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10 CFR 50.73

W3F1-2012-0022

April 13, 2012

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

Subject: Licensee Event Report 2012-002-00  
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) 2012-002-00 for Waterford Steam Electric Station Unit 3. This report provides details associated with a failed valve actuator diaphragm causing component inoperability for a period greater than allowed by the Technical Specification action.

Based on plant evaluation, it was determined that this condition is reportable under 10 CFR 50.73(a)(2)(i)(B) requirements.

This report contains no new commitments. Please contact William J. Steelman at (504) 739-6685 if you have questions regarding this information.

Sincerely,

A handwritten signature in black ink, appearing to be "DJ/WH", written over the printed name.

DJ/WH

Attachment: Licensee Event Report 2012-002-00

IE22  
NRR

cc:	Mr. Elmo E. Collins, Jr. Regional Administrator U. S. Nuclear Regulatory Commission Region IV 1600 E. Lamar Blvd. Arlington, TX 76011-4511	RidsRgn4MailCenter@nrc.gov
	NRC Senior Resident Inspector Waterford Steam Electric Station Unit 3 P.O. Box 822 Killona, LA 70066-0751	Marlone.Davis@nrc.gov Dean.Overland@nrc.gov
	U. S. Nuclear Regulatory Commission Attn: Mr. N. Kalyanam Mail Stop O-07D1 Washington, DC 20555-0001	Kaly.Kalyanam@nrc.gov
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**Attachment to**  
**W3F1-2012-0022**  
**Licensee Event Report 2012-002-00**

<b>NRC FORM 366</b> <b>U.S. NUCLEAR REGULATORY COMMISSION</b> (10-2010)					<b>APPROVED BY OMB NO. 3150-0104</b> <b>EXPIRES 10/31/2013</b>														
<b>LICENSEE EVENT REPORT (LER)</b> (See reverse for required number of digits/characters for each block)										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 FOIA/Privacy Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resource@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 an 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					05000 382					1 OF 6									
4. TITLE																			
Failed Valve Actuator Diaphragm Causes Inoperability Greater Than Allowed by TS LCO Action																			
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							
02	16	2012	2012	- 002 -	00	04	13	2012	FACILITY NAME			DOCKET NUMBER							
												05000							
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9. OPERATING MODE			11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)																
1			<input type="checkbox"/> 20.2201(b)				<input type="checkbox"/> 20.2203(a)(3)(i)				<input type="checkbox"/> 50.73(a)(2)(i)(C)				<input type="checkbox"/> 50.73(a)(2)(vii)				
			<input type="checkbox"/> 20.2201(d)				<input type="checkbox"/> 20.2203(a)(3)(ii)				<input type="checkbox"/> 50.73(a)(2)(ii)(A)				<input type="checkbox"/> 50.73(a)(2)(viii)(A)				
			<input type="checkbox"/> 20.2203(a)(1)				<input type="checkbox"/> 20.2203(a)(4)				<input type="checkbox"/> 50.73(a)(2)(ii)(B)				<input type="checkbox"/> 50.73(a)(2)(viii)(B)				
			<input type="checkbox"/> 20.2203(a)(2)(i)				<input type="checkbox"/> 50.36(c)(1)(i)(A)				<input type="checkbox"/> 50.73(a)(2)(iii)				<input type="checkbox"/> 50.73(a)(2)(ix)(A)				
			<input type="checkbox"/> 20.2203(a)(2)(ii)				<input type="checkbox"/> 50.36(c)(1)(ii)(A)				<input type="checkbox"/> 50.73(a)(2)(iv)(A)				<input type="checkbox"/> 50.73(a)(2)(x)				
			<input type="checkbox"/> 20.2203(a)(2)(iii)				<input type="checkbox"/> 50.36(c)(2)				<input type="checkbox"/> 50.73(a)(2)(v)(A)				<input type="checkbox"/> 73.71(a)(4)				
100			<input type="checkbox"/> 20.2203(a)(2)(iv)				<input type="checkbox"/> 50.46(a)(3)(ii)				<input type="checkbox"/> 50.73(a)(2)(v)(B)				<input type="checkbox"/> 73.71(a)(5)				
			<input type="checkbox"/> 20.2203(a)(2)(v)				<input type="checkbox"/> 50.73(a)(2)(i)(A)				<input type="checkbox"/> 50.73(a)(2)(v)(C)				<input type="checkbox"/> OTHER				
			<input type="checkbox"/> 20.2203(a)(2)(vi)				<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)				<input type="checkbox"/> 50.73(a)(2)(v)(D)				Specify in Abstract below or in NRC Form 366A				
12. LICENSEE CONTACT FOR THIS LER																			
FACILITY NAME										TELEPHONE NUMBER (Include Area Code)									
Waterford 3 Steam Electric Station William Steelman										(504) 739-6685									
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										
B	BA	FCV	M120	N															
14. SUPPLEMENTAL REPORT EXPECTED										15. EXPECTED SUBMISSION DATE									
<input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO										MONTH    DAY    YEAR									
<b>ABSTRACT</b> (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)																			
<p>During a scheduled surveillance per procedure STA-001-005 (Leakage Testing of Air and Nitrogen Accumulators for Safety Related Valves) for the nitrogen accumulator system, an accumulator as-found leak rate exceeded the acceptance criteria. Subsequent investigation determined that the cause of the leakage was an emergency feedwater valve failed actuator diaphragm. This failure could have existed prior to discovery for a duration longer than the Technical Specification Limiting Condition for Operation action statement allows. The applicable Technical Specifications are 3.6.3 (Containment Isolation), 3.7.1.2 (Emergency Feedwater), and 3.7.1.7 (Atmospheric Dump Valves).</p> <p>The failed diaphragm was replaced and system operability restored within 72 hours after discovery.</p> <p>This identified condition is being reported as a Licensee Event Report (LER) under reporting criteria 10CFR50.73(a)(2)(i)(B): Any operation or condition which was prohibited by the plant's Technical Specifications.</p>																			

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## NARRATIVE

## REPORTABLE OCCURRENCE

On 02/16/2012 during a scheduled surveillance per procedure STA-001-005 (Leakage Testing of Air and Nitrogen Accumulators for Safety Related Valves) for the nitrogen accumulator system, an accumulator as-found leak rate exceeded the acceptance criteria. Subsequent investigation determined that the cause of the leakage was an emergency feedwater valve failed actuator diaphragm. This failure could have existed prior to discovery for a duration longer than the Technical Specification Limiting Condition for Operation action statement allows. The applicable Technical Specifications are 3.6.3 (Containment Isolation), 3.7.1.2 (Emergency Feedwater), and 3.7.1.7 (Atmospheric Dump Valves).

This identified condition is being reported as a Licensee Event Report (LER) under reporting criteria 10CFR50.73(a)(2)(i)(B): Any operation or condition which was prohibited by the plant's Technical Specifications.

## INITIAL CONDITIONS

During this time period, Waterford Steam Electric Station Unit 3 (W3) was operating in Mode 1, stable at or near 100% power. The Emergency Feedwater (EFW) system was aligned for normal operations with no plant protection system actuation signals present.

## EVENT DESCRIPTION

On 02/16/2012, Operations commenced scheduled periodic testing per procedure STA-001-005 (Leakage Testing of Air and Nitrogen Accumulators for Safety Related Valves) for Nitrogen Accumulator VIII/X (NG MACC0008 and NG MACC0010). The as-found leak rate of 88.62 psid/hr exceeded the acceptance criteria of  $\leq 55$  psid/hr (operational limit). Operations proceeded with troubleshooting, in accordance with STA-001-005, to determine which component or components attached to the accumulator were contributing to the high leak rate. Operations isolated valve EFW-223B and the leakage substantially lowered to approximately 16.4 psid/hr. Four components were declared inoperable due to Nitrogen Accumulator VIII/X failing STA-001-005 acceptance criteria; EFW-223B (EFW Hdr B To SG2 Backup Flow Cntrl), EFW-228B (EFW To SG2 Primary Isolation), MS-116B (Operator for SG2 MS Atm Dump Vlv), and NG MACC0008 (Nitrogen Accumulator #8). The plant entered TS 3.6.3, 3.7.1.2, and 3.7.1.7 actions (CR-WF3-2012-00860).

On disassembly of the valve actuator for EFW-223B, engineering and maintenance personnel determined that the diaphragm internal to the valve actuator had a 1.5 inch tear along the lateral (folded) portion of the diaphragm which was the cause of the excessive leakage found during the accumulator drop test. The failed diaphragm had been originally procured as a commercial item and upgraded through the site commercial grade evaluation program.

While examining the effect of the event on the past operability of the affected components and systems, it became apparent that previous scheduled performances of valve Inservice Testing (IST) for EFW-223B contained indications of stroke time anomalies that would be explained by the presence of a leaking actuator valve diaphragm. The earliest documented IST performance that could have been affected occurred on 9/12/2011.

This reported condition is entered into the site corrective action program as CR-WF3-2012-00860.

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## System and Component Design

The EFW system consists of three pumps which take a common suction from the Condensate Storage Pool, discharge to a common header, and supply water to either of two Steam Generators (SGs) [HX] through redundant flow control and isolation valves. EFW Pumps A and B are 50% capacity motor driven pumps. EFW Pump AB is a 100% capacity steam turbine driven pump. All three EFW pumps automatically start on Emergency Feedwater Actuation Signal (EFAS) and act, along with flow control and isolation valves, to automatically maintain water level in the non-faulted SGs to provide an adequate heat sink for residual heat removal post-trip. The system remains in standby unless actuated in response to a loss of Main Feedwater to the SGs.

Each SG receives EFW flow via two parallel paths, each path consisting of a flow control valve and isolation valve in series. On one path, the flow control valve is Train A powered and the isolation valve is Train B powered. The other (parallel path) valves to the same SG are oppositely powered. All are air to close, spring open (fail open) valves. This design ensures that, regardless of the postulated single failure, the ability to feed a non-faulted SG or isolate a faulted SG remains. The valves can be operated locally using the manual handwheels.

Nitrogen Accumulator VIII/X provides a safety-related, backup pneumatic supply to allow operation of EFW-223B, EFW-228B, and MS-116B during a loss of Instrument Air (IA) [LD] supply. Accumulators VIII and X are connected in parallel to increase the capacity for their associated valve supply headers. The nitrogen accumulator is connected to the valve supply header through a solenoid-operated isolation valve (SOV) and a pressure control valve (PCV). The header is normally supplied by the IA system via a check valve. Lowering air header pressure automatically aligns the nitrogen accumulator for service. Nitrogen Accumulator VIII/X is credited and tested to provide a minimum 10-hour supply of nitrogen gas.

The valve with the failed actuator diaphragm, EFW-223B, is a 4-inch Masoneilan Air Operated Valve (AOV) model number 47-40512 Sigma-F consisting of a globe valve and a diaphragm actuator. EFW-223B is air-to-close, spring-to-open (fail open) and is externally provided with a backup nitrogen supply via a safety related accumulator. The actuator accessories include a Fisher 67FR filter regulator, a Masoneilan 8012-3C I/P transducer, and a Moore 61H volume booster.

EFW-228B is a 4-inch, Masoneilan Air Operated Valve (AOV) model number 47-40411 Sigma-F consisting of a globe valve and a diaphragm actuator. EFW-228B is air-to-close, spring-to-open (fail open) and is externally provided with a backup nitrogen supply via a safety related accumulator. Operation is either fully open or fully closed. As a primary EFW isolation valve, EFW-228B is required to open on an EFAS (Emergency Feedwater Actuation Signal).

MS-116B (SG 2 Atmosphere Dump Valve) was rendered inoperable by the inoperability of Accumulator VIII/X. By design, there is one SG atmosphere dump valve per SG, located upstream of the associated main steam isolation valve. The valves are air operated, spring close valves with stacked disc flow control elements. These valves are required to maintain Reactor Coolant system (RCS) temperature during loss of offsite power. When reactor thermal power exceeds 70%, automatic operation of the atmospheric dump valves (ADVs) is credited in addition to the high pressure safety injection pumps in mitigating a small break LOCA under the worst case single failure conditions. One hour is the maximum time that the ADVs are required to function in the automatic mode following a LOCA since

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the operator will take manual action before one hour to initiate a controlled RCS cooldown. Local manual operating capability is required to maintain plant in safe shutdown following a cable vault and control room fire.

## CAUSAL FACTORS

An apparent cause evaluation was performed. The following causes were determined:

- The diaphragm internal to the valve actuator for EFW-223B had a 1.5 inch tear along the lateral portion of the diaphragm which was the cause of the excessive leakage found during accumulator drop testing. The apparent cause evaluation attributes the cause of the tear as a manufacturing defect of the commercial grade diaphragm.
- Vendor and technical manual troubleshooting instructions did not address diaphragm failure as a likely cause, influencing failure analysis efforts.
- Maintenance practices allowed adjustment of actuator volume boosters without verifying that no diaphragm leakage exists.

## EXTENT OF CONDITION

An Extent of Condition (EOC) was performed for the apparent cause evaluation by reviewing all actuators with the same type, make, and model diaphragm as installed in EFW-223B. IST stroke time trends and nitrogen accumulator pressure drop tests were evaluated with no adverse trends identified. Engineering performed a walkdown for all accessible valve actuators and found the indications identified for EFW-223B were not apparent. All diaphragms from the same purchase order that included the failed EFW-223B diaphragm have been removed from the warehouse. The only diaphragm still in service is installed in EFW-223A.

## CORRECTIVE ACTIONS

The apparent cause evaluation listed the following corrective actions:

- Site maintenance personnel replaced the actuator diaphragm for EFW-223B (completed).
- IST trends for valves identified during the extent of condition evaluation were reviewed. No other adverse trends were identified (completed).
- Engineering conducted walkdowns of remaining applicable EFW valves (completed).
- Instructions were added to receipt inspection guidance for diaphragms (completed).
- Inspected all similar diaphragms in warehouse for surface cracks and tears. No other issues identified (completed).
- Revise Air Operated Valve (AOV) Program to include post maintenance test requirements for volume booster, needle valve, or metering valve adjustment. This is to ensure that other potential leakage sources are not masked (tracked by corrective action).
- Replace the diaphragm in EFW-223A and provide the diaphragm to engineering for analysis (tracked by corrective action).

## SAFETY SIGNIFICANCE

The apparent cause evaluation determined the risk significance of the diaphragm failure of EFW-223B.

The major assumptions in this risk assessment are as follows:

- 1) The EFW-223B diaphragm failure will also affect EFW-228B and MS-116B since all three of these valves are operated using Nitrogen Accumulator VIII/X.

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- 2) EFW-223B and EFW-228B can be operated manually with or without air.
- 3) EFW-223B and EFW-228B fail open on loss of air. MS-116B may fail as-is or closed on loss of air (IA and nitrogen backup).
- 4) EFW-223B had acceptable test results on June 17, 2011.

## Other evaluation inputs:

- 1) Over the analyzed time period, the opposite train valve MS-116A (SG 1 Atmospheric Dump Valve) was out of service for a total duration of 1 hour and 45 minutes. This was spread over 3 planned surveillance activities and never exceeded the TS allowed outage time.
- 2) This evaluation did not directly consider the impacts of EFW Primary and Back-Up lines to SG #1 being out of service. The evaluation bounds this condition as it utilizes a standard equipment failure and maintenance probability and the most limiting failure would be Nitrogen Accumulator V/IX. Based on this most limiting failure, the supply or isolation of EFW to SG #1 is not impacted based on system design.

The base risk (CDF or core damage frequency) for this evaluation is  $4.398\text{E-}06/\text{yr}$  using the Waterford 3 baseline cutset file with truncation limit set at E-13. The base risk includes all of the average maintenance and failure probabilities.

The EFW valve function of concern is the closure for SG isolation to prevent feeding a faulted SG #2. There are redundant valves in the line (EFW-229B and EFW-224B) that perform the same function, which results in low risk significance. These valve failures (EFW-223B and EFW-228B transfer open) are below the E-13 truncation limit and therefore the change in CDF due to these valve failures is less than  $1\text{E-}13/\text{yr}$ . Any maintenance on the redundant valves would involve manual closure of the valves and the maintenance evolution would reduce risk during a SG isolation event.

MS-116B valve failure is evaluated for risk by setting its failure events to true in the cutset file. The resulting CDF is  $4.482\text{E-}06/\text{yr}$ , and the delta-CDF is  $8.4\text{E-}08/\text{yr}$  ( $4.482\text{E-}06/\text{yr} - 4.398\text{E-}06/\text{yr}$ ).

On 2/17/2012, the valves and associated nitrogen accumulator were declared operable after EFW-223B was repaired and the accumulator passed its specified drop test. The meantime of interest is approximately 4 months (one-half the overall time of 8 months (6/17/11 through 2/17/12)). Thus, the ICCDP (incremental conditional core damage probability) is  $8.4\text{E-}08/\text{yr} \times (4 \text{ mo} / 12 \text{ mo} / \text{yr}) = 2.8\text{E-}08$ .

During the eight-month period of MS-116B being potentially inoperable, maintenance on the opposite train valve, MS-116A, was performed for a total duration of 1.75 hours while in Modes 1 through 4. The increase in delta risk during this evolution was evaluated and the resulting ICCDP was  $3.4\text{E-}11$ , which is insignificant.

The risk significance of the diaphragm failure on EFW-223B is considered low as defined in RG 1.174.

## SIMILAR EVENTS

Corrective action program data for past three years was searched for relevant diaphragm failures. The following condition reports documented diaphragm leakage problems which affected valve stroke timing on safety related equipment:



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CR-WF3-2010-02293 (04/12/2010) – (Waterford 3) Following a planned Blowdown (BD) [WI] system outage, BD-103B, S/G 2 BD Outside Containment Isolation, failed to go OPEN when trying to restore BD flow to SG 2. No maintenance was performed on BD-103B. The Apparent Cause Evaluation (CR-WF3-2011-03743) identified that the internal diaphragm stem nut was not being torqued to 100 ft-lbs as required by the technical manual, causing a leakage path past the diaphragm.

CR-WF3-2011-03743 (05/22/2011) – (Waterford 3) On 5/22/2011 it was noted that BD-103B (SG 2 BD Outside Containment Isolation) was indicating intermediate (this valve was noted as indicating full open at the beginning of the shift and no actions were taken to affect the position of this valve). Further investigation revealed that air leakage of the diaphragm mating surface on the valve actuator caused the valve to drift approximately a quarter of an inch in the closed direction.

**ADDITIONAL INFORMATION**

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