system and the radwaste system to transport and process this liquid waste. Is there sufficient makeup available to the SFP to compensate for coolant losses due to evaporation and the maximum possible leakage through the liner?

PSE&G Response:

Given that liner leakoff isolation valves or caps will be installed, the maximum liner leakage would be maintained by the pool's seismic class I structure and anti-siphon piping. The pool integrity will be maintained and the flow to the radwaste system will be minimal. As stated in response to question 4b. above, the existing condition of the liner is good such that the leakage is minimal.

Leakage from the SFP is pumped by the fuel pool area sump pumps to the radwaste system. The fuel pool area sump pumps have a flow rate of 100 gpm. The sump pump directs the water to the three (3) waste holdup tanks which have a capacity of 25,000 gallons each. The waste holdup tanks are then pumped to the two (2) waste monitor tanks which have a capacity of 21,600 gallons each. The waste holdup tanks are enclosed within a dike to accommodate tank overflow.

Makeup for loss of coolant due to evaporation or other postulated leakage can be done by four normal makeup water sources. These makeup sources are the Demineralized Water System, the Refueling Water Storage Tank, the Chemical and Volume Control System Holdup Tanks, and the Primary Water Storage Tank SFP makeup can also be performed from the refueling cavity when the refueling cavity is available.

For the case of emergency make-up, the SFP emergency fill procedure utilizes a portable pump to restore level from the refueling water storage tank or the primary water storage tank. The worst case boiloff rate (and therefore the worst case required makeup rate) with a full core off-load at the end of plant life was calculated at 92.3 gpm. The makeup water flow rate of the portable pump is sufficient to meet this worst case requirement as stated in the UFSAR Section 9.1.3.3.