CATEGORY 1

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FACIL:50-315 Donald C. Cook Nuclear Power Plant, Unit 1, Indiana M 05000315
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SUBJECT: LER 97-003-01:on 970205,determined that Safety Injection pumps could potentially experience runout conditions.Cause indeterminate.Revised plant operating procedures re safety injection pump.W/970331 ltr.

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INDIANA MICHIGAN POWER

March 31, 1997

United States Nuclear Regulatory Commission
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Operating Licenses DPR-58
Docket No. 50-315

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In accordance with the criteria established by 10 CFR 50.73 entitled Licensee Event Report System, the following report is being submitted:

97-003-01

Sincerely,

A. A. Blind
Site Vice President

/mbd

Attachment

c: A. B. Beach, Region III
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NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
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LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	Page 1 of 6
Donald C. Cook Nuclear Plant - Unit 1	50-315	

TITLE (4)
Condition Outside the Design Basis Due to Potential Safety Injection Pump Runout

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 NAME	DOCKET NUMBER
02	05	97	97	- 003 -	01	03	31	97	Cook Unit 2	50-316
									FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
POWER LEVEL (10)	96.7	20.2201(b)		20.2203(a)(3)(i)		50.73(a)(2)(iii)		73.71(b)	
		20.2203(a)(1)		20.2203(a)(3)(ii)		50.73(a)(2)(iv)		73.71	
		20.2203(a)(2)(i)		20.2203(a)(4)		50.73(a)(2)(v)		OTHER	
		20.2203(a)(2)(ii)		50.36(c)(1)		50.73(a)(2)(vii)		(Specify in Abstract below and in Text, NRC Form 366A)	
		20.2203(a)(2)(iii)		50.36(c)(2)		50.73(a)(2)(viii)(A)			
		20.2203(a)(2)(iv)		50.73(a)(2)(i)		50.73(a)(2)(viii)(B)			
		20.2203(a)(2)(v)	X	50.73(a)(2)(ii)		50.73(a)(2)(x)			

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Robert Gillespie, Operations Superintendent	616/465-5901, x2325

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	X	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On February 5, 1997, with Unit 1 at 96.7 percent Rated Thermal Power and Unit 2 at 99.8 percent Rated Thermal Power, preliminary information was received from Westinghouse that indicated that the Safety Injection pumps could potentially experience runout conditions if the accumulator fill line were open during a large break LOCA demand. An ENS notification was made under 10CFR50.72(b)(1)(ii)(B), to report a condition outside the design basis at that time.

Cook Technical Specification 4.5.2.h states that total Safety Injection system flow shall not exceed 700 gpm with a single pump running and the minimum flow valve open. If only one safety Injection pump is providing flow to all four injection lines while the accumulator fill line is fully open and the minimum flow valve is open, which may occur during the injection phase of a large break LOCA towards the end of blowdown, the runout limit may be exceeded. By letter dated February 21, 1997, Westinghouse has confirmed, by model, that the pumps will run out to between 708 and 720 gpm, dependent on initial conditions.

The flowpath created by opening the accumulator fill line had not been previously identified as affecting the emergency core cooling system analysis and therefore had not been adequately addressed in the analysis.

This event was evaluated against the analyses for large break LOCA, small break LOCA, containment and the sump recirculation flow requirements, and found to have no safety significance.

Conditions Prior to Occurrence
Unit 1 in Mode 1 at 96.7 percent Rated Thermal Power
Unit 2 in Mode 1 at 99.8 percent Rated Thermal Power

Description of Event
During preparations to increase water level in an emergency core cooling system accumulator, questions were raised by the control room operators related to the operability of the safety injection pumps during accumulator level adjustment. Specifically, a question was raised regarding the potential for diverting safety injection flow from the injection flowpath during the accumulator level adjustment evolution.

The potential for exceeding the design runout flow limit for the safety injection pumps during accumulator level adjustments was identified on February 5, 1997, based on preliminary pump runout calculations. The potential for a runout condition was not identified until February of 1997, however, filling accumulators while aligned for emergency core cooling support had been the standard practice throughout the lifetime of the plant.

The Cook Nuclear Plant NSSS vendor, Westinghouse, was requested to perform an evaluation to determine the potential impact of creating an unanalyzed flowpath through the accumulator fill line. It has been determined that a potential existed for the safety injection pump runout flow to exceed its runout design flow limit during the injection phase of an emergency core cooling system actuation with an accumulator fill line open. The results of the Westinghouse evaluation confirmed that the safety injection pumps flow would exceed the Technical Specification flow limit. Cook Technical Specification 4.5.2.h states that total Safety Injection system flow shall not exceed 700 gpm with a single pump running and the minimum flow valve open. If only one safety Injection pump is providing flow to all four injection lines while the accumulator fill line is fully open and the minimum flow valve is open (which may occur during the injection phase of a large break LOCA towards the end of blowdown) the pumps will run out to between 708 and 720 gpm.

This finding was reported pursuant to 10CFR50:72(b)(1)(ii)(B), as a condition outside the design basis on February 5, 1997.

Cause of Event
The potential runout issue was not considered or identified previously. A reason for this oversight could not be determined.

During the investigation it was noted that the plant design and the Final Safety Analysis Report (FSAR) recognized the need to fill the accumulators during normal power operations. There were no limitations identified in the FSAR that would preclude the fill evolution.

Analysis of the Event

This event is being reported in accordance with 10CFR50.73(a)(2)(ii)(B), as a condition outside of the plant design basis.

A question was raised by the Operations Department regarding the safety injection (SI) pump operability while performing an accumulator fill operation. During power operation, the south SI pump is used to maintain level in the accumulators when it decreases below an administrative limit. This is in accordance with the original design of the system. Section 6.2.2 of the FSAR also indicates that the accumulator levels are maintained at power by use of a SI pump.

The concern involves the effect of the flow diverted by the fill operation on the SI flow balance and the SI pump runout limit. Specifically, Nuclear Safety and Analysis was asked to determine if the loop flow requirements or the SI pump runout limits in the Technical Specifications could be exceeded if a LOCA were to occur while an accumulator fill operation was in progress. Subsequent analysis by Westinghouse demonstrates that the SI pump runout limit may be exceeded under certain conditions. This assessment applies to both units.

The flow requirements for the SI pumps are based on ECCS requirements for LOCA (minimum flow limit) and for protection against pump runout (maximum flow limit). These requirements are reflected in Technical Specification 3.5.2 for a single SI pump as a minimum flow of 300 gpm for each header (600 gpm total) and a maximum flow of 640 gpm for both headers, plus 60 gpm for the minimum flow line (700 gpm total). This leaves a maximum possible margin of 40 gpm for a single SI pump to remain between its minimum and maximum injection flow requirements of 600 gpm and 640 gpm, respectively. By opening the accumulator fill line, an additional flow path is introduced which could cause the affected SI pump to exceed the runout limit if a demand on the SI system (i.e., a LOCA) were to occur. If the runout limit is exceeded, then the SI pump could be operating outside of its original design envelope. In addition, the accumulator fill line would divert some of the SI flow from the cold leg injection lines.

Operating Conditions of Concern

There is a certain set of conditions that must simultaneously exist in order for the SI pump to exceed the runout limit -

- The accumulator fill operation is in progress.

  This procedure is performed to restore accumulators to above administrative limits. This evolution is performed approximately 4 times a year, with a typical duration of 5 minutes. Therefore, the total exposure time is on the order of 20 minutes per year.

- The Safety Injection discharge line crossties are open.

  This is the normal operating position for the safety injection discharge line crossties. If the safety injection discharge line crossties are closed, the pumps cannot approach the runout limit. The crosstie valves are also closed during the recirculation phase of a LOCA.

Analysis of the Event (cont'd)

Operating Conditions of Concern (cont'd)

- While the accumulator fill operation is in progress, a large break LOCA (LBLOCA) occurs.

  A LBLOCA will quickly reduce the RCS pressure to the point where the SI pump runout may occur. A small break LOCA (SBLOCA) does not pose a problem with respect to runout since the RCS pressure remains elevated, providing a higher back pressure on the SI system and thus reducing the SI pump flow.

- One of the SI pumps must fail to start or fail to run.

  One pump is assumed to fail by single failure of the pump or its associated diesel generator if loss of offsite power occurs. If both SI pumps are delivering flow into two headers, then the flow delivered by each will be reduced compared to the case of one pump delivering flow into both headers. In this case, neither pump would approach the runout limit.

Under these conditions, a single SI pump may exceed the runout limit.

Probabilistic Impact

Due to the infrequent occurrence and very short duration of the fill operation, the exposure time to this event is very limited (Item 1 above). Per conversations with Westinghouse, this is the reason that the accumulator fill line has never been included in the SI pump runout evaluations performed. A calculation was performed that demonstrates that the core damage frequency (CDF) resulting from the accumulator fill line operation with all of the conditions assumed above is approximately 3.11×10^{-10} per year. This is well below the Nuclear Energy Institute guidelines of 1×10^{-6} for acceptable risk for a given evolution. On this basis alone, the LBLOCA event occurring during a fill operation with a simultaneous loss of offsite power and one train of emergency AC is considered to be incredible. Therefore, based on probabilistic considerations, it is concluded that the risk associated with using the accumulator fill line during power operation is negligible.

Expected Pump Performance

The pump runout calculations performed by Westinghouse estimate that one SI pump delivering flow to four injection lines (i.e., LBLOCA conditions), the SI pump minimum flow line, and the accumulator fill line will reach a flow of 720 gpm. This exceeds the Technical Specification runout limit of 700 gpm. A calculation was also performed using Cook plant SI flow balance data using the highest flow pump from 1994, and results in an estimated runout flow of 708 gpm, which is still in excess of the Technical Specification limit. However, per discussions with Westinghouse, the SI pump will only reach the runout condition under LBLOCA conditions. For smaller breaks, the Main Steam Line Break (MSLB), and the Steam Generator Tube Rupture (SGTR), the RCS pressure remains high enough to prevent pump runout.

Analysis of the Event (cont'd)

Expected Pump Performance (cont'd)

Given the above operating conditions, a SI pump may exceed the design pump runout limit. For the purposes of the accident analysis, the pump is assumed to fail if it exceeds its runout limit. However, per discussions with Mechanical Safety Systems, the real response of the pump is not so severe. The inherent rugged construction of industrial pumps, and design margin built into the pumps, are factors that support the engineering judgment that the affected pump will continue to operate for some time, at some capacity beyond the manufacturer's design limit. If the pump exceeds its design limit, it may experience some cavitation and additional wear requiring corrective maintenance, but would be expected to deliver a significant fraction (possibly 100%) of its design flow. The generic Westinghouse calculation shows that the pump runout would be 20-45 gpm (2.9%-6.7%) above the manufacturer's design runout limit. Using the calculation based on the Cook specific flow data for the strongest SI pump (i.e., the 708 gpm runout), the pump runout would be 8-33 gpm (1.1%-4.9%) above the manufacturer's design runout limit. Therefore, it is expected that there will be some flow delivered by the pump even if it reaches the calculated runout value of 708 gpm.

Impact on Chapter 14 Accident Analysis

Westinghouse performed calculations to address the impact of the reduced SI flow due to the use of the accumulator fill line on the LBLOCA, sump recirculation, and containment pressure transient. The results of these calculations are discussed below. Note that the possibility of SI pumps exceeding the pump runout on other transients that use the SI system (i.e., small break LOCA, main steam line break, steam generator tube rupture) is not considered plausible.

Large Break LOCA

The SI system provides mitigation for the large break and small break LOCAs, steam generator tube rupture, and the main steam line break. However, as noted above, SI pump runout is only a concern for the LBLOCA. Westinghouse has performed an evaluation of the effect that the reduced SI flow (i.e., one RHR and one centrifugal charging pump only) has on the LBLOCA analysis. It was concluded that the reduced SI flow would result in an 8 °F peak cladding temperature (PCT) penalty. This is due to the slightly slower rate of core reflood. The PCT for past years operation was still within the 2200 °F limit from 10CFR50.46.

Sump Recirculation Flow Requirements

If the containment pressure exceeds 8 psig, the Emergency Operating Procedures (EOPs) prompt the operator to align an RHR pump to the RHR spray header to reduce the containment pressure transient. If both SI pumps are inoperable (one due to loss of an emergency diesel generator, the other due to pump runout related failure), and the only remaining RHR pump is aligned for spray flow, then the core will only be receiving sump water from one centrifugal charging pump (CCP). One CCP is not sufficient to provide adequate core cooling until later in the transient, when the decay heat is sufficiently low. It is expected that the operator would realign the RHR pump back to cold leg recirculation upon indication of inadequate core cooling, since the core cooling requirement has a higher priority in the Critical Safety Function Status Trees in the EOPs than the containment integrity requirement. Thus, the core would have adequate cooling during the recirculation phase of the LBLOCA even in the event of a loss of both SI pumps.

Analysis of the Event (cont'd)

Containment Integrity

As described above, it is expected that the operator would realign the RHR spray to cold leg recirculation given indications of inadequate core cooling. This has a negative impact on the containment pressure analysis. To address the effect of prematurely stopping the RHR spray, Westinghouse calculated the long term containment pressure transient without RHR sprays. Their calculation showed that, although the actual containment pressure may exceed the design pressure (12 psig) by approximately 3.27 psi, it will not exceed the ultimate pressure of the containment (36 psig). Note that the ultimate pressure of 36 psig has been reviewed and approved by the NRC with respect to the hydrogen control program for the Donald C. Cook Nuclear Station. Westinghouse also reviewed some of the input assumptions used in the containment analysis. AEP provided them with best estimate values for the following variables; 1) core power, 2) containment yield pressure, 3) ice condenser ice mass, 4) containment spray heat exchanger UA, 5) essential service water temperature and flow to the containment spray heat exchanger, and 6) containment spray flow from one train. Using these best estimate values, Westinghouse believes that the pressure may still exceed the design pressure, but not nearly by the amount calculated above. Therefore, given the results of the Westinghouse calculation, and the margins used in the analysis, it is concluded that the containment would not have failed given that the RHR spray would be prematurely stopped.

Conclusion

The main conclusion of this safety consequence assessment is that the risk from the postulated sequence of events described above is insignificant. Because of the very small exposure time, coupled with the small frequency of the LBLOCA, failure of offsite power, and failure of a train of emergency AC, this event is considered to be incredible. In addition, we do not believe that the runout of an SI pump to the estimated value of 708 gpm will result in a catastrophic failure of that pump, and that it will continue to deliver a portion (possibly 100%) of its flow. Therefore, the pump runout scenario would not result in inadequate SI flow to the RCS during a LBLOCA.

However, if the SI pump does fail, the Westinghouse analysis shows that the LBLOCA PCT penalty would not result in exceeding the 2200 °F limit. Also, while the containment pressure may exceed the design pressure (12 psig), it will not exceed the accepted yield pressure (36 psig), and thus not result in any increases in offsite dose. Therefore, the consequences of this event are within acceptable limits.

Corrective Actions

Plant operating procedures have been revised to require the operating safety injection pump to be declared INOPERABLE, power to be reduced (Unit Two only), and the system cross-tie closed during accumulator level adjustment evolutions.

Failed Component Identification

Not Applicable

Previous Similar Events

315/97-001-00