Boston Edison
Pilgrim Nuclear Power Station
Rocky Hill Road
Plymouth, Massachusetts 02360

10 CFR 50.90

L. J. Olivier
Vice President Nuclear Operations
and Station Director

June 20, 1997
BECo Ltr. 2.97.063

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Docket No. 50-293
License No. DPR-35

SUBJECT: Revised Commitment Concerning Crediting Containment Pressure in ECCS NPSH LOCA Analysis

References:

1) Boston Edison Letter (BECo letter No. 97.004) to NRC dated January 20, 1997, entitled "Request for Review"
2) Boston Edison Letter (BECo letter No. 97.008) to NRC dated January 30, 1997, entitled "Significant Hazards Evaluation for Pilgrim Nuclear Power Station's Net Positive Suction Head Analyses"
3) Boston Edison Letter (BECo letter No. 97.023) to NRC dated February 27, 1997, entitled "Supplemental Submittal on Pilgrim Station NPSH Analysis"
4) Boston Edison Letter (BECo letter No. 97.042) to NRC dated April 11, 1997, entitled "Revised Request for License Amendment to Credit Containment Pressure in ECCS NPSH LOCA Analyses"
5) Boston Edison Letter (BECo Letter No. 97.035) dated May 14, 1997, "Response to Request for Additional Information

By this letter, Boston Edison Company changes a commitment made in our letter dated April 11, 1997, concerning seawater inlet temperature as it relates to emergency core cooling system (ECCS) net positive suction head (NPSH). We are changing the seawater inlet temperature administrative limit from 65°F to 68°F.

Background

By letter dated April 11, 1997, BECo informed the NRC of an evaluation of emergency core cooling system (ECCS) net positive suction head (NPSH) at Pilgrim using the larger ECCS strainers installed during refueling outage 11. This analysis concluded containment pressure was not needed to maintain sufficient NPSH using a 65°F heat sink temperature and current design basis values for debris volume.

In the April 11, 1997, letter we also committed to enter the loss of containment cooling limiting condition of operation (LCO) whenever seawater inlet temperature exceeded 65°F.

This commitment was an interim compensatory measure until the NRC reviewed and approved our January 20, 1997, request for a license amendment that would credit containment pressure and raise the seawater inlet temperature assumed (to 75°F) in Pilgrim's ECCS NPSH analysis.

Our April 11, 1997, 65°F commitment was predicated on receiving NRC approval of the January 20, 1997, request prior to Pilgrim's seawater inlet temperature rising to the 65°F limit. Temperatures greater than 65°F occur sporadically during the summer months generally as a result of short duration environmental influences (e.g., tidal action, diurnal effects and wind direction). However, approval of our amendment has not arrived, and inlet temperature is approaching 65°F at a faster rate than originally anticipated.

While 65°F is not specifically mentioned in Pilgrim's Technical Specifications, exceeding it under our April 11, 1997, commitment requires Pilgrim to be in cold shutdown within 24 hours. This shutdown would be required because the NRC has determined an unreviewed safety question [USQ] exists when credit for containment pressure is required in ECCS NPSH analyses. Resolution of the USQ for Pilgrim through the license amendment process (10CFR50.90) was the subject of our January 20, 1997, letter to the NRC.

New Commitment

We are changing our April 17, 1997, commitment. An administrative limit will require entering the loss of containment cooling limiting condition for operation whenever seawater inlet temperature exceeds 68°F.

Reason for Request and Justification for Change

Analysis has demonstrated that Pilgrim can operate safely with a 75°F seawater inlet temperature with credit taken for containment pressure. (See the above referenced correspondence associated with our requested license amendment). Discussions with the NRC concerning our license amendment request indicate approval is imminent but will not likely be received prior to seawater inlet temperature exceeding 65°F.

Analysis also indicates Pilgrim can operate safely with a 68°F seawater inlet temperature without taking credit for containment pressure. Therefore, the containment pressure, which is central to the USQ, is not an issue at or below 68°F, and plant operation in the USQ regime does not occur at or below 68°F. The 50.59 evaluation documenting this conclusion is attached.

Summary

We submitted an amendment request concerning ECCS NPSH that addresses the seawater inlet temperature issue in Reference 1. The commitment change made in this letter will be used until the NRC completes its review and approval of the amendment request during periods when seawater inlet temperature does not exceed 68°F. Station procedures will be revised to allow interim operation using 68°F as the absolute vs. indicated temperature requiring entry into the containment cooling LCO.

Should you have further questions concerning this issue, please contact P. M. Kahler at (508) 830-7939.

L. J. Olivier

PMK/dmc/ECCS1

Attachment: Pilgrim 10CFR50.59 Review for Operation with a Seawater Inlet Temperature of 68°F.

cc: Mr. Alan B. Wang, Project Manager
Project Directorate I-3
Office Of Nuclear Reactor Regulation
Mail Stop: OWF 14B2
1 White Flint North
11555 Rockville Pike
Rockville, MD 20852

U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

Senior Resident Inspector
Pilgrim Nuclear Power Station

Mr. Robert Hallisey
Radiation Control Program
Center for Communicable Diseases
Mass Dept. of Public Health
305 South Street
Jamaica Plain, MA 02130

Mr. Jim Muckerheide
400 Worcester Road
P.O. Box 1496
Framingham, MA 01701

Mr. Peter Laporte, Director
Mass. Energy Management Agency
400 Worcester Road
P.O. Box 1496
Framingham, MA 01701-0313

Safety Evaluation
No. 3104
RTYPE A9.03

SAFETY EVALUATION
PILGRIM NUCLEAR POWER STATION

Initiator	Dept.	Division	Document No.	Calc. No.	System Name
P.D. Harizi	NESG	Mech. Eng.		Calc M-664 Calc M-662 Calc M-734	Cont. Heat Removal RBCCW RHR Core Spray

Description of Proposed change, test, or experiment: Interim evaluation of Containment Heat Removal systems with an Ultimate Heat Sink (UHS) temperature of 68°F by extrapolation of original FSAR design basis LOCA analysis with a 65°F UHS.

SAFETY EVALUATION CONCLUSIONS:

	Yes	No	
1.	☐	☒	May the proposed activity increase the probability of occurrence of an accident previously evaluated in the Final Safety Analysis Report?
2.	☐	☒	May the proposed activity increase the consequences of an accident previously evaluated in the Final Safety Analysis Report?
3.	☐	☒	May the proposed activity increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the Final Safety Analysis Report?
4.	☐	☒	May the proposed activity increase the consequences of a malfunction of equipment important to safety previously evaluated in the Final Safety Analysis Report?
5.	☐	☒	May the proposed activity create the possibility of an accident of a different type than any previously evaluated in the Final Safety Analysis Report?
6.	☐	☒	May the proposed activity create the possibility of a different type of malfunction of equipment important to safety than any previously evaluated in the Final Safety Analysis Report?
7.	☐	☒	Does the proposed activity reduce the margin of safety as defined in the basis for any Technical Specification?

BASIS FOR SAFETY EVALUATION CONCLUSIONS:

This interim evaluation demonstrates that the original licensing basis assumptions are conservatively met with the new ECCS suction strainers based on the original LOCA analysis using a 65°F UHS and extrapolating to a 68°F UHS and current design basis values for debris loading. See Attachment 1.

Safety Evaluation
Performed by Philip D. Harizi Date 6-19-97

Safety Evaluation
No. 3104

SAFETY EVALUATION
PILGRIM NUCLEAR POWER STATION

A. APPROVAL

Comments: ____________________

[signature] for 6/20/97
Discipline Division Mgr./Date

N/A
Supporting Discipline Division Mgr./Date

B. REVIEW/APPROVAL

☐ Comments: ____________________

[signature] for JL Rogers 6/20/97
S&SA Division Mgr./ Date [signature] 6/20/97

NOTES: 1) Items (14) and (15) are not required for Safety Evaluation prepared by the Plant Department.

2) The independent technical review of Plant Department Safety Evaluations is documented in Item C below.

C. ORC REVIEW

☐ This proposed change involves an unreviewed safety question and a request for authorization of this change must be filed with the NRC prior to implementation.

☑ This proposed change does not involve an unreviewed safety question.

ORC Chairperson [signature] Date 6/20/97

ORC Meeting Number 97-75

cc:

Safety Evaluation
No. 3104

D. FSAR Review Sheet

List FSAR text, diagrams, and indices affected by this change and corresponding FSAR revision.

Affected FSAR Section	Preliminary revision to the affected FSAR Section is shown on:
NONE	

NOTE:

This SE provides an interim evaluation based on limiting conditions. The assumptions used are conservatively bounded by the current FSAR. The FSAR will be appropriately updated as part of the final response to NRC Bulletin 96-03 and/or as part of an updated accident analysis for higher heat sink temperatures.

PRELIMINARY FSAR REVISION (to be completed at time of Safety Evaluation preparation).

Prepared by: P.D. Harizi Date: 6-19-97

Approved by: [signature] Date: 6-20-97

FINAL FSAR REVISION - Prepared in accordance with NOP83E4 following operational turnover of related systems, structures, or components for use at PNPS.

Safety Evaluation
No. 3104

E. SAFETY EVALUATION WORK SHEET

A. System/Component Failure and Consequence Analyses.

	System/Component	Failure Modes	Effects of Failure	Comments
1	RHR and Core Spray	LOCA pipe break jet impingement destroys insulation and transports debris into torus.	Debris accumulation on torus suction strainers for RHR and Core Spray pumps increases suction head losses.	Effect of debris was evaluated and the increased suction head loss is within the margin for NPSH available to the ECCS pumps. See Attachments.
2	Containment Heat Removal Systems	RBCCW cooling water at higher than original equipment rating temperatures may occur.	Equipment may not achieve rated heat removal and/or EQ conditions may be exceeded.	All affected systems were evaluated as summarized in Calculation M-664 for suppression pool temperatures up to 178F and RBCCW temperatures of 98F.
3				

General Reference Material Review

FSAR SECTION	PNPS TECH. SPECS	CALCULATIONS DESIGN SPECS. PROC.	REGULATORY GUIDES STANDARDS CODES
4.8.5.1	Section 3.2.H	Calculation M-664 Rev. 0	Reg. Guide 1.82 Rev. 1
6.4.3	Section 3.5.A & B	Calculation M-734 Rev. 0	NRC Bulletin 96-03
14.5	Section 3.7.A	Calculation M-662 Rev. E2	
	Section 4.7.A.2	GE Report GE-NE-B13-01805-11	

B. For the proposed hardware change, identify the failure modes that are likely for the components consistent with FSAR assumptions. For each failure mode, show the consequences to the system, structures, or related components. Especially show how the failure(s) affects the assigned safety basis (FSAR text for each system) or plant safety functions (FSAR Chapter 14 and Appendix G.)

Prepared by P.D. Harizi Date 6-19-97

Safety Evaluation - Attachment 1

A. Description of Change

This Safety Evaluation provides an interim analysis of Containment Heat Removal systems and RHR and Core Spray pump Net Positive Suction Head (NPSH) conditions following a Design Basis Loss of Coolant Accident (DBA-LOCA) with an Ultimate Heat Sink (UHS) temperature of 68°F. This interim evaluation is based on the current design basis analysis for LOCA-generated debris, new RHR and Core Spray pump suction strainers, and an extrapolation of the original FSAR DBA-LOCA analysis with a 65°F heat sink.

B. Purpose of the Change

Replacement of the original drywell piping insulation in 1984 and the potential effect on ECCS pump NPSH was evaluated in SE-2971 [Ref. 1]. In RFO-11, the RHR and Core Spray pump suction strainers were replaced with large capacity stacked disk strainers as part of the response to NRC Bulletin 96-03 [Ref. 2]. To support Pilgrim operation at UHS temperature above 65°F, it is necessary to produce this interim Safety Evaluation that is based on the new strainer debris capacity and an extrapolation of the original FSAR DBA-LOCA analysis based on a 65°F heat sink temperature. The postulated LOCA-generated debris is the current Pilgrim design basis value from an analysis performed in accordance with Regulatory Guide 1.82 Rev. 1 [Ref. 3]. With these conditions, it is demonstrated that there is adequate NPSH margin to accommodate the postulated debris without affecting pump performance using an NPSH margin that is very conservatively based on zero containment positive pressure following a DBA-LOCA.

Proper operation of the Containment Heat Removal systems also requires that the peak Suppression Pool and UHS temperatures following a design basis LOCA be within established limits. This evaluation includes or references analyses of increased UHS temperatures on the Containment Heat Removal systems.

This evaluation will remain applicable until the Pilgrim design basis analysis is upgraded in accordance with Regulatory Guide 1.82 Rev. 2 as part of the final resolution for NRC Bulletin 96-03 and/or is superseded by an updated accident analysis for higher heat sink temperatures.

C. Systems, Subsystems, Components Affected

1. Directly Affected:

   Containment Heat Removal Systems
   Residual Heat Removal (RHR) System
   Core Spray System

2. Indirectly Affected:

   Reactor Building Closed Cooling Water (RBCCW) System
   Salt Service Water (SSW) System

3. List drawings, FSAR, Tech. Spec., other documents:

The following documents are referred to by [Ref. #] in this SE:

[1] SE-2971 "Replace all piping thermal insulation in the drywell with Owens-Corning NUKON fiberglass blanket insulation", 25-MAR-96.

[2] NRC Bulletin 96-03 "Potential Plugging of Emergency Core Cooling Suction Strainers by Debris in Boiling-Water Reactors".

[3] Regulatory Guide 1.82 Rev. 1, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident", U.S. Nuclear Regulatory Commission, November, 1985.

[4] BECo Calculation M-662 Rev. E2 "RHR and Core Spray Pump NPSH and Suction Pressure Drop".

[5] BECo Calculation M-734 Rev. 0 "RHR and Core Spray Pump Suction Strainer Debris Head Loss NPSH Evaluation".

[6] GE Report GE-NE-B13-01805-11 "Effects of Fiberglass Insulation Debris on Pilgrim ECCS Pump Performance" January 1996, SUDDS/RF # 96-02.

[7] BECo Calculation M-664 Rev. 0 "Containment Heat Removal".

[8] SE-2983 "Evaluate results of a design verification for safety related cooling systems using the FSAR site maximum SSW temperature of 75F°."

[9] BECo Specification E-536 Rev. 6 "Environmental Parameters for Use in the Environmental Qualification of Electrical Equipment per 10CFR50.49".

[10] BECo Calculation M-665 Rev. 0 "Equipment Area Cooler Performance".

[11] BECo Calculation N-127 Rev. 1 "Secondary Containment Heatup Analysis".

D. <u>Functions of Affected Systems/Components</u>

The Residual Heat Removal (RHR) and Core Spray (CS) Pumps are part of the Core Standby Cooling Systems (CSCS)(FSAR Section 6). The RHR Pumps provide low pressure coolant injection (LPCI) to the reactor after depressurization either due to a Loss of Coolant Accident (LOCA) or by operation of the Automatic Depressurization System (ADS). The RHR Pumps also provide for decay heat removal in the Suppression Pool Cooling and Containment Spray modes of operation (FSAR Section 4.8). The CS Pumps provide low pressure core spray (LPCS) flow to the vessel in a continuous recirculation mode from the Suppression Pool. Both the LPCI and LPCS are required to mitigate the consequences of the various postulated LOCA and Steam Line Break (SLB) accidents by providing emergency core cooling and containment cooling via the RHR operating modes.

The Containment Heat Removal systems include RHR, RBCCW, and SSW. These systems control the environment within primary and secondary containment following the loss of coolant accident. Together, these systems must maintain all safety-related equipment within established operating limits and within the established Environmental Qualification (EQ) limits.

E. Effect on Functions

As a consequence of a LOCA or SLB, the NUKON insulation in the vicinity of the break may be damaged or destroyed by the jet impingement forces. The fiberglass debris generated by the line break may then be transported from the drywell into the Suppression Pool. Insulation shreds and fibers in various forms may continue to transport through the Suppression Pool water and ultimately some portion may accumulate on the suction strainers of the operating ECCS pumps. The accumulated debris on the strainers would increase the head loss of the strainer and thereby decrease the Net Positive Suction Head (NPSH) available to the ECCS pumps. If a sufficient amount of debris accumulates on the strainer, the margin for NPSH available to the pump may be exceeded resulting in cavitation, reduced performance, and potential damage to the pump.

The peak Suppression Pool and UHS temperatures following a design basis LOCA are the primary considerations for operation of the Containment Heat Removal systems. The heat transfer from containment, the RBCCW cooling water temperature, and resulting environmental conditions in primary and secondary containment are dependent on the Suppression Pool temperature and the UHS temperature.

F. Analysis of Effect on Functions

The maximum Suppression Pool temperature for which containment positive pressurization is not required for NPSH analysis is 169°F as shown in Attachment 2. This represents a three degree increase from the original FSAR value of 166°F. Based on the three degree increase in peak Suppression Pool temperature, the UHS may be increased by three degrees to 68°F by simple extrapolation.

The effect of LOCA-generated debris on the NPSH available to the RHR and Core Spray pumps is evaluated in Calculation M-734 [Ref. 5]. The assumptions used in this interim evaluation are based on the current design basis analysis for LOCA-generated debris, new suction strainer debris capacity, and an extrapolation of the original FSAR DBA-LOCA analysis with a 65°F heat sink as described above.

The calculated total volume of LOCA-generated debris from [Ref. 6] is 23 ft^3. Applying the entire volume to one suction strainer with 2 RHR and 1 Core Spray pump operating at maximum flow, the head loss due solely to the debris is less than 0.01 ft. The minimum available margin for LOCA debris for the limiting Core Spray pump is 0.03 ft assuming zero positive pressure following a DBA-LOCA with a peak Suppression Pool temperature of 169°F per Attachment 2. Therefore, there is adequate NPSH margin to accommodate the postulated debris loading without affecting pump performance.

The heat transfer achieved by the RHR and RBCCW systems with a peak Suppression Pool temperature of 169°F and UHS of 68°F is equal to the heat transfer assumed in the original FSAR analysis with a peak Suppression Pool temperature of 166°F and UHS of 65°F and as confirmed in Calculation M-664 [Ref. 7]

The current Environmental Qualification (EQ) profiles for equipment are based on containment temperature profiles that are referenced in SE-2983 [Ref. 8] for design

basis accident analysis with a 75°F UHS and are now included in the EQ Specification E-536 [Ref. 9] that is the controlling document for the EQ program. SE-2983 is currently under review by the NRC and there are issues relating to the decay heat inputs used in the analysis and the use of containment positive pressure for NPSH analysis. However, this current evaluation is based on a 68°F UHS and does not require consideration of containment positive pressure. It can also be concluded that the containment EQ profiles currently used by Pilgrim are bounding for a 68°F UHS even if a decay heat input were used that is 10% higher than referenced in SE-2983.

It is also necessary to evaluate the acceptability of the peak RBCCW cold-side loop temperature for the safety-related equipment, other than the RHR heat exchanger , which is cooled by RBCCW under emergency conditions. These components include the following:

1. RHR, HPCI, RCIC area coolers.
2. RHR pump seal coolers.
3. Core Spray pump thrust bearing cooler.

The peak RBCC[illegible]de loop temperature evaluated in [Ref. 7] is 98°F when the Suppression Pool is a[illegible]°F. The RHR, HPCI, and RCIC area coolers are analyzed at various water inlet temperatures in [Ref. 10]. The design water inlet temperature for rating area cooler performance is 85°F. Water inlet temperatures up to 100°F are used in the [Ref. 10] performance analyses. The area cooler performance at or above the 98°F water inlet condition was used to calculate K-factors that are included in the secondary containment accident thermal analysis [Ref. 11]. The effect of RBCCW peak cold-side loop temperature on area cooler performance is thereby included in the analysis that determines the post-accident area temperatures in secondary containment.

The RHR pump seal coolers are evaluated in [Ref. 7] as fixed heat loads with a maximum 98°F inlet temperature. The temperature rise in the cooler is only 10.1°F for an outlet temperature of 108.1°F. The pump's mechanical seal purging arrangement consists of a tap on the pump discharge from which water passes through a cyclone separator with the clean discharge passing through the seal cooler and then injecting into the seal chamber for flushing and cooling. The seal cooler is a small shell & tube heat exchanger that uses RBCCW water on the shell side to cool the seal purge water.

The RHR pump requires a seal cooler because it must operate in the shutdown cooling mode where the water temperature can exceed 300°F. For the safety-related modes of operation (LPCI and ECCS), the water is drawn from the Suppression Pool with a maximum temperature of 178°F. The RHR mechanical seal is a John Crane Model 8B1 which is a commonly used rotating-spring O-ring pusher design, equipped with Viton O-rings. For this type of seal, cooling is required to hold the seal chamber below the temperature at which water will flash at the seal faces (212°F). The seal itself can withstand up to 300°F and is therefore not the limiting factor. The seal will operate satisfactorily at temperatures approaching 212°F, therefore the calculated cooling water temperatures are well within the acceptable range. It is concluded that although effective cooling is provided, the accident modes do not require the seal cooling function for proper seal operation. That is the reason the Core Spray pumps, with similar seals (Durametallic Type PTO) do not have seal coolers.

The Core Spray pump thrust bearing coolers are evaluated in [Ref. 7] as fixed heat loads with a maximum 98°F inlet temperature. The temperature rise in the cooler is only 7.6°F for an outlet temperature of 105.6°F. The thrust bearings are a duplex set of angular contact ball bearing in an oil bath in which the cooling coils are also immersed. Ball bearings with oil lubrication are typically considered to operate in the range of 120 to 160°F with an upper limit of 180°F, therefore the calculated cooling water temperatures are well within the acceptable range. The motor outline drawing specifies a maximum cooling water inlet temperature of 165°F for short periods.

G. Summary

Since this evaluation is based on a DBA-LOCA analysis that is from the original FSAR, together with an evaluation of LOCA-generated debris that comprises the current design basis, and NPSH margin is very conservatively based on zero containment positive pressure following a DBA-LOCA, there is no unreviewed safety question involved for plant operation that remains within the defined limits of a 68°F heat sink.

1. Q: May the proposed activity increase the probability of occurrence of an accident previously evaluated in the Final Safety Analysis Report?

   A: No, there are no new accident initiators or changes to the existing assumptions for the probability of any event considered in the FSAR.

2. Q: May the proposed activity increase the consequences of an accident previously evaluated in the Final Safety Analysis Report?

   A: No, there is no change to the consequences for postulated accidents since there is no change to the assumed RHR and Core Spray pump performance or operation of the Containment Heat Removal systems.

3. Q: May the proposed activity increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the Final Safety Analysis Report?

   A: No, there is adequate NPSH margin to accommodate the postulated debris without affecting pump performance. The components of the Containment Heat Removal systems remain within their established operating limits.

4. Q: May the proposed activity increase the consequences of a malfunction of equipment important to safety previously evaluated in the Final Safety Analysis Report?

   A: No, there is no change in the equipment failure assumptions for the accident analysis.

5. Q: May the proposed activity create the possibility of an accident of a different type than any previously evaluated in the Final Safety Analysis Report?

   A: No, there is no changes or effect upon the events considered in the FSAR accident analyses.

6. Q: May the proposed activity create the possibility of a different type of malfunction of equipment important to safety than any previously evaluated in the Final Safety Analysis Report?

   A: No, there is no change in the way that equipment failures are considered for accident analyses.

7. Q: Does the proposed activity reduce the margin of safety as defined in the basis for any Technical Specification?

   A: No, the potential effect from insulation debris accumulating on ECCS pump suction strainers has been evaluated [Ref. 5]. The conclusion is that the increase in suction head loss from the postulated debris accumulation is within the margin for NPSH available to the ECCS pumps. Since the NPSH available at the pump suction exceeds the NPSH required, the pump will achieve its rated performance. Therefore, there is no effect on ECCS pump performance and no change in the margin of safety as determined by the accident analyses. The bases for the Technical Specification requirements regarding Core Spray, LPCI, and Containment Cooling (Sections 3.5.A & B) do not prescribe NPSH criteria per se but it is an implicit assumption for the pump performance criteria that adequate NPSH be provided. There is no requirement that a specific amount of excess NPSH margin be available after all postulated degradations have been included in the analysis. Furthermore, [Ref. 3] explicitly defines a design as adequate when $NPSH_A$ is simply greater than $NPSH_R$ (corrected for air ingestion when appropriate).

   The components of the Containment Heat Removal systems, including RHR, RBCCW, and SSW, remain within their established operating limits with a peak Suppression Pool temperature of 169°F with a 68°F UHS. Considerations regarding Environmental Qualification of equipment are also bounded by the current EQ specification for affected equipment.

Table 5a - NPSH & Max Suction dP

Torus Temp T_{POOL} (F)	Vapor Press P_{VP} (psia)	Spec Volume V_{SP} (ft^3/lbm)	Suction Elev Head h_Z (ft)	(Table 4) Suction Head Loss h_{SL} (ft)	Wetwell Press P_C (psig)	(Eq 8) Available $NPSH_A$ (ft)	(Ref 5&6) Required $NPSH_R$ (ft)	(Eq 9) Available Margin $NPSH_M$ (ft)	Available Margin for LOCA Debris $NPSM_M$ (ft)	(Eq 10) Max Suction dP Measured @ IST Conditions (psi)
Core Spray Pumps A & B @ 4400 GPM:										
169.00	5.8629	0.016440	12.50	2.38	0.000	31.03	29.00	2.03	0.03	1.82
					0.500	32.21	29.00	3.21	1.21	1.82
					3.635	39.64	29.00	10.64	8.64	1.82
					5.600	44.29	29.00	15.29	13.29	1.82
RHR Pumps A & D @ 5100 GPM:										
169.00	5.8629	0.016440	12.50	2.62	0.000	30.79	23.00	7.79	5.79	2.06
					0.500	31.97	23.00	8.97	6.97	2.06
					3.635	39.40	23.00	16.40	14.40	2.06
					5.600	44.05	23.00	21.05	19.05	2.06
RHR Pumps B & C @ 5100 GPM:										
169.00	5.8629	0.016440	12.50	2.02	0.000	31.39	23.00	8.39	6.39	1.83
					0.500	32.57	23.00	9.57	7.57	1.83
					3.635	40.00	23.00	17.00	15.00	1.83
					5.600	44.65	23.00	21.65	19.65	1.83

Note:

[1] Equations and tables referenced here are contained in BECo calculation M662.

[2] This Table is a modified version of Table 5 from BECo calculation M662, Rev. E2 where the torus temperature in column one is changed from 166F to 169F and the vapor pressure and specific volume changed accordingly per the steam tables. The available margin for LOCA debris is reduced from 0.96 feet to 0.03 feet which is greater than the current debris load of 0.01 feet per BECo calculation M734.

[3] Two feet is subtracted from the total available margin to account for Inservice Testing (IST) measurement variations. The remaining margin is available for LOCA debris.