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**Richard L. Anderson**
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1CAN061704

June 26, 2017

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

Subject: Licensee Event Report 50-313/2017-001-00
Arkansas Nuclear One, Unit 1
Docket No. 50-313
License No. DPR-51

Dear Sir or Madam:

Pursuant to the reporting requirements of 10 CFR 50.73, attached is the subject Licensee Event Report concerning the manual reactor trip and the automatic start of emergency diesel generators and the emergency feedwater system caused by the loss of offsite power due to severe weather for Arkansas Nuclear One, Unit 1.

There are no new commitments contained in this submittal.

Should you have any questions concerning this issue, please contact Stephenie Pyle, Manager, Regulatory Assurance, at 479-858-4704.

Sincerely,

**ORIGINAL SIGNED BY RICHARD L. ANDERSON**

RLA/rwc

Attachment: Licensee Event Report 50-313/2017-001-00

cc: Mr. Kriss Kennedy
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
1600 East Lamar Boulevard
Arlington, TX 76011-4511

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NRC FORM 366 (04-2017) U.S. NUCLEAR REGULATORY COMMISSION

# 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/)

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 03/31/2020

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 Information Services Branch (T-2 F43), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by 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 |
|---|---|---|
| Arkansas Nuclear One – Unit 1 | 05000313 | 1 OF 5 |

**4. TITLE** Automatic Start of an Emergency Diesel Generator Due to the Loss of Offsite Power due to Severe Weather

| 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 |
| | | | | | | | | | Arkansas Nuclear One, Unit 2 | 05000368 |
| 04 | 26 | 2017 | 2017 | 001 | 00 | 06 | 26 | 2017 | FACILITY NAME | DOCKET NUMBER |
| | | | | | | | | | N/A | |

| 9. OPERATING MODE | 11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)* | | | |
|---|---|---|---|---|
| 1 | ☐ 20.2201(b) | ☐ 20.2203(a)(3)(i) | ☐ 50.73(a)(2)(ii)(A) | ☐ 50.73(a)(2)(viii)(A) |
| | ☐ 20.2201(d) | ☐ 20.2203(a)(3)(ii) | ☐ 50.73(a)(2)(ii)(B) | ☐ 50.73(a)(2)(viii)(B) |
| | ☐ 20.2203(a)(1) | ☐ 20.2203(a)(4) | ☐ 50.73(a)(2)(iii) | ☐ 50.73(a)(2)(ix)(A) |
| | ☐ 20.2203(a)(2)(i) | ☐ 50.36(c)(1)(i)(A) | ☒ 50.73(a)(2)(iv)(A) | ☐ 50.73(a)(2)(x) |
| **10. POWER LEVEL** | ☐ 20.2203(a)(2)(ii) | ☐ 50.36(c)(1)(ii)(A) | ☐ 50.73(a)(2)(v)(A) | ☐ 73.71(a)(4) |
| 100 | ☐ 20.2203(a)(2)(iii) | ☐ 50.36(c)(2) | ☐ 50.73(a)(2)(v)(B) | ☐ 73.71(a)(5) |
| | ☐ 20.2203(a)(2)(iv) | ☐ 50.46(a)(3)(ii) | ☐ 50.73(a)(2)(v)(C) | ☐ 73.77(a)(1) |
| | ☐ 20.2203(a)(2)(v) | ☐ 50.73(a)(2)(i)(A) | ☐ 50.73(a)(2)(v)(D) | ☐ 73.77(a)(2)(i) |
| | ☐ 20.2203(a)(2)(vi) | ☐ 50.73(a)(2)(i)(B) | ☐ 50.73(a)(2)(vii) | ☐ 73.77(a)(2)(ii) |
| | | ☐ 50.73(a)(2)(i)(C) | ☐ OTHER Specify in Abstract below or in NRC Form 366A | |

**12. LICENSEE CONTACT FOR THIS LER**

| LICENSEE CONTACT | TELEPHONE NUMBER *(Include Area Code)* |
|---|---|
| Stephenie L. Pyle, Manager, Regulatory Assurance | 479 858-4704 |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

| 14. SUPPLEMENTAL REPORT EXPECTED | | 15. EXPECTED SUBMISSION DATE | MONTH | DAY | YEAR |
|---|---|---|---|---|---|
| ☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* | ☒ NO | | | | |

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

On April 26, 2017, Arkansas Nuclear One, Unit 1 (ANO-1), was operating normally at 100% rated thermal power. The 500kV transmission line to the substation at Pleasant Hill, Arkansas was out of service for planned maintenance. The area around the plant was experiencing severe weather from thunderstorms and tornado warnings had been issued from the National Weather Service for the four county area.

At approximately 1002 CST switchyard breakers for 500kV lines opened on fault current. High winds had damaged the transmission towers approximately 16 miles away from ANO and caused phase to ground faults. This resulted in a loss of all offsite power lines to the 500kV bus. The autotransformer also locked out as designed when the 500kV transmission lines faulted.

The Reactor Operator initiated a manual reactor trip about 8 seconds after the 500kV lines tripped and prior to the reactor protection system initiating an automatic trip. During this time both emergency diesel generators (EDGs) [EK] started as expected. EDG #2 re-energized one Engineered Safeguards bus. EDG #1 ran unloaded until shutdown.

The plant was stabilized in Mode 3 with Emergency Feedwater (EFW) pumps supplying the steam generators, maintaining the water level at the natural circulation setpoint.

| 1. FACILITY NAME | 2. DOCKET NUMBER | 3. LER NUMBER | | |
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| | | YEAR | SEQUENTIAL NUMBER | REV NO. |
| Arkansas Nuclear One, Unit 1 | 05000-313 | 2017 | 001 | 00 |

**NARRATIVE**

A. PLANT STATUS

Arkansas Nuclear One, Unit 1 (ANO-1) was operating at 100% rated thermal power. The 500kV transmission line to the substation at Pleasant Hill, Arkansas was out of service for planned maintenance. The area around the plant was experiencing severe weather from thunderstorms and tornado warnings had been issued from the National Weather Service for the four county area. There were no other structures, systems, or components (SSCs) that were inoperable at the time that contributed in the event.

B. BACKGROUND

Switchyard and High Voltage Electrical System Description

The switchyard 500kV bus is a ring bus design, which allows transmission of 500kV power through three transmission lines to substations in Mabelvale, Ft. Smith, and Pleasant Hill, Arkansas. A fourth line supplies power to the bus tie autotransformer. The autotransformer interconnects the 500kV and 161kV busses. It has two tertiary windings to provide 22kV power from the 500kV or 161kV buses to offsite power transformer Startup #1 (SU1), which supplies power to ANO-1, and to offsite power transformer Startup #3 (SU3), which supplies power to ANO, Unit 2 (ANO-2). The 161kV bus is also a ring bus design, and includes two transmission lines to substations at Russellville East and Pleasant Hill, Arkansas, and a distribution line to the London, Arkansas, substation. It also supplies power to the SU2 which can supply power to both ANO-1 and ANO-2.

During normal operation of ANO-1, station equipment is supplied from the main generator through the Unit Auxiliary Transformer (UAT). During startup and shutdown conditions, the switchyard is used as a means of supplying station equipment from the utility grid through one of the startup transformers. Following a turbine generator trip, station loads are designed to fast transfer to one of the startup transformers without the loss of power to plant loads.

There are four 4160-volt buses. The main buses, A1 and A2 [EA], provide power to non-Engineering Safeguards (ES) motors and supply transformers that feed 480-volt non-ES load centers. The 4160-volt ESF buses, A3 and A4 [EB], are also powered through A1 and A2, and supply equipment essential for the safe shutdown of the plant. Two 6.9kV buses, H1 and H2 [EA], supply the reactor coolant pumps.

On an ANO-1 trip, power is automatically fast transferred from the UAT to either SU1 or SU2, whichever is selected as the preferred power source. If the selected transformer is not available, the buses will transfer to the non-preferred startup transformer. If all normal and backup offsite power sources are lost, ES buses A3 and A4 are energized from their respective emergency diesel generator (EDG) [EK].

SU1, which only supplies ANO-1, can support buses A1, A2, H1, and H2 simultaneously. Since SU2 is shared by both units, it must be protected from overload. Procedures administratively limit automatic transfer of loads to SU2 only to ANO-1 buses A1 and A3, and ANO-2 buses 2A1 and 2A3. This is assured by normally maintaining the supply breakers from SU2 to ANO-1 buses A2, H1, and H2, and ANO-2 buses 2A2, 2H1, and 2H2 in pull-to-lock. In this condition, the associated supply breakers from SU2 to these buses will not close automatically after a loss of power from another power source.

Another source of power to ESF bus A3 / A4 cross-tie is the alternate AC diesel generator (AACDG). The AACDG is an independent, non-safety related power source intended to be used in the event of a station blackout (SBO). The AACDG is started using a touch screen in the ANO-2 Control Room or the AACDG building.

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|---|---|---|---|---|
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| Arkansas Nuclear One, Unit 1 | 05000-313 | 2017 | 001 | 00 |

C. DESCRIPTION OF EVENT

On April 26, 2017, ANO-2 was in day 28 of a refueling outage with a complete core off load that had moved all fuel to the spent fuel pool (SFP). Power to ANO-2 plant equipment was supplied from SU2 while SU3 was out of service for planned maintenance. 500kV lines to Fort Smith and Mabelvale, Arkansas, were in service. 161kV transmission lines to Russellville and Pleasant Hill, Arkansas, were also in service.

ANO-1 was operating normally at full power. The area around the plant was experiencing severe weather from thunderstorms, and tornado warnings had been issued from the National Weather Service for the four county area. Switchyard work was ceased.

At approximately 1002 CST switchyard breakers for 500kV lines to Fort Smith and Mabelvale, Arkansas, opened on fault current. These two transmission lines run offsite in the same right-of-way. High winds had damaged the transmission towers approximately 16 miles away from ANO and caused phase to ground faults. This resulted in a loss of all offsite power lines to the 500kV bus. The autotransformer also locked out as designed when the 500kV transmission lines faulted. The impact of this condition on ANO-2 is addressed in an ANO-2 LER (LER 05000-368 / 2017-002-00).

The load rejection was sensed by the ANO-1 main turbine causing all governor valves to close. Generator output breakers had not opened when all 500kV power was lost because there was no energy to actuate the reverse power trip. During this time plant loads remained powered from the main generator via the UAT. Turbine speed and generator frequency rose and peaked at 64.27 Hz (1928 rpm) in approximately 3 seconds. The turbine then began slowing down to 1800 rpm (normal speed).

Approximately two seconds after the loss of 500kV lines, reactor control rod safety groups 1-4 dropped fully into the core, while regulating groups remained partially withdrawn. A reactor trip signal had not been initiated, so no rods should have dropped. This ratcheting trip condition was due to voltage fluctuations. The Reactor Operator at the controls initiated a manual reactor trip about 8 seconds after the 500kV lines tripped and prior to the reactor protection system initiating an automatic trip on low reactor coolant system pressure. After initiating the manual reactor trip, all remaining control rods fully inserted into the core as expected.

The turbine tripped immediately following the manual reactor trip, which caused the UAT to trip. SU1 was selected as the backup power supply. SU2 was the alternate backup with buses A2, H1, and H2 in pull to lock. SU1 was powered from the switchyard autotransformer. During the electrical transient, the autotransformer protective relays had actuated due to the transmission line faults which opened the 500kV and 161kV supply breakers. This resulted in a loss of all power to the autotransformer and to SU1.

Because the turbine generator speed had increased above 60 Hz, there was a frequency difference between the A1 bus and SU2 that prevented a fast transfer of A1 to SU2. Because A1 was de-energized while awaiting a slow transfer of power from SU2, both EDGs [EK] started as expected. EDG #2 re-energized ES bus A4 because the breaker from SU2 to bus A2 was in pull to lock. By this time the slow transfer to SU2 had completed and bus A1 was re-energized; therefore, EDG #1 was not required to connect to the bus and ran unloaded until shutdown by Operations.

Many loads powered from A1 had de-energized during the slow transfer to SU2. This resulted in a temporary loss of SFP cooling.

The plant was stabilized in Mode 3 with Emergency Feedwater (EFW) pumps supplying the steam generators, maintaining the water level at the natural circulation setpoint. Operations aligned SU2 to 4160-volt bus A2 and restored SFP cooling. SFP cooling was lost for approximately 69 minutes. The SFP temperature increased approximately 1 degree F during the 69 minute period. The Emergency Feedwater Initiation and Control (EFIC) System controlled EFW flow as designed.

## D. EVENT CAUSES

The identified condition occurred due to severe weather which caused an electrical fault in the 500kV Fort Smith and Mabelvale, Arkansas, transmission lines coincident with an ongoing 500kV Pleasant Hill, Arkansas, transmission line maintenance outage.

SU2 remained operable and capable of performing its required function. The EDGs and the EFW system performed as designed and remained capable of performing the respective safety functions.

## E. CORRECTIVE ACTIONS

The following corrective actions were completed upon identification

- Restored offsite power
- Entered the Spent Fuel Pool Emergencies procedure and restarted both SFP cooling pumps
- Secured the #1 EDG due to running unloaded.

## F. SAFETY CONSEQUENCES

This event had no actual safety consequences impacting plant or public safety.

The EDGs automatically started properly when a loss of AC power was detected, as designed. All other systems functioned normally.

G. BASIS FOR REPORTIBILITY

This event is reportable pursuant to the following criteria:

10 CFR 50.73(a)(2)(iv)(A) Any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B) of this section.

Paragraph (B)(1) lists "Reactor protection system (RPS) including: reactor scram or reactor trip".

Paragraph (B)(6) states "PWR auxiliary or emergency feedwater system".

Paragraph (B)(8) lists "Emergency ac electrical power systems, including: emergency diesel generators (EDGs)".

The guidance provided in NUREG 1022 states under 10 CFR 50.73(a)(1):

*The holder of an operating license for a nuclear power plant (licensee) shall submit a Licensee Event Report (LER) for any event of the type described in this paragraph within 60 days after the discovery of the event.*

H. ADDITIONAL INFORMATION

10 CFR 50.73(b)(5) states that this report shall contain reference to "any previous similar events at the same plant that are known to the licensee." NUREG 1022 reporting guidance states that term "previous occurrences" should include previous events or conditions that involved the same underlying concern or reason as this event, such as the same root cause, failure, or sequence of events.

A review of the ANO corrective action program and LERs for the previous three years was performed. There were no similar events identified at ANO during this time period.

It should be noted that the NRC was initially notified of this event in Event Notification (EN) 52710. In this EN it was stated that the reactor automatically tripped. Based upon further review, the reactor trip was manually initiated as described in this LER.

Energy Industry Identification System (EIIS) codes and component codes are identified in the text of this report as [XX].