PSEG Nuclear LLC
P.O. Box 236, Hancocks Bridge, New Jersey 08038-0236

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SALEM GENERATING STATION – UNIT 1 AND UNIT 2
FACILITY OPERATING LICENSE NOS. DPR-70 AND DPR 75
NRC DOCKET NOS. 50-272 AND 50-311

Subject: **LICENSE AMENDMENT REQUEST LAR S07-05**
REVISION TO LICENSING BASIS – NPSH METHODOLOGY FOR ECCS PUMPS

In accordance with the provisions of 10 CFR 50.90, PSEG Nuclear, LLC (PSEG) hereby requests an amendment of the Operating License for Salem Generating Station Unit 1 and Unit 2.

The enclosed License Amendment Request (LAR) requests revision to the licensing basis for the Net Positive Suction Head available (NPSHa) for Emergency Core Cooling System (ECCS) and Containment Heat Removal System Pumps, as described in Appendix 3A of the Salem Updated Final Safety Analysis Report (UFSAR). As a result of the required Generic Safety Issue (GSI)-191 (Generic Letter (GL) 2004-02) evaluations, a change in methodology is required for calculating the NPSHa. 10 CFR 50.59(c)(1)(viii) requires that a licensee not make changes in the facility as described in the final safety analysis report (as updated), that result in a departure from a method of evaluation described in the FSAR (as updated) used in establishing the design bases or in the safety analyses, without first obtaining a license amendment pursuant to 10 CFR 50.90.

PSEG has determined that this LAR does not involve a significant hazard consideration as determined per 10 CFR 50.92. PSEG's regulatory and technical evaluation of this LAR is attached.

The changes in this LAR are required to address compliance with GL 2004-02; therefore, PSEG requests approval of this LAR by no later than December 31, 2007, so that it can be implemented by that date.

A001
NRR

If you have any questions or require additional information, please do not hesitate to contact Mr. Jamie Mallon at (610) 765-5507.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 8/15/07
(Date)

Sincerely,

Robert C. Braun
Site Vice President - Salem

Attachments (2)

cc Mr. S. Collins, Administrator - Region I
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Mr. R. Ennis, Licensing Project Manager - Salem
U. S. Nuclear Regulatory Commission
Mail Stop 08B1
Washington, DC 20555

USNRC Senior Resident Inspector – (Salem X24)

Mr. P. Mulligan
Bureau of Nuclear Engineering
P. O. Box 415
Trenton, NJ 08625

SALEM GENERATING STATION - UNIT 1 AND UNIT 2
DOCKET NO. 50-272 AND 50-311
LICENSE AMENDMENT REQUEST LAR S07-05
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1.0 DESCRIPTION

This License Amendment Request (LAR) submittal requests a revision to the licensing basis for the Net Positive Suction Head available (NPSHa) for Emergency Core Cooling System (ECCS) and Containment Heat Removal System Pumps, as described in Appendix 3A of the Salem Updated Final Safety Analysis Report (UFSAR). As a result of the required Generic Safety Issue (GSI)-191 (Generic Letter (GL) 2004-02) evaluations, a change in methodology is required for calculating the NPSHa. 10 CFR 50.59(c)(1)(viii) requires that a licensee not make changes in the facility as described in the final safety analysis report (as updated), that result in a departure from a method of evaluation described in the FSAR (as updated) used in establishing the design bases or in the safety analyses, without first obtaining a license amendment pursuant to 10 CFR 50.90.

2.0 PROPOSED CHANGE

The proposed change would revise the NPSH methodology described in the UFSAR Appendix 3A. Currently, containment pressure is assumed to be equal to the vapor pressure of the sump fluid, thus excluding the initial containment air pressure value. Crediting initial containment air pressure is an acceptable approach per RG 1.1, RG 1.82, and NEI 04-07 Volume 2, as discussed in Sections 3 and 4 of this submittal. The proposed change to UFSAR Appendix 3A (page 3A-3) is provided below:

$$NPSH_{available} = (h)_{containment\ pressure} - (h)_{vapor\ pressure} + (h)_{static\ head} - (h)_{loss}$$

~~It is assumed that the vapor pressure of the liquid in the sump (corresponding to the temperature of the liquid at the onset of recirculation) is equal to the containment pressure. This assumption assures that the actual available NPSH is always greater than the calculated value determined from the reduced equation:~~

~~$NPSH_{available} = (h)_{static} - (h)_{loss}$~~

~~head~~

The containment pressure value will be equal to the initial air pressure in containment prior to the LOCA. However, when the containment sump vapor pressure exceeds the containment initial pressure then the following will be assumed:

$$(h)_{containment\ pressure} = (h)_{vapor\ pressure}$$

The containment air pressure value used in the NPSHa calculation is based on the containment conditions prior to the accident only and does not include any credit for accident pressure conditions, is conservatively determined based on minimum containment initial pressure, and maximum temperature and relative humidity conditions. The calculation also accounts for further reduction of this initial air pressure based on possible maximum cooldown of the containment environment post-LOCA.

The vapor pressure term used in the NPSHa calculation for the sump water being pumped, is based on the highest temperature of the sump fluid for the condition being evaluated.

In addition, the following statement is being removed from the UFSAR Appendix 3A:

~~Added conservatism is introduced into the NPSH calculation by calculating the static head from the elevation of the top of the sump instead of the available water level above the sump.~~

3.0 BACKGROUND

Immediately following a Loss Of Coolant Accident (LOCA) the Emergency Core Cooling Systems (ECCS) take suction from the Refueling Water Storage Tank (RWST) and inject this water into the Reactor Coolant System (RCS) to provide core cooling. This is known as the injection phase. As there is a break in the RCS, water flows out of the break and on to the containment floor. This water forms a pool and starts to flood the containment lower level. When the RWST reaches its low level setpoint, and the containment flood level (water level in the containment) has been verified to have reached the minimum required for recirculation operation, operators switch the suction of the ECCS from the RWST to the containment sump. This is the long term core cooling configuration of the ECCS. Water is drawn from the containment through the containment sump by the RHR pumps, sent through the RHR heat exchangers for cooling, and then injected into the RCS by the RHR, SI, and Charging pumps. The water then cools the core and flows out the break and back into the containment pool where it will be sent through the process again. A portion of this flow can also be directed through the spray header in the containment to help control containment pressure. This is the basic design function of the ECCS systems.

To meet this design function the ECCS systems, most specifically the RHR pumps, must be able to draw water from the containment sump. In order to perform this function there must be adequate NPSHa to meet the RHR pump required NPSH (NPSHr) for the applicable flow rate. Several factors affect the RHR pump NPSHa during recirculation operation: containment sump water level, RHR pump flow rate, RHR suction line losses, and sump screen head loss from debris blockage. NPSHr is a function of the RHR pumps and the flow rate at which they are operating.

NPSHa is a calculated value that normally consists of four terms as outlined above. The current Salem specific methodology for determining RHR pump NPSHa during post LOCA recirculation operation is outlined in the Salem UFSAR and is a more conservative approach over the typical NPSHa calculation methodology.

The current licensing basis for ECCS pump NPSH is contained in Appendix 3A of the Salem UFSAR:

$$NPSH_{available} = (h)_{containment\ pressure} - (h)_{vapor\ pressure} + (h)_{static\ head} - (h)_{loss}$$

It is assumed that the vapor pressure of the liquid in the sump (corresponding to the temperature of the liquid at the onset of recirculation) is equal to the containment pressure. This assumption assures that the actual available NPSH is always greater than the calculated value determined from the reduced equation:

$$NPSH_{available} = (h)_{static\ head} - (h)_{loss}$$

The UFSAR methodology is consistent with the requirements of RG 1.1 and RG 1.82, Revision 1. The additional added conservatism of equating vapor pressure of the liquid in the sump and containment pressure is consistent with the supplemental guidance provided by NUREG-0800 (Standard Review Plan) Section 6.2.2 which states:

> "In the recirculation phase; i.e., in the long term (after about 1 hour) following a LOCA, the containment spray system is required to circulate the water in the containment. The NPSH analysis will be acceptable if (1) it is done in accordance to the guidance in Regulatory Guide 1.82, Rev. 1 and (2) it is done in accordance with the guidelines of Regulatory Guide 1.1, i.e., is based on maximum expected temperature of the pumped fluid and with atmospheric pressure in the containment. For clarification, the analysis should be based on the assumption that the containment pressure equals the vapor pressure of the sump water. This ensures that credit is not taken for containment pressurization during the transient"

Consequently, the only purpose of the additional conservatism was to ensure no credit was taken for post-LOCA containment air pressure.

In September of 2004, the NRC issued GL 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004. GL 2004-02 requires that addressees perform an evaluation of the LOCA recirculation functions based on

potential susceptibility of the PWR recirculation sump screens to debris blockage and chemical effects. The nuclear industry developed a methodology (NEI 04-07, Pressurized Water Reactor Sump Performance Evaluation Methodology (GSI-191), Volume 1) to perform the required evaluations and the NRC has issued a supporting Safety Evaluation Report (NEI 04-07 Volume 2).

As a result of the new detailed and stringent analysis performed under the NEI 04-07 guidelines, which include evaluation of containment sump pool chemical effects, the ECCS suction strainer head loss values are much higher than those used under the previous design basis criteria which assumed the ECCS strainers were 50% blocked during recirculation operation. The higher strainer head loss values have resulted in a significant reduction of the calculated RHR pump NPSHa value for post LOCA recirculation operation when the current conservative UFSAR methodology is used. Therefore, it is necessary to amend the current licensing basis related to RHR LOCA recirculation operation.

4.0 REGULATORY AND TECHNICAL ANALYSIS

Safety Guide 1 which later became Regulatory Guide 1.1, provided the first guidance on determining ECCS system NPSH during recirculation operation. The guide notes that one of the conditions that could impact the performance of the ECCS systems is inadequate pump NPSH. With inadequate pump NPSH, cavitation of the pumped fluid can occur and significantly reduce the capability of the ECCS system to accomplish its safety function. The guide continues with an example:

"... if proper operation of the ECCS system depends on maintaining the containment pressure above a specified minimum amount, then too low an internal pressure (resulting from impaired containment integrity or operation of the containment heat removal systems at too high a rate) could significantly affect the ability of this system to accomplish its safety functions by causing pump cavitation. In addition, the deliberate continuation of a high containment pressure to maintain an adequate pump NPSH would result in greater leakage of fission products from the containment and higher potential offsite doses under accident conditions than would otherwise result."

The guide further explains that the changes in the ECCS system NPSH caused by increased temperatures of the pumped fluid under accident conditions can be accommodated for by locating the pumps at suitable elevations with respect to the storage volumes connected to their suction sides, and not by reliance on calculated increases in the containment pressure. The final regulatory position stated in the guide is:

"Emergency core cooling and containment heat removal systems should be designed so that adequate net positive suction head (NPSH) is provided to system pumps

assuming maximum expected temperatures of pumped fluids and no increase in containment pressure from that present prior to postulated loss of coolant accidents."

Safety Guide 1/Regulatory Guide 1.1 indicate that no credit for increase in containment pressure from that present prior to postulated loss of coolant accidents may be taken in the NPSHa calculation. This infers that credit for the normal containment initial pressure prior to the LOCA may be used in the calculation; however, no credit for any additional pressure increase (accident over pressure) as a result of the LOCA conditions may be used. Also inferred in this guidance is that consideration should be made for the effects of decreased temperature due to the operation of the containment heat removal systems at too high a rate. A decrease in the containment temperature below the temperature that existed prior to the LOCA could actually lower the effective pressure of the air in containment during LOCA conditions.

The Salem UFSAR Appendix 3A, PSEG Positions on USNRC Regulatory Guides, contains a discussion for Regulatory Guide 1.1. This discussion essentially provides the NPSHa calculation methodology to be used for the ECCS systems at Salem. This discussion notes that for Salem the post LOCA recirculation mode of operation of the ECCS systems provides the limiting conditions for ECCS pump NPSH requirements, specifically the RHR pumps as these are the only ECCS pumps taking suction from the containment sump during recirculation operation. The NPSHa methodology outlined in Appendix 3A starts with the basic NPSHa calculation which contains four factors which are the pressure head (containment pressure), static head, vapor pressure (pumped fluid) head, and suction line head loss terms.

$$NPSHa = h_{p(\text{containment pressure})} + h_{s(\text{static})} - h_{vp(\text{vapor pressure})} - h_{l(\text{suction line losses})}$$

For conservatism, the assumption is made that the vapor pressure of the pumped fluid is equal to the pressure in containment, the pressure head (containment pressure) term, and as such these two terms cancel out. The reduced NPSHa calculation methodology provided in Appendix 3A is:

$$NPSHa = h_{s(\text{static})} - h_{l(\text{suction line losses})}$$

This methodology is conservative relative to the Safety Guide 1/Regulatory Guide 1.1 requirements, because no credit for containment pressure is taken at all, while these guiding documents only indicate that no credit for any increase in containment pressure from that present prior to postulated loss of coolant accidents may be taken in the NPSHa calculation. This additional conservatism is consistent with NUREG-0800 (SRP) Section 6.2.2 that provides further discussion on RG 1.1:

"*In the recirculation phase; i.e., in the long term (after about 1 hour) following a LOCA, the containment spray system is required to circulate the water in the containment. The NPSH analysis will be acceptable if (1) it is done in accordance to the guidance in Regulatory Guide 1.82, Rev. 1 and (2) it is done in accordance with*

the guidelines of Regulatory Guide 1.1, i.e., is based on maximum expected temperature of the pumped fluid and with atmospheric pressure in the containment. For clarification, the analysis should be based on the assumption that the containment pressure equals the vapor pressure of the sump water. This ensures that credit is not taken for containment pressurization during the transient".

Consequently, the only purpose of the additional conservatism was to ensure no credit was taken for post-LOCA containment air pressure.

Regulatory Guide 1.82

Regulatory Guide 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," was originally issued in June 1974. This regulatory guide provided significantly more detailed guidelines for the design and evaluation of the ECCS systems for recirculation operation. This regulatory guide addressed issues such as sump design, sump screen and trash rack design, pump location, and air ingestion impact on pump NPSH. However, the issue regarding the use of containment air pressure in the ECCS NPSHa calculation is not addressed in the early revisions of this document. It is assumed that this is due to the existence of Safety Guide 1/Regulatory Guide 1.1 and the fact that this issue is addressed therein. This specific issue is not incorporated into Regulatory Guide 1.82 until Revision 3, which was issued in November 2003. Essentially the guidance provided in Safety Guide 1/Regulatory Guide 1.1, as detailed above, was incorporated into Revision 3 of the Regulatory Guide 1.82, with some minor differences. The discussion from Revision 3 is as follows:

"Predicted performance of the ECCS and the containment heat removal pumps should be independent of the calculated increases in containment pressure caused by postulated LOCAs in order to ensure reliable operation under a variety of possible accident conditions. For example, if proper operation of the ECCS or containment heat removal systems depends on containment pressure above a specified minimum amount, operation of these systems at a containment pressure less than this amount (resulting, for example, from impaired containment integrity or operation of the containment heat removal systems at too high a rate) could significantly affect the ability of this system to accomplish its safety functions. However, for some operating reactors, some credit for containment accident pressure may be necessary. This should be minimized to the extent possible."

The two differences to note are that there is no direct reference to the use of the containment pressure "present prior to postulated loss of coolant accidents" and the addition of the statement that "for some operating reactors, some credit for containment accident pressure may be necessary. This should be minimized to the extent possible". This guidance does imply that the use of additional containment pressure increase (accident over pressure) may be used if necessary, so it can be assumed that the containment air pressure present prior to the accident condition can also be used.

The regulatory position presented in Section C of the Regulatory Guide does provide much more detail on the use of containment pressure in ECCS system NPSHa calculations.

"Section 1.3.1.1, ECC and containment heat removal systems should be designed so that sufficient available NPSH is provided to the system pumps, assuming the maximum expected temperature of pumped fluid and no increase in containment pressure from that present prior to the postulated LOCA."

"Section 1.3.1.2, For certain operating PWRs for which the design cannot be practicably altered, conformance with Regulatory Position 1.3.1.1 may not be possible. In these cases, no additional containment pressure should be included in the determination of available NPSH than is necessary to preclude pump cavitation. Calculation of available containment pressure and sump water temperature as a function of time should underestimate the expected containment pressure and overestimate the sump water temperature when determining available NPSH for this situation."

These two sections of the regulatory position indicate that for determining ECCS NPSHa, the use of a containment pressure value that does not exceed the containment pressure present prior to the postulated LOCA is allowed.

In addition, a draft Revision 4 of Regulatory Guide 1.82 has been developed that specifically discusses the acceptability of the use of initial containment air pressure in the NPSHa calculation, providing indication of current industry and regulatory positions.

NEI 04-07 Volume I

NEI 04-07 Volume I, "Pressurized Water Reactor Sump Performance Evaluation Methodology," Revision 0, contains a discussion regarding determination of ECCS pump NPSHa. This discussion is included in Chapter 6, Alternate Evaluation, section 6.4, Region II Analysis, subsection 6.4.7, Net Positive Suction Head Calculation. The primary purpose of this section of the NEI is to discuss the possibility of using an alternate NPSH calculation methodology in lieu of the conservative methodology outlined in Regulatory Guides 1.1, and 1.82 Revision 3, for the evaluation of break sizes larger than the alternate break size.

Subsection 6.4.7.1, NPSH Available, (page 6-12) provides a discussion for determination of the containment pressure prior to the accident.

"...Typically for PWRs that do not credit containment overpressure in the design basis analysis, the basic assumption is to conservatively assume that containment pressure equals the vapor pressure of the liquid in the sump. In reality, this assumes that there is no air partial pressure in the containment prior to the event, or that the

air pressure is non-mechanistically lost during the event. A more realistic assumption is that at the time of safety injection recirculation, the containment partial steam pressure is equal to sump fluid vapor pressure plus an air partial pressure equal to the containment air pressure prior to the event. The air pressure prior to the event is to be calculated assuming 100% relative humidity at a containment temperature corresponding to the maximum normal temperature experienced at the plant. Alternatively, the pre-event minimum containment pressure minus the partial steam pressure at the dew point temperature for the cooling water temperature can be assumed for the air pressure. The recognition of the pre-event air pressure acknowledges the thermal-hydraulic condition of containment prior to the event without crediting containment overpressure based on the accident scenario."

This NEI 04-07 Volume I guidance provides a conservative approach to be used to determine the containment initial air pressure value to be used in ECCS NPSHa calculations.

NEI 04-07, Volume II

NEI 04-07, Volume II (Safety Evaluation by the Office of Nuclear Reactor Regulation Related to NRC Generic Letter 2004-02, Revision 0, December 6, 2004) Section 6 contains the NRC evaluation of the NEI 04-07 Volume I methodology presented above. The NRC discussion relative to volume I subsection 6.4.7.1 is located on page 122 of volume II.

"...Section 6.4.7.1 of the of the GR discusses these assumptions for each of the factors which contribute to the available NPSH, including suction elevation head, absolute pressure head, vapor pressure head, and friction and form head losses. The staff finds the GR discussion in Section 6.4.7.1 to be acceptable with one caveat. The discussion of friction losses notes that experience has shown that calculations of friction loss based on handbook values tend to overestimate the friction loss. The GR states that these values may be reduced based on engineering judgment or test results. To quantify the available margin in these calculations, the staff's position is that a more substantive basis than engineering judgment should be used. Engineering judgment by itself, without further technical basis, does not provide adequate justification for removing conservatism in handbook friction loss values. The staff will accept a reduction in head-loss calculations based on accepted handbook values only if its basis is technically justified."

In addition, NEI 04-07, Volume II, page 123 (subsection 6.4.7.3 discussion) states:

"One of the items listed in this section refers to: "containment pressure head based on absolute pressure rather than vapor pressure." Rather than "absolute pressure," the term "pressure of the containment atmosphere," would be clearer. The staff expects that licensees will provide detailed information regarding the application of more realistic analysis assumptions in their GL responses. The staff will assess these assumptions as part of the GL response reviews and closeout process.

Additionally, application of certain assumptions may require plant-specific exemptions and/or license amendment requests."

This review by the NRC indicates that the methodology for determining the minimum containment air pressure available in containment prior to the accident outlined in NEI 04-07 Volume I Revision 0, Subsection 6.4.7.1 is an acceptable approach. The proposed PSEG approach is consistent with the NEI guidance and related NRC Safety Evaluation Report (SER).

Additional Change – Static Head

In addition to the above discussed changes, the following statement is being removed from the UFSAR Appendix 3A:

"Added conservatism is introduced into the NPSH calculation by calculating the static head from the elevation of the top of the sump instead of the available water level above the sump."

The current Salem RHR pump recirculation operation NPSHa calculation, originally issued in 1997, uses the minimum sump pool water level required for recirculation operation for determination of the static head available for NPSHa concerns. This water level was determined to be at plant elevation 80'-10", which is approximately 2'-1" above the top of the ECCS containment sump curb. The ECCS containment sump water level is monitored with float type level instrumentation and the level is displayed in the control room. Salem Emergency Operating Procedures (EOP's) require that operations personnel verify that the ECCS containment sump level is adequate, i.e., it has reached this minimum level required (accounting for instrument uncertainty) to provide adequate NPSHa for operation of the RHR pumps in recirculation mode, prior to initiating the switchover of the ECCS system from injection to recirculation operation. Therefore, the added conservatism is not required and the current calculation deviation from the UFSAR does not impact the plant safety.

The new ECCS containment sump strainers, which were installed to meet GSI-191 concerns, were designed and installed to ensure that with this minimum water level in the containment the new strainers would have a minimum of 3" of water cover. As a result of the previously existing configuration, and the design of the new ECCS containment sump strainers, the removal of this statement from the Salem UFSAR is acceptable.

Conclusion

The proposed change will modify the current UFSAR described methodology for determining RHR pump NPSHa during post LOCA recirculation operation by including terms for both absolute air pressure on the surface of the fluid being pumped (containment air pressure) and the vapor pressure of the fluid being pumped at the temperature of the fluid being pumped (sump pool water). The proposed new

methodology removes conservatism from the current RHR pump NPSHa calculation methodology, resulting in a departure from a method of evaluation described in the UFSAR used in establishing the design basis. This proposed change therefore requires prior NRC approval prior to implementation.

Although this change removes conservatism in the Salem methodology for calculation of RHR pump NPSHa during post LOCA recirculation, the proposed new methodology is in accordance with NPSHa calculation methodologies provided in Safety Guide 1, Regulatory Guides 1.1, and 1.82, and the guidance of NEI 04-07, and accompanying SER. The new methodology will be:

$$NPSHa = h_{p(\text{containment pressure})} + h_{s(\text{static})} - h_{vp(\text{vapor pressure})} - h_{l(\text{suction line losses})}$$

The containment pressure value will be equal to the initial air pressure in containment prior to the LOCA. However, when the containment sump vapor pressure exceeds the containment initial pressure then the following will be assumed:

$$h_{p(\text{containment pressure})} = h_{vp(\text{vapor pressure})}$$

In addition, the static head will be determined based on the minimum containment sump water level required by the EOP's."

Use of this new NPSH methodology is considered acceptable with the following:

- The containment air pressure value used in the NPSHa calculation is based on the containment conditions prior to the accident only and does not include any credit for accident pressure conditions, is conservatively determined based on minimum containment initial pressure, and maximum temperature and relative humidity conditions. The calculation also accounts for further reduction of this initial air pressure based on possible maximum cooldown of the containment environment post-LOCA.

- The vapor pressure term used in the NPSHa calculation for the sump water being pumped, is based on the highest temperature of the sump fluid for the condition being evaluated.

The above requirements will be part of the Salem NPSH methodology. This, in conjunction with the more rigorous GSI-191 analyses, provides assurance that the ECCS pumps can perform their design function.

5.0 REGULATORY SAFETY ANALYSIS

5.1 Significant Hazards Consideration

PSEG has evaluated whether or not a significant hazards consideration is involved with the proposed amendment(s) by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

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

Response: No.

The change in NPSH methodology for ECCS pumps allows the use of initial containment air pressure in calculating NPSHa. Although this change is a non-conservative change in the Salem methodology for calculation of RHR pump NPSHa during post LOCA recirculation (per 10 CFR 50.59(c)(1)(viii)), the proposed new methodology is in accordance with NPSHa calculation methodologies provided in Safety Guide 1, Regulatory Guides 1.1, and 1.82, and the guidance of NEI 04-07, Pressurized Water Reactor Sump Performance Evaluation Methodology (GSI-191) and accompanying SER. The containment air pressure value used in the NPSHa calculation is based on the containment conditions prior to the accident only and does not include any credit for accident pressure conditions, is conservatively determined based on minimum containment initial pressure, and maximum temperature and relative humidity conditions. In addition, the vapor pressure term for the sump water being pumped is also included in the NPSHa equation, and the value chosen for the NPSHa calculation is based on the highest temperature of the sump fluid for the condition being evaluated. This, in conjunction with the more rigorous GSI-191 analyses, provides assurance that the ECCS pumps can perform their design function. Consequently, the ECCS pumps will continue to perform their design function and there is no significant increase in the probability or consequences of an accident previously evaluated

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

Response: No

The ECCS pumps take suction from the containment sump during the recirculation phase of the LOCA to provide long term core cooling. This system is not utilized during normal operation of the plant. Therefore, it does not cause initiation of any accident.

However, the ECCS pumps will continue to perform their design function during the recirculation phase. Crediting initial containment air pressure in the NPSH

methodology does not create any new or different kind of accident from any accident previously evaluated. This change removes an additional conservatism built into the original methodology. By changing the UFSAR described methodology to credit the containment initial air pressure in the RHR pump NPSHa calculation, a more realistic methodology is established. The sole purpose of the additional conservatism was to ensure credit was not taken for post-LOCA pressure. The revised methodology continues to meet this requirement.

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

Response: No

The proposed change removes conservatism from the existing UFSAR methodology. However, the purpose of the conservatism (equating containment pressure to sump vapor pressure) was solely to ensure that no credit was taken for transient (post-LOCA) pressure in the NPSHa calculation. The purpose was not to deny credit for initial containment air pressure. Consequently, removing the conservatism does not alter the basic intent of the NPSH methodology per RG 1.1 requirements, and is consistent with the requirements of RG 1.82, Revision 1 and NEI 04-07. This change to include a containment air pressure value establishes a more realistic methodology that still encompasses adequate conservatisms; no credit is given for the higher accident pressure conditions, and the value is conservatively determined based on minimum initial containment air pressure and maximum temperature and relative humidity conditions. In addition, the vapor pressure term for the sump water being pumped is also added to the NPSHa equation, and the value chosen for the NPSHa calculation is based on the highest temperature of the sump fluid for the condition being evaluated. Consequently, this change does not involve a significant reduction in a margin of safety.

Based on the above, PSEG concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

Appendix A of 10 CFR Part 50, General Design Criterion (GDC) 35, "Emergency Core Cooling", states:

"A system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts.

Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure."

GDC 38, "Containment Heat Removal", states:

"A system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels.
Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure."

The above criteria continue to be met, or are not impacted, by the proposed change in NPSH methodology.

5.3 Conclusions

In conclusion, based on the considerations discussed above, (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.

6.0 ENVIRONMENTAL CONSIDERATION

PSEG has evaluated the proposed amendment for environmental considerations. The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

7.0 REFERENCES

- NEI 04-07 Volumes I and II, Pressurized Water Reactor Sump Performance Evaluation Methodology and associated NRC Safety Evaluation

- Safety Guide 1/Regulatory Guide 1.1, Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal System Pumps

- Regulatory Guide 1.82, Revisions 1, 2, 3, and draft Revision 4, Water Sources for Long-Term Recirculation Cooling Following a Loss-Of-Coolant Accident

LICENSE BASIS PAGES WITH PROPOSED CHANGES

The following License basis for Salem Unit 1 (Facility Operating License DPR-70) and Salem Unit 2 (Facility Operating License DPR-75) are affected by this amendment request:

UFSAR	Page
Appendix 3A	3A-2

rates. The recirculation mode of operation gives the limiting NPSH requirement for the residual heat removal pumps, and the minimum NPSH available is determined from the following calculation:

$$NPSH_{available} = (h)_{\substack{containment\\pressure}} - (h)_{\substack{vapor\\pressure}} + (h)_{\substack{static\\head}} - (h)_{loss}$$

~~It is assumed that the vapor pressure of the liquid in the sump (corresponding to the temperature of the liquid at the onset of recirculation) is equal to the containment pressure. This assumption assures that the actual available NPSH is always greater than the calculated value determined from the reduced equation:~~

~~$$NPSH_{available} = (h)_{static} - (h)_{loss}$$~~

~~head~~

The containment pressure value will be equal to the initial air pressure in containment prior to the LOCA. However, when the containment sump vapor pressure exceeds the containment initial pressure then the following will be assumed

$$(h)_{containment\ pressure} = (h)_{vapor\ pressure}$$

The containment air pressure value used in the NPSHa calculation is based on the containment conditions prior to the accident only and does not include any credit for accident pressure conditions, is conservatively determined based on minimum containment initial pressure, and maximum temperature and relative humidity conditions. The calculation also accounts for further reduction of this initial air pressure based on possible maximum cooldown of the containment environment post-LOCA.

The vapor pressure term used in the NPSHa for the sump water being pumped, is based on the highest temperature of the sump fluid for the condition being evaluated.

~~Added conservatism is introduced into the NPSH calculation by calculating the static head from the elevation of the top of the sump instead of the available water level above the sump.~~

It is believed that the methods utilized in calculating NPSH meet the intent of the Regulatory Guide, of ensuring adequate NPSH with adequate margin for the centrifugal charging, safety injection, residual heat removal, and containment spray pumps.

Regulatory Guide 1.2 - THERMAL SHOCK TO REACTOR PRESSURE VESSELS

Although NRC Regulatory Guide 1.2 was withdrawn by the NRC on July 31, 1991, SGS commitments, as stated below, are not affected by this withdrawal.

Current Westinghouse research programs and pressure vessel design conform with the intent of the Regulatory Guide.

Westinghouse is continuing to obtain fracture toughness data through participation in the HSST Program at the Oak Ridge National Laboratory. The fracture toughness data recently obtained include