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 AUTH. NAME AUTHOR AFFILIATION
 SAMPSON, J.R. Indiana Michigan Power Co. (formerly Indiana & Michigan Ele
 BLIND, A.A. Indiana Michigan Power Co. (formerly Indiana & Michigan Ele
 RECIP. NAME RECIPIENT AFFILIATION

SUBJECT: LER 92-001-00: on 920122, unit 2 refueling water storage tank boron concentration greater than specification limit due to incomplete mixing. Operations Dept procedures are scheduled to be revised before third quarter. W/920221 ltr.

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February 21, 1992

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Docket No. 50-316

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In accordance with the criteria established by
10 CFR 50.59 entitled Licensee Event Report System, the
following report is being submitted:

92-001-00

Sincerely,

A. A. Blind
A. A. Blind
Plant Manager

/sb

Attachment

c: D. H. Williams, Jr.
A. B. Davis, Region III
E. E. Fitzpatrick
P. A. Barrett
B. F. Henderson
R. F. Kroeger
B. Walters - Ft. Wayne
NRC Resident Inspector
T. Colburn - NRC
J. G. Keppler
M. R. Padgett
G. Charnoff, Esq.
D. Hahn
INPO
S. J. Brewer/B. P. Lauzau
B. A. Svensson

JE22

LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1) D. C. Cook Nuclear Plant - Unit 2	DOCKET NUMBER (2) 0 5 0 0 0 3 1 6	PAGE (3) 1 OF 08
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TITLE (4) Unit Two Refueling Water Storage Tank Boron Concentration Greater than Specification Limit Due to Incomplete Mixing

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 NAMES	DOCKET NUMBER(S)
0	1	2	9	2	0	0	2	1		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9) 1	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)	60.73(a)(2)(iv)	73.71(b)	
	20.405(a)(1)(i)	60.38(c)(1)	60.73(a)(2)(v)	73.71(c)	
	20.405(a)(1)(ii)	60.38(c)(2)	60.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)	
	20.405(a)(1)(iii)	X 60.73(a)(2)(i)	60.73(a)(2)(viii)(A)		
	20.405(a)(1)(iv)	60.73(a)(2)(ii)	60.73(a)(2)(viii)(B)		
	20.405(a)(1)(v)	60.73(a)(2)(iii)	60.73(a)(2)(ix)		

LICENSEE CONTACT FOR THIS LER (12)	
NAME John R. Sampson, Operations Superintendent	TELEPHONE NUMBER AREA CODE: 6 1 6 4 6 5 - 5 9 0 1

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)			X NO				

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

On 1-22-92, sample results of the unit 2 refueling water storage tank (RWST) identified that the boron concentration was greater than the Technical Specification (TS) limit. The RWST was declared inoperable and confirmatory samples were drawn which confirmed the out-of-specification boron concentration. Dilution and recirculation of the RWST were completed followed by a reactor shutdown and declaration of an unusual event to meet the TS action statement requirements. Dilutions, recirculations, and increased sampling continued until the RWST boron concentration was restored to within specification. The reactor shutdown and unusual event were terminated on the receipt of a temporary waiver of compliance.

An Engineering evaluation concluded that the out-of-specification RWST boron concentration was caused by the combination of incomplete mixing in the RWST, less than precise blender control, and inadequate administrative control of RWST boron concentration.

The findings of this event were reviewed by the Operations Superintendent with the Operations Department personnel. In addition, Operations Department procedures have been scheduled to be revised to address the findings of this event.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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

Conditions Prior To Occurrence

Unit one in mode one at 100% power.

Unit two in mode one at 100% power.

Description of Event

On 1-22-92 at 0630, the sample results of the unit 2 refueling water storage tank (RWST) (EIIS/BP-TK) drawn at 0620 identified that the boron concentration in the tank was 2,628 ppm. With unit 2 in mode one, Technical Specification (TS) 3.1.2.8 (Borated Water Sources - Operating) and TS 3.5.5 (Refueling Water Storage Tank) require the RWST boron concentration to be between 2,400 and 2,600 ppm of boron. With the boron sample of the RWST greater than the high specification limit, the Unit Supervisor (US) declared the RWST inoperable and entered the TS action statement associated with TS 3.1.2.8 and 3.5.5. The TS action statement required that the RWST be restored to operable within one hour, or the unit to be in at least hot standby within six hours and in cold shutdown within the following 30 hours.

Additional samples were requested of the unit 2 RWST boron concentration. A sample taken at 0658 determined a boron concentration of 2,644 ppm, a sample taken at 0728 determined a boron concentration of 2,641 ppm, and a sample taken at 0729 determined a boron concentration of 2,624 ppm.

At 0743, the unit 2 primary water storage tank (PWST) (EIIS/WD-TK), which has a boron concentration of <10 ppm, was aligned to blend to the unit 2 RWST. By 0815, approximately 4,000 gallons of water were blended from the PWST to the RWST.

At 0822, confirmatory boron samples of the unit 2 RWST measured the boron concentration to be between 2,624 and 2,644 ppm of boron. Following this initial attempt to reduce the tank boron concentration and with the boron concentration remaining greater than the specification, a shutdown of unit 2 was commenced from 100% power and an unusual event was declared.

At 0940, the unit 2 shutdown was terminated based on the receipt of a preliminary verbal agreement that a waiver of compliance would be considered.

At 1043, an additional 8,000 gallons of PWST water were added to the unit 2 RWST followed by recirculation via the containment spray (CTS) pump (EIIS/BE-P) and samples of the RWST.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 500 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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Description of Event (Continued)

At 1200, the unusual event was terminated on the receipt of the temporary waiver of compliance provided that the following conditions were met:

- The Plant must set bounds on the unit 2 RWST boron concentration. The high boron concentration was set at 2,700 ppm and the low boron concentration was set at 2,400 ppm.
- With the CTS pump aligned to recirculate the unit 2 RWST, no work was to be performed on the other train of CTS.
- Procedures should be in place to return the CTS pump aligned to recirculate the RWST to service during accident conditions.
- The waiver of compliance would be granted for up to six days, or until the unit 2 RWST boron concentration is returned to within the specifications, and no further mixing is required.
- Any anomalies in Plant conditions associated with the RWST boron would be promptly communicated to the NRC (Nuclear Regulatory Commission) Resident Inspector.

The Plant responded immediately to the elevated boron concentration by a process of dilution, recirculation, and increased sampling. The dilutions were based on independently verified bounding calculations to ensure that the limits for low boron concentration were not violated. In addition, actions were taken to add the dilution volume in steps to permit recirculation of the RWST during dilution.

By 1046 on 1-22-92, a sufficient amount of water (approximately 12,000 gallons) had been blended from the PWST and recirculation had been started, utilizing the west CTS pump, to ensure that the RWST boron concentration was within the TS limits. By 1200, initial samples taken at the west CTS pump discharge indicated a boron concentration of approximately 2,560 ppm in the RWST.

Following the dilution, recirculation, and confirmatory samples of the unit 2 RWST, the boron concentration leveled off at approximately 2,530 ppm. Approximately 24 hours later on 1-23-92, after the recirculation of the RWST was stopped, measurements of the RWST boron concentration leveled off at approximately 2,505 ppm.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-630), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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Description of Event (Continued)

The following are the circumstances leading to the greater-than-specification unit 2 RWST boron concentration on 1-22-92 at 0630:

- On about 12-17-91, the unit 2 RWST boron concentration was identified to management as a parameter outside self-imposed administrative limits. The self-imposed administrative limits were 2,450 to 2,550 ppm (TS limits are 2,400 to 2,600 ppm). The boron concentration in the RWST was at 2,577 ppm.
- On 1-3-92, the Operations and Chemistry Departments presented a plan of action for returning the unit 2 RWST to within the administrative guidelines. This plan included a decision not to adjust the boron concentration during power operations and was approved by Plant management.
- On 1-11-92, in accordance with normal operation procedures, the unit 2 RWST level was raised from 91.5% to 95.5% level. A blend of borated water was used to ensure minimal impact on boron concentration. This activity was accomplished to provide adequate volume in the unit 2 RWST to allow for storage and use of processed radioactive waste water. At the conclusion of this water addition to the RWST, the tank was sampled and the sample results of the RWST boron concentration was within the TS limit at 2,587 ppm. A check calculation made prior to commencing this activity indicated that the boron concentration would not exceed the TS limit.
- On 1-20-92, a routine sample of the RWST for boron concentration identified the concentration at 2,607 ppm, which was above the TS limit of 2,600 ppm. As a result of this sample, the unit 2 RWST was declared inoperable at 1245 and confirmatory samples were ordered. By 1338, double confirmatory samples had been drawn to verify the boron concentration was in specification; the sample results were 2,589 and 2,595 ppm of boron. In response to the unexpected elevated concentration, the Operations Superintendent directed that 2,000 gallons of primary water (<10 ppm boron) be added to the unit 2 RWST and the tank recirculated. To ensure adequate mixing, the recirculation of the tank was started at 0429 via the CTS pump on 1-21-92 and completed at 0545 on 1-22-92.
- At 0620 on 1-22-92, a sample was drawn and analyzed with the results reported to the unit 2 control room at 0630, which led to the above stated sequence of events.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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Cause of Event

On 1-22-92, an Engineering evaluation was completed as part of the waiver of compliance request to TS 3.1.2.8 and 3.5.5. As part of this preliminary review, an Engineer reviewed the unit 2 RWST, PWST, and middle boric acid storage tank (BAST) (EIIS/CB-TK) level changes and the initial boron concentrations of the tanks during the 1-11-92 blend to the Unit 2 RWST. An upper bound was calculated for the maximum boron concentration, indicating it could have been as high as 2,611 ppm. To reach this concentration, a blend concentration of about 3,600 ppm would have been needed. A sample taken during the blending indicated a boron concentration of 2,650 ppm. The blend concentration was reduced following that sample result. Considering this calculation, the Plant believes that the sample results on 1-20-92 of 2,607 ppm, 2,589 ppm, and 2,595 ppm were reasonable.

On 1-22-92, following the preliminary Engineering evaluation, the Plant believed that the 2,644 ppm boron concentration in the unit 2 RWST was most likely contributed to by the introduction of boric acid plated out on the RWST wall above the initial water level, and/or stratification cause by the increased level and/or temperature changes caused by subsequent recirculation.

Following the initial Engineering evaluation performed as part of the waiver of compliance request, further Engineering review concludes that the increased boron concentration in the unit 2 RWST was not significantly affected by plating out of boron on the RWST walls, but rather caused by the combined effects of incomplete mixing in the RWST, less than precise blender control, and inadequate administrative control of RWST boron concentration. Therefore, it is believed that the combination of these effects led to the unit 2 RWST boron concentration exceeding the TS limit during the blend to the tank on 1-11-92. This conclusion is based on the following:

- A calculation made prior to delivering the 12,000 gallons of PWST water to the RWST and mixing estimated that the resulting boron concentration would be higher than what was measured. It was in this context in which the Plant referred to the "stratification" of boron in the RWST during the tele-conference on 1-22-92. Following further review, the Plant could not identify any mechanism present in the RWST that would cause the separation of water into separate volumes of unequal boron concentration.
- A review of the RWST boron concentration following the unit 2 Refueling Outage identified that the RWST boron concentration was approximately at, or just below, the upper administrative limit of 2,550 ppm.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

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Cause of Event (Continued)

Considering that the boron concentration was near the upper administrative limit and that the blender used to make up borated water for the RWST is coarsely controlled, these two factors together are believed to have contributed to the exceeding of the TS limit.

- A sample was taken through the top of the RWST in an attempt to visually observe any indication of the presence of a ring of boric acid plated out on the walls of the tank. During the sample the observation conditions were not ideal due to the high water level and temperature of the water in the tank, and therefore, a ring of boric acid could not be identified. A discussion with Chemistry Department personnel noted that previous inspections of the RWST have not identified a ring of boric acid plated out on the tank walls. In addition, a calculation was performed to determine the amount of boric acid coating that would be required to raise the concentration of the entire RWST 50 ppm. The amount of water added on 1-11-92 would have raised the RWST level 14 inches. A 50 ppm increase would require a band of boric acid 14 inches wide and more than 1 inch thick. Considering that previous inspections of the RWST have not identified a ring of boric acid and the assumptions for the above calculation, it is believed that the presence of a band of boric acid of the above calculated magnitude was not present during the increase in the RWST level.

During the review of this event, the Plant did not discover an incorrect valve line-up which could have contributed to the increased boron concentration in the unit 2 RWST.

Analysis of Event

TS 3.1.2.8 (Borated Water Sources - Operating) and TS 3.5.5 (Refueling Water Storage Tank) require the RWST boron concentration to be between 2,400 and 2,600 ppm of boron. With the boron sample of the unit 2 RWST greater than the high TS limit, the TS action statement requires that the inoperable RWST be restored to operable status within one hour, or the unit to be in at least hot standby within six hours and in cold shutdown within the following 30 hours. With the boron concentration in the unit 2 RWST greater than the specification, this event is reportable per 10 CFR 50.73.(a).(2).(i).(B).

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

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Analysis of Event (Continued)

The following is the analysis of this event as reported in the initial waiver of compliance request.

The upper limit for the RWST boron concentration is based on the calculation of post-LOCA (loss of coolant accident) sump pH and boron concentration. The key assumptions in this calculation are that the RWST boron concentrations equal to 2,600 ppm and the reactor coolant system (RCS) boron concentration is equal to 2,400 ppm. By taking credit for current operating conditions (i.e., near end of cycle, low boron concentration), an Engineering evaluation has determined that adequate margin exists in the design basis calculation to permit RWST boron concentration to run as high as 2,872 ppm. Based on this calculation, the Plant implemented a temporary upper limit of 2,700 ppm for RWST boron concentration as part of the waiver of compliance.

The above Engineering calculation was performed by American Electric Power Service Corporation (AEPSC). An RCS boron concentration of 700 ppm was used to conservatively reflect current core conditions (130 ppm at 100% power) in place of the 2,400 ppm RCS concentration assumed in the design basis calculation. The calculation concentration shows that as long as the RCS boron concentration remains below 700 ppm, the boron concentration in the RWST may be up to 2,700 ppm without impacting the results of the original analysis.

Also considered during the above analysis was the effect of the RWST boron concentration at 2,700 ppm on the hot leg recirculation switchover time and containment spray pH. Based on the above Engineering calculation, it was concluded that the validity of the hot leg recirculation switchover time is ensured by the same reasoning. In addition, the containment spray pH will be within its design basis during injection using the RWST with 2,700 ppm boron.

Considering the effects of the RWST boron concentration at 2,700 ppm on reactivity control, a boron concentration greater than the 2,600 ppm limit is conservative.

Based on the final review of this event, the above analysis of the RWST boron concentration greater than the specifications is still considered to be valid. Therefore, the RWST boron concentration greater than the specification requirements is not considered to have created a significant safety concern or a significant hazard to the health and safety of the general public.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

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Corrective Action

- When the unit 2 RWST sample identified that the boron concentration was greater than the specification, confirmatory samples were drawn which confirmed the out-of-specification boron concentration and a reactor shutdown was commenced. In addition, a process for dilution, recirculation, and increased sampling was begun until the unit 2 RWST boron concentration was restored to within the Technical Specification requirements.
- The lessons learned from this event were forwarded by the Operations Department Superintendent by a letter to the Operations Management personnel to be discussed with their assigned personnel. This letter stressed the need for conservative decision making and the responsibility of management personnel to clearly communicate Plant objectives and priorities to the appropriate control room personnel.
- Operations Department procedures are scheduled to be revised before the third quarter to provide directions for the mixing of the RWST following additions to the tank, to restrict additions to the RWST that are outside the administrative boron concentration limits placed on RWST boron concentration, and to require planned additions to RWST volume.

Failure Component Identification

None

Previous Similar Events

None identified.