NRC Form 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

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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 (T-6 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

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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TITLE (4)

Operation Outside Design Bases for ECCS and Containment Spray Pumps for Switchover to Recirculation Sump Suction

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
08	22	97	97	–	011	– 02	12	02	98	DC Cook - Unit 2	05000-316
										FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
		0.2201 (b)	0.2203(a)(2)(v)	0.73(a)(2)(i)	0.73(a)(2)(viii)
POWER LEVEL (10)	100	0.2203(a)(1)	0.2203(a)(3)(i)	X 50.73(a)(2)(ii)	0.73(a)(2)(x)
		0.2203(a)(2)(i)	0.2203(a)(3)(ii)	0.73(a)(2)(iii)	3.71
		0.2203(a)(2)(ii)	0.2203(a)(4)	0.73(a)(2)(iv)	THER
		0.2203(a)(2)(iii)	0.36(c)(1)	0.73(a)(2)(v)	
		0.2203(a)(2)(iv)	0.36(c)(2)	0.73(a)(2)(vii)	Specify in Abstract below or n NRC Form 366A

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Mr. Stan Farlow, I & C Engineering Manager	616/697-5147

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)	MONTH	DAY	YEAR
X YES (If Yes, complete EXPECTED SUBMISSION DATE).	NO		01	29	99

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

While evaluating a proposed procedure change that affected switchover from the Refueling Water Storage Tank (RWST) to the containment recirculation sump during a Loss of Coolant Accident (LOCA), it was determined that level indications used to determine when the switchover is required were not adequate to prevent vortexing in the containment recirculation sump or to ensure adequate water is transferred from the RWST for long term cooling of the core and containment. The indications involved were the RWST level instruments and the containment level instruments. This event was reported under 10 CFR 50.73(b)(1)(ii)(B) as any event or condition that resulted in a condition outside the design basis of the plant.

The cause for the RWST level instrumentation inadequacy was lack of complete understanding of instrument design basis and failure to fully address velocity effects. The cause for the inadequate containment level to prevent vortexing was attributed to ineffective change management. To correct this condition the RWST level taps were relocated, the procedure for switchover, 01(02) OHP 4023.ES-1.3, Transfer to Cold Leg Recirculation, was revised, and the UFSAR will be revised to clearly indicate assumptions associated with minimum water level requirements during a LOCA.

An evaluation of the safety significance of the originally identified condition was performed. It was concluded that the only accident where safety significance existed was the LOCA. For the LOCA, it was identified that re-criticality could have occurred during Cycle 3 of Unit 2 operation. However, this LER revision identifies another condition which could have caused RWST level instrumentation to read incorrectly due to inadequate venting during maximum ECCS flow. It was identified that this could leave up to 28.5 additional inches of water in the tank when suction is transferred to the recirculation sump. Due to this, the safety significance will be re-evaluated, combining information from the original condition with information from the venting issue. This re-evaluation is expected to be completed, and an updated LER submitted, by January 29, 1999.

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Conditions Prior to Event
Unit 1 Mode 1, 100 percent Rated Thermal Power
Unit 2 Mode 1, 100 percent Rated Thermal Power

Description of Event
While evaluating a proposed procedure change that affected switchover from the Refueling Water Storage Tank (RWST) to the containment recirculation sump during a Loss of Coolant Accident (LOCA), it was determined that level indications used to determine when the switchover is required were not adequate to prevent vortexing in the containment recirculation sump or to ensure adequate water is transferred from the RWST for long term cooling of the core and containment. The indications involved were the RWST level instruments and the containment level instruments. It was determined that the RWST level indication may read lower than actual level due to transmitter location and flow induced bias. Additionally, the volume of water in containment based on containment level indicators used in 01(02) OHP 4023.ES-1.3, Transfer to Cold Leg Recirculation, to backup the RWST level was not sufficient to prevent vortexing in the containment recirculation sump. If vortexing occurs in the sump a potential exists for the loss of the Emergency Core Cooling System (ECCS) and the Containment Spray system (CTS).

The ECCS and CTS provide core cooling and reduce containment pressure under design basis accident conditions. Accident conditions require switchover of the suction source for the ECCS pumps and CTS pumps from the RWST to the containment recirculation sump. The determination of the time that switchover occurs is based on the inventory remaining in the RWST, as indicated on the RWST level instruments, and backed up by containment level indicators. The RWST instruments sensed pressure in the suction line from the RWST to the ECCS and CTS pumps, and use this sensed pressure to develop an indicated level in the RWST. It was postulated that the flow through this line could make the indicated level appear lower than the actual RWST level, with the effect that insufficient water might be in containment when the operators were executing the switchover procedure. Additionally, the containment level used as a confirming indication of the proper level in containment for switchover was inadequate to prevent vortexing in the containment recirculation sump. The containment level setpoint used as confirmation of sufficient water for switchover was less than the required level to prevent vortexing. The containment elevation level to prevent vortexing is 602 feet 10 inches. The value identified in 01(02) OHP 4023.ES-1.3 for switchover was based on a level equivalent to 599 feet 5 inches.

For the Cook plant the RWST level is determined using a differential pressure transmitter. This is a typical method used for measuring static level in a tank. However, given the original design of mounting the differential transmitter on the suction pipe, the level of the tank may not be static at the time of level measurement. A pressure drop is caused by one or more pumps taking suction from the bottom of the tank. The instrument process tap for the differential pressure transmitter was connected to the discharge pipe well downstream of the tank. The velocity of the fluid through the discharge pipe was significant due to the relatively small pipe diameter and large flow. Analysis of the flow induced Bernoulli effects on the RWST level instrumentation, performed during the 1997 NRC Architect Engineer Inspection, revealed that a potential bias of up to 22 percent of indicated level could be induced at peak ECCS flows during accident conditions. This bias could potentially cause the level indication to read lower than actual tank levels, which may have resulted in the operator prematurely starting the switchover to long term containment sump recirculation.

In accordance with the original design, the RWST is equipped with an 8 inch vent line and a 10 inch overflow line. Section 6 of the UFSAR states, " Should the 8 inch vent become plugged the 10 inch overflow line would maintain sufficient venting area to prevent any adverse effect on the safety function of the tank". In late 1997, with both units in Mode 5, Cold Shutdown, a drip catch device was found installed on the 10 inch overflow line of both the Unit 1 and Unit 2 RWST. The drip catch issue was originally identified by plant staff in March 1997, and the devices removed. However, in December 1997, the devices were again found installed (see NRC Inspection Report 98004, EEI 50-315/98004-16; EEI 50-316/98004-16). The investigations into the drip catches performed in 1997 concentrated on the control of temporary modifications, and failure to take adequate preventive actions to prevent reoccurrence, but did not evaluate the

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potential impact on the RWST level instrumentation in the event of an ECCS initiation. As the drip catch devices were known to have been installed on both units in the past when the units were at power, another Condition Report was initiated in late June 1998 to specifically address the potential impact of the devices on the RWST level indication.

The investigation revealed that a calculation had been performed in 1976 which showed a differential pressure of 0.2 psi when the 10 inch overflow line was blocked and the 8 inch vent open, assuming a maximum ECCS flow value of 17,800 gallons per minutes (gpm) out of the tank. As the calculation was noted to contain several discrepancies, including the ECCS flow value, a new calculation was performed to determine what the pressure would be inside the tank at maximum ECCS flow conditions of 18,530 gpm, and with the other discrepancies corrected. The new calculation revealed that the pressure inside the tank could be as much as 1.03 psi less that atmospheric at maximum flow. This would cause the level instrumentation to interpret the water level to be less than actual; leaving as much as 28.5 inches of water in the RWST that would not be transferred to the containment recirculation sump.

Cause of Event

RWST Level (initially identified condition)

The cause for this condition was lack of complete understanding of instrument design basis and failure to fully address velocity effects.

Lack of complete understanding of instrument design basis: The engineering control procedure (ECP) associated with the RWST level instrument indicated that the function of the RWST instrument was to protect pumps taking suction from the RWST from loss of Net Positive Suction Head (NPSH), that is to ensure that pumps taking suction from the RWST during the injection phase did not lose a suction source. It did not recognize that the instrument was also being used to assure adequate water is transferred from the RWST to containment for long term cooling of the core and containment. In 1993, during an NRC Systems Based Instrumentation and Control Inspection, it was recognized that a velocity term impacted the instrument due to the location and a violation was issued. A re-analysis was performed, however, not all velocity terms were included. The friction loss associated with entrance losses as water entered the pipe from the RWST and the dynamic head loss associated with the velocity in the pipe were not recognized. The friction error associated with water flow in pipes and elbows was recognized and accounted for in the calculation. The result was that the actual level was higher than indicated. Based on the understanding that the design basis was to provide adequate NPSH during injection, as opposed to ensuring adequate water level in containment, the new calculation resulted in a conservative change and no further actions were taken.

Failure to fully address velocity effects: Based on supporting calculations, there was no recognition of the error introduced by flow velocity based on the instrument location. The supporting calculations were revisited in 1993 after the NRC inspection identified that not all velocity terms were recognized, as noted above.

Containment Level

Failure to Incorporate Revised Design Calculation: Design calculations performed during Unit 2 pre-operational testing indicated that at elevation 602 feet 10 inches NPSH requirements would be met, and that vortexing would not be encountered while operating the RHR and CTS pumps. This design basis information did not get transferred to the Emergency Operating Procedures (EOPs). The EOPs retained an original containment level of containment level elevation of 599 feet 5 inches, which is less than the required 602 feet 10 inches. In 1995 discussions relative to the required level were conducted and it was determined that the lower level was adequate as containment level was a backup indication beyond the design basis and that continued use of the value was appropriate.

RWST Level (newly identified condition)

This condition is attributed to a failure by management to effectively communicate expectations regarding quality requirements for calculation packages, ineffective monitoring of the quality of calculations, and a ineffective review and

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approval process that allowed calculations to be approved when they contained errors and incorrect or invalid assumptions. In addition, the procedures governing calculations lacked these same attributes, as well as lacking specific controls for numbering and storage of the calculations.

Analysis of Event

This condition was determined to be reportable at 1856 hours EDT on August 22, 1997. An NRC notification was made at 1943 hours EDT on August 22, 1997 under reporting criteria 10 CFR 50.72(b)(1)(ii)(A) and 10 CFR 50.72(b)(1)(ii)(C) as any event or condition that resulted in the nuclear power plant being in an unanalyzed condition that significantly compromised plant safety and in a condition not covered by the plant's operating and emergency procedures, respectively. This LER is therefore submitted in accordance with 10 CFR 50.73(b)(1)(ii)(B) as any event or condition that resulted in a condition outside the design basis of the plant

The ECCS is required to provide adequate cooling to the reactor core in compliance with requirements of 10 CFR 50.46. The ECCS is considered an Engineered Safeguards System (ESF) required to meet general design criteria in effect in accordance with the plant license. This includes the single failure criteria which, for Cook, is the single active failure prior to recirculation, or the single active or passive failure (but not both) following recirculation.

The CTS is required to provide sufficient spray water so that, when operating in conjunction with the ECCS and ice condenser, 1) the containment long term pressure stays below its design value of 12 psig, and 2) sufficient radioactive material is removed from the containment atmosphere to assure radiation doses to the public remain below those specified in 10 CFR Part 100. The CTS is also considered an ESF required for meeting general design criteria in accordance with the plant license. This includes the single failure criteria as discussed above.

Following the transfer to cold leg recirculation, both the ECCS and CTS will draw water from the active containment sump. In order to prevent damage to the pumps, the water level in the active sump must remain above that required to prevent damage to the pumps which would make them inoperable. Pump damage can occur either due to vortexing or inadequate NPSH. The active containment sump level to prevent damage due to vortexing is 602 feet 10 inches. The level to assure adequate NPSH is several feet below that. Therefore the level of 602 feet 10 inches becomes the minimum level at which the ECCS/CTS pump suction operability can be assured under full flow conditions.

The RWST flow biases created the possibility that less water is transferred to the containment than assumed in the safety analysis. In addition, after the water gets into containment, it is not distributed in the manner that was assumed in the original FSAR safety analysis which assumed the water went to either the cavity or the active sump. The net effect is that less water transferred from the RWST to the containment then was assumed in the accident analysis and, of the RWST water transferred to the containment, not all of it goes to a location where it is immediately useful to support long term cooling needs (Refer to Cook Nuclear Plant LER #315/97-017 and LER #316/97-005 for additional detail on water transfer in containment).

A safety significance evaluation for the period from initial operation of the units to September 9, 1997 was completed in June of 1998. The potential impact of the (originally identified) condition on post-LOCA containment integrity, post-LOCA subcriticality, environmental qualification, and secondary system pipe ruptures inside containment was investigated. It was concluded that the only accident where safety significance exists is the LOCA. The post-LOCA subcriticality evaluations associated with that accident identified that recriticality could have occurred during Cycle 3 of the Unit 2 operation.

However, at the time the June evaluation was completed, the potential impact of the RWST venting issue had not yet been identified. Therefore, a re-evaluation of the safety significance of the combined issues will be performed. This will be completed, and an updated LER submitted, by January 29, 1999.

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Corrective Actions

A change sheet was issued to 01(02) OHP.4023.ES-1.3 Revision 4 on August 22, 1997. This change sheet revised the required containment level. The required containment level is now 29 percent (37 percent adverse containment), which corresponds to elevation 602 feet 10inches plus instrument uncertainties. This level assures adequate level to prevent vortexing in the containment recirculation sump.

The ECCS System Description, SD-12-ECCS-100, was revised to address the requirement for containment elevation required to ensure NPSH and vortexing requirements. The engineering control procedure for the EOP setpoints, ECP 1-2-O0-14, was also revised to document the minimum containment level for operation in the recirculation mode and the RWST level required for transition to cold leg recirculation.

A review of EOP footnote values will be performed to identify and validate all footnote values used in the EOPs. The purpose of the validation will be to identify the design basis for each value used and ensure the footnote value is consistent with the plant design basis. Completion of this review has been identified as a restart item.

The RWST for Unit 1 and the RWST for Unit 2 have been declared inoperable for Modes 1, 2, 3 and 4.

A design change will be implemented to increase the venting capability of the tank. This design change will be completed prior to Mode 4 to ensure that the tank is adequately vented under maximum ECCS flow conditions.

To improve the quality of calculations and the calculation process, Peer Group Review requirements, revisions to the calculation process, and additional training have been implemented.

Failed Component Identification

Not Applicable

Previous Similar Events

315/97-018-01
315/97-023-01