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United States Nuclear Regulatory Commission
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Docket No. 50-315

Document Control Manager:

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

LER 315/1997-017-02: "Condition Outside Design Basis Results in Technical Specification Required Shutdown"

No commitments are identified in this submittal.

Should you have any questions regarding this correspondence, please contact Mr. Ronald W. Gaston, Manager, Regulatory Affairs, at (616) 465-5901, extension 1366.

Sincerely,

Joseph E. Pollock
Plant Manager

/pae

Attachment

IE22

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

LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001

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

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TITLE (4)

Condition Outside Design Basis Results in Technical Specification Required Shutdown

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
09	08	1997	1997	--	017	--	02	08	17	2001	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)	74		20.2201 (b)		20.2203(a)(2)(v)	X	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)		50.73(a)(2)(v)		Specify in Abstract below or n NRC Form 366A
			20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Richard Meister, Regulatory Compliance	616/465-5901, x1707

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
	YES (If Yes, complete EXPECTED SUBMISSION DATE).	X NO				

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

On September 8, 1997, at 2000 hours, with Unit 1 at 74 percent Rated Thermal Power, it was discovered that under certain scenarios the volume of water resident in the active sump of the containment would not have been adequate to support long term Emergency Core Cooling System (ECCS) or Containment Spray (CTS) pump operation during the recirculation phase of a loss-of-coolant accident (LOCA).

This was determined to be reportable under 10CFR50.72(b)(1)(ii)(B), as a condition outside the design basis. A Technical Specification required shutdown was undertaken, and was reported under 10CFR50.72(b)(1)(i)(A). An LER was submitted in accordance with 10CFR50.73(a)(2)(ii) and 10CFR50.73(a)(2)(i)(A). On September 10, 1997 Unit 1 entered Mode 5, cold shutdown.

The root cause of this event was determined to be a breakdown in the design control process. This process breakdown resulted in engineering reviews that did not evaluate the impact of flow diversions into the inactive sump volumes of the containment.

This revision incorporates information from the root cause investigation and replaces Licensee Event Report (LER) 50-315/1997-017-01 in its entirety.

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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 1 at 74 percent Rated Thermal Power.

Description of Event

During the development of a revision to procedure OHP 4023.ES-1.3, Transfer to Cold Leg Recirculation, an effort was made to retrieve the calculation of record for the Refueling Water Storage Tank (RWST) inventory transfer to containment. The calculation could not be located, and preparation of an alternate calculation was started.

During preparation of the alternate calculation and evaluation of the current containment analysis, it became apparent the potential existed that under certain scenarios, the volume of water resident in the active sump of the containment might not be adequate to support long term Emergency Core Cooling System (ECCS) or Containment Spray System (CTS) pump operation during the recirculation phase of a Loss of Coolant Accident (LOCA). The containment drainage system is designed to ensure that the water entering the containment from a breach of the Reactor Coolant System (RCS), ECCS injection, and ice condenser melt, flows back to the active containment sump volume and the recirculation sump. However, at the time of this event, the plant licensing basis did not credit water from the ice melt in the containment sump water inventory. Therefore, the analysis was unable to confirm that an adequate quantity of water would be resident in the containment structure and that adequate communication existed in the containment subcompartment boundaries to ensure sufficient drainage to the containment active sump and the recirculation sump. Without adequate drainage into the recirculation sump, a low sump water level could result which would jeopardize long term operation of the ECCS and CTS pumps due to potential vortexing and air entrainment.

This evaluation originally was based upon a large break scenario. However, during the reconfirmation analysis, it was determined that a small break scenario could also result in an inadequate volume of water resident in the active sump volume of containment. During original design analysis, the large break scenario was considered to be the bounding analysis. The original containment analysis did not include containment filling calculations for the small break scenarios.

On September 8, 1997, at 1655 hours, Unit 1 commenced a conservative shutdown when it became apparent that analysis might not be able to confirm that a sufficient volume of water would be resident within the containment. Unit 2 also commenced a shutdown at this same time, which is covered in LER 316/97-005-02. At 2000 hours that same day it was determined that an adequate volume of water might not exist in containment to support long term operation of the ECCS and CTS pumps and the unit entered Technical Specification (T/S) 3.0.3 due to both trains of ECCS and CTS being inoperable. An Unusual Event (UE) was officially declared at 2000 hours on September, 8, 1997 under the potential loss of containment barrier. The shutdown was uneventful and Unit 1 entered Mode 5, cold shutdown, on September 10, 1997. The UE was terminated on September 10, 1997 when both units entered Mode 5.

This was determined to be reportable under 10CFR50.72(b)(1)(ii)(B), as a condition outside the design basis. A Technical Specification required shutdown was undertaken, and was reported under 10CFR50.72(b)(1)(i)(A). An LER was submitted in accordance with 10CFR50.73(a)(2)(ii) and 10CFR50.73(a)(2)(i)(A).

This revision incorporates information from the root cause investigation and replaces Licensee Event Report (LER) 50-315/1997-017-01 in its entirety

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Cause of Event

The root cause of this event was determined to be a breakdown in the design control process. The previously performed engineering reviews did not evaluate the impact of flow diversions into the inactive sump volumes of the containment. Assumptions were made that small break LOCA scenarios did not need to be reviewed with respect to recirculation sump performance and that additional evaluations were not needed to supplement this simplified methodology.

The containment recirculation sump level calculations were initially performed in 1977, and used a simplistic approach to determine the adequacy of expected post-accident sump levels. These calculations assumed a transfer of useable RWST volume only into the active containment sump.

The cause of this condition was investigated by a team, using the fault tree method. The team identified four contributors to the recirculation sump inventory issue. These consist of:
- Loss of inventory to the inactive sump through the containment spray header in the accumulator/fan rooms
- Loss of inventory to the inactive sump through the upper containment stairwell drains into the pipe annulus
- Loss of inventory through unsealed penetrations in the crane wall
- The lack of knowledge on the part of the plant staff, regarding the response of plant systems to events requiring the utilization of containment spray.

The following is a brief discussion of each contributor:

Loss of Inventory to Fan/Accumulator Rooms:

Loss of inventory to the accumulator/fan rooms is a consequence of the design of the CTS system and the containment of each unit. The CTS system is designed to provide a flow of approximately 300 gpm per train to spray nozzles in the accumulator/fan rooms of the containment. The accumulator/fan rooms are directly above and drain to the pipe annulus. The annulus area is outside the crane wall and is not part of the active sump volume. This design is not a part of the original Westinghouse design for the CTS system. In the Westinghouse design, all spray flow is directed into the upper volume of containment. Water deposited into the annulus does not communicate with the active sump until post-accident containment water level is well above the minimum containment elevation required for long term Residual Heat Removal (RHR) and CTS pump operation. When the Westinghouse design was modified to include spray into the accumulator/fan rooms the implications of this change were not thoroughly reviewed.

Loss of Inventory to the Upper Containment Stairwell Drains:

Inventory from CTS is lost not only through the accumulator/fan room spray nozzles, but also through upper containment spray flow down the stairwells near the Containment Hydrogen Skimmer Fans. Water entering the stairwells flows into drains that direct flow into the pipe annulus. As previously noted, water deposited into the annulus does not immediately communicate with the active sump volume.

Loss of Inventory through Unsealed Penetrations in the Crane Wall:

In addition to the above pathways for inventory loss from the active sump, unsealed penetrations existed in the crane wall, in which water could flow from the active sump into the inactive sump. Documentation showed that it was the intent of the original design that these penetrations be sealed. The failure to seal these penetrations resulted from improper implementation of the design expectations.

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Lack of Knowledge on the Part of the Plant Staff Regarding the Response of Plant Systems:

Through review of this issue, it was determined that there had been a lack of knowledge on the part of the plant staff regarding the effect of the inactive sump on the recirculation sump inventory during accident scenarios involving utilization of containment spray in the recirculation mode of operation. Specifically, information regarding loss of recirculation sump inventory had to be reconstituted by review of various pieces of design information, and therefore, had not been available to operating crews and personnel developing operator training in a form that would support operator awareness of the subject.

Analysis of Event

An evaluation was performed by Westinghouse that addressed the impact on safety of the "as found" conditions that existed at Donald C. Cook Nuclear Plant just prior to the TS required shut down in September 1997. The analysis was documented in a Justification for Past Operation (JPO) and applies to all past operating cycles for both Units 1 and 2. The JPO was initially issued in February 1999, and Revision 1 was issued in March 1999 to include postulated additional loss of RWST water due to a potentially blocked vent.

As part of the JPO, the sump level analysis performed in 1998 was reviewed. The 1998 analysis demonstrated adequate sump inventory for a range of nine small and large breaks from .5 inches up to 10.48 square feet, and showed that the most limiting break LOCA scenario in terms of establishing and maintaining adequate sump level was a 2.75 inch Control Rod Drive Mechanism (CRDM) housing rupture. However, it was determined that the analysis should be reperformed to account for all known conditions, including postulated blockage of the RWST vent. The re-analysis was performed using 2 different sets of assumptions regarding operation of the containment air recirculation/hydrogen skimmer (CEQ) fans. The first assumed both CEQ fans to be operable, which would result in additional ice melt and an increase of available sump inventory to offset the additional loss of RWST inventory. The result was that sump level remained above the minimum required level. The second re-analysis was performed assuming the limiting single failure of a CEQ fan. This results in the water level in the active sump dropping to 4 inches below the minimum required. This is considered acceptable for the most limiting break, a 2.75 inch CRDM housing rupture, since ECCS pump flows would be less than for a large break, and the sump level would remain above the level at which air entrainment would occur. Therefore, no air entrainment is expected and no reduction in net positive suction head margin needs to be taken. It was therefore concluded, considering the effect of all known conditions, that adequate sump level would have been available to support continued operation of the ECCS pumps in the recirculation mode.

Based on the analyses that were performed, it has been concluded that the combined conditions that could prevent full transfer of RWST water to the containment sump were of minimal safety significance.

Corrective Actions

Resolution of this issue was accomplished through a combination of license amendments, plant modifications, new analyses of containment recirculation sump inventory, and resultant changes to the accident analyses to ensure sufficient water inventory in the containment recirculation sump. These modifications and analyses resulted in Amendment 234 to the Donald C. Cook (CNP) Unit 1 Technical Specifications (TS).

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Amendment 220 allowed ice melt to be credited for supplyng water to the containment sump water inventory during post-accident operation. Amendment 234 provided for changes to TS 3.1.2.8, "Borated Water Sources - Operating", and 3.5.5, "Refueling Water Storage Tank" (RWST). The minimum RWST inventory requirement was increased from 350,000 to 375,500 gallons. The change was implemented by increasing the height of the RWST overflow line. Increasing the RWST inventory results in more water being available to the containment recirculation sump to prevent vortexing and air entrainment in the ECCS and CTS pumps. The design change for the overflow line was installed on the Unit 1 RWST prior to restart of that unit. The TS amendment also added a requirement to limit the maximum allowable RWST water temperature to 100 degrees Fahrenheit to ensure that actual RWST temperature is maintained less than the maximum assumed temperature in the existing accident analysis.

TS Table 3.3-3, "Engineered Safety Feature Actuation System (ESFAS) Instrumentation", TS Table 3.3-4, "Engineered Safety Feature Actuation System Instrumentation Trip Set Points", TS Table 4.3-2, "Engineered Safety Feature Actuation System Instrumentation Surveillance Requirements", and TS 3.6.5.6, "Containment Air Recirculation Systems" were also affected by Amendment 234. The changes reflect a modification to the ESFAS actuation logic and to the time delay relay for starting of the Containment Air Recirculation (CEQ) fans in order to ensure that ice melt occurs in accordance with assumptions in the new containment sump water inventory analysis. After modification, the CEQ fans start 120 seconds plus or minus a 12 second time delay after receipt of a containment pressure - high ESFAS signal. Earlier actuation of the CEQ fans increases the rate of ice melting in the containment. Earlier CEQ actuation increases the steam flow into the ice condenser bays which in turn promotes more rapid ice melting, making more water available in the sump.

TS 3.6.5.1, "Ice Condenser", was amended to reduce the minimum required weight of ice in the ice condenser to a nominal 2.2 million pounds or 1144 pounds of ice per basket, measured at the end of cycle. This value was used in the safety analyses, and ensures that the amount of ice available will provide sufficient pressure suppression to maintain the peak containment pressure following a design basis accident below the containment design pressure. In addition, the water from the melting of all or part of this ice, when combined with water from the reactor coolant system, safety injection accumulators, and the RWST will be sufficient to ensure that the ECCS and CTS pumps will operate above the vortexing level criterion during recirculation following a LOCA. The Unit 1 ice condenser was loaded, in accordance with approved plant procedures, to meet the new TS requirements.

In addition to the modifications associated with TS amendments, 3 other modifications were installed on Unit 1 prior to the restart of that unit. These modifications are:

- Openings were installed in the containment crane wall to ensure adequate communication between the inactive sump region and the active sump;
- Additional sump level instrumentation was installed to provide additional indication to the control room operators of containment water level; and
- Drain lines from the CEQ fan rooms were modified to ensure these rooms would drain to the annulus, which communicates with the active sump region.

A new containment recirculation sump water inventory analyses was performed, which included consideration of limiting single failures of ECCS and CTS components. The analyses demonstrated that the increased RWST inventory, the analyzed amount of ice melt, and RCS and safety injection accumulator water inventory released to containment, is sufficient to ensure that the minimum containment recirculation sump level required to prevent vortexing is maintained.

In addition, Procedure 01 OHP 4023.ES-1.3 , "Transfer to Cold Leg Recirculation", was revised to optimize the amount of water transferred from the RWST prior to entering the recirculation phase following an accident.

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Corrective actions for the identified programmatic weaknesses within CNP's design and licensing basis were documented in Letter AEP:NRC:1260GH, "Enforcement Actions 98-150, 98-151, 98-152 and 98-186 Reply to Notice Of Violation October 13, 1998," dated March 19, 1999. The corrective actions included the development and implementation of a configuration management program; revision of the calculation process; implementation of new procedures for the design change process, and implementation of a new Engineering Support Personnel training program.

Previous Similar Events

There have been various LERs from 1999 and 2000 that have been linked to the design control inadequacies root cause. Since the condition described here is historical, the corrective actions from these LERs would not have identified or prevented this condition.