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John P. Jarrell III  
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Waterford 3

W3F1-2016-0083

10 CFR 50.73

November 30, 2016

U.S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
11555 Rockville Pike  
Rockville, MD 20852

Subject: Licensee Event Report (LER) 2016-002-01, Both Trains of Essential Services  
Chilled Water Inoperable due to Failing to Maintain Exiting Chilled Water  
Temperature in Specification Resulting in Event or Condition that Could Have  
Prevented Fulfillment of a Safety Function  
Waterford Steam Electric Station, Unit 3 (Waterford 3)  
Docket No. 50-382  
License No. NPF-38

Dear Sir or Madam:

Pursuant to 10 CFR 50.73, Entergy is hereby submitting supplemental LER 2016-002-01 for an event that occurred at Waterford 3 on August 12, 2016.

It was determined that this condition is reportable pursuant to 10 CFR 50.73(a)(2)(v)(D), "Event or Condition that Could Have Prevented Fulfillment of a Safety Function of Structures or Systems that are Needed to (D) Mitigate the Consequences of an Accident." This revision provides updates to the corrective actions and the results of the Apparent Cause Evaluation and Safety Significance Determination that was not complete when LER 2016-002-00 was submitted.

This report contains no new commitments. Please contact John P. Jarrell, Regulatory Assurance Manager, at (504) 739-6685 if you have questions regarding this information.

Sincerely,

A handwritten signature in black ink, appearing to be "JPJ/MMZ", written over a large, stylized, cursive signature that is mostly illegible.

JPJ/MMZ

Attachment: LER 2016-002-01

cc: Mr. Kriss Kennedy, Regional Administrator  
U.S. NRC, Region IV  
RidsRgn4MailCenter@nrc.gov

U.S. NRC Project Manager for Waterford 3  
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U.S. NRC Senior Resident Inspector for Waterford 3  
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**Attachment  
to  
W3F1-2016-0083  
Licensee Event Report 2016-002-01  
(4 pages)**

**LICENSEE EVENT REPORT (LER)**

(See Page 2 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form  
<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/>)

Estimated burden per response to comply with this mandatory 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 and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to [Infocollections.Resource@nrc.gov](mailto:Infocollections.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**

Waterford Steam Electric Station, Unit 3

**2. DOCKET NUMBER**

05000-382

**3. PAGE**

1 OF 4

**4. TITLE**

Both Trains of Essential Services Chilled Water Inoperable due to Failing to Maintain Exiting Chilled Water Temperature in Specification Resulting in Event or Condition that Could Have Prevented Fulfillment of a Safety Function

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
08	12	2016	2016	002	01	11	30	2016	FACILITY NAME	DOCKET NUMBER
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)(ii)(A)	
			<input type="checkbox"/> 20.2201(d)			<input type="checkbox"/> 20.2203(a)(3)(ii)			<input type="checkbox"/> 50.73(a)(2)(ii)(B)	
			<input type="checkbox"/> 20.2203(a)(1)			<input type="checkbox"/> 20.2203(a)(4)			<input type="checkbox"/> 50.73(a)(2)(iii)	
			<input type="checkbox"/> 20.2203(a)(2)(i)			<input type="checkbox"/> 50.36(c)(1)(i)(A)			<input type="checkbox"/> 50.73(a)(2)(iv)(A)	
10. POWER LEVEL			<input type="checkbox"/> 20.2203(a)(2)(ii)			<input type="checkbox"/> 50.36(c)(1)(ii)(A)			<input type="checkbox"/> 50.73(a)(2)(v)(A)	
			<input type="checkbox"/> 20.2203(a)(2)(iii)			<input type="checkbox"/> 50.36(c)(2)			<input type="checkbox"/> 50.73(a)(2)(v)(B)	
			<input type="checkbox"/> 20.2203(a)(2)(iv)			<input type="checkbox"/> 50.46(a)(3)(ii)			<input type="checkbox"/> 50.73(a)(2)(v)(C)	
			<input type="checkbox"/> 20.2203(a)(2)(v)			<input type="checkbox"/> 50.73(a)(2)(i)(A)			<input checked="" type="checkbox"/> 50.73(a)(2)(v)(D)	
			<input type="checkbox"/> 20.2203(a)(2)(vi)			<input type="checkbox"/> 50.73(a)(2)(i)(B)			<input type="checkbox"/> 50.73(a)(2)(vii)	
						<input type="checkbox"/> 50.73(a)(2)(i)(C)			<input type="checkbox"/> OTHER Specify in Abstract below or in NRC Form 366A	

**12. LICENSEE CONTACT FOR THIS LER**

LICENSEE CONTACT

John Jarrell

TELEPHONE NUMBER (Include Area Code)

(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
E	CHU	IMOD	C150	Y					

**14. SUPPLEMENTAL REPORT EXPECTED**☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE) ☒ NO**15. EXPECTED SUBMISSION DATE**

MONTH	DAY	YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On August 12, 2016, at 1704 CDT, the shift operating crew noted that Essential Chiller B outlet temperature exceeded the allowed maximum Technical Specification (TS) Surveillance Requirement (SR) 4.7.12.1.b limit of 42 degrees Fahrenheit (deg F) and Essential Services Chilled Water Loop B (Loop B) was declared inoperable. Essential Services Chilled Water Loop A (Loop A) had previously been declared inoperable on August 11, 2016. The shift operating crew entered TS 3.0.3 due to both trains of Essential Services Chilled Water being inoperable. Essential Chiller AB was subsequently aligned to Loop B and TS 3.0.3 was exited on August 12, 2016, at 1802, when outlet temperature was verified to be less than or equal to 42 deg F.

The Essential Chiller A elevated temperature was due to a failed capacity control module. The apparent cause was inadequate preventative maintenance (PM) strategy. Corrective action to replace the module and return Essential Chiller A to service is complete. In addition, the PM to replace the module will be performed more frequently. The Essential Chiller B elevated chilled water temperature was due to incorrect guide vane setup. The incorrect setup resulted in adjusting the thermostat too high. The high thermostat setting prevented the chiller from maintaining outlet temperature less than 42 deg F following a large demand increase. The apparent cause was that inadequate guidance exists for guide vane actuator linkage setup. Corrective actions to properly set up the linkage, set the thermostat, return Essential Chiller B to service, develop actuator installation instructions, and revise post-maintenance tests are complete. Additional actions include establishing new maintenance and troubleshooting procedures.

**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

(See NUREG-1022, R.3 for instruction and guidance for completing this form  
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		YEAR	SEQUENTIAL NUMBER	REV NO.
Waterford Steam Electric Station, Unit 3	05000-382	2016	- 002	- 01

**NARRATIVE****INITIAL CONDITIONS**

Waterford 3 was in Mode 1 at approximately 100% power. Essential Services Chilled Water Loop A had previously been declared inoperable on August 11, 2016. There were no other structures, components, or systems inoperable at the start of this event that contributed to this event.

**SYSTEM DESCRIPTION**

The Essential Services Chilled Water System is a safety-related system which provides chilled water flow to cooling coils [CL] of the air handling units [AHU] which provide cooling for the essential equipment rooms and main control room during normal operation and operation following a design basis accident. The system is designed to supply less than or equal to 42 deg F chilled water at a flow rate of greater than or equal to 500 gpm to the air handling systems during design basis accident conditions. The system consists of three 100 percent capacity subsystems (Essential Chillers A, B, and AB) each consisting of one water chiller [CHU], one chilled water pump [P], one chilled water expansion tank [TK] with level control [LC] actuated makeup, and instrumentation and controls, piping and valves. These subsystems are piped such that chilled water is circulated from any two of the subsystems through two loops (Loop A and Loop B) which serve equipment in various parts of the Reactor Auxiliary Building. Two subsystems are required to be operable to provide redundancy to ensure that the system functions to remove post-accident heat loads, assuming the worst case single failure.

**EVENT DESCRIPTION**

On April 10, 2016, Essential Chiller B was removed from service for a scheduled chiller outage. During this outage, the guide vane actuator [FCO] was replaced. During post-maintenance testing, Essential Chiller B was repeatedly tripping on low refrigerant pressure. Following efforts to correct this problem (which included making an adjustment to the guide vane linkage), the chiller ran acceptably and was returned to operable on April 22, 2016. On May 4, 2016, the hot gas bypass valve [V] began cycling. In addition, chilled water outlet temperature was low for the period from April 10, 2016 through August 11, 2016. On two separate occasions, at the request of engineering, operations attempted to raise the outlet water temperature by adjusting the thermostat. These adjustments were not successful in raising outlet temperature, nor in reducing hot gas bypass valve cycling.

On August 11, 2016, at 1130 CDT, Essential Chiller A outlet temperature exceeded 42 deg F; temperature continued to oscillate between 42-46 deg F for the next 10 hours. At 2115, Loop A was declared inoperable due to the outlet temperature exceeding the TS SR 4.7.12.1.b limit of 42 deg F. TS 3.7.12 was entered. This required that with only one essential services chilled water loop OPERABLE, restore two loops to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

Switchgear A [SWGR] ventilation [AHU] loads were subsequently transferred to Loop B. Essential Chiller B, which was supplying cooling to Loop B, was slow to respond to this additional load. On August 12, 2016, at 1704 CDT, the shift operating crew noted that Essential Chiller B outlet temperature exceeded the allowed maximum TS SR 4.7.12.1.b limit of 42 deg F. The shift operating crew entered TS 3.0.3 due to both trains of Essential Services Chilled Water being inoperable. For this condition, TS 3.0.3 required that when a limiting condition for operation is not met, except as provided in the associated ACTION requirements, within 1 hour, action shall be initiated to place the unit in a MODE in which the specification does not apply by placing it in at least COLD SHUTDOWN within the next 24 hours.

The amount of time that Loops A and B were both inoperable was 58 minutes. Prior to exceeding the allowed outage time, Essential Chiller AB was aligned to Loop B and TS 3.0.3 was exited on August 12, 2016, at 1802, when outlet temperature was verified to be less than or equal to 42 deg F.

Troubleshooting performed on Essential Chiller A determined that the capacity control module was the cause of the elevated chilled water temperature. Following replacement and calibration, Loop A was returned to service on August 12, 2016, at 2300, and TS 3.7.12 was exited. Resistance readings taken across the removed capacity control module's thermostat potentiometer

**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

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**NARRATIVE**

revealed infinite resistance at several locations and subsequent testing identified several dead spots. The module had been in service since October 17, 2005. It is located in an area with elevated temperature and humidity.

Extensive troubleshooting performed on Essential Chiller B identified that the as found configuration of the guide vanes was such that when at the minimum (closed) actuator position, the guide vanes were approximately 5% open. This partially open guide vane provided additional cooling, resulting in a low outlet temperature with a high thermostat setting. The linkage and actuator arm were adjusted to ensure full guide vane closure and the set screws were tightened.

**REPORTABLE OCCURRENCE**

This event is reportable pursuant to 10 CFR 50.73(a)(2)(v)(D), "Event or Condition that Could Have Prevented Fulfillment of a Safety Function of Structures or Systems that are Needed to (D) Mitigate the Consequences of an Accident" due to both Essential Services Chilled Water Loops being inoperable.

**PREVIOUS OCCURRENCES**

A review of Waterford 3's corrective action program and LERs for previous similar events was performed. The following were identified:

CR-WF3-1997-2698: Essential Chiller A chilled water outlet temperature was discovered to be above 42 deg F. Local observation revealed that the compressor inlet vanes [CDMP] would not change position in automatic or manual. Loop A was declared inoperable. The cause was due to a failure of the guide vane actuator. The actuator was replaced. It was also identified that there was no PM strategy for the capacity control modules and therefore new replacement tasks were added at 12 year intervals.

CR-WF3-2005-3270: Essential Chiller AB chilled water outlet temperature was noted to be 48 deg F. Readings indicated oscillating voltage, which was ascribed to a failed part within the capacity control module. The task frequency for capacity control module replacement was changed to 10 years with a 25% grace period based on the known operating experience at the time. Modules in all chillers were replaced in 2005.

CR-WF3-2006-0191: Essential Chiller B chilled water outlet temperature was observed at approximately 43 deg F. The actuator linkage was observed to have been twisted, in that the top and bottom "knuckle" connections were not parallel and the guide vane and guide vane actuator shaft arms were no longer at the correct angles with respect to each other. An 18 month PM task was initiated to lubricate the actuator linkage.

**CAUSAL FACTORS**

Essential Chiller A: The direct cause of the elevated chilled water outlet temperature was failure of the chiller's capacity control module. The apparent cause is an inadequate PM strategy for replacement of the capacity control module. This apparent cause resulted in this condition by not replacing the module before age related degradation resulted in failure. The contributing cause is the system is not configured with high and low alarms [TA] for exiting Essential Chiller chilled water temperatures. This contributing cause contributed to this condition by delaying identification of the high Essential Chiller A chilled water outlet temperature for 10 hours.

Essential Chiller B: The direct cause of the elevated chilled water outlet temperature was incorrect guide vane setup. The incorrect setup resulted in adjusting the thermostat too high. The high thermostat setting prevented the chiller from maintaining outlet temperature less than 42 deg F following a large demand increase. The apparent cause is that inadequate guidance exists for guide vane actuator linkage setup. This apparent cause resulted in this condition by providing additional cooling due to the partially open guide vane. This resulted in a low outlet temperature with a high thermostat setting.

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**NARRATIVE****CORRECTIVE ACTIONS****Essential Services Chilled Water Loop A:**

- (1) Replace the capacity control module, calibrate, and return the chiller to operation. (complete)
- (2) Change the frequency of the capacity control module replacement tasks to 6 years with a 10% grace period. (complete)
- (3) Add high and low temperature alarms for chilled water outlet temperature for all chillers. (planned)

**Essential Services Chilled Water Loop B:**

- (1) Adjust linkage and arm correctly and set thermostat. (complete)
- (2) Create detailed model work instructions for the correct installation of the Essential Chiller guide vane actuator. (complete)
- (3) Establish a procedure for Essential Chiller troubleshooting. (planned)
- (4) Revise the post-maintenance tests for all work orders that require removal of the guide vane linkage. (complete)
- (5) Create a maintenance procedure for guide vane linkage setup, which will include checking the guide vane and actuator arm shaft set screws. (planned)

**SAFETY SIGNIFICANCE**

After additional load was placed on Essential Chiller B, outlet temperature stabilized at approximately 45 deg F. Essential Chiller B did not trip and continued to provide cooling to all supplied loads until the decision was made to secure the chiller and place Essential Chiller AB in service. Calculation 5-T, Essential Chilled Water Cooling Loads & Coil Performance Determination, determined the available margin for Essential Chiller B for normal operation, normal shutdown, post-LOCA, and post-tornado shutdown. The calculation determined that the most limiting scenario is post-LOCA. For this scenario, with 44.6 deg F chilled water outlet temperature, Essential Chiller B would have 14 tons of margin. The impact of the additional 0.4 deg F is approximately 0.8%, whereas the existing margin is 5%. The additional capacity available in the chiller more than offsets the slightly exceeded outlet temperature.

The actual consequence was that with Loop A inoperable, Essential Chiller B outlet temperature exceeded the allowed maximum TS SR 4.7.12.1.b limit of 42 deg F and TS 3.0.3 was entered due to both trains of Essential Services Chilled Water being inoperable. There were no other actual consequences to general safety of the public, nuclear safety, industrial safety and radiological safety for this event. As described in the preceding paragraph, although both trains of Essential Services Chilled Water were inoperable at the same time, Loop B remained available to perform the required safety function of the Essential Services Chilled Water System during all required accident conditions. Therefore, it has been determined that the Essential Services Chilled Water System was capable of performing its safety function.

Essential Chiller AB was put in service replacing Essential Chiller B. The potential consequences to general safety of the public, nuclear safety, industrial safety and radiological safety of this event if response actions were delayed to put Essential Chiller AB in service would have been a small reduction in Essential Chiller B operating margin. The safety significance of this event is considered low.

**ADDITIONAL INFORMATION**

Energy industry identification system (EIIIS) codes and component function identifiers are identified in the text with brackets [ ].