NRC 2001-057

10 CFR 50.73

August 17, 2001

Document Control Desk
U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, DC 20555

Ladies/Gentlemen:

DOCKET 50-301
LICENSEE EVENT REPORT 301/2001-002-00
MANUAL REACTOR TRIP DUE TO DECREASING WATER
LEVEL IN CIRCULATING WATER SYSTEM
POINT BEACH NUCLEAR PLANT UNIT 2

Enclosed is Licensee Event Report 301/2001-002-00 for the Point Beach Nuclear Plant Unit 2. This report is provided in accordance with 10 CFR 50.73(a)(2)(iv)(A) as, "any event or condition that resulted in a manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B) of this section... including reactor scram and trip." This report documents a manual reactor trip from approximately 70% power that was directed by plant procedure as a result of a declining water level in the Circulating Water Pump House pump bay. The drop in water level was caused by a large influx of small forage fish into the pumphouse forebay.

Immediate corrective actions have been completed and are listed in this report. Additional corrective action commitments are identified by italics in this report.

Please contact us if you require additional information concerning this event.

Sincerely,

Tim Weld for

A. J. Cayia
Plant Manager

Enclosure

CWK/tyf

IE22

cc: NRC Resident Inspector
NRC Regional Administrator
NRC Project Manager
PSCW
INPO

NRC FORM 366 (1-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 6-30-2001

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
POINT BEACH NUCLEAR PLANT UNIT 2	05000301	1 OF 6

TITLE (4)
Manual Reactor Trip Due To Decreasing Water Level in Circulating Water System Pump Bay

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
06	27	2001	2001	B 002	B 00	08	17	2001	FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	1
POWER LEVEL (10)	70

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR : (Check all that apply) (11)

20.2201(b)	20.2203(a)(3)(ii)	50.73(a)(2)(ii)(B)	50.73(a)(2)(ix)(A)
20.2201(d)	20.2203(a)(4)	50.73(a)(2)(iii)	50.73(a)(2)(x)
20.2203(a)(1)	50.36(c)(1)(i)(A)	X 50.73(a)(2)(iv)(A)	73.71(a)(4)
20.2203(a)(2)(i)	50.36(c)(1)(ii)(A)	50.73(a)(2)(v)(A)	73.71(a)(5)
20.2203(a)(2)(ii)	50.36(c)(2)	50.73(a)(2)(v)(B)	OTHER Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iii)	50.46(a)(3)(ii)	50.73(a)(2)(v)(C)	
20.2203(a)(2)(iv)	50.73(a)(2)(i)(A)	50.73(a)(2)(v)(D)	
20.2203(a)(2)(v)	50.73(a)(2)(i)(B)	50.73(a)(2)(vii)	
20.2203(a)(2)(vi)	50.73(a)(2)(i)(C)	50.73(a)(2)(viii)(A)	
20.2203(a)(3)(i)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Charles Wm. Krause, Senior Regulatory Compliance Engineer	(920) 755-6809

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	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 June 27, 2001, at approximately 18:20, the Point Beach Nuclear Plant (PBNP) Unit 2 reactor was manually tripped with reactor power at approximately 70%. This trip was directed by procedure (AOP-13A) when the water level in the Circulating Water (CW) System pump bay decreased to less than –11 feet (normal pump bay level with four CW pumps in service is about –7 feet). The Service Water (SW) pumps also take a suction from the pump bays and –11 feet is a conservative minimum water level to assure that components serviced by the SW system will remain capable of performing their safety functions. The decrease in pump bay water level was attributed to the influx of a large number of small forage fish (Alewives) on the Unit 2 traveling water screens. This influx caused a high differential water level across the screens and ultimately resulted in the disabling of the traveling screen drive mechanism. Following the trip one of the two running Unit 2 CW pumps was secured. This action; in conjunction, we believe, with a screen failure that permitted increased water flow into the pump bay; resulted in a rapid recovery of the pump bay level. The preliminary root cause report has identified the following causal factors: ineffective implementation of previously identified corrective actions from related events, delays in operator response while in the AOP, and problems with the sequence of action steps within the procedure. With the exception of two minor equipment problems identified in the report, the operator and equipment responses to the transient were as expected and the unit was stabilized in the hot shutdown condition. Unit 2 returned to normal operation on July 1, 2001.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Point Beach Nuclear Plant Unit 2	05000301	2001	- 002 -	00	2 OF 6

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

Event Description:

On June 27, 2001, the Point Beach Nuclear Plant (PBNP) Unit 2 reactor [RCT] was manually tripped in accordance with the requirements of Abnormal Operating Procedure (AOP) 13A, "Circulating Water System Malfunction" because of a low and decreasing water level in the Unit 2 pump bay. Prior to this event, both PBNP units were operating normally at full power (CR 01-2178). This event began at approximately 18:05 hours (all times are CDT) after the control room received a Unit 2 traveling water screen differential level high alarm [PDA]. AOP 13A was entered and an Auxiliary Operator (AO) and Operating Supervisor (SRO) went to the Circulating Water (CW) Pump House to investigate. The AO reported that a large number of Alewives (a small forage fish) appeared to have entered the CW system [SG] forebay. The presence of the live fish against the Unit 2 traveling water screens [SCN] (which are intended to keep marine life and other aquatic debris out of the pump bays [MK]) created a high differential level across the screens. The high differential level and the dynamic loading caused by the presence of the fish caused the shear pins for the screen driving mechanism to break. The SRO directed the AO to begin manual measurement of the Unit 2 pump bay level. The AO reported to the control room a decreasing level in the Unit 2 pump bay. The Unit 1 traveling screens and Unit 1 pump bay level were observed to be normal at this time.

Based on the decreasing Unit 2 pump bay level, the Shift Manager entered AOP-17A "Rapid Load Reduction," at about 18:07 and ordered a power reduction to 50%. At an estimated time of 18:18 manual measurement of the Unit 2 pump bay level was reported as -10 feet (Normal pump bay level with two circulating pumps in operation is approximately –7 feet). At 18:20 hours the pump bay level was reported as –11.5 feet. As directed by the AOP-13A with the pump bay level less than –11 feet, the Unit 2 reactor was manually tripped. This action is directed by the procedure to maintain operability of equipment supplied by the Service Water [BI] (SW) system. Three SW pumps take a suction from the Unit 2 pump bay and three from the Unit 1 pump bay. Reactor power was at approximately 70% at the time of the trip. The lowest pump bay level reported was –11.5 feet. PBNP emergency operating procedure for the reactor trip (EOP-0) was entered. At approximately 18:23 one of the two operating Unit 2 CW water pumps [P], 2P-30B, was secured. Shortly after that action was taken, the Unit 2 pump bay water level was reported to be equalizing with the forebay level. At 1828 the Unit 2 pump bay and forebay levels were reported at –5 feet (the normal level for three CW pump operation - two pumps running on Unit 1 and one on Unit 2). AOP-13A was revised with an emergent change to allow continued operation of the single running Unit 2 CW water pump.

Following the manual reactor trip and the actions taken in accordance with EOP-0, "Reactor Trip or Safety Injection," and EOP-0.1, "Reactor Trip Recovery;" Unit 2 was placed in a stable hot shutdown condition. During the brief period of time when the pump bay water level was less than –11 feet, from about 18:20 to 18:23, Technical Specification (TS) LCO 15.3.0.B was entered for the SW system in accordance with the directions in AOP-13A. With the following exceptions, the plant equipment required to operate during and following the reactor trip and recovery performed as expected: Source Range nuclear instrument [IG] (NI) detector N-32 failed to energize automatically or manually and a P-10 high flux at power permissive bistable failed to de-energize with reactor power at zero. The auxiliary feedwater system [BA] was actuated from a loss of feedwater turbine trip signal following the reactor trip. This was an expected response and the auxiliary feedwater pumps were secured at 18:28 in accordance with EOP-0.1. At the time of this event only one of the two SW basket strainers [STR] was in service, the north strainer having been taken out of service on June 26, 2001 for maintenance. The south SW strainer functioned properly and prevented any significant ingestion of aquatic debris into the safety related or non safety related portions of the SW system.

Both a four hour and an eight hour notification were communicated to the NRC as required by 10 CFR 50.72(b)(2)(iv)(B) and 50.72(b)(3)(iv)(A) for the manual reactor protection system actuation and auxiliary feedwater system actuation respectively at 20:09 on June 27, 2001, (EN# 38100). This notification was supplemented at 14:18 on June 28, 2001, to clarify that this event was not precipitated by a fish kill but by an intrusion of a large number of live Alwives which caused the temporary blockage of the Unit 2 travelling water screens.

Although not a reportable condition, later that day PBNP Unit 1 also experienced problems with Alewife intrusion

causing a similar but smaller fluctuation in Unit 1 pump bay water level. At 20:44 on June 27, 2001, Unit 1 entered AOP-13A and AOP-17A due to a Travelling Water Screen Differential Level High Alarm. Power was reduced to approximately 80% and one of the two running CW pumps was secured. This action was successful in recovering the pump bay level and AOP-13A was exited at 21:00.

Cause:

The proximate cause of this event was an unexpected and abnormally large intrusion of live fish into the CW system. This resulted in traveling water screen flow restriction and ultimately failure of the mechanical drive for the traveling screen system due to differential water levels across the screens exceeding the design limits. With the failure of the screen drive and the presence of a large number of fish in front of the screens, insufficient water flowed into the pump bay from the forebay and the water level in the pump bay dropped. Following the unit trip the Unit 2 pump bay water level was recovered. The level recovery was apparently due to a combination of securing one of the two running Unit 2 CW pumps, water flowing through a damaged section of the travelling screens, and the movement of the fish away from the screens. As a result of those events, the water flow across the traveling screens was sufficient to supply one Unit 2 CW pump and the Unit 2 pump bay level returned to normal.

The presence of a large number of forage fish in the lake at the PBNP intake and within the CW system was not a unique situation. There have been other incidents associated with fish intrusions in the past, most recently in August 1996, which have resulted in power reductions and/or failures of the traveling water screens. However, this event was the first reactor trip resulting from the fish intrusion.

A Root Cause Evaluation team was appointed shortly after the event. The Charter of that team was to investigate why a decreasing pump bay level propagated to the point where a manual trip of the Unit 2 reactor was required. The scope of this investigation focused on the responses to the event of the operating crew, the operation and function of plant equipment during and following the event, and an assessment of the adequacy of the recent traveling water screen component modifications. Based on preliminary information from the team, the following issues have been identified as either root causes or significant contributing factors to this event:

1. The implementation of corrective actions identified following previous related events, such as providing pump bay level instrumentation, were deferred.

2. The operator response to assess and mitigate the environmental factors and plant conditions, including the pump bay level, was not timely. This was due in part to some difficulties in initiating the taking and reporting of manual pump bay water levels and was exacerbated by their understanding of the sequence of steps in the abnormal operating procedure concerning when the CW pumps could be secured.

3. The procedural guidance available to the operators was not optimized to facilitate their response to the environmental factors causing the traveling screen failures and the reduction in pump bay water level.

Corrective Actions:

As required by plant procedures, an Incident Investigation and Post Trip Review was completed. This review was completed at 00:57 on June 29, 2001, and the unit released for a reactor startup. Unit 2 was taken critical at 10:06 on June 29, and returned to full power operations at 06:34 on July 1, 2001. Corrective actions completed prior to the start up included:

- The NI source range Channel 32 detector element and a high voltage pre-amp [JX] were replaced and the channel successfully tested and returned to service.

- The P-10 bistable from power range Channel 44 which failed to de-energize was replaced. The bistable was calibrated, tested and returned to service.

- Extensive efforts were made to remove the large number of Alewives from the forebay. Prior to the Unit 2 startup approximately 10,000 pounds of fish were removed from the forebay; however, the presence of Alewives continued to be observed in the CW system. Following fish intrusion events on July 3 (CR 01-2247) and July 7 (CR 01-2271), an additional 6800 pounds of fish were removed from the forebay.

Subsequent to the unit's return to power, Procedure AOP-13A was revised (Revision 11 dated 7/13/2001). The procedure now provides in Step One direction to the operators to check that only one CW pump is running in each unit. If both pumps in a unit are running, and action is necessary to restore forebay or pump bay levels, the operator is immediately directed to secure one of the two running CW pumps in each unit. This revision also clarified the process for obtaining the manual measurement of the pump bay water level.

(The draft RCE report has identified numerous additional corrective action recommendations. These corrective action recommendations are being reviewed by the appropriate plant groups and the Corrective Action Review Board for effectiveness and applicability. Following approval, corrective actions will be entered and tracked within the PBNP corrective action program.)

Component and System Description:

The circulating water intake system at PBNP is common to both units. The system was designed and constructed to provide a reliable supply of Lake Michigan water, regardless of weather or lake conditions, to the suction of four CW pumps, six SW pumps and two fire water [KP] pumps. These pumps are located in the CW Pump House. The pump house is Class I seismic structure. Two CW pumps per unit circulate water from the lake through the main condensers to condense the steam exhausting from the turbines. The water is discharged back to the lake through on shore discharge flumes. The CW system also supplies cooling water to the condensate coolers for maintaining the main generator hot gas temperature. The six SW pumps provide cooling water to various safety related and non-safety systems. The fire water pumps supply a distribution piping system for fire protection purposes.

The intake structure [NN] for the CW pump house is located about 1750 feet from the shore in a water depth of 22 feet at mean historic lake level. The structure consists of two annular rings constructed of 12 inch structural steel "H" piles driven into the lake bed and vertically reinforced with sections of "H" bars. The annulus is filled with limestone blocks. The structure has an outside diameter of 110 feet, an inside diameter of 60 feet. Prior to modifications completed this spring, the intake structure had a top elevation of approximately eight feet above mean lake level. The structure was modified to remove the above water portion of the intake. This was done to eliminate the impact of the structure on migratory water fowl, specifically Double Crested Cormorants, in accordance with a settlement agreement with the U. S. Fish and Wildlife Service. The structure now raises about eleven feet above the lake bed and is about nine feet below the current lake water level. The very center of the annular opening is now covered with a large central metal plate to promote ice-melt operations while the remainder of the opening is made up of structural "I" beams and fiberglass bars creating many small (about seven by seventeen inch) water flow openings. Although this is a recent change, the impact of the modification on the potential for fish intrusion had been assessed and determined to be essentially no different then the original structure.

Water flows from the intake structure to the pump house forebay through two 14 feet diameter, corrugated, galvanized, structural plate pipes buried to a minimum depth of 3 feet below the lake bed. Flow through either of the intake pipes can be reversed during winter operation to re-circulate warm condenser discharge water to the intake to prevent freezing in the system. Water flows from the forebay through bar grate trash racks and then through travelling screens having 3/8 in. mesh to the Unit 1 or 2 pump bays. The circulating water, service water and fire water pumps take their suctions from the pump bays. The circulating water system is periodically treated with sodium hypochlorite to prevent

the buildup of slime and algae in the system and to reduce zebra mussel colonization. Sodium bisulfite is simultaneously injected at the outlet of the condensers to dechlorinate the discharged circulating water. This treatment is performed as frequently as daily, dependent on lake temperature. A one hour treatment had been completed about two hours before this event. This action was evaluated and eliminated as a significant contributing factor to this event.

Safety Assessment:

With the exception of the failure of the N-32 source range detector and a P-10 bistable, the plant response during and following this manual RPS actuation was as expected. Systems and equipment necessary to mitigate the consequences of this transient performed as designed and maintained the plant in a stable hot shutdown condition following the trip. Following the incident investigation of the proximate cause of the unit transient and the correction of the equipment problems identified above, no additional problems were experienced during the subsequent unit restart and return to full power operations. Other than the inadvertent challenge of the reactor protection system and other plant equipment necessary to remove shutdown decay heat and maintain the plant in a stable configuration, the impact on nuclear safety due to this event was not significance.

As discussed in the Event Description, the SW system was momentarily declared out of service by the AOP-13A procedural directions while the pump bay level was below – 11 feet. We compared the lake environmental conditions and the configuration of the SW system at the time of this event to the conditions assumed in the SW calculations which established the minimum acceptable pump bay water level. This review established that their was significant margin in those assumptions as compared to the actual conditions observed such that we could conclude that the SW system and those systems supplied by SW, remained fully capable of performing their respective safety related functions at all times during this transient. An assessment was also completed to quantify the increased risk attributed to the fact that one of the two main SW strainer was out of service at the time of this event. This assessment calculated that under these conditions, the increase in core damage risk was about 1.8 times the probability of a normal trip with the loss of the power conversion system. Accordingly, the safety and welfare of the public and the plant staff was not significantly impacted by this event.

There was at no time a loss of a system, structure, or component related safety functions during this event; therefore, we have also concluded that this event did not involve a safety system functional failure.

Similar Occurrences:

A review of recent LERs (past three years) identified the following events which involved unplanned reactor scrams or ESF actuations:

LER NUMBER	Title
301/2001-001-00	Ground Fault Relay Actuation Causes Generator Lockout and Reactor Trip
301/2000-007-00	Fault Associated with "C" Phase Main Step-up Transformer Results in Reactor Scram
301/2000-006-00	Failed Fuse in Intermediate Range Nuclear Detector Results in Reactor Scram
301/2000-005-00	Unplanned ESF Actuation During Calibration and Testing of Safeguards Bus Relays
301/2000-004-00	Unplanned ESF Actuation During Safeguards Bus Restoration

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Point Beach Nuclear Plant Unit 2	05000301	2001	- 002	- 00	6 OF 6

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

266/2000-010-00	Manual Reactor Trip Due to Concerns for Diver Safety
266/2000-001-00	Manual Reactor Trip Due To Decreasing Circulating Water System Forebay Level
266/1999-013-00	Inadvertent ESF Actuation During Post Maintenance Testing