



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
1600 EAST LAMAR BOULEVARD
ARLINGTON, TEXAS 76011-4511

June 26, 2019

Mr. Richard L. Anderson, Site Vice President
Arkansas Nuclear One
Entergy Operations, Inc.
N-TSB-58
1448 S.R. 333
Russellville, AR 72802-0967

SUBJECT: ARKANSAS NUCLEAR ONE, UNITS 1 AND 2 – TEMPORARY INSTRUCTION
2515/194 REPORT 05000313/2019013 AND 05000368/2019013

Dear Mr. Anderson:

On June 6, 2019, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Arkansas Nuclear One, Units 1 and 2 and discussed the results of this inspection with Mr. Terry Evans, Coord-Site Vice President, and other members of your staff. The results of this inspection are documented in the enclosed report.

The NRC inspector did not identify any finding or violation of more than minor significance.

This letter, its enclosure, and your response (if any) will be made available for public inspection and copying at <http://www.nrc.gov/reading-rm/adams.html> and at the NRC Public Document Room in accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding."

Sincerely,

/RA/

Nicholas H. Taylor, Chief
Engineering Branch 2
Division of Reactor Safety

Docket Nos. 50-313 and 50-368
License Nos. DPR-51 and NPF-6

Enclosure:
Inspection Report 05000313/2019013
and 05000368/2019013

cc: Electronic Distribution to Arkansas Nuclear One

**U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report**

Docket Numbers: 05000313 and 05000368

License Numbers: DPR-51 and NPF-6

Report Numbers: 05000313/2019013 and 05000368/2019013

Enterprise Identifier: I-2019-013-0000

Licensee: Entergy Operations, Inc.

Facility: Arkansas Nuclear One, Units 1 and 2

Location: Russellville, AR

Inspection Dates: June 3, 2019, to June 6, 2019

Inspector: S. Graves, Senior Reactor Inspector

Approved By: Nicholas H. Taylor, Chief
Engineering Branch 2
Division of Reactor Safety

Enclosure

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting a Temporary Instruction 2515/194 inspection at Arkansas Nuclear One, Units 1 and 2 in accordance with the Reactor Oversight Process. The Reactor Oversight Process is the NRC's program for overseeing the safe operation of commercial nuclear power reactors. Refer to <https://www.nrc.gov/reactors/operating/oversight.html> for more information. Findings and violations being considered in the NRC's assessment are summarized in the table below.

List of Findings and Violations

No findings were identified.

Additional Tracking Items

None.

INSPECTION SCOPE

Inspections were conducted using the appropriate portions of the Temporary Instruction (TI) inspection in effect at the beginning of the inspection unless otherwise noted. Samples were declared complete when the TI requirements most appropriate to the inspection activity were met consistent with Inspection Manual Chapter (IMC) 2515, "Light-Water Reactor Inspection Program - Operations Phase." The inspector reviewed selected procedures and records, observed activities, and interviewed personnel to assess licensee performance and compliance with Commission rules and regulations, license conditions, site procedures, and standards.

OTHER ACTIVITIES – TEMPORARY INSTRUCTIONS, INFREQUENT AND ABNORMAL

Temporary Instruction 2515/194 - Inspection of the Licensee's Implementation of Industry Initiative Associated with the Open Phase Condition Design Vulnerabilities in Electric Power Systems (NRC Bulletin 2012-01) (1 Sample)

This inspection was conducted using Temporary Instruction 2515/194 (ADAMS Accession No. ML17137A416), effective November 1, 2017, to verify that licensees have appropriately implemented the Nuclear Energy Institute Voluntary Industry Initiative (ADAMS Accession No. ML15075A454) dated March 16, 2015, including updating their licensing basis to reflect the need to protect against open phase conditions. The inspector reviewed the licensee's implementation of Nuclear Energy Institute's voluntary industry initiative in compliance with Commission guidance. The inspector reviewed and discussed the licensee's open phase condition system design, installation, testing and maintenance plans with plant staff, and performed system walkdowns to verify that the installed equipment was supported by the design documentation.

Temporary Instruction 2515/194-03.01 - Voluntary Industry Initiative (Part 1)

Entergy Operations Inc. selected the open phase detection system designed and manufactured by PCS2000 Solutions, LLC, as the design vendor for the open phase condition system at Arkansas Nuclear One.

During normal operations, auxiliary power for plant electrical loading is supplied by each unit's main generator through an associated Unit Auxiliary Transformer. Arkansas Nuclear One has three standby transformers, Startup Transformers 1, 2, and 3, which are credited General Design Criteria, GDC-17, offsite power sources. During normal operation, Startup Transformers 1 and 3 are connected to 22-kV tertiary windings of the switchyard bus tie autotransformer bank. Startup Transformer 2 is connected to the switchyard 161-kV ring bus.

Each Startup Transformer provides a source of power for startup, shutdown, and post-shutdown loads. Startup Transformer 1 serves as a standby source for the plant auxiliaries of Unit 1, Startup Transformer 3 serves as a standby source for the plant auxiliaries of Unit 2. Startup Transformer 2 is common to both units. The system is designed to transfer loads to a Startup Transformer following a turbine generator or reactor trip without a loss of auxiliary load. Each unit's engineered safety features busses are capable of being supplied from either the unit auxiliary transformer during normal operation, the associated unit's Startup Transformer, or Startup Transformer 2.

Arkansas Nuclear One installed redundant open phase detection systems on each Startup Transformer and at the end of this inspection the PCS2000 system was operating with all functions enabled for each Startup Transformer.

INSPECTION RESULTS

Observation	2515/194
<p>Based on discussions with licensee staff, review of design, installation and testing documentation, and walkdowns of installed equipment, the inspector had reasonable assurance the licensee is appropriately implementing the voluntary industry initiative.</p> <p>The inspector determined by design document review, walkdowns, staff discussions, and observation that:</p> <p><u>Detection, Alarms, and General Criteria</u></p> <p>(1) Open phase conditions will be detected and alarmed in the control rooms.</p> <p>(2) Detection circuits are sensitive enough to identify an open phase condition for all credited loading conditions.</p> <p>(3) The PCS2000 system is designed to minimize misoperation or spurious action in the range of voltage unbalance normally expected in the transmission system that could cause separation from an operable offsite power source. The licensee had demonstrated that the actuation circuit design did not result in lower overall plant operation reliability.</p> <p>(4) No Class-1E circuits were replaced with non-Class 1E circuits in the design.</p> <p>(5) The licensee had updated the Unit 1 and Unit 2 Final Safety Analysis Reports to discuss the design features and analyses related to the effects of, and protection for, any open phase condition vulnerabilities.</p> <p><u>Protective Actions Criteria</u></p> <p>(1) Startup Transformers 1, 2, and 3 were identified as susceptible to an open phase condition and the licensee had implemented design changes to mitigate the effects.</p> <p>(2) With an open phase condition present and no accident condition signal present, the PCS2000 system would not adversely affect the function of important-to-safety systems, structures, or components. The licensee's open phase condition design solution added a set of additional tripping inputs in parallel with existing transformer isolation controls. This addition added a new tripping condition (open phase) to the previously analyzed electrical faults which result in isolation of the transformers. The credited plant response was unaffected and would be the same independent of the conditions that generated the isolation of the transformer.</p> <p>(3) With an open phase condition present and accident condition signal present, the PCS2000 system would not adversely affect the transfer of 4.16-kV engineered safeguards buses to the onsite emergency diesel generators as required by the current licensing bases; only a new tripping condition (open phase) was added to the electrical faults which result in isolation of the alternate offsite source of power.</p>	

The 4.16-kV engineered safeguards buses are normally energized from the main generator through the unit auxiliary transformer and the non-engineered safeguards busses. Upon loss of the normal power source, the engineered safeguards loads are automatically transferred to the selected Startup Transformer. Isolation of the Startup Transformer due to an open phase condition results in the engineered safeguards loads being automatically transferred and energized from the respective emergency diesel generator in the same manner as required by the current licensing bases.

Protective Actions Criteria Exception

At the time of this inspection, the licensee had not finalized development for all periodic tests, calibrations, setpoint verifications, or inspection procedures for open phase protection system equipment. The licensee had developed and implemented work instructions and procedures for the uninterruptible power supplies used to power the open phase protection equipment, had established preventive maintenance identification for the system components, and had established plans for repair or replacement of degraded components. The inspector held discussions with licensee staff and identified that the vendor guidance, including periodic tests, setpoint verification, and equipment maintenance and inspections would be integrated into plant procedures and processes. The licensee had performed a pre-inspection self-assessment, documented in Condition Report LO-ALO-2019-00029 which documented, in part, the licensee's pending actions to determine if any of the open phase detection components needed to be included in the Maintenance Rule program and, if so, ensure actions are in place to include the components in the program.

EXIT MEETINGS AND DEBRIEFS

On June 6, 2019, the inspector presented the Temporary Instruction 2515/194 results to Mr. T. Evans, Coord-Site Vice President, and other members of the licensee staff. The inspector verified no proprietary information was retained or documented in this report.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
2515/194	Calculations	CALC-14-E-2001-01	EMTP Station Open Phase LOCA Analysis	0
		CALC-15-D-3001-01	EMTP Transmission Line Open Phase Analysis	0
		CALC-15-D-3001-02	EMTP Station Open Phase Analysis	0
		CALC-17-E-3001-01	Coordination of Open Phase Detection Time Delay Trip Setting	0
		CALC-84-E-0103-01	General Criteria for Safety Buses	10
		CALC-ANOC-EE-18-00001	ANO SU1 & SU3 Open Phase Detection Monitoring Period Report June - December 2017	0
		CALC-ANOC-EE-18-00003	SU2 Open Phase Detection Monitoring Period Report October 2018	0
	Corrective Action Documents	LO-ALO-2019-00029	Track the Pre-NRC Inspection Focused Self-Assessment for Open Phase Condition Design Vulnerabilities	2/21/2019
	Corrective Action Documents Resulting from Inspection	CR-ANO-1-2019-01375		6/04/2019
	Drawings	E-1	Station Single Line Diagram	62
		E-112	Schematic Diagram StartUp XFMR Aux Systems Local Annunciator Reflash Modules	7
		E-2001	Station Single Line Diagram	39
		E-2094	Schematic Diagram Startup Transformer #3 Lockout Relay	20
E-2112		Schematic Diagram Start-Up Transformer Auxiliary System	12	
E-2812		Transformer Area Grounding & Underground Ductbank Layout	8	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		E-2814	Transformer Area Grounding & Underground Ductbank Layout	8
		E-2816	Transformer Area Isophase and Non-Segregated Busses and Overhead Lines	13
		E-2819	Transformer Yard Deluge System Conduit Layout	3
		E-613	Underground Conduit and Grounding Transformer Yard Area	16
		E-614	Transformer Yard Area Isophase Bus, Structures and Overhead Lines	14
		E-94	Schematic Diagram Startup Transformers No 1 & No 2 Lockout Relays	21
	Engineering Changes	EC-48770	Provide Open Phase Detection and Protection for Startup Transformer No. 2	0
		EC-73661	Enable Open Phase Detection Trip Circuits (Parent EC)	0
		EC-73663	Enable Open Phase Detection Trip and Alarm Circuits Startup Transformer 1 (CHILD EC TO EC 73661)	12/21/2017
		EC-73664	Enable Open Phase Detection Trip and Alarm Circuits Startup Transformer 2 (CHILD EC TO EC 73661)	12/21/2017
		EC-73665	Enable Open Phase Detection Trip and Alarm Circuits Startup Transformer 3 (CHILD EC TO EC 73661)	12/21/2017
ECT-48708-01	Post Modification Testing of Trip and Alarm Functions for SU3 Open Phase Detection	4/20/2017		

Inspection Procedure	Type	Designation	Description or Title	Revision or Date	
			(OPD)		
		ECT-48770-01	Post Modification Testing of Trip and Alarm Functions for SU2 Open Phase Detection (OPD)	9/24/2017	
		ECT-48771-01	Post Modification Testing of Trip and Alarm Functions for SU1 Open Phase Detection (OPD)	11/17/2017	
	Miscellaneous		Arkansas Nuclear One, Unit 1 Safety Analysis Report	Amendment 29	
			Arkansas Nuclear One, Unit 2 Safety Analysis Report	Amendment 28	
			PCS2000 Open Phase Detection System Factory Acceptance Testing for Start Up Transformers 1, 2, and 3	8/08/2016	
			PCS2000 Open Phase Detection System ANO SU1 Site Acceptance Test	11/11/2016	
			PCS2000 Open Phase Detection System ANO SU2 Site Acceptance Test	9/24/2017	
			PCS2000 Open Phase Detection System ANO SU3 Site Acceptance Test	4/20/2017	
			Process Applicability Determination for EC 73661, Enable Open Phase Detection Trip Circuits (Parent EC)	11/12/2018	
			Licensing Basis Document Change LBDC 17-015	Clarification of Offsite Power Operability Requirements — TSTF-556-T	3/15/2017
			Licensing Basis Document Change LBDC 17-016	Clarification of Offsite Power Operability Requirements — TSTF-556-T	3/10/2017
		Procedures	1107.001	Electrical System Operations	123

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		1203.012B	Annunciator K02 Corrective Action	048
		2107.001	Electrical System Operations	129
		2203.012A	Annunciator 2K01 Corrective Action	049
		2203.054	Abnormal Grid	002
	Work Orders	00499121-01	D-71 Battery Charger for SU1 Open Phase Detection, Perform Monthly Battery Charger Checks for Voltage and Current Output, Check and Reset Alarms and Perform Alarm Indication Lamp Tests	
		00506901-01	D-71 Start-up (SU) #1 Open Phase Detection 125 VDC Battery Bank Monthly Monitoring and Inspection	11/07/2018
		00506913-01	2D-70 Battery Bank for SU3 Open Phase Detection Monthly Monitoring and Inspection	10/29/2018
		52816135-01	2D-70 Battery Bank for SU3 Open Phase Detection Monthly Monitoring and Inspection	12/03/2018
		52843065	D-71 Battery Charger Monthly PM	4/24/2019

ARKANSAS NUCLEAR ONE, UNITS 1 AND 2 – TEMPORARY INSTRUCTION 2515/194
 REPORT 05000313/2019013 AND 05000368/2019013 – JUNE 26, 2019

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ADAMS ACCESSION NUMBER: ML19178A249

SUNSI Review: ADAMS: Non-Publicly Available Non-Sensitive Keyword: NRC-002
 By: STG Yes No Publicly Available Sensitive

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