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

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Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT
LICENSEE EVENT REPORT 94-004-01 - ESS PUMP COOLING SINGLE FAILURE - SUPPLEMENTAL REPORT

Licensee Event Report (LER) 94-004-01 is attached. This supplemental report provides the final evaluation of the safety significance that a loss of cooling to the ESS room pumps would have on the pumps post accident operability.

This event was originally reported in accordance with 10CFR50.73(a)(2)(ii)(B) as a condition outside the design basis.

SUMMARY OF COMMITMENTS

This LER contains one new commitment, as follows:

The FSAR will be updated to clarify the requirements for ESS pump cooling and also the requirement to use the "subcooled suction" flow path for the HPSI pumps.

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Plant Safety and Licensing Director

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

Attachment

JE22

NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
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LICENSEE EVENT REPORT (LER)

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

TITLE (4) LICENSEE EVENT REPORT 94-004-01 - ESS PUMP COOLING SINGLE FAILURE

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (6)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	
0 2	0 9	9 4	9 4	0 0 4	0 1	1 2	2 8	9 4	N/A	0 5 0 0 0
									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)	1 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)
William 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

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

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

On February 9, 1994, at 5:45 pm, while the plant was operating at 100% power, a previously unidentified single failure mechanism which could affect the Engineered Safeguards System (ESS) pumps was discovered. It was discovered that a single active failure could disable the seal cooling to the ESS pumps and that the backup cooling supply was not fully qualified. An initial evaluation of the plant condition and of the effects of the potential failure mechanism concluded that the operability of the pumps was not affected.

As an immediate corrective action, the normally closed pump cooling valves were opened to eliminate the possibility of the subject single failure, their failing to open. The plant remained at power. Subsequent analysis determined that post accident loss of cooling water to the ESS pumps may have resulted in the pumps not being able to perform their design basis function.

EVENT DESCRIPTION

On February 9, 1994, at 5:45 pm, while the plant was operating at 100% power, a previously unidentified single failure mechanism which could affect the Engineered Safeguards System (ESS) pumps was discovered. It was discovered that a single active failure could disable the seal cooling to the ESS pumps and that the backup cooling supply was not fully qualified. An evaluation of the plant condition and of the effects of the potential failure mechanism concluded that the operability of the pumps was not affected.

The affected valves were opened to eliminate the possibility of the subject single failure, their failing to open. The plant remained at power.

This event is reportable in accordance with 10CFR50.73(a)(2)(ii)(B) as a condition outside the design basis.

CAUSE OF THE EVENT

The cause of this event was the failure to recognize that the ESS pumps are dependent on seal and bearing cooling and that this dependence was outside the plant design basis.

ANALYSIS OF THE EVENT

The Palisades Engineered Safeguards Systems (ESS) pumps are equipped with seal and bearing cooling. The initial design, as currently understood, considered the seal and bearing cooling as an optional function intended to extend pump bearing and seal life. Subsequent correspondence with the equipment vendors has determined that pump cooling is required for the long term operability of the pumps. This is a condition outside the plant design basis.

ESS pump cooling is provided by: diverting a small portion of each pump's discharge flow through a heat exchanger, where it is cooled by Component Cooling Water (CCW); directing it through cooling jackets around the pump's seal areas; and then returning it to the pump suction. CCW is also directed to cooling jackets around the pump bearing areas. The CCW flow for all pump cooling is controlled by common supply and return valves, CV-0913 and CV-0950. (The Palisades CCW system has redundant trains of pumps and pump controls, but uses a single, common, piping system.) These two valves are opened automatically on a Safety Injection Signal (SIS). A backup cooling supply is available, through non-automatic valves, from the Service Water System (SWS). A sketch of the pertinent portions of the piping systems is attached.

The normal configuration for the CCW to the pump seal cooling had been for both CV-0913 and CV-0950 to be closed. Both of these valves are spring loaded to the open position, requiring

availability of both instrument air and electrical power to hold them closed. The valves which supply the SWS backup cooling are also normally closed, but are spring loaded to the closed position, requiring availability of both instrument air and electrical power to open them.

If, following a Loss Of Coolant Accident (LOCA), either CV-0913 or CV-0950 failed to open on demand (possibly due to binding of the valve stem or similar failure) cooling flow to the ESS pumps would not be available from the CCW system. Conceptually, recovery from such a failure would simply require the operators to initiate the alternate cooling by closing the open CCW valve and opening the SWS valves. Palisades design features complicate this recovery; instrument air is not a safety grade system and thereby might not be available. These conditions lead to the possibility of a single active failure disabling the ESS pumps.

The use of non-safety grade instrument air to open the backup cooling implies that credit should not be taken, in the design basis, for operation of backup cooling. Therefore, if either CV-0913 or CV-0950 should fail to open on demand, all (safety grade) cooling to the ESS pumps, and consequently the functioning of the pumps themselves, could eventually be lost.

There are three types of ESS pumps used at Palisades, Containment Spray (CS), High Pressure Safety Injection (HPSI), and Low Pressure Safety Injection (LPSI). In the FSAR descriptions of both the HPSI and the LPSI pumps, the seal coolers are described as being supplied "to prolong seal life"; the FSAR description of the CS pumps makes no mention of the seal cooling at all. The statement "to prolong seal life" has typically been taken to mean that the pumps would survive their required accident duties without cooling, but cooling was provided to reduce maintenance due to normal wear. The safety injection pumps were supplied by Combustion Engineering; the containment spray pumps by Bechtel. The system designers and, probably, the writers of the FSAR descriptions were different. An evaluation of ESS pump and seal performance and cooling dependence was performed. Each pump type is discussed below:

1) The CS pumps are single stage centrifugal pumps. The original quotation from the vendor stated "Should there be a stoppage of cooling water, the only damage would occur to the pump seal." Subsequent correspondence with the vendor, discussing pump operation with 325°F water, states that operation without cooling could quickly lead to seal failure, and questioned the effects on bearing life. Consequently, cooling water is required for operation of the CS pumps.

2) The HPSI pumps are seven stage centrifugal pumps. The HPSI pump seal manufacturer has supplied data that state the pump seals can function properly, with no cooling, while pumping 300°F water. The HPSI pump vendor approved bearing operation with no cooling, while pumping 250°F water. Both the pump and seal vendors do, however, recommend cooling water be provided to extend pump and seal life. The highest temperature water the HPSI pumps would encounter would be that at the initiation of recirculation. Existing analysis which calculate sump temperatures were done to bound the conditions following

an accident, and assume the complete failure of one train of safeguards equipment. The highest analytical sump temperature at the time of recirculation, 235.5°F, is found in the analyses which assumes failure of the right train. The HPSI pumps, therefore, would not be directly affected by a loss of cooling.

The HPSI pumps do, however, have a dependence on the CS pumps. A manually controlled suction path from the discharge of the CS pumps, through the shutdown cooling heat exchangers, to the suction of the HPSI pumps was provided as part of the original Palisades design. Use of this suction path can boost the net positive suction head of the HPSI pumps by raising the suction pressure. The FSAR states that use of this "sub-cooled suction" path is not required for pump operation. Subsequent engineering evaluations have led to questioning of this statement. It is currently believed that the increase in pressure from use of the sub-cooled suction is necessary to maintain adequate NPSH for the HPSI pumps during particularly high flow portions of the post-LOCA recirculation phase. Current operating procedures direct the operators to align the HPSI pumps to utilize the sub-cooled suction path following initiation of recirculation. This reliance upon the sub-cooled suction paths for HPSI operation is not in conformance with the plant design, as presented in the FSAR. It is this dependance, on the sub-cooled suction from the CS pump discharge, which also makes the HPSI pumps indirectly dependant on seal and bearing cooling.

3) The LPSI pumps are single stage centrifugal pumps. They are not affected, during accident scenarios, by a loss of seal and bearing cooling since they are automatically tripped on initiation of recirculation.

The LPSI pumps are used, however, for shutdown cooling (decay heat removal) service, where pumped fluid temperature can be as high as 300°F. Provision is also made in the design to bypass the LPSI pump trip on recirculation initiation, or to restart them after initiation of recirculation. The FSAR states that the seals are designed for operation at 325°F. Subsequent correspondence with the vendor, discussing pump operation with 325°F water decreasing to 130°F, states that operation without cooling in either continuous or intermittent duty is not recommended. Consequently, cooling water is required for operation of the LPSI pumps.

SAFETY SIGNIFICANCE

Common mode failure of the ESS pumps due to a loss of cooling water is of considerable safety significance. The probability of such a failure due to the subject single failure is judged to be quite low. The two valves involved are both "fail open" valves, meaning that if instrument air pressure or electrical power to the valves were lost, they would stroke to their open (safety) position. Proper operation of these valves is verified quarterly. The action taken, to operate with both of the subject valves in their open position, removes the potential for their failing to

open on demand.

A re-evaluation of the ESF pump cooling requirements was completed. It was thought that a re-evaluation might show that the ESF pumps required no cooling to perform their design basis function. The original calculations for ESF pump cooling used very conservative inputs such as a containment sump water temperature equivalent to the peak containment LOCA temperature. The results of the re-analysis determined that the ESF pumps would still, however, require some amount of post accident cooling water flow.

Therefore, a loss of cooling water to the ESF pumps following a LOCA, may have resulted in the ESF pumps not being able to perform their design basis function for the time required.

CORRECTIVE ACTION

1) Immediate action was taken to revise the plant operating procedures so that the normal position for both CV-0913 and CV-0950 is "OPEN", and to place the valves in that position. Since the valves are spring operated to the open position, and require both instrument air and electrical power to close them, this action eliminates the potential for a single active failure disabling the ESS pumps due to the subject failure.

2) An assessment was made of the interim valve alignment for the CCW cooling to the engineered safeguards pumps (CV-0913 and CV-0950 open) to verify that the alignment meets plant design and licensing requirements and serves to minimize plant risk. The results of the assessment determined that operating with the CCW valves normally open meets plant design and licensing requirements and will reduce the overall plant risk compared with having the CCW valves normally closed.

3) A re-evaluation of the ESF pump cooling requirements was completed. The evaluation concluded that cooling water is required. The FSAR will be updated to clarify the requirements for ESF pump cooling and also the requirement to use the "subcooled Suction" flow path for the HPSI pumps.

4) An action was completed to confirm the need to provide sub-cooled suction (from the containment Spray pumps) to the HPSI pumps following RAS. If such an operation is not required, the seal cooling and bearing cooling water requirements for the containment spray pumps may have been reduced since their required post accident mission time would be reduced. The results of the evaluation determined that sub-cooling of the HPSI pump suction is necessary to assure HPSI pump NPSH following RAS. Consequently, no reduction in containment spray pump mission time can be justified.

5) Perform a design review of the CCW and SWS systems, including a single failure analysis of the systems.