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ComEd

May 1, 2000
BW000055

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Braidwood Station, Unit 2
Facility Operating License No. NPF-77
NRC Docket No. STN 50-457

Subject: Submittal of Licensee Event Report Number 2000-001-00

10 CFR 50.73(a) requires a Licensee Event Report (LER) to be submitted within 30 days after discovery of the event. The purpose of this letter is to provide the subject LER in accordance with 10 CFR 50.73(a)(2)(iv) by the required May 1, 2000 submittal date.

Should you have any questions concerning this letter, please contact Mr. T. W. Simpkin, Regulatory Assurance Manager, at (815) 458-2801, extension 2980.

Respectfully,

Timothy J. Tulon
Site Vice President
Braidwood Station

Attachment: Braidwood Station, Unit 2 LER Number 2000-001-00

cc: Regional Administrator - NRC Region III
NRC Senior Resident Inspector - Braidwood Station

IE22

NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS 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 (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1):	DOCKET NUMBER (2)	PAGE (3)
Braidwood Unit 2	05000457	1 of 7

TITLE (4) 2A Essential Service Water Pump Inoperable for more than the Technical Specification Allowed Outage Time resulting from Inadequate Testing Criteria due to a Design Deficiency and Inadequate Methodology for the Return To Service

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
03	30	2000	2000	-- 001	-- 00	05	01	2000	FACILITY NAME	DOCKET NUMBER

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

LICENSEE CONTACT FOR THIS LER (12)

NAME (Include Position Title)	TELEPHONE NUMBER (Include Area Code)
Jim Kuchenbecker, System Engineering Manager	(815) 458-2801 Extension 2243

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)

At 1900 on March 26, 2000, the 2A Essential Service Water (SX) Pump was taken Out of Service for planned maintenance. The appropriate Required Actions of the Technical Specifications (TS) were entered. Upon completion of the maintenance, Operations personnel performed post maintenance testing of the system. At 1241 on March 29, the pump was declared Operable. At 1206 on March 30, 2000, the 2A SX Pump was started and showed indications of inadequate flow when the 2B SX Pump was secured. The 2A SX Pump was declared inoperable and the Required Actions of the TS were again entered. Significant quantities of entrained air were found in the 2A SX Pump piping. Additional venting activities were conducted and the 2A SX Pump was declared Operable at 1045 on April 1, 2000.

As a result of inadequate design of the SX suction headers and knowledge deficiencies of the system configuration, the 2A SX Pump was prematurely declared Operable.

The safety significance of the event was minimal. The plant would have been fully capable of coping with the design basis accident on Unit 2, even with the additional single failure of the 2B SX Pump. The required cooling functions of the SX System could have been maintained, and the impact of the additional period of unavailability of 2A SX Pump was not risk significant.

This event is being reported pursuant to 10CFR50.73(a)(2)(i)(B).

A. PLANT CONDITIONS PRIOR TO EVENT:

Unit: Unit 2 Event Date: 3/30/00 Event Time: 1206

MODE: MODE 1 Reactor Power: 99.9 percent RCS [AB] Temperature: 581 degrees F. RCS [AB] Pressure: 2238 psig

B. DESCRIPTION OF EVENT:

The 2A Essential Service Water Pump (SX) [BI] was inoperable at the beginning of this event and contributed to the initiation of the event. The 1A SX Pump was also inoperable but it had no effect on Technical Specification (TS) requirements because Unit 1 was in Modes 5 and 6 during the event.

During the last Unit 1 refueling outage (A1R08), planned maintenance was scheduled to replace the suction valves (1SX001A and 2SX001A) on the 1A and 2A SX Pumps. At 1900 on March 26, 2000, the 2A SX Pump was taken Out of Service (OOS) and Condition A of TS 3.7.8 "Essential Service Water (SX) System" was entered. This TS is applicable in Modes 1-4. The Required Action A.1 states that the pump must be restored to an Operable status within 72 hours. In support of this work activity, the A train SX piping from the suction header to the 1A and 2A SX Pumps' discharge valves was drained. This suction header supplies the 1A and 2A SX Pumps. The work was scheduled to take 57 hours and contingency plans were in place.

Upon completion of the replacement activities, the following criteria were established to declare the 2A SX Pump Operable:

- 1/2SX001A valves in the open position and capable of closing in 30 minutes (flood analysis consideration). Manual operator closure of the valves was determined to be acceptable.
- The work was complete, Post Maintenance Tests were complete, and work packages required for operability were closed out.
- The system was water solid at the pump vents.
- The pumps were started and continued to run without cavitation, and with steady current and pressure indication.

Operations performed a two-part evolution to fill and vent the SX suction header. The first part of the evolution was performed using Braidwood Operating procedures, which involved throttling open the SX isolation valves in the Lake Screen House (LSH). The procedure allows for this fill and vent evolution to be performed as required, "until the SX suction header has been adequately filled and vented."

The second part of the fill and vent evolution involved starting/running the 1A and 2A SX Pumps. Since the SX suction header has high points not equipped with vent valves, multiple starts of the pumps may have been necessary to dynamically vent the suction header to "sweep" any trapped air from the suction header. At 2340 on March 28, 2000, Operations personnel began the static fill and vent of the SX suction line. After the 1A SX Pump was dynamically vented, the 2A SX Pump would then be started to ensure its lines were also vented.

At 0859 on March 29, 2000, the 1A SX Pump was initially started to perform a dynamic vent of the common and 1A SX suction header. At 1013 on March 29, 2000, with the 1A SX Pump running with normal indications, the 2A SX Pump was started. The Main Control Room and field operators noted that the 2A SX Pump started normally with pump discharge and header pressures increasing as expected, and amps on the 2A SX Pump were within approximately 5 amps of the already running 2B SX Pump. Shortly after the 2A SX Pump was started, operators noted that the amps and pressures of the 1A SX Pump were declining, and at 1018 secured the 1A SX Pump. At 1104 on March 29, the 2A SX Pump was secured with the 1B and 2B SX Pumps supplying Unit 1 and 2 loads.

Following the shutdown of the 1A and 2A SX Pumps, the 1A SX Pump and strainer were vented and a large amount of air was expelled. The 2A SX Pump and strainer were also vented but only a small amount of air was present. After the 1A SX Pump was vented, the pump was restarted, run for 23 minutes with normal indications and secured. When the 1A SX Pump was stopped normal indications were observed, normal annunciators alarmed and the discharge check valve closed. The 1A SX Pump and strainer were vented again and only a small amount of air was present. At 1241 on March 29, 2000, following verification that the post maintenance tests were complete on the replacement valves, the 2A SX Pump was declared Operable.

At 1206 on March 30, 2000, the 2A SX Pump was started and the 2B SX Pump was secured to align Unit 2 and Unit 1 SX Pumps on opposite trains, which is the normal alignment. Shortly after the 2B SX Pump was secured, the 2A SX Pump experienced discharge pressures oscillating between 30 and 90 psig. As a result, the 2B SX Pump was restarted and the 2A SX Pump was secured. Condition A of TS 3.7.8 for the 2A SX Pump being inoperable was entered due to the failure to develop sufficient discharge pressure. Investigations by Operations and Engineering personnel subsequently determined that the A train SX suction header was not adequately filled and vented for normal system operation. Over the next 26 hours, various combinations of SX Pumps were operated to sweep entrained air from the SX System, including a dual 1A and 2A SX Pump ASME surveillance (full flow through both pumps simultaneously) that was completed at 1707 on March 31, 2000. Following the dual pump run, additional pump runs were performed to ensure all air was evacuated from the SX System, and all high point vents downstream of

the pumps were also vented. At 1045 on April 1, 2000, the 2A SX Pump was declared Operable.

C. **CAUSE OF EVENT:**

At some point in time after the 2A SX Pump was declared Operable at 1241 on March 29, 2000 and prior to the start of the pump at 1206 on March 30, 2000, significant quantities of air gathered in the suction piping for the pump and rendered it inoperable. Because it is unknown when this occurred, we have conservatively assumed the 2A SX Pump was inoperable for approximately a 24-hour period. Using this conservative assumption, the total period of inoperability exceeded the TS Allowed Outage Time.

The inadequate design/as-built condition of the SX suction and insufficient system knowledge contributed to an inadequate return to service. The inadequate design is the lack of vent valves in the high point of the suction header. Inadequate operating procedures for the fill and vent of the SX suction header and improper planning of the fill and vent aspect of the work window also contributed to this event.

These contributing events were identified since if either condition had not existed, this event would not have occurred. Specifically, if adequate vents existed on the SX suction header, a normal fill and vent of the header should have been sufficient to ensure that the header was adequately water-solid and the event would not have occurred. Conversely, if the return to service methodology had identified the effect of running the B train SX Pumps in parallel on the flow through the A train SX Pumps, or specified that the suction header must be subjected to some minimum flow to ensure that the dynamic venting process was adequate, the event would also not have occurred.

The root cause report for this event is not complete. If upon completion of the root cause report, changes are necessary for the content of this report or the Corrective Actions, a supplemental License Event Report will be submitted.

D. **ASSESSMENT OF SAFETY CONSEQUENCES:**

The SX System for each Unit consists of two redundant, independent, 100% capacity trains. During this event, the 2B and 1B trains were available, and the pumps and their supplied components were observed to be performing acceptably. In the event of a design basis accident [i.e., Loss of Offsite Power/Loss of Coolant Accident (LOOP/LOCA)] on Unit 2, the cooling requirements would have been fully met by the 2B SX Pump. The 1B SX train, including the 1B Diesel Generator (DG)

[EK] was protected and fully capable of providing the cooling requirements of the Unit 1, which was shutdown and in a refueling outage.

In the event of a design basis accident on Unit 2, with an additional single failure of the 2B SX Pump or the 2B DG, the necessary cooling could have been supplied from Unit 1 by cross-tieing it to Unit 2. The system would be aligned per the direction in procedure BwOA PRI-8 in a manner that isolated cooling to non-essential loads, but maintained cooling to essential loads on Unit 1 and to the accident loads on Unit 2. An engineering evaluation confirmed that the 1B SX Pump was capable of providing all the required cooling flow during the event. This included supplying adequate flow to the common Component Cooling [CC] Heat Exchanger for Unit 1, which was in Mode 5 and Mode 6 at different times during the event. For Unit 2, the Updated Final Safety Analysis Report (UFSAR) design flows could be achieved for all components. For two components, the 1B SX Pump room cooler/oil cooler (combined flow) and the OB Main Control Room Chiller [VI], the flow model indicated slightly less than the UFSAR design flows. However, with the Ultimate Heat Sink temperature significantly less than 100 degrees F (approximately 58 degrees F during the event), these heat exchangers would have been fully capable of removing the design heat loads.

In summary, the plant would have been fully capable of coping with the design basis accident on Unit 2, even with the additional single failure of the 2B SX Pump.

An evaluation was performed to determine the risk impact based on Conditional Core Damage Probability (CCDP). The following assumptions were used in this evaluation:

1) Because it is unknown when sufficient air accumulated in the 2A SX Pump to cause it become inoperable following its return to service, it was conservatively assumed that the 1A and 2A SX Pumps became unavailable at 1241 on March 29, 2000. The 2A SX Pump had been declared Operable at that time. Based upon subsequent venting operations, the 2A SX Pump was considered available at 0935 on March 31, 2000. The duration of this condition was therefore approximately 45 hours.
2) It was assumed that the 2A SX Pump could have been recovered following failure of both of the remaining SX Pumps (1B and 2B). This is based on the fact that the 2A SX Pump was successfully recovered following the second entry into the Technical Specification Required Actions, after running the pump for a total duration of about 6 hours. Operations of the SX Pumps were being conducted in a very deliberate manner, and other pump combinations were being run, during the period of the second entry into the Required Actions. It is reasonable to conclude that if the 2A SX Pump was the priority (i.e., the 1B and the 2B SX Pumps were unavailable), the 2A SX Pump could have been recovered in substantially less time. With an SX Pump recovered in a time frame of less

than 10 hours, a consequential Reactor Coolant Pump Seal LOCA could either be avoided or mitigated. Recovery of the 2A SX Pump was considered in the risk assessment by applying a "failure to recover" probability of 0.1 (i.e., 10% chance that recovery would not be accomplished). This probability was only applied to the Dual Unit Loss of SX Initiating Event in the upgraded Probabilistic Risk Analysis (PRA).

The CCDP was calculated by assuming the 1A and 2A SX Pumps were unavailable and re-quantifying the upgraded PRA model for Braidwood Unit 2. In addition, the impact on the Loss of SX Initiating Events (both Single and Dual Unit Initiators) was requantified.

The impact on the Initiating Event Frequencies (IEF) is provided below:

Initiating Event	Base Value (events/yr.)	IEF 1A & 2A SX Pumps Unavailable (events/yr.)	Recovery of 2A SX Pump	Final IEF used in evaluation (events/yr.)
%SX-DLSX----DUIE	2.24E-5	5.55E-04	0.1	5.55E-05
%SX-DLSX--R-DUIE	1.10E-3	2.72E-02	N/A	2.72E-02
%SX-LOSX2---HWIE	3.66E-5	1.95E-03	N/A	1.95E-03
%SX-LOSX2-R-HWIE	1.79E-3	9.55E-02	N/A	9.55E-02

With these revised initiating events and the 1A & 2A SX Pumps set to failed in the PRA model, the configuration specific Core Damage Frequency (CDF) is calculated to be 9E-5/year. This would be the CDF if the period of unavailability of the 2A SX Pump was extended to the entire year. This is compared to the base case CDF (normal maintenance) of 5E-5/year. With an actual additional duration of unavailability of 45 hours, this represents a CCDP of 5E-7. Therefore, the impact of the period of unavailability of the 2A SX Pump was not risk-significant.

The results of the assessment confirmed that required cooling functions could have been maintained, and that the impact of the period of unavailability of 2A SX Pump was not risk significant. No Safety System Functional Failure existed as a result of this event.

E. CORRECTIVE ACTIONS:

The following corrective actions will be taken to prevent a similar event from occurring:

- Appropriate return to service acceptance criteria will be developed, in consideration of the current SX suction header configuration and potential

effects of parallel pump operation, which will ensure that the SX suction header is adequately filled and vented.

- Appropriate Operating procedures will be revised to incorporate the appropriate return to service methodology.
- A modification to install high point vent valve(s) on the train A and B SX suction headers will be evaluated.
- The Operations and Engineering Curriculum Review Committees will review this event to determine necessary lesson-learned training. This will be developed into a Lessons Learned for Work Control.

The root cause report for this event is not complete. If upon completion of the root cause report, changes are necessary for the content of this report or the Corrective Actions, a supplemental License Event Report will be submitted.

F. PREVIOUS OCCURRENCES:

On November 10, 1997, during a Unit 2 refueling outage (A2R06), a water hammer of the 2D Main Feedwater [SJ] piping and the associated Auxiliary Feedwater [BA] piping was caused by inadequate venting while opening the 2FW-039D valve. Corrective actions taken for this event would not have precluded the problems associated with the SX System.

G. COMPONENT FAILURE DATA:

NONE