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Robert J. Murillo
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Waterford 3

W3F1-2010-0012

February 25, 2010

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

Subject: Licensee Event Report 2009-006-00
Waterford Steam Electric Station, Unit 3 (Waterford 3)
Docket No. 50-382
License No. NPF-38

Dear Sir or Madam:

Entergy is hereby submitting Licensee Event Report (LER) 2009-006-00 for Waterford Steam Electric Station Unit 3. This report provides details associated with the Main Feedwater Isolation Valves failing their timed stroke tests during Inservice Testing.

Based on these failures, it was determined that Waterford 3 operated in a condition prohibited by the Limiting Condition for Operation (LCO) delineated in Technical Specification 3.7.1.6, which requires that each Main Feedwater Isolation Valve (MFIV) shall be operable in modes 1 through 4. Additionally, it was determined that this condition could have prevented the fulfillment of a safety function that is needed to mitigate the consequences of an accident, and that a single cause led to the inoperability of two independent trains. The condition is reported herein as required by 10 CFR 50.73(a)(2)(i)(B), 10 CFR 50.73(a)(2)(v)(D), and 10 CFR 50.73(a)(2)(vii).

This report contains no new commitments. Please contact Robert J. Murillo at (504) 739-6715 if you have questions regarding this information.

Sincerely,

RJM/RJP

Attachment: Licensee Event Report 2009-006-00

IE22
NRR

cc: Mr. Elmo E. Collins, Jr.
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U. S. Nuclear Regulatory Commission
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R.K. West, lerevents@inpo.org - INPO Records Center

Attachment

W3F1-2010-0012

Licensee Event Report 2009-006-00

NRC FORM 366 U.S. NUCLEAR REGULATORY COMMISSION
(9-2007)

LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB NO. 3150-0104 EXPIRES 8/31/2010

Estimated burden per response to comply with this mandatory information collection request: 80 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.

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Waterford 3 Steam Electric Station	05000382	1 OF 6

4. TITLE

Degraded Hydraulic Fluid Causes Both Main Feedwater Isolation Valves to Fail Inservice Test Stroke

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									NA	05000
10	22	2009	2009	- 006 -	00	02	25	2010	FACILITY NAME NA	DOCKET NUMBER 05000

9. OPERATING MODE

5

10. POWER LEVEL

00

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

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

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Waterford 3 Steam Electric Station Robert J. Murillo	(504) 739-6715

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
E	SJ	VOP	A391	YES					

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE) ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

ABSTRACT

On 12/28/2009, it was established that inservice test (IST) failures that occurred on 10/22/2009 on both Main Feedwater Isolation Valves (MFIVs) had a common cause and could have prevented the fulfillment of the MFIVs safety function needed to mitigate the consequences of an accident. The plant operated in a condition prohibited by Technical Specification 3.7.1.6, which requires both MFIVs to be operable in Modes 1 through 4. Surveillance requirement 4.7.1.6 requires the closure time of less than or equal to 5 seconds.

Both MFIVs use hydraulic actuators, and each contains two separate hydraulic trains. An actuation signal results in both trains closing the valve. While in Mode 5 with Reactor Coolant System temperature and pressure at approximately 170 degrees F and 350 psia, IST testing using one of their hydraulic trains resulted in MFIV A closing in 12.6 seconds, and MFIV B failing to close. The maximum allowed stroke time for the IST is 7.56 seconds. The MFIV tests using their other hydraulic trains were satisfactory. The Apparent Cause Evaluation determined that moisture intrusion during a previous plant shutdown likely caused gel to form, restricting flow in the affected four way valves.

Corrective action included replacing the hydraulic fluid. Planned corrective action is to replace the hydraulic fluid prior to plant startup in which moisture could exist in the fluid.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Waterford 3 Steam Electric Station	05000382	2009	- 006 -	00	2 OF 6

NARRATIVE

REPORTABLE OCCURRENCE

This condition meets three reporting criteria:
10CFR50.73(a)(2)(i)(B),
10CFR50.73(a)(2)(v)(D), and
10CFR50.73(a)(2)(vii).

10CFR50.73(a)(2)(i)(B):
Waterford 3 operated in a condition prohibited by the limiting condition for operation (LCO) delineated in Technical Specification 3.7.1.6, which requires that each Main Feedwater Isolation Valve (MFIV) [SJ] shall be OPERABLE in MODES 1, 2, 3, and 4. The MFIVs were not recognized as inoperable in cycle 16. The requirement was not met to close and deactivate, or isolate the inoperable valve within 72 hours and verify inoperable valve closed and deactivated or isolated once every 7 days; otherwise, be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

10CFR50.73(a)(2)(v)(D):
A condition existed that could have prevented the fulfillment of a safety function of a system that is needed to mitigate the consequences of an accident. Specifically, the condition could have prevented the ability to isolate Main Feedwater flow to the Steam Generators within the time limit allowed by design.

10CFR50.73(a)(2)(vii):
A condition existed where single cause led to inoperability of two independent trains. Specifically, the M and M1 4-way valves for both the A MFIV and B MFIV respectively experienced moisture induced gelling of its Fyrquel hydraulic fluid. The M1 and M 4-way valves for both the A MFIV and B MFIV respectively functioned properly. This single cause resulted in a reasonable expectation that both trains of the MFIVs were not functional at some time during operating cycle 16.

The event date is 10/22/2009 based on failure of the MFIVs to successfully pass Inservice Testing performed on 10/22/2009. Following an evaluation of information provided in the associated condition report's apparent cause and additional information obtained from engineering, it was established on 12/28/2009 that the MFIVs did not meet their design closure time. The cause was due to gelling that likely occurred over a period of time during operating cycle 16. The 60 day report due date was determined to be 2/26/2010.

INITIAL CONDITIONS

During the period of inservice testing on the MFIVs, the plant was in cold shutdown (Mode 5) conducting refueling operations for refueling outage 16. Reactor Coolant System [AB] temperature was approximately 170 degrees F and Reactor Coolant System pressure was at approximately 350 psia. There was no requirement for the MFIVs to be operable in this plant condition. This plant condition did not contribute to this event. There were no other structures, systems, or components inoperable at the start of the event that contributed to the event.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Waterford 3 Steam Electric Station	05000382	2009	- 006 -	00	3 OF 6

NARRATIVE

INITIAL CONDITIONS (continued)

The main feed water isolation valves isolate main feedwater flow to the secondary side of the steam generators and isolate the non-safety related main feedwater supply from the safety-related portion of the system. The MFIVs close on receipt of a Main Steam Isolation Signal (MSIS), generated by either low steam generator pressure or high containment pressure. The MFIVs may also be actuated manually from the control room.

The MFIV hydraulic actuator consists of two systems: the pneumatic system and the hydraulic system. The pneumatic system supplies the motive force to operate the air motor of the hydraulic pump and supplies motive air to position the 4-way hydraulic valves that direct hydraulic fluid flow to the piston actuator and the hydraulic accumulators. Each MFIV train has a hydraulic reservoir with an associated pump providing hydraulic fluid to two in-parallel 4-way hydraulic valves (designated as 'M' and 'M1') that feed the MFIV's accumulators and valve actuator. The design of each MFIV valve operator requires both of its accumulators to supply the motive force needed to achieve its designed closure stroke time. That is, both the 'M' and 'M1' 4-way valves must function in order to have both accumulators operate simultaneously. Failure of any one 4-way valve results in an MFIV not able to achieve its design closure time.

The hydraulic fluid used in the MFIVs is Fyrquel 220 MLT. Water or moisture in this type of hydraulic fluid can undergo hydrolysis producing an acid which can result in gel formation. A desiccant breather cap is used to minimize moisture in the reservoirs.

When the valve is first opened for plant start up, the hydraulic fluid (Fyrquel) is drawn into the accumulator through the 'M' and 'M1' valves where it is locked in place by the 'M' and 'M1' valves. The fluid in the reservoirs is sampled on-line monthly and changed approximately every 3 months. However, the hydraulic fluid within each 4-way valve is trapped and not sampled or changed while on-line.

The plant was shutdown in preparation for Hurricane Gustav on 8/31/2008. The MFIVs were closed for this shut down, and the hydraulic fluid from the actuators was discharged to the reservoirs. During the hurricane force winds and rain, moisture intrusion likely occurred through the desiccant breather. Upon reopening of the MFIVs after several days, the hydraulic fluid (that was exposed to moisture) was drawn back into the accumulator through the 'M' and 'M1' 4-way valves. As noted above, the hydraulic fluid within each 4-way valve is trapped and is not sampled or changed while on-line. Thus, for approximately 13 months, Fyrquel with moisture was captured inside the 'M' and 'M1' 4-way valves, creating the conditions for gel formation within the 4-way valves which are actuated by the IST train A tests.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Waterford 3 Steam Electric Station	05000382	2009	- 006 -	00	4 OF 6

NARRATIVE

EVENT DESCRIPTION

While in Mode 5 on 10/22/2009 at approximately 19:45 hours, in-service testing determined valve FW-184A (Steam Generator No. 1 MFIV) [SJ] closed in 12.6 seconds using the A accumulator and hydraulic train. Inservice Tests (IST) are performed at no feedwater flow or pressure conditions with only one hydraulic train in service per procedure OP-903-033. The IST procedure limit is a maximum allowed closed stroke time of less than 6.6 seconds. The design analysis limit per Waterford 3 calculation EC-M00-006 is a maximum allowed closed stroke time of less than 7.56 seconds. The test used the "M" 4-way valve to close the valve. This was the initial as-found test of FW-184A using the A train test circuit.

At approximately 20:28 hours on 10/22/2009, FW-184A (Steam Generator No. 1 MFIV) was close stroke time tested per procedure OP-903-033 using the B accumulator and hydraulic train. The test used the "M1" 4-way valve to close the valve. The valve closed in 6.4 seconds. This was the initial as-found test of FW-184A using the B train test circuit.

At approximately 21:40 hours on 10/22/2009, FW-184B (Steam Generator No. 2 MFIV) was stroke time tested per OP-903-033 using the B accumulator and hydraulic train. The test used the "M1" 4-way valve to close the valve. The valve did not move off the full open position (did not stroke closed). This was the initial as-found test of FW-184B using the A train test circuit.

At approximately 21:48 hours on 10/22/2009, FW-184B (Steam Generator No. 2 MFIV) was stroke time tested per OP-903-033 using the A accumulator and hydraulic train. The test used the "M" 4-way valve to close the valve. The valve closed in 6.7 seconds, which did not meet the procedure acceptance criteria but was within the design analysis limit of 7.56 seconds. This was the initial as-found test of FW-184B using the B train test circuit.

It is a reasonable expectation that the MFIVs could have failed to meet their required stroke times during design basis conditions based on the IST train A closure stroke times.

The last successful test of MFIV closure was completed when the plant was shutdown in Refueling Outage 15 on April 29, 2008.

When discovered, this event did not affect the systems needed to remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident. The systems needed to maintain Mode 5 were available and operating as required by plant conditions and the Technical Specifications.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Waterford 3 Steam Electric Station	05000382	2009	- 006 -	00	5 OF 6

NARRATIVE

CAUSAL FACTORS

The cause analysis determined the most probable cause is that the four way hydraulic valve was sluggish during the first stroke due to gelled hydraulic fluid that developed over time. When sitting static, Fyrquel fluid has a known history of gelling. This localized gelling caused the four way hydraulic 'M' and 'M1' valves on the 'A' and 'B' MFIVs respectively to have sluggish operation. This sluggish operation delayed the porting of fluid to the main hydraulic piston to cause a delay on the MFIV A and failure to stroke on the MFIV B.

A contributing cause was that plant processes did not direct replacement of the hydraulic fluid during outages that did not involve a refueling outage.

CORRECTIVE ACTIONS

During maintenance on MFIV A, the valve hydraulic fluid was replaced, the valve hydraulic components were flushed, and the valve was successfully stroked.

The entire hydraulic actuator on MFIV B was replaced. The hydraulic fluid was replaced during the refueling outage as part of a preplanned replacement of the actuator.

Planned corrective action is to revise the preventative maintenance task to replace the hydraulic fluid in MFIV A and MFIV B with new oil prior to plant startup (including forced outages) in which moisture could exist in the reservoir or actuator to ensure oil is not in a degraded condition.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Waterford 3 Steam Electric Station	05000382	2009	- 006 -	00	6 OF 6

NARRATIVE

SAFETY SIGNIFICANCE

The as found condition supports that the MFIVs would have closed upon demand at a rate slower than called for in their design. The risk associated with the 10/22/09 failure of the MFIVs (FW-184A and FW-184B) [SJ] to meet their OP-903-033 stroke time requirements for maximum closing time was bounded by a conservative risk assessment using the current Waterford 3 PSA model. Since in one of the MFIV tests (FW-184B with the ESFAS-A test circuit) the valve did not close at all, and there was a hydraulic fluid problem common to both valves, it was conservatively assumed in the risk assessment that both MFIVs failed to close. Failure to close of the MFIVs does not adversely affect the core damage risk, since availability of feedwater (i.e., the valves being open) maintains decay heat removal and contributes to prevention of core damage; the potential risk impact of failure to close of the MFIVs is in terms of failure to isolate in a core damage sequence, measured by the Large Early Release Frequency (LERF). The impact of MFIV closure on large early release risk was assessed by modeling a feedwater line break with failure of the feedwater line to isolate. In order for a large release from containment following a core damage event to occur through the ruptured feedwater line, failure of the MFIV to close would require, in addition, failure to close of the upstream check valve (FW-181A or B) and failure to close of either the main feedwater regulating valve (FW-173A or B) or the startup feedwater regulating valve (FW-166A or B). The probability of these failures was estimated using the W3 PSA model and combined with the CDF for a feedwater line break. The large early release risk impact (change in large early release frequency, delta-LERF) for both MFIVs failing to close was estimated to be an increase of 3.8E-14 per reactor year, which is very small (the generally accepted LERF threshold for risk significance is 1E-7; see for example Regulatory Guide 1.174.). Therefore, since the LERF increase was estimated to be extremely small, there is no risk significance to the condition of the MFIVs failing to meet their OP-903-033 stroke time requirements for maximum closing time.

There were no safety consequences due to this occurrence. When discovered, this event did not affect the systems needed to remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident. The systems needed to maintain Mode 5 were available and operating as required by plant conditions and the Technical Specifications. The main feedwater regulating valves (FW-173A and B) and the startup feedwater regulating valves (FW-166A and B) are credited as backups to the MFIVs upon a failure of its associated MFIV to close. These backup valves also close on receipt of an MSIS and were available to provide the backup function. Thus, if a design basis accident would have occurred, redundant equipment was available to meet the design function.

SIMILAR EVENTS

There have been no previous, similar events associated with IST failure of the MFIVs due to degradation of the hydraulic fluid.

ADDITIONAL INFORMATION

Energy industry identification system (EIIS) codes are identified in the text within brackets [ ].