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June 19, 2015

U.S. Nuclear Regulatory Commission  
Attention: Document Control Desk  
Washington, D.C. 20555-0001

Subject: Duke Energy Carolinas, LLC (Duke Energy)  
Catawba Nuclear Station, Unit 2  
Docket No. 50-414  
Licensee Event Report (LER) 414/2015-001-0

Pursuant to 10 CFR 50.73(a)(1) and (d), attached is LER 414/2015-001-0, entitled "Auxiliary Feedwater (AFW) System Train 2A and Its Automatic Transfer Function to the Nuclear Service Water System (NSWS) Were Determined to Have Been Inoperable in Violation of Technical Specifications (TS)".

This report is being submitted in accordance with 10 CFR 50.73(a)(2)(i)(B).

There are no regulatory commitments contained in this letter or its attachment.

This event is considered to be of no significance with respect to the health and safety of the public.

If there are any questions on this report, please contact L.J. Rudy at (803) 701-3084.

Sincerely,

Kelvin Henderson  
Vice President, Catawba Nuclear Station

LJR/s

Attachment

IE22  
NRR

Document Control Desk  
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xc (with attachment):

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**LICENSEE EVENT REPORT (LER)**(See Page 2 for required number of  
digits/characters for each block)

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 internet e-mail to 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**

Catawba Nuclear Station, Unit 2

**2. DOCKET NUMBER**

05000414

**3. PAGE**

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**4. TITLE**

Auxiliary Feedwater (AFW) System Train 2A and Its Automatic Transfer Function to the Nuclear Service Water System (NSWS) Were Determined to Have Been Inoperable in Violation of Technical Specifications (TS)

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
04	20	2015	2015	001	0	06	19	2015	NA	05000
									FACILITY NAME	DOCKET NUMBER
									NA	05000

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)
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)(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)
	<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**

LICENSEE CONTACT

L.J. Rudy

TELEPHONE NUMBER (Include Area Code)

(803) 701-3084

**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
X	JE	Slide Link	Stawick	Yes					

**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 April 20, 2015, it was determined that TS 3.7.5, "Auxiliary Feedwater (AFW) System", Condition B had been violated. Due to the inability to meet a TS Surveillance Requirement, it was determined that AFW System Train 2A had been unknowingly technically inoperable beginning on November 10, 2014 and ending on February 28, 2015 when Unit 2 entered Mode 4 at the start of its End of Cycle 20 Refueling Outage. The cause of the inoperability was the inability of valves 2CA-60 and 2CA-56 (motor driven AFW Train 2A discharge flow control valves to steam generators A and B, respectively) to automatically open to their safe position. It was also determined that TS 3.3.2, "Engineered Safety Feature Actuation System (ESFAS) Instrumentation", had not been met, resulting in TS Limiting Condition for Operation (LCO) 3.0.3 being unknowingly entered and violated. This was due to AFW System Train 2A being unable to automatically transfer to its assured source of supply (the NSWS). The cause of this event was determined to be a failed sliding link. The failed sliding link was replaced during the refueling outage. During this event, the normal feedwater supply to the steam generators remained available and actuation of the AFW System or transfer of its suction to the NSWS was not required. Had actuation of the AFW System been required, valves 2CA-56 and 2CA-60 were open, except for brief periods as described in this LER. Therefore, with the exception of these brief periods, the AFW System would have performed its safety related function. In addition, AFW System Train 2B remained capable of transferring its suction to the NSWS, had it been required to do so. Therefore, this event had no adverse effect upon the health and safety of the public.

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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 internet e-mail to [Infocollects.Resource@nrc.gov](mailto: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.

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**NARRATIVE****BACKGROUND**

This event is being reported under the following criterion:

10 CFR 50.73(a)(2)(i)(B), any operation or condition which was prohibited by the plant's Technical Specifications (TS).

Throughout this LER, Energy Industry Identification System (EIIIS) codes are identified in the text as [EIIIS: XX].

Catawba Nuclear Station, Unit 2 is a Westinghouse four-loop Pressurized Water Reactor (PWR) [EIIIS: RCT].

The Auxiliary Feedwater (AFW) System [EIIIS: BA] (Duke Energy designation "CA") supplies feedwater to the steam generators [EIIIS: SG] to remove decay heat from the Reactor Coolant System [EIIIS: AB] upon the loss of normal feedwater supply. The AFW pumps [EIIIS: P] take suction through suction lines from the Condensate Storage System (CSS) [EIIIS: KA] and pump to the steam generator secondary side. The normal supply of water to the AFW pumps is from the CSS. The supply valves [EIIIS: V] are open with power removed from the valve operators. The assured source of water to the AFW System is supplied by the Nuclear Service Water System (NSWS) [EIIIS: BI]. The turbine and motor driven pump discharge lines to each individual steam generator join into single lines outside containment. These individual lines penetrate the containment and enter each steam generator through the auxiliary feedwater nozzle. The steam generators function as a heat sink for core decay heat. The heat load is dissipated by releasing steam to the atmosphere from the steam generators via the Main Steam Safety Valves (MSSVs) [EIIIS: SA] or the steam generator Power Operated Relief Valves (PORVs) [EIIIS: SA]. If the main condenser [EIIIS: COND] is available, steam may be released via the steam dump valves [EIIIS: JI] and recirculated to the hotwell.

The AFW System consists of two motor driven AFW pumps and one steam turbine driven pump configured into three trains. Each of the motor driven pumps supplies 100% of the flow requirements to two steam generators, although each pump has the capability to be realigned to feed other steam generators. The turbine driven pump provides 200% of the flow requirements and supplies water to all four steam generators. Travel stops are set on the steam generator flow control valves [EIIIS: FCV] such that the pumps can supply the minimum flow required without exceeding the maximum flow allowed. The pumps are equipped with independent recirculation lines to prevent pump operation against a closed system. Each motor driven AFW pump is powered from an independent Class 1E power supply. The steam turbine driven AFW pump receives steam from two main steam lines upstream of the Main Steam Isolation Valves (MSIVs) [EIIIS: SB]. Each of the steam feed lines will supply 100% of the requirements of the turbine driven AFW pump.

The AFW System is capable of supplying feedwater to the steam generators during normal unit startup, shutdown, and hot standby conditions. One turbine driven pump at full flow is sufficient to remove decay

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heat and cool the unit to Residual Heat Removal (RHR) [EIS: BP] entry conditions. During unit cooldown, steam generator pressures and main steam pressures decrease simultaneously. Thus, the turbine driven AFW pump with a reduced steam supply pressure remains fully capable of providing flow to all steam generators. Thus, the requirement for diversity in motive power sources for the AFW System is met.

The AFW System is designed to supply sufficient water to the steam generators to remove decay heat with steam generator pressure at the lowest setpoint of the MSSVs plus 3% accumulation. Subsequently, the AFW System supplies sufficient water to cool the unit to RHR entry conditions, with steam released through the steam generator PORVs or MSSVs.

The motor driven AFW pumps actuate automatically on steam generator water level low-low in one out of four steam generators by the Engineered Safety Features Actuation System (ESFAS) [EIS: JE]. The motor driven pumps also actuate on loss of offsite power, safety injection, and trip of all Main Feedwater (MFW) [EIS: SJ] pumps. The turbine driven AFW pump actuates automatically on steam generator water level low-low in two out of four steam generators and loss of offsite power.

TS 3.7.5 governs the AFW System. Limiting Condition for Operation (LCO) 3.7.5 requires three AFW trains to be operable in Modes 1, 2, and 3. In Mode 4 when the steam generator(s) are relied upon for heat removal, only one AFW train, which includes a motor driven pump, is required to be operable. Since the ESFAS instrumentation that actuates the AFW System is not required to be operable in Mode 4, manual actuation of the required AFW train in this mode is sufficient.

Condition B states in part that with one AFW train inoperable in Mode 1, 2, or 3 for reasons other than one inoperable turbine driven AFW pump steam supply, the AFW train must be restored to operable status within 72 hours. If this is not accomplished, then the unit must be placed in Mode 3 within 6 hours and in Mode 4 within 12 hours according to Condition C.

Valves 2CA-60 and 2CA-56 are motor driven AFW Train 2A discharge flow control valves to steam generators A and B, respectively. These pneumatically operated, fail open valves receive a safety signal to automatically open to their travel stop settings on a motor driven AFW pump automatic start signal, even though the valves are normally open, in order to ensure flow path availability. A safety grade solenoid in the airline for each valve vents the valve operator, which opens the valve. With 2CA-60 and 2CA-56 closed and incapable of automatically opening, the motor driven AFW Train 2A flowpath to steam generators A and B is unavailable and the unit enters TS 3.7.5, Condition B.

Surveillance Requirement (SR) 3.7.5.3 requires verification that each AFW automatic valve that is not locked, sealed, or otherwise secured in position, actuates to the correct position on an actual or simulated actuation signal. SR 3.7.5.3 is modified by a Note which states that it is not applicable in Mode 4 when steam generator is relied upon for heat removal. The SR Frequency is specified as being in accordance with the Surveillance Frequency Control Program.

As stated above, the NSWS is the assured source of supply for the AFW System. A low pressure signal in the AFW pump suction line protects the AFW pumps against a loss of the normal supply of water for the pumps. Three pressure switches [EIS: PS] per train are located on the AFW pump suction line from the CSS. A low pressure signal sensed by two out of three switches will align the train related motor driven AFW pump and the turbine driven AFW pump to the assured water supply (NSWS) on an

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automatic AFW System start. The NSWWS is then lined up to supply the AFW pumps to ensure an adequate supply of water for the AFW System to maintain at least two of the steam generators as the heat sink for reactor decay heat removal.

TS 3.3.2 governs the Engineered Safety Feature Actuation System (ESFAS) Instrumentation, of which this function is a part. This function is listed in Table 3.3.2-1, "Engineered Safety Feature Actuation System Instrumentation" as Function 6.f. (Auxiliary Feedwater Pump Train A and Train B Suction Transfer on Suction Pressure - Low). This function is required to be operable in Modes 1, 2, and 3. Condition M allows for one channel on one or both trains of this function to be inoperable. With more than one channel on one or both trains of this function inoperable, no TS Condition is provided; therefore, the unit must enter LCO 3.0.3.

When this event was determined to be reportable, Unit 2 was in Mode 1, having recently completed its End of Cycle 20 Refueling Outage. Throughout the duration of inoperability described in this LER, Unit 2 had operated in Modes 1, 2, and 3.

Except as indicated in the Safety Analysis section of this LER, no other structures, systems, or components were out of service that had any effect on this event.

## EVENT DESCRIPTION

On March 3, 2015, Unit 2 was in Mode 5 (down) during the End of Cycle 20 Refueling Outage. Engineered Safety Features (ESF) testing was being conducted. During the conduct of this test, valves 2CA-56 (motor driven AFW pump 2A flow control valve to steam generator 2B) and 2CA-60 (motor driven AFW pump 2A flow control valve to steam generator 2A) did not operate as expected.

Troubleshooting was conducted under Work Order 02199337. The resistance across sliding link E-12 in cabinet 2EATC16 was measured as 3.64 k ohms. The sliding link was found to be loose. It was noted in the work order that the sliding link was closed, but it was not tight. The sliding link was tightened and the resistance was subsequently measured as 0.2 ohms.

Based on a search of work requests, work orders, and completed procedures, the last manipulation of sliding link E-12 prior to this event occurred on November 10, 2014 during the performance of procedure PT/2/A/4200/009 A, "Auxiliary Safeguards Cabinet Periodic Test". Sliding link E-12 is opened per the applicable procedure enclosure to prevent isolation of steam generator blowdown, tempering flow, and AFW pump start valve alignments which would include 2CA-56 and 2CA-60. At the completion of the test, sliding link E-12 is reclosed and secured with a locking screw. The technician that closed the sliding link stated that he did not notice anything unusual while manipulating the sliding link.

Because of the issue with sliding link E-12, valves 2CA-56 and 2CA-60 were unable to automatically open under all required test conditions. This resulted in the inability to meet the requirements of SR 3.7.5.3; therefore, LCO 3.7.5 was not being met and TS 3.7.5, Condition B was violated. Sliding link E-12 also supports the operation of a relay which is required to function in order to support the automatic transfer of AFW System Train 2A from the CSS to the NSWWS. This resulted in the inability to meet the requirements of TS 3.3.2 for this function, and hence, a violation of LCO 3.0.3.

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It was determined that AFW System Train 2A and its automatic transfer function to the NSWS had been inoperable since November 10, 2014 based on the fact that sliding link E-12 had not been securely closed.

**CAUSAL FACTORS**

The cause of this event was determined to be an intermittent connection across sliding link E-12 which resulted from frequent manipulation of the sliding link.

After the sliding link was removed and replaced, plant personnel attempted to recreate the condition on the old sliding link. They were able to tighten the screw with a nut driver until it felt snug in the closed position. Nevertheless, they were able to move the sliding link to the open position even though the screw felt snug. If the sliding link were operating correctly, it would have remained in the closed position.

There were no human performance, procedural, programmatic, organizational, or cultural aspects associated with this event.

**CORRECTIVE ACTIONS**

**Immediate:**

1. Troubleshooting was conducted under Work Order 02199337 to identify the cause of valves 2CA-56 and 2CA-60 failing to operate as designed.

**Subsequent:**

1. Sliding link E-12 was replaced under Work Order 02127190 on March 22, 2015.

**Planned:**

1. Selected frequently manipulated sliding links will be replaced.
2. Preventive maintenance will be initiated to replace selected frequently manipulated sliding links on a frequency commensurate with the testing frequency that requires them to be manipulated.

**SAFETY ANALYSIS**

Due to the inability to technically meet SR 3.7.5.3, AFW System Train 2A had been unknowingly technically inoperable beginning on November 10, 2014 and ending on February 28, 2015 when Unit 2 entered Mode 4 at the start of its End of Cycle 20 Refueling Outage.

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It was determined that there was no safety significance to this event. During the vast majority of the time that AFW System Train 2A was inoperable, valves 2CA-56 and 2CA-60 were in their required open position and capable of passing the required AFW flowrates to steam generators 2B and 2A, respectively. The only exceptions were as follows:

- November 14, 2014: 2CA-56 was closed for approximately 1.2 hours for running the air leak test procedure.
- November 14, 2014: 2CA-56 and 2CA-60 were closed for approximately 1.5 hours in support of AFW pump inservice testing.
- January 14, 2015: 2CA-56 and 2CA-60 were closed for approximately 40 minutes in support of preventive maintenance on AFW pump 2A.
- February 13, 2015: 2CA-56 and 2CA-60 were closed for approximately 10 minutes in support of AFW valve inservice testing.

Valves 2CA-56 and 2CA-60 were open during all other times since the manipulation of sliding link E-12 on November 10, 2014.

During the time period that AFW System Train 2A was inoperable, there were six instances where AFW System Train 2B was simultaneously inoperable. The longest of these instances was 2 hours and 40 minutes, which was within the allowed TS limit of 6 hours for placing the unit in Mode 3 and 12 hours for placing the unit in Mode 4. Also, during the time period that AFW System Train 2A was inoperable, there were four instances where the AFW System turbine driven train was simultaneously inoperable. The longest of these instances was 14 hours and 38 minutes, which exceeded the allowed TS limit of 6 hours for placing the unit in Mode 3 and 12 hours for placing the unit in Mode 4. There were no instances where all three AFW System trains were simultaneously inoperable.

During the same time period that the Auxiliary Feedwater Pump Train 2A Suction Transfer on Suction Pressure - Low ESFAS function was inoperable, there were no instances where the Auxiliary Feedwater Pump Train 2B Suction Transfer on Suction Pressure - Low ESFAS function was simultaneously inoperable. However, because the entire Train 2A of this function was inoperable (as opposed to just one channel), the unit was unknowingly in LCO 3.0.3 during this event and did not comply with its shutdown time requirements.

During this event, no transients or accidents requiring the actuation of the AFW System or transfer of its suction to the NSWS occurred. The normal feedwater supply to the steam generators remained available during this event. Had actuation of the AFW System been required, valves 2CA-56 and 2CA-60 were open, except for the brief periods as described above. Therefore, with the exception of these brief periods, the AFW System would have performed its safety related function. In addition, AFW System Train 2B remained capable of transferring its suction to the NSWS, had it been required to do so.

This event therefore had no adverse effect upon the health and safety of the public.

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## ADDITIONAL INFORMATION

Within the previous three years, there were two LER related events involving the AFW System. On January 29, 2013, Catawba submitted 60 Day Report "Invalid Actuation of the AFW System" (Event Notification Report Number 48706). This event occurred on Unit 1 while in Mode 4. The Train 1A AFW pump automatically started due to the failure to reset the signal created when the 1B main feedwater pump was tripped for testing. The 1A main feedwater pump was already in the tripped condition when the 1B main feedwater pump was tripped, resulting in an automatic start signal being generated for the AFW System. On March 22, 2013, Catawba submitted LER 413/2012-003, "Technical Specification (TS) Limiting Conditions for Operation (LCOs) 3.0.4 and 3.7.5 Were Violated Due to Unit 1 Entering Mode 3 with Turbine Driven Auxiliary Feedwater (AFW) Pump Unknowingly Inoperable". This event occurred on Unit 1 as a result of a human performance error when reassembling the drive coupling between the turbine governor and the turbine. Corrective actions taken as a result of these previous LER related events could not have prevented this event from occurring. This event is therefore considered to be non-recurring.

This event is considered to be reportable to the INPO Consolidated Event System (ICES) (formerly called the Equipment Performance and Information Exchange (EPIX) program).

This event is not considered to constitute a Safety System Functional Failure. There was no release of radioactive material, radiation overexposure, or personnel injury associated with the event described in this LER.