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Waterford 3

W3F1-96-0037
A4.05
PR

March 28, 1996

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Reporting of Licensee Event Report

Gentlemen:

Attached is Licensee Event Report Number LER-96-004-00 for Waterford Steam Electric Station Unit 3. This Licensee Event Report is submitted in accordance with 10CFR50.73(a)(2)(i)(B). The details of the events surrounding the Waterford 3 Auxiliary Component Cooling Water (ACCW) system's susceptibility to water hammer are discussed in NRC Inspection Report 95-23. This LER specifically addresses the failure to meet the intent of Technical Specification surveillance 4.7.3.c for the ACCW system and is not intended to cover all related issues in depth.

Very truly yours,

D.R. Keuter
General Manager
Plant Operations

DRK/DFL/tjs
Attachment
cc: L.J. Callan, NRC Region IV, C.P. Patel, NRC-NRR, D.F. Packer, J.T. Wheelock - INPO Records Center, R.B. McGehee, N.S. Reynolds, NRC Resident Inspectors Office
Administrator - LRPD

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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 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)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
WATERFORD STEAM ELECTRIC STATION UNIT 3	05000 382	1 OF 10

TITLE (4)

FAILURE TO MEET INTENT OF T.S. SURVEILLANCE DUE TO INADEQUATE CORRECTIVE ACTIONS

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
									N/A	05000
02	28	96	96	004	00	03	28	96	N/A	05000

OPERATING MODE (9)	1
POWER LEVEL (10)	100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	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)		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 in 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)
D.W. VINCI, LICENSING MANAGER	(504) 739-6370

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 15 single-spaced typewritten lines) (16)

In evaluating the past operability of the Auxiliary Component Cooling Water (ACCW) system following the discovery of air intrusion into the system in December, 1995, it was determined that the intent of past Technical Specification (TS) surveillances on this system were not fully met by the implementing procedure. The intent of the TS surveillance is to demonstrate, to the extent practicable, that the system will function under design basis conditions. This intent was not met due to the proceduralization of closing the pump discharge valves prior to pump starts. The cause of this condition was ineffective corrective actions to address a system design susceptibility to hydraulic transients. Corrective actions include an ACCW system design change, a review of surveillance procedures for unidentified work arounds, and Corrective Action Program enhancements. The ACCW system remained capable of performing its safety function. Had the past surveillances been performed with the pump discharge valves open, the functional capability of the system would have been demonstrated. Therefore, this event did not compromise the health and safety of the public.

REQUIRED NUMBER OF DIGITS/CHARACTERS FOR EACH BLOCK

BLOCK NUMBER	NUMBER OF DIGITS/CHARACTERS	TITLE
1	UP TO 46	FACILITY NAME
2	8 TOTAL 3 IN ADDITION TO 05000	DOCKET NUMBER
3	VARIES	PAGE NUMBER
4	UP TO 76	TITLE
5	6 TOTAL 2 PER BLOCK	EVENT DATE
6	7 TOTAL 2 FOR YEAR 3 FOR SEQUENTIAL NUMBER 2 FOR REVISION NUMBER	LER NUMBER
7	6 TOTAL 2 PER BLOCK	REPORT DATE
8	UP TO 18 -- FACILITY NAME 8 TOTAL -- DOCKET NUMBER 3 IN ADDITION TO 05000	OTHER FACILITIES INVOLVED
9	1	OPERATING MODE
10	3	POWER LEVEL
11	1 CHECK BOX THAT APPLIES	REQUIREMENTS OF 10 CFR
12	UP TO 50 FOR NAME 14 FOR TELEPHONE	LICENSEE CONTACT
13	CAUSE VARIES 2 FOR SYSTEM 4 FOR COMPONENT 4 FOR MANUFACTURER NPRDS VARIES	EACH COMPONENT FAILURE
14	1 CHECK BOX THAT APPLIES	SUPPLEMENTAL REPORT EXPECTED
15	6 TOTAL 2 PER BLOCK	EXPECTED SUBMISSION DATE

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
WATERFORD STEAM ELECTRIC STATION UNIT 3	05000 382	96	004	00	2 OF 10

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

REPORTABLE OCCURRENCE

In evaluating the past operability of the ACCW system (EIIS identifier BS) with regard to potential water hammer, it was discovered that procedures which require starting the ACCW pumps, ACCMPMP0001 A&B (EIIS identifier BS-P), had been revised sometime in the past to close the pumps discharge valves, ACC-110 A&B (EIIS identifier BS-ISV), prior to starting the pumps. The first examples of this being done were following a hydraulic transient on the ACCW system in 1986. Project Evaluation/Information Request (PEIR) 10274, which evaluated this event, recommended administrative controls to shut the discharge valves any time the ACCW pumps are started to prevent potential water hammer until additional testing could be performed to determine a permanent fix. Operations surveillance procedures were revised to include shutting the pump discharge valves prior to starting the pumps.

The purpose of the TS surveillance requirements is to demonstrate the operability of the system. A narrow interpretation of TS 4.7.3.c is to verify the ACCW pumps start automatically on an SIAS signal. The past performances of this surveillance have demonstrated this automatic start function. The collective intent of the TS 4.7.3 surveillances, however, is to demonstrate ACCW system operability. The intent of closing the discharge valve was to remove the potential for water hammer induced system degradation. These procedure changes were a precautionary measure taken to remove the potential for damage due to a phenomenon that had been observed on an intermittent basis. It was intended that the cause of the waterhammer potential would be resolved by separate corrective actions. However the corrective actions taken associated with eliminating the potential for column separation or air intrusion in ACCW were inadequate. Thus, the practice of closing the discharge valve for the 18 month surveillance combined with the inadequate corrective action for dealing with potential water hammer in the ACCW System brings the adequacy of past system operability testing into question.

Based on the above Waterford 3 has concluded that the intent of the 18 month surveillance test was not being met, even though the acceptance criteria was met with

starting the pumps with the discharge valves closed. Although the ACCW system is believed to have remained operable in the past, not meeting the intent of a TS surveillance is reportable to the NRC as a condition prohibited by TS per 10CFR50.73(a)(2)(i)(B).

The "event date" for this condition is considered to be each time since 1987 that the 18 month ACCW pump autostart test was performed on recirculation with the pump discharge valves closed and with no actions in place to address ACCW system susceptibilities to water hammer. The "discovery date" for this condition is considered to be December 4, 1995, when it was discovered that ultrasonic testing established to periodically check the ACCW system for air intrusion was not being performed as scheduled. Subsequent investigation into the ACCW system operating history under Condition Report CR-95-1300 introduced questions on the adequacy of past ACCW system surveillances. This condition was determined to be reportable as a condition prohibited by Technical Specifications on February 28, 1996.

INITIAL CONDITIONS

At the time this condition was identified, Waterford 3 was operating at approximately 100% power in Operational Mode 1 (Power Operation). No procedures were being performed specific to this event, nor was any major equipment out of service specific to this event.

EVENT DESCRIPTION

On March 13, 1986, a hydraulic transient, or water hammer, apparently occurred in both trains of the ACCW system. Condition Identification Work Authorization (CIWA) 025735 documented that an apparent hydraulic transient caused damage to the paddles of rigid restraint CCRR-419 (EIIS identifier BS-SPT) located near ACCW pump 'B' discharge. CIWA 025739 documented that an apparent hydraulic transient caused a misalignment of rigid restraint CCRR-456 (ACCW pump 'A' discharge), the same pipe restraint damaged in a June 20, 1985 transient. Project Evaluation/Information

Request (PEIR) 10274 was generated to address this event. The Architect Engineer (Ebasco) was requested to walkdown and evaluate both trains of ACCW from the pump discharge to the Component Cooling Water (CCW) Heat Exchanger (EIIS identifier CC-HX). The PEIR states that no one witnessed the events, but that damaged pipe supports were discovered.

Although not a corrective action document, the apparent cause of failure and actions to prevent recurrence are addressed in the PEIR. The cause of the failure was attributed to "hydraulic transients" caused by leakage at pump discharge check valves, ACC-108 A&B (EIIS identifier BS-V). System integrity was maintained after the event, and no evidence of damage to the piping, pump or heat exchanger was noticed. PEIR 10274 stated that a permanent solution to the hydraulic transient problem will be established after system operation is witnessed. As a temporary measure it was recommended that administrative controls be incorporated to manually close pump discharge valves before starting the pumps at any time. Additionally, the PEIR stated that Operations shall provide system surveillance by using a temporary pressure indicator to monitor the system fill condition. This would preclude potential adverse system operation during an accident condition pump start. Although no documentation could be found to verify that this was performed or record the results, Systems Engineering personnel from the 1986 time frame were interviewed that recalled this being done. Readings were apparently taken for some period of time that indicated that column separation was not occurring, and the pressure gauge was removed.

OP-002-001, "Auxiliary Component Cooling Water," and OP-903-050, "CCW and ACCW Pump and Valve Operability Test, " were subsequently revised in 1986 to require closure of the discharge valves prior to the start of the ACCW pumps. In March, 1987, OP-903-094, "ESFAS Subgroup Relay Test - Operating" was revised to require closing the discharge valves prior to starting the ACCW pumps. OP-903-094 was credited as meeting the requirements of TS 4.7.3.c which requires verification that each ACCW pump starts automatically on an SIAS test signal. The implementing procedure for this TS surveillance requirement was changed to OP-903-068, "EDG and Subgroup

Relay Operability Verification," in November, 1991 which continued the requirement to close ACC-110 A&B prior to running the test.

On January 30, 1994, Condition Report (CR) 94-0072 documented that the ACCW system operating pressure was found to be greater than the piping design pressure while investigating lifting of relief valve ACC-121B (EIIS identifier BS-RV). Corrective action for CR-94-0072 required Operations to review their procedures to determine in which ones an ACCW pump can be started and provide guidance to ensure that the pump discharge isolation valves ACC-110A&B are closed prior to pump start. Procedures OP-903-115 and OP-903-116, "EDG/ESF Integrated Tests," were identified and changed in August, 1995 per CR-94-0072 to close the ACCW pumps discharge valves before testing.

CAUSAL FACTORS

Proceduralization of closing the ACCW pumps discharge valves, ACC-110 A&B, prior to ACCW pump starts in OP-903-094 as well as other procedures was originally intended to be a temporary measure to prevent unnecessary system transients until a permanent solution to prevent hydraulic transients could be developed. However, no documentation of any further action to develop a long-term solution can be found. No corrective action documents were apparently initiated. Only the corrective maintenance program and an engineering evaluation program were employed. The engineering evaluation (PEIR) did contain recommended actions to prevent recurrence, but was not a Corrective Action Program document and so no assignment or verification of corrective actions was apparently accomplished. Discussion with Systems Engineering personnel familiar with the 1986 transient event have revealed that some follow-up action was taken as recommended by the PEIR. Apparently a manometer was attached to the ACCW pumps discharge piping to monitor for column separation which would indicate back leakage through the pumps discharge check valves, ACC-108 A&B. Per the engineer's recollection, no indication of column separation was evident and the issue was not investigated any further.

In January and February, 1994, air was discovered in both trains of the ACCW system. Root Cause Investigation 94-003 attributed the root cause for air presence as inadequate venting after system maintenance. In January, 1995, air was again found in ACCW piping. Per CR-95-0059, this air was also attributed to inadequate removal of air following maintenance. When air was again found in both trains of ACCW in December, 1995, trends were performed which indicated air in-leakage in the train A outlet piping. Significant CR-95-1300 was written to address the discovery of air in the ACCW system. The root cause of the discovered air intrusion was attributed to the design of the ACCW system. The original design of the Waterford 3 ACCW system did not contain specific design features to prevent susceptibility to hydraulic transients upon pump starts following system idle periods.

In 1994, Repetitive Tasks were created to periodically monitor the ACCW system for air intrusion using ultrasonic testing. These tasks, however, were not performed in their specified intervals. The failure to perform these tasks is discussed in NRC Inspection Report 95-23 dated February 20, 1996.

CR-95-1329 was written as a result of the December 1995 event to document a potential corrective action program deficiency relating to inadequate identification of root cause and ineffective corrective actions from previous events. The root cause determination for this CR determined that the Root Cause Analysis and Corrective Action Plan approval process employs a narrow review cycle that is limited to specific department management and Quality Assurance. This method does not provide the desired synergistic effect that is gained in the front end of the CR process through the Condition Review Board.

Per discussion with plant operators, the closing of the ACC-110 valves prior to pump starts over the past years was not viewed as a necessary measure to ensure system operability during pump starts, but rather as a good practice to minimize potential system transients. The operators were aware of pump autostarts which had no impact on system operability. Thus the mindset of the operators was that this practice was acceptable and, therefore, it was not identified as a work around. Engineering has

developed a better understanding of water hammer over the past several years and has been aware of the susceptibilities of the ACCW system due to its design. However, the actions taken in 1994 and 1995 were narrowly focused in that they only corrected one mechanism of air intrusion (following maintenance), and failed to include a permanent solution to the susceptibilities presented by the ACCW system design.

IMMEDIATE CORRECTIVE MEASURES

Following the discovery of air intrusion into the ACCW Train A Heat Exchanger outlet piping and air pockets in the Train B Heat Exchanger inlet piping in December, 1995, a decision was made to operate the ACCW pumps continuously on minimum recirculation or greater flow as conditions allow to keep the system pressurized to preclude air intrusion or column separation until a permanent design solution is implemented. Engineering has determined that this action will have no negative impact on ACCW system performance. The pump and motor bearing temperatures and vibration are being closely monitored.

ACTIONS TO PREVENT RECURRENCE

Design Change DC-3470 has been initiated. This design change will evaluate a motor or air operator on the ACCW pump discharge valve, which will function to preclude excessive dynamic loads from air intrusion or column separation. This will preclude the requirement to manually close the discharge valve prior to starting an ACCW pump.

Design Engineering has reviewed other safety related fluid systems for (1) susceptibility to potentially damaging hydraulic transients caused by column separation and rejoining and (2) susceptibility to air intrusion due to vacuum conditions utilizing EPRI NP-6766, "Water Hammer Prevention, Mitigation and Accommodation" and NUREG -0582, "Water Hammer in Nuclear Power Plants" as guidance. Per this review other susceptible configurations were identified. These configurations, however, do not affect operability of the systems due to design/operating barriers in place. Further actions will be taken as deemed appropriate.

Root Cause Analyses and their associated corrective action plans for Significant Adverse Conditions and others, as deemed appropriate, will be presented to the Condition Review Board for approval. This added review barrier should provide additional assurance that root causes are adequately identified and corrective action plans are aggressive in preventing recurrence. Procedure UNT-006-011, "Condition Report," has been revised to delineate this requirement.

Quality Assurance will perform follow-up assessments to verify effectiveness of corrective actions for Significant CRs. Procedure UNT-006-011, "Condition Report," has been revised to delineate this requirement.

The Operations Department will complete a review of Operations Surveillance procedures to identify any proceduralized "work-arounds" and implement appropriate corrective actions.

The Operational Experience Engineering group will independently review all Operations Surveillance procedures to determine if any work arounds/preconditioning is present that could potentially mask system or component performance.

The Training Department will develop lesson plans on air intrusion and column separation based on Waterford 3 events and other industry reviews, such as NUREG-0582 and EPRI NP-6766, and include this training in the next round of Operations requalification and Engineering Support Personnel training. The Operations Requalification portion of this training will also include a review of the ACCW event in order to improve the identification of "work-arounds".

SAFETY SIGNIFICANCE

In its present design configuration, the ACCW system is susceptible to two distinct hydraulic transient phenomenon upon automatic pump start with significantly different consequences; air intrusion and column separation. While the hydraulic effects of air intrusion into an otherwise solid fluid system cannot be accurately modeled with hand calculations, as a general rule free or entrapped air is beneficial regarding water hammer or pressure surges in fluid systems because of its effect in cushioning shocks. Column separation and subsequent rejoining on the other hand, which can be modeled with hand calculations, can result in a substantial pressure pulse upon pump start when the water vapor bubble rapidly collapses, and is an identified mechanism for severe water hammer.

The ACCW system, while susceptible to column separation, has from all indications been experiencing, at least since 1994, air entrapment during idle periods. Air intrusion which was identified in the outlet piping of the ACCW Heat Exchanger did not affect the operability of the system. The ACCW system has been evaluated to remain operable with the outlet piping empty. No trends of air intrusion on the ACCW Heat Exchanger inlet piping have been identified. The small amounts of air which have been identified on the inlet piping can be attributed to maintenance and/or air coming out of solution at idle conditions. The ACCW system has been evaluated to remain operable for all identified air pockets on the inlet piping.

It is unclear as to what mechanism caused the ACCW system transient in 1986. Although the event was attributed to check valve back leakage, subsequent monitoring indicated that this was not occurring. In any case the ACCW system remained operable following this transient. Although ACCW system surveillances subsequent to this event did not show true system response to an automatic pump start , several automatic pump starts with the discharge valves open have been documented since that time. Automatic ACCW pump starts with the discharge valve open have been documented in 1989 (Train A), 1992 (Trains A&B), and twice in 1994 (Train B). Walkdowns of the system piping subsequent to these events revealed no damage to

the ACCW piping or its supports. This indicates that no significant column separation or air intrusion on the inlet piping was occurring. Based on the above, Waterford 3 has concluded that the ACCW system has remained capable of performing its safety function, despite design susceptibilities to hydraulic transients and the failure to remove those susceptibilities in a timely manner.

SIMILAR EVENTS

A review of LERs dating back to 1993 revealed several incidents of missed TS surveillances. This condition is different in that the surveillance was performed as required but was inadequate due to not meeting the full intent of the surveillance to confirm system operability. No similar events have been identified specific to not meeting the intent of a TS surveillance.