

NRC Form 366 (6-1998)		U.S. NUCLEAR REGULATORY COMMISSION				APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001							
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)										ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (IT-4 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503			
FACILITY NAME (1) Cook Nuclear Plant Unit 1						DOCKET NUMBER (2) 05000-315		PAGE (3) 1 of 3					
TITLE (4) Safety Injection and Centrifugal Charging Throttle Valve Cavitation During LOCA Could Lead to ECCS Pump Failure													
EVENT DATE (6)			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			
03	27	1999	1999	013	00	06	01	1999	D.C. Cook, Unit 2	05000-316			
OPERATING MODE (9) 5			THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)										
POWER LEVEL (10) 0%			20.2201 (b)			20.2203(a)(2)(v)			50.73(a)(2)(i)	50.73(a)(2)(viii)			
			20.2203(a)(1)			20.2203(a)(3)(i)			X 50.73(a)(2)(ii)	50.73(a)(2)(x)			
			20.2203(a)(2)(i)			20.2203(a)(3)(ii)			50.73(a)(2)(iii)	73.71			
			20.2203(a)(2)(ii)			20.2203(a)(4)			50.73(a)(2)(iv)	OTHER			
			20.2203(a)(2)(iii)			50.36(c)(1)			X 50.73(a)(2)(v)	Specify in Abstract below or on NRC Form 368A			
			20.2203(a)(2)(iv)			50.36(c)(2)			50.73(a)(2)(vii)				
LICENSEE CONTACT FOR THIS LER (12)													
NAME Ms. Brenda W. O'Rourke, Compliance Engineer								TELEPHONE NUMBER (Include Area Code) (616) 465-5901 x2604					
COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)													
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX				
SUPPLEMENTAL REPORT EXPECTED (14)								EXPECTED SUBMISSION DATE (15)					
X	YES	(If Yes, complete EXPECTED SUBMISSION DATE).			NO			MONTH	DAY	YEAR			
								12	01	1999			
Abstract (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16) On March 27, 1999, during development of an Emergency Core Cooling System (ECCS) thermal hydraulic flow analysis model, Engineering concluded that preliminary hydraulic flow analysis results indicated that the Unit 1 Safety Injection (SI) and Centrifugal Charging (CC) throttle valves could potentially experience cavitation during a LOCA. Specifically, during a LOCA, large differential pressures created across the SI and CC throttle valves would result in cavitation and possible mechanical erosion of the valves and downstream piping. During post-LOCA conditions, throttle valve erosion could lead to a pump runout condition and subsequent failure of the ECCS pumps. Radiography performed to determine valve position showed the valves to be less open than predicted by the hydraulic analysis. This condition could result in LOCA generated debris becoming lodged in the throttle valve, resulting in reduced flow to the reactor core. Similar conditions exist for the Unit 2 SI and CC throttle valves. During continuing evaluation, plant personnel concluded that the conditions were reportable on May 4, 1999, and a 4-hour notification was made to the NRC in accordance with 10CFR50.72, for a condition that resulted in the plant being in an unanalyzed condition, and for any event or condition that alone could have prevented the fulfillment of the SI or CC system safety function needed to mitigate the consequences of an accident. The preliminary cause is inadequate original design application of the SI and CC throttle valves. Because five of the six Unit 1 throttle valves were found to be less than 44 percent open, these valves could be assumed to be partially or fully plugged with debris although the amount of plugging would depend on the nature and geometry of the debris. However, partial or full plugging could render the systems not capable of performing their intended safety function during the recirculation phase of a LOCA event. As part of the evaluation, a permanent solution for the cavitation-induced erosion and potential debris plugging will be developed to restore conformance with the plant design basis and to support ECCS operability. Possible modifications are currently under review and the method selected will be implemented prior to restart of each unit. A supplement to this LER will be provided upon completion of the condition evaluation.													

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TEXT (If more space is required, use additional copies of NRC Form (366A) (17))

Conditions Prior to Event

Unit 1 was in Mode 5, Cold Shutdown
Unit 2 was in Mode 5, Cold Shutdown

Description of Event

On March 27, 1999, during development of an Emergency Core Cooling System (ECCS) thermal hydraulic flow analysis model, Engineering concluded that preliminary hydraulic flow analysis results indicated that the Unit 1 Safety Injection (SI)[BQ] and Centrifugal Charging (CC)[SJ] throttle valves [FCV] could potentially experience cavitation during a LOCA. Specifically, during a LOCA, large differential pressures created across the SI and CC throttle valves would result in cavitation and possible mechanical erosion of the valves and downstream piping. Throttle valve erosion during post-LOCA conditions could cause the valves to allow excess flow through the SI and CC pumps, which could lead to a pump runout condition and subsequent failure of the ECCS pumps.

The preliminary flow analysis also predicted that the SI and CC throttle valves would be less open than previously determined during evaluation of an industry event in 1995. In addition, actual valve stem measurements concluded that the SI and CC throttle valves were less open than predicted by the preliminary flow analysis. As a result, radiography was performed on April 8, 1999, for two SI throttle valves to better assess their position. Radiography results also concluded that the throttle valves were more closed than predicted by the hydraulic analysis, and also showed indications of possible valve erosion. With the throttle valves found less open, debris generated in containment during a LOCA could potentially become lodged in the throttle valves, resulting in reduced flow to the reactor core. Similar conditions exist for the Unit 2 SI and CC throttle valves. During continuing evaluation of the identified conditions, on May 4, 1999, plant personnel concluded that these conditions were reportable to the NRC.

Cause of Event

The preliminary cause is inadequate original design application of the SI and CC throttle valves. At the time of original plant design, this throttle valve design was commonly used throughout the industry for the same throttling application. However, it was not recognized that these valves are susceptible to mechanical cavitation damage as a result of high differential pressures across the valve.

Opportunities to identify this potential condition were missed during previous evaluations of industry events regarding the potential for post-LOCA ECCS pump runout damage due to throttle valve degradation.

Analysis of Event

In accordance with the requirements of 10CFR50.72(b)(2)(i) and 10CFR50.72(b)(2)(iii)(D), a 4-hour notification was made to the NRC for a condition that resulted in the plant being in an unanalyzed condition, and for any event or condition that alone could have prevented the fulfillment of the SI or CC system safety function needed to mitigate the consequences of an accident. As such, this LER is being submitted in accordance with the requirements of 10CFR50.73.

UFSAR Section 6.2 states that the primary function of the ECCS is to provide cooling water to the reactor core in the event of a LOCA. The ECCS system consists of six ECCS pumps: two Centrifugal Charging pumps, two Residual Heat Removal (RHR) pumps, and two Safety Injections pumps. The subject throttle valves are installed on each of the four CC pump lines to the reactor coolant loops and on the discharge side of each SI pump.

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The operation of the ECCS following a LOCA consists of two distinct phases: 1) the injection phase during which reactivity is controlled, initial cooling of the core is accomplished, and coolant lost from the primary system is replenished, and 2) the recirculation phase, in which long term core cooling is provided during the accident recovery period. Long term core cooling is provided, in part, by the SI and CC systems that deliver coolant water from the containment recirculation sump back to the reactor coolant system. Following a LOCA event, any debris that was generated in containment will be filtered through a 0.25-inch square mesh screen [BP][SCN] prior to entering the containment sump to prevent foreign material from entering the ECCS system.

The preliminary results of the ECCS hydraulic flow analysis were used to calculate the potential cavitation damage to the SI and CC throttle valves under various ECCS system operating configurations. The most limiting operating configuration assumes the throttle valves to be wide open to simulate the maximum erosion condition. The flow analysis concluded that with the throttle valves wide open, cavitation would likely occur and the SI pumps would be in a runout condition, while both CC pumps would remain available. For the case where only one CC pump is running, analysis results conclude that the single CC pump would go to the runout condition, in addition to both SI pumps. For this configuration, calculations indicate that the SI valves would be in a choked flow condition, which could cause cavitation-induced erosion of the valves and/or downstream piping. In addition, the CC throttle valves were calculated to be in the incipient damage range, which is the level at which cavitation is considered sufficient to result in erosion damage. Westinghouse letter NSAL-96-001, "Erosion of Globe Valves in ECCS Throttling Applications," indicates that even with throttle valve erosion, the CC and SI pumps should remain operable long enough to allow the operators to use the RHR pumps for long term cooling. However, no formal analysis has been performed to validate the impact this condition has on long term ECCS post-LOCA operation.

Information received from the valve manufacturer requires the throttle valves to be approximately 44 percent open to ensure debris would not become lodged in the valve. Because five of the six Unit 1 throttle valves were found to be less than 44 percent open, these valves could be assumed to be partially or fully plugged with debris although the amount of plugging would depend on the nature and geometry of the debris. However, partial or full plugging of the SI and CC throttle valves could render the systems not capable of performing their intended safety function during the recirculation phase of a LOCA.

Corrective Actions

A permanent solution for the cavitation-induced erosion and potential debris plugging of the throttle valves will be developed to restore conformance with the plant design basis and to support ECCS system operability. Possible modifications are currently under review and the method selected will be implemented prior to restart of each unit.

As part of the Restart effort, an improved operating experience program is being developed. In addition, the Expanded System Readiness Review project teams are evaluating operating experience information to assess whether applicable industry issues have been adequately addressed for applicability to D.C. Cook.

The adequacy of the systems to perform their safety and accident mitigation functions is being reviewed during the discovery process at D.C. Cook under a number of system assessments and programmatic assessments to support the Restart Plan. These include the Expanded System Readiness Review (ESRR) and the Licensing Basis Review. Identified deficiencies are being addressed under the Corrective Action Program.

The evaluation for this condition has not been completed. Based on the results of the completed evaluation, information regarding the safety significance, and corrective and preventive actions will be provided in an update to this LER.

Previous Similar Events

None