Consumers Power
POWERING MICHIGAN'S PROGRESS
Palisades Nuclear Plant: 27780 Blue Star Memorial Highway, Covert, MI 49043

G B Slade
General Manager

February 19, 1991

Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT -
LICENSEE EVENT REPORT 90018 - INADEQUATE FLOWS THROUGH PCS HOT LEG INJECTION CHECK VALVES - SUPPLEMENTAL REPORT

Supplemental report for Licensee Event Report (LER) 90018 (Inadequate Flows Through PCS Hot Leg Injection Check Valves) is attached.

Gerald B Slade
General Manager

CC Administrator, Region III, USNRC
NRC Resident Inspector - Palisades

Attachment

IE22

NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Palisades Nuclear Plant	0 5 0 0 0 2 5 5	1 OF 0 5

TITLE (4)
INADEQUATE FLOWS THROUGH HOT LEG INJECTION CHECK VALVES

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
									N/A	0 5 0 0 0
0 9	2 0	9 0	9 0	0 1 8	0 1	0 2	1 9	9 1	N/A	0 5 0 0 0

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER	
	AREA CODE	
W. L. Roberts, Staff Licensing Engineer	6 1 6	7 6 4 - 8 9 1 3

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
B	B P	I S V							

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

ABSTRACT

On September 30, 1990, at 1632 hours the plant was shutdown and on shutdown cooling. The Surveillance Test RO-65, "HPSI/RHPSI Check Valve Test", which provides for full stroke testing of certain High Pressure Safety Injection (HPSI) pump suction and discharge check valves and the Hot Leg Injection (HLI) check valves was being conducted. Technical Specification 4.0.5a requires testing of valves in accordance with the ASME Boiler and Pressure Vessel Code, Section XI, edition and addenda as specified by 10CFR50.55a(g). The Code requires that check valves be exercised "to the position required to fulfill their function." The NRC has interpreted this to mean full stroke testing is required or, if full stroking of the disc cannot be verified, full flow testing. The resultant flow rates for each of the two Primary Coolant System (PCS) hot legs were less than the acceptance criteria of 250 gallons per minute (gpm). The failure of the test to satisfy the acceptance criteria was reported to the system engineer and the shift manager and a corrective action document was issued. Subsequent analysis on October 12, 1990 determined that the flow delivered to the hot legs was less than that required by the plant safety analysis. The HLI check valves (CK-ES-3408, 3409 and 3410) were replaced with swing check valves. This event is reportable as a condition outside the design basis of the plant.

NRC Form 366
(9-83)

EVENT DESCRIPTION

On September 30, 1990, at 1632 hours the plant was shutdown and on shutdown cooling. The Surveillance Test RO-65, "HPSI/RHPSI Check Valve Test", which provides for full stroke testing of certain High Pressure Safety Injection (HPSI) pump suction and discharge check valves [BQ;ISV] and the Hot Leg Injection (HLI) check valves [BP;ISV] was being conducted. Technical Specification 4.0.5a requires testing of valves in accordance with the ASME Boiler and Pressure Vessel Code, Section XI, edition and addenda as specified by 10CFR50.55a(g). The Code requires that check valves be exercised "to the position required to fulfill their function." The NRC has interpreted this to mean full stroke testing is required or, if full stroking of the disc cannot be verified, full flow testing. The resultant flow rates for each of the two PCS hot legs were less than the acceptance criteria of 250 gallons per minute (gpm). The failure of the test to satisfy the acceptance criteria was reported to the system engineer and the shift manager and a corrective action document was issued. Subsequent analysis on October 12, 1990 determined that the flow delivered to the hot legs was less than that required by the plant safety analysis. This event is reportable as a condition outside the design basis of the plant.

HLI is required in a large cold-leg break to provide flow required to make up for core boil off and a small net core flushing flow (total of 227 gpm). The core flushing flow is needed to prevent excessive boric acid concentration in the core, which could result in boric acid precipitation and possible core flow blockage.

The HLI flow path is also needed to support heavy load movements in containment during reactor shutdown periods. The HLI flow path provides an alternate flow path to loop 1A hot leg in the event that cold leg injection is no longer available due to a heavy load drop event. In the event that shutdown cooling is lost, the HLI flow path is required to deliver 100 gpm of flow to mitigate a heavy load drop.

A similar reduced flow problem with the valves was discovered in 1988 when the same flow testing produced lower than expected results. The check valves were disassembled and inspected. The results showed no apparent problems with the mechanical clearances and freedom of operation. One theorized interference point on the valve internals was modified under the Specification Change number 88-252. This modification removed a sharp edge interface between the valves' disc guides and the valves' closure caps. Although not identified, during the valve disassembly and inspection, as an interference point, it was decided to provide this relief on each of the affected valves, to provide some added assurance for future operation. Following the 1988 modification of the valves, the RO-65 flow test was successfully completed three times with repeatable satisfactory results. Flows achieved during this testing were around 300 gpm.

CAUSE OF THE EVENT

Universal Testing Laboratories was requested to complete a study to investigate the root causes of the inadequate flow through the HLI Check Valves. The results of the study show that a full stroke opening of the valves for this application was prevented by the following weaknesses in the valve design. The disc guide location in the valves prevents flow distribution around the disc while a cover which screws in the valve body leads to misalignment. Furthermore, short disc guides and inefficient drainage are also a result of a weak design. These design deficiencies point to a root cause of improper application of this valve in the HLI system.

CORRECTIVE ACTION

The hot leg injection check valves (CK-ES 3408, CK-ES 3409, and CK-ES 3410) were replaced with swing check valves.

The plant equipment data base was reviewed and it was determined that no other valves of this design are installed at the plant. Based on the results of the root cause investigation, the fact that no other valves of this design are installed in the plant, and ALARA considerations; the problem valves were not disassembled for any further investigation after their removal.

An additional analysis was performed to verify that the flow rate of 250 gpm, as an acceptance criteria for RO-65 test conditions, provides the correct flow rate for the hot leg injection check valves. Based on current accident analysis methodology and some additional analysis conservatisms, a new flow rate acceptance criteria of greater than 264 gpm has been established. The surveillance procedure RO-65 which tests the HLI check valves, and the procedure basis document were revised accordingly. The Basis Document for RO-65 was also revised to clarify the flow requirements for heavy load movements versus post accident hot leg injection.

All of the corrective actions have been completed.

ANALYSIS OF THE EVENT

The measured flows to the two PCS Hot Legs as a result of the RO-65 testing (190 gpm and 210 gpm) were sufficient to support heavy load movements which require a boric acid flow path capable of supplying 100 gpm to the PCS, but less than the test acceptance criteria for the HLI.

The minimum flow required at 4 hours after a large break LOCA to replace coolant lost due to boil off is defined as 222 gpm in CE document P-PEC-170, "Head Losses and Flow Requirements for the Hot Leg Injection Line for Palisades". An additional 5 gpm is required for core boron flushing. Therefore the total minimum required flow for the HLI at four hours is 227

gpm. The RO-65 acceptance criteria of 250 gpm therefore provided margin to assure the minimum flow requirements were verified.

The Palisades Design Basis Document for the HPSI System (DBD-2.02), explains that hot leg injection should not be initiated until at least 4 hours into the event and before 6½ hours into the event. To assure that the four hour minimum time has passed, both DBD-2.02 and Emergency Operating Procedure (EOP) 4.0, "Loss of Coolant Accident," require verification that safety injection has been operating for at least five and one-half hours prior to initiating HLI. A table of required flows as a function of decay heat fraction is provided in the DBD and is based on an initial core power of 2650 MWt plus 2% for uncertainty. At 4 hours into the event 222 gpm is required, and at 6 hours 200 gpm is required to replace water lost to boil off.

The plant operated at 100% power only at the beginning of the Cycle 8 which was shortly after the successful completion of RO-65 in the 1988 refueling outage. Plant operation was limited to 80% of full power for the remainder of the cycle. Therefore, it is appropriate to evaluate the consequences of the tested flows verses the actual flow requirements assuming a plant operating history of 80% of full power.

The flow requirements at 4 and 6 hours into the event for Cycle 8 operation at 80% of full power was determined by simply scaling the value in the table given in DBD-2.02. The values are first scaled down by the ratio of 2530 to 2650 (actual licensed full power to the analysis assumed value) then multiplied by 0.80. The resulting required flows are 170 gpm and 153 gpm at 4 and 6 hours, respectively.

Additional corrective action required that an analysis be performed to verify that the acceptance criteria in RO-65 of 250 gpm is the correct flow rate for testing the HLI check valves. The conclusion of this analysis was that approximately 37 gpm should be added to the accident analysis required flow (of 227 gpm) to more conservatively account for differences introduced as a result of the test conditions and methods being different than actual accident conditions. This would then raise the RO-65 test acceptance criteria from 250 gpm to 264 gpm. When this bias is added to the required flows for Cycle 8 operation plus the 5 gpm required for core boron flushing, the required flows would have been approximately 212 gpm and 195 gpm at four and six hours respectively. As stated above, these are considered conservative values which account for differences between the test method and accident conditions. One of the conservatisms is the 5 gpm requirement for core boron flushing flow. DBD-2.02 states that boron precipitation will not occur until 29 hours post-LOCA for the limiting break size, therefore, core flushing would not actually be needed until many hours later when core decay heat was even further reduced.

Therefore, although the flow rates measured during RO-65 (210 and 190 gpm) were less than the stated acceptance criteria, sufficient flow would have been available during Cycle 8 to meet the requirements for successful hot leg injection, and the effect on the consequences of the event would have been negligible.

As a result, this event did not adversely impact the operational safety of the plant or the safety of the plant personnel or the general public.

This event is being reported under 10 CFR 50.73(a)(2)(ii) as a condition outside the design basis of the plant.