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SUBJECT: Provides 90 day response to GL 97-04, "Assurance of Sufficient Net Positive Suction Head for ECC & Containment Heat Removal Pumps."

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JOHN T. CONWAY
Vice President
Nuclear Engineering

January 5, 1998
NMP1L 1280

United States Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

RE: Nine Mile Point Unit 1
Docket No. 50-220
DPR-63

Subject: *90 Day Response to Generic Letter 97-04, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps"*

Gentlemen:

On October 7, 1997, the Nuclear Regulatory Commission (NRC) issued the referenced Generic Letter (GL) regarding an issue which may have generic implications for Emergency Core Cooling System pumps. The GL required, within 90 days, that licensees provide the information outlined below for each of their facilities:

1. Specify the general methodology used to calculate the head loss associated with the ECCS suction strainers.

2. Identify the required net positive suction head (NPSH) and the available NPSH.

3. Specify whether the current design-basis NPSH analysis differs from the most recent analysis reviewed and approved by the NRC for which a safety evaluation was issued.

4. Specify whether containment overpressure (i.e., containment pressure above the vapor pressure of the sump or suppression pool fluid) was credited in the calculation of available NPSH. Specify the amount of overpressure needed and the minimum overpressure available.

5. When containment overpressure is credited in the calculation of available NPSH, confirm that an appropriate containment pressure analysis was done to establish the minimum containment pressure.

A076 1/1

By this letter, Niagara Mohawk Power Corporation (NMPC) is providing the required 90-day response. In Attachment 1, NMPC is providing plant specific Emergency Core Cooling System (ECCS) information to assist in the review of this submittal. The requested information is provided on Attachment 2 to this letter.

Very truly yours,

John T. Conway
Vice President - Nuclear Engineering

JTC/TRE/cmk

xc: Mr. H. J. Miller, Regional Administrator, Region I
Mr. B. S. Norris, Senior Resident Inspector
Mr. A. W. Dromerick, Acting Director, Project Directorate I-1, NRR
Mr. D. S. Hood, Senior Project Manager
Records Management

UNITED STATES NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
Niagara Mohawk Power Corporation	)	
	)	
Nine Mile Point Unit 1	)	Docket No. 50-220

John T. Conway, being duly sworn, states that he is Vice President - Nuclear Engineering of Niagara Mohawk Power Corporation; that he is authorized on the part of said Corporation to sign and file with the Nuclear Regulatory Commission the document attached hereto; and that the document is true and correct to the best of his knowledge, information and belief.

John T. Conway

John T. Conway
Vice President - Nuclear Engineering

Subscribed and sworn before me,
in and for the State of New York
and the County of Oswego,
this 5th day of January, 1998

My Commission expires: 4/14/98

Judith S. Proud

NOTARY PUBLIC

JUDITH S. PROUD
Notary Public, State of New York
No. 01PR4856665
Qualified in Oswego County
Commission Expires April 14, 1998

Attachment 1

Nine Mile Point Unit 1
Plant Specific Emergency Core Cooling System (ECCS) Background

Nine Mile Point Unit 1, (NMP1) is a General Electric Company, Boiling Water Reactor - 2, (BWR2) with a Mark I primary containment. The Mark I primary containment system consists of a drywell, suppression chamber (torus), and interconnecting vent piping. The NMP1 ECCS consists of four core spray pump sets (core spray pump and core spray topping pump) and four containment spray pumps that take a direct suction from the torus (i.e., NMP1 is not a ring header plant). No other pumps at NMP1 are in the scope of this Generic Letter. The core and containment spray pumps are vertical well pumps. The vertical well pump is considered a superior design over standard skid mounted centrifugal pumps as the pump well provides additional positive suction head for the first stage impellers within the pump bowls.

The core spray system consists of two separate and independent core spray loops to prevent overheating of the fuel following a postulated Loss-of-Coolant Accident (LOCA). Each loop has redundant active components within itself. This system in combination with the Automatic Depressurization System (ADS) is designed to accommodate the range of LOCAs from the smallest up to the largest line break, i.e., double-ended guillotine reactor recirculation line break.

The containment spray system provides the cooling required to maintain the primary containment integrity following a LOCA. This system rejects heat to the ultimate heat sink (Lake Ontario) through the containment spray system heat exchangers to the containment spray raw water system which takes suction from Lake Ontario through the intake canal.

The core and containment spray pump suction lines do not utilize an in-torus strainer. Instead, a coarse grate is welded to a 12" x 20" expander within the torus. This coarse grate keeps large particles of post-LOCA debris from entering the suction bowls (NMP1 is primarily a reflective metal insulation plant). In-line strainers downstream of the pumps screen out particulates that could interfere with the discharge of water from the spray nozzles. These strainers are monitored against plugging by differential pressure indicating switches with control room alarms. Because these strainers are outside of the torus and accessible during normal station operation, one strainer (of the eight total) is inspected every quarter to assure that all strainers are inspected at least once every 2 years.

On October 14, 1992 the NRC issued Amendment No. 133 to Facility Operating License No. DPR-63 for NMP1 to revise Technical Specification 3.1.4/4.1.4 (Core Spray System), 3.3.2/4.3.2 (Pressure Suppression System Pressure and Suppression Chamber Water Temperature and Level), 3.3.7/4.3.7 (Containment Spray System), and the associated Bases to authorize an increase in the maximum allowable water temperature limit of Lake Ontario from 77°F to 81°F. This Amendment was requested as five year trends showed an increase in the peak water temperature of Lake Ontario during mid-summer months. The original FSAR assumed a peak lake temperature of 77°F. Evaluations have been performed for affected safety systems to justify

plant operability for lake water temperatures up to 81°F. NMP1 completed analyses supporting containment spray operation at a design basis temperature of 82°F which allowed for a 1°F margin to the proposed limit of 81°F. Plant specific changes associated with this Technical Specification Amendment included: a minimum downcomer submergence of 3.5 feet (increased from 3.0 feet), a maximum allowed suppression pool temperature of 85°F (increased from 77°F), and the start of a containment spray raw water cooling pump within 15 minutes (decreased from 30 minutes) of LOCA initiation.

The containment spray system raw water (lake) temperature directly affects the heat removal capability of the containment spray heat exchangers. An increase in the design basis assumption for lake temperature directly affects the ability of the containment spray system to perform its design basis function of cooling the suppression chamber. The analysis of the effect of the increased lake temperature was conducted under the Design Bases Reconstitution (DBR) program in July 1991. The results of the analysis show that the peak bulk torus water temperature is 158.9°F assuming the containment spray system is operated in the drywell and wetwell spray mode (original design basis). The peak temperature is 163°F under the Emergency Operating Procedures (EOPs), using a combination of spray and torus cooling. Under the EOPs, sprays are terminated and torus cooling is initiated once containment pressure is reduced to 3.5 psig. Drywell spray is initiated if the drywell pressure increases above 13 psig.

If ECCS flows were affected by debris clogging, the operators would employ redundant pump/pump sets to maintain required ECCS flows. The NMP1 ECCS configuration allows for alternate injection sources other than the torus. Specifically, the core spray system can be supplied from two independent and redundant containment spray raw water pumps with power supplied by the emergency diesel generators. The containment spray system can be supplied likewise. In addition, the core spray system can be manually aligned to take suction from the condensate surge and storage tanks. All of these alternate ECCS injection sources are procedurally controlled and referenced in the NMP1 EOPs.

Attachment 2

The information requested by Generic Letter (GL) 97-04 is provided below for Nine Mile Point Unit 1 (NMP1).

1. Specify the general methodology used to calculate the head loss associated with the ECCS suction strainers.

Response:

NMP1 uses the industry standard equation for determining net positive suction head (NPSH), NPSH = $h_a + h_{st} - h_{vpa} - h_{fs}$, where:

h_a = Absolute pressure (in feet of liquid) on the surface of the liquid supply level
h_{st} = Static height (in feet) that the liquid supply level is above the pump datum
h_{vpa} = Head (in feet) corresponding to the vapor pressure of the liquid at the temperature being pumped
h_{fs} = All suction line losses (in feet) including entrance losses and friction losses

This evaluation accounts for all sources of line losses, including piping, fittings, and components. Thus, the evaluations were not limited to just the head loss across the ECCS suction line coarse grate. Moreover, the NMP1 line loss evaluations have been conservatively performed using the most limiting piping geometry. A discussion of the NPSH equation variables, including the plant specific values and considerations, follows:

h_a = NMP1 does not credit containment overpressure. Therefore, this term is equal to the atmospheric pressure inside the containment expressed in absolute terms relative to the density of the water being pumped. The NMP1 peak torus water temperature is 163 °F in the Emergency Operating Procedure (EOP) case, using a combination of spray and torus cooling. For NMP1, at 0 psig containment pressure, P_{atm} = 14.696 psia and h_a = 34.7 feet.

h_{st} = The core spray and containment spray pumps are vertical well pumps. For the core spray pumps, h_{st} = 18.5 feet. For the containment spray pumps, h_{st} = 18.0 feet. This is based on a minimum torus water level of 211'-0" (i.e., minimum Technical Specification downcomer submergence of 3.5 feet) and a first stage impeller elevation of 192.5 feet for the core spray pumps and 193 feet for the containment spray pumps.

h_{vpa} = NMP1 conservatively determines this based on the maximum calculated bulk suppression pool water temperature of 163 °F. This temperature assumes the following conditions prior to the design basis Loss of Coolant Accident (LOCA): 1) a maximum lake water temperature of 82 °F, 2) a minimum downcomer submergence of 3.5 feet, and 3) a maximum allowed initial suppression pool temperature of 85 °F. For NMP1, h_{vpa} = 12 feet.

h_{fs} = NMP1 calculates suction line losses considering the suction grate clear as well as in a 50% fouled condition. Line losses are calculated assuming the most limiting piping geometry. For the core spray system, with a 50% fouled coarse grate, the suction line loss is equal to 3.799×10^{-7} feet of H_2O/gpm^2. For the containment spray system, with a 50% fouled coarse grate, the suction line loss is equal to 3.650×10^{-7} feet of H_2O/gpm^2 for the primary loop and 3.799×10^{-7} feet of H_2O/gpm^2 for the secondary loop. These correlations yield the following head losses at the maximum expected loop flows:

Core Spray: h_{fs} = 8.84 feet (at 4825 gpm)
Containment Spray (Primary Loop): h_{fs} = 5.33 feet (at 3820 gpm)
Containment Spray (Secondary Loop): h_{fs} = 5.26 feet (at 3720 gpm)

These line losses are based on calculations utilizing "Crane Technical Paper 410" for frictional loss factors which include frictional losses for all pipe, fittings, and valves from the coarse grate to the pump. These analyses do not account for pipe "aging."

2. Identify the required NPSH and the available NPSH.

Response:

All NPSH required information is obtained from original equipment manufacturer literature, such as pump curves, and/or direct correspondence with the manufacturer. The required NPSH ($NPSH_r$) is specific to each pump and is dependent on the flow rate being evaluated. The available NPSH ($NPSH_a$) is dependent on the containment pressure, number of pumps operating (system flow), piping configuration, and the suppression pool temperature at the most limiting condition. Considering these parameters, the $NPSH_r$ and $NPSH_a$ for the limiting cases for pumps taking suction from the suppression pool following a design-basis LOCA are provided in the table below.

The following table is based on a suppression pool water temperature of 163°F in accordance with the EOPs using a combination of spray and torus cooling. As the table shows, the core spray pump is the most limiting for $NPSH_a$.

PUMPS	FLOWS	$NPSH_r$ (feet)	$NPSH_a$ (feet)
Core Spray* Core Spray** Core Spray***	4825 gpm 4825 gpm 4825 gpm	37 37 37	37.22 40.63 32.35
Containment Spray (Primary Loop)	3820 gpm	35.2	35.4
Containment Spray (Secondary Loop)	3720 gpm	33.5	35.4

* With a clean grate and containment spray auto-initiation, $NPSH_r = NPSH_a$ at a suppression pool temperature of approximately 160°F. A temperature of 160°F is never exceeded in the design-basis drywell and suppression pool spray mode.

** In the EOP case where containment spray is manually inhibited with a containment pressure of 3.5 psig and the maximum suppression pool temperature is 163°F with a 50% clogged suction grate, the effect of terminating the drywell and wetwell sprays at 3.5 psig and entering the torus cooling mode would be an increase in the NPSH available to the core spray and containment spray pumps.

*** In the EOP case where containment spray is manually inhibited with a containment pressure of 0 psig and the maximum suppression pool temperature is 163°F with a 50% clogged suction grate, $NPSH_r = NPSH_a$ at a suppression pool temperature of approximately 140°F. This temperature would be reached approximately 6 hours after a LOCA with containment in a flood-up status. The pump manufacturer has confirmed that operation at a $NPSH_a$ slightly less than $NPSH_r$ would be inconsequential due to the short period of time (six hours) that the pumps would be operating in this condition.

3. Specify whether the current design-basis NPSH analysis differs from the most recent analysis reviewed and approved by the NRC for which a safety evaluation was issued.

Response:

The current design-basis ECCS NPSH analyses are based on evaluations submitted to the NRC addressing unresolved items noted in Core Spray System Safety System Functional Inspection (SSFI) Report 50-220/88-201, for which an NRC Safety Evaluation was received. The current design basis is also based on the evaluations submitted in support of Technical Specification Amendment No. 133 to Facility Operating License No. DPR-63 which authorized an increase in the maximum allowable water temperature limit of Lake Ontario.

4. Specify whether containment overpressure (i.e., containment pressure above the vapor pressure of the sump or suppression pool fluid) was credited in the calculation of available NPSH. Specify the amount of overpressure needed and the minimum overpressure available.

Response:

NMP1 does not credit containment pressure above atmospheric pressure in the calculation of available NPSH. NMP1 has reviewed conditions of low available NPSH with the core spray pump manufacturer and concluded that operation at an $NPSH_a$ slightly less than $NPSH_r$ would be inconsequential due to the short period of time (six hours) that the pumps would be operating in this condition. If severe cavitation was evident, the operators have the procedures, equipment, and training in place to throttle the core spray pumps as necessary. In the EOP case, which is the most limiting condition for $NPSH_a$, terminating the drywell and wetwell sprays at 3.5 psig and entering the torus cooling mode increases NPSH available to the core spray and containment spray pumps and lessens the severity of the low NPSH condition.

5. When containment overpressure is credited in the calculation of available NPSH, confirm that an appropriate containment pressure analysis was done to establish the minimum containment pressure.

Response:

As stated above, NMP1 does not credit overpressure. In July 1991, under NMP1's Design Basis Reconstitution (DBR) program, five cases were analyzed by the General Electric Company (GE) using their analysis code SHEX-04 to evaluate the containment pressure and temperature response to a postulated design-basis LOCA. This analysis was performed because of increased Lake Ontario water temperatures during the summer months. Of particular concern to NMP1 was NPSH margin for the ECCS pumps. The analysis showed that, following a double-ended recirculation discharge line break with the containment spray system operating in accordance with the original design basis assumption of continuous drywell and wetwell sprays, a peak suppression pool temperature of 158.9°F is achieved with no airspace overpressurization. Assuming the same design-basis LOCA, with the containment spray system operated in accordance with the EOPs, the suppression pool maximum temperature is 163°F with 3.5 psig wetwell minimum airspace pressure. Thus, operator actions would result in containment overpressure to aid NPSH.