ATTACHMENT

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT UNIT 1

DOCKET NO. 50-220

1.0 INTRODUCTION

The licensee, Niagara Mohawk Power Corporation (NMPC) in letters dated March 28, 1989 and July 6, 1989, submitted their response to the unresolved items noted in the staff Safety System Functional Inspection Report 50-220/88-201. The SSFI team raised the following concerns in their inspection report (a) net positive suction head (NPSH) for the core spray pumps may not be adequate to support the flows expected during large-break LOCAs, (b) the design of the core spray "keep fill system" did not appear to prevent water hammer throughout the system and existing testing did not ensure that water hammer would not occur under certain LOCA conditions. . NMPC submitted NPSH calculations and water hammer analyses as part of their responses.

2.0 EVALUATION

NMP-1 core spray system consists of two automatically actuated, independent systems capable of cooling reactor fuel for a range of loss of coolant accidents (LOCA). Each of the two independent systems consists of a sparger in the RPV with 2 subsystems having one pump set of a core spray pump and core spray topping pump.

2.1 Core Spray Pump NPSH

NMPC calculated core spray pump NPSH for conditions as shown below.

Condition	Torus Pressure (psig)	Torus Temperature (°F)
LOCA Condition 1	22	140
LOCA Condition 2	3.5	140
NRC Regulatory Guide 1.1	0	140

LOCA Condition 1 is at the time of maximum torus pressure due to the design basis LOCA. LOCA Condition 2 is late post-LOCA when the torus air space is assumed to be pressurized due to the increase in the torus air temperature from 90°F to 140°F. The third condition is according to NRC Regulatory Guide 1.1 and assumes no increase in containment pressure above that which existed prior to the LOCA. Results of the calculations are provided below.

Condition	Max Pump Flow (gpm)	NPSH (feet) Required	NPSH (feet) Available
LOCA Condition 1			
1 Pump Set	5000	39	88
2 Pump Sets	3350	26	93
LOCA Condition 2			
1 Pump Set	5000	39	44
2 Pump Sets	3350	26	50
NRC Regulatory Guide 1.1			
1 Pump Set	5000	39	36
2 Pump Sets	3350	26	41

As shown in the above table, the core spray pumps have sufficient NPSH for the expected containment conditions during a LOCA. But if one assumes the

conservative assumptions of Regulatory Guide 1.1, the core spray pumps available NPSH is less than the NPSH required for one pump set operation.

During one pump set operation at a reactor pressure of 0 psig, the calculated flow through the core spray pumps is about 5000 gpm. From the pump performance curves, the required NPSH at this flow is 39 feet. At the maximum water temperature during a LOCA of 140°F and a torus air pressure of 0 psig (Regulatory Guide 1.1 Conditions), the available NPSH is calculated to be 41 feet with a clean (unblocked) pump suction strainer. However with the strainer 40 percent blocked, the available NPSH is calculated to be 35 feet, i.e., 3 feet less than the required NPSH. This NPSH deficiency may result in pump cavitation.

The torus temperature is reduced to 118°F when the containment pressure is reduced to 0 psig. For a containment pressure of 0 psig and torus water temperature of 118°F, the available NPSH equals the required NPSH of 39 ft. From Figure E-33 of the NMP-1 FSAR, Appendix E, this temperature (118°F) occurs at about 6 hrs after the accident. According to the licensee, the core spray pumps may run with cavitation for 6 hrs if Regulatory Guide 1.1 conditions are assumed.

Based upon input from the pump vendor, the licensee stated that the core spray pumps will run with cavitation for 6 hours and the pumps will not fail in the 6 hours of operation. We have reservations about the pump vendor's conclusions, since operation of the pump in a cavitating mode is not a design condition. There is no testing which demonstrate that the pumps will continue to operate when in cavitation and therefore perform its intended safety function during a LOCA. The staff does not have reasonable assurance that the core spray pumps would operate for sufficient duration with the assumed containment pressure and temperature conditions given in Regulatory Guide 1.1.

The initial conditions given in Regulatory Guide 1.1 are conservative. For design basis accident conditions the containment pressure will be greater than

0 psig and suppression pool temperature will be less than 140°F during a LOCA. The operators will start suppression pool cooling sufficiently early to keep the pool temperature below 140°F and the containment will be pressurized during a LOCA.

Therefore, with the expected containment conditions described above, the core spray pumps will have sufficient NPSH for design basis accidents.

In the unlikely event of the core spray pumps become inoperable, the following systems can be used during a LOCA.

(1) Control rod drive system taking suction from the condensate storage tank (CST) with 105,000 gallons of water.

(2) HPCI/FW system taking suction from the condenser hotwell with makeup from the CST with 180,000 gallons of water.

(3) Raw water system via an intertie between the raw water system and the core spray system. Lake water would enter the reactor vessel through the core spray spargers. This system is capable of providing water indefinitely in the event of a loss of the core spray pumps.

(4) Fire water system via an intertie between the fire water system and the feedwater system. Lake water would enter the reactor vessel through the feedwater spargers.

In summary, with the expected containment conditions, the core spray pumps will have sufficient NPSH for design basis accidents. Moreover, the availability of alternate systems described above give additional assurance that the core will be covered even if the core spray pumps become inoperable. Thus, we conclude that the NMP-1 core spray system will perform its safety function and is backedup by the alternate systems.

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2.2 Core Spray System Water Hammer

The inspection team was concerned that the present configuration of the core spray system appeared susceptible to water hammer during large-break LOCA situations. In the present design, the keep-fill lines join the core spray piping at points downstream of injection check valves 40-03 and 40-13. This filled the piping from these valves to inboard isolation valves, 40-01, 40-09, 40-10 and 40-11. However, the piping upstream of the injection check valves was not supplied by the keep-fill system. Much of the piping was above the torus level and free to drain back to the torus through the pumps by way of the topping pump discharge check valve bypass lines. There is a vacuum breaker from the topping pump discharge to the torus to reduce the chances of a water hammer. This design may create voids when the system was not running and create conditions conducive to water hammer upon system initiation in response to a large-break LOCA.

The licensee stated that no problems with water hammer have been observed during system surveillance testing. The team was concerned that existing tests did not simulate large-break LOCA conditions.

The licensee, in their letter dated July 6, 1989, committed to perform a core spray injection test prior to startup. The test, titled 88-7.12, will be an augmented version of the core spray operability test NI-ST-R9 using demineralized water from the condensate storage tank (CST). The sequence for starting the core spray and topping pumps, and opening the isolation valves inside the drywell will be similar to the sequence of events expected during a LOCA. Both loops will be tested using a small-break LOCA sequence and the large-break LOCA sequence. Walkdowns of the core spray system will be performed before and after the tests to verify that dynamic loads during startup of the core spray system did not cause damage to the system.

Since the core spray pumps are tested with suction from CST rather than the torus, the test will not simulate exactly the actual core spray pump suction

condition. But the pump and valve operating conditions are simulated and the pump discharge piping layout is the same as used in a real LOCA. Therefore, we believe the test will provide reasonable assurance that the core spray system will perform its safety function. The licensee commitment to perform the test prior to startup is sufficient to start NMP-1. Should the licensee note any water hammer during the test, the staff should be informed.

3.0 CONCLUSION

As a result of our review, which is described in Section 2.0 of this evaluation, we conclude that the SSFI open item 50-220/88-201-01 regarding core spray pump NPSH can be considered closed. The water hammer issue is considered closed for plant-startup with the licensee's commitment to perform an augmented system operability test for water hammer.