**Scott L. Batson**
*Vice President*
*Oconee Nuclear Station*

***Duke Energy***
*ON01VP | 7800 Rochester Hwy*
*Seneca, SC 29672*

*o:* 864.873.3274
*f:* 864.873. 4208
*Scott.Batson@duke-energy.com*

ONS-2016-012 10 CFR 50.73

February 5, 2016

Attn: Document Control Desk
U. S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2746

Duke Energy Carolinas, LLC (Duke Energy)
Oconee Nuclear Station (ONS) Unit 3
Docket No. 50-287
Renewed License Number DPR-50

Subject: Licensee Event Report 287/2015-002, Revision 0

The enclosed Licensee Event Report (LER) 287/2015-002, Revision 0, describes the discovery of a broken conductor related to the Unit 3 startup transformer which created a temporary loss of the power paths required by Technical Specification 3.8.1 and is reportable in accordance with 10 CFR 50.73(a)(2)(v)(A), (B), (C) and (D) as a condition that could have prevented the fulfillment of a safety function.

There are no regulatory commitments associated with this LER.

If there are questions, or further information is needed, contact David Haile, ONS Regulatory Affairs, at (864) 873-4742.

Sincerely,

Scott L. Batson
Vice President
Oconee Nuclear Site

Enclosure
LER: Broken Electrical Conductor Supplying Unit 3 Start-up Transformer

IE22
NRR

cc :

Ms. Catherine. Haney
Administrator Region II
U.S. Nuclear Regulatory Commission
Marquis One Tower
245 Peachtree Center Ave., NE, Suite 1200
Atlanta, Georgia 30303-1257

Mr. James R. Hall, Project Manager (ONS)
(by electronic mail only)
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Mail Stop O-8B1
Rockville, MD 20852

Mr. Jeffery Whited, Project Manager
(by electronic mail only)
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Mail Stop O-8B1A
Rockville, MD 20852

Mr. Eddy Crowe
NRC Senior Resident Inspector
Oconee Nuclear Station

INPO (Word File via E-mail)

NRC FORM 366 (11-2015) U.S. NUCLEAR REGULATORY COMMISSION

# LICENSEE EVENT REPORT (LER)

(See Page 2 of form 366 for required number of digits/characters for each block)

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2018



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**4. TITLE**
Broken Electrical Conductor Supplying Unit 3 Start-up Transformer

| 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 |
| | | | | | | | | | NA | 5000 |
| 12 | 07 | 2015 | 2015 | 002 | 00 | 02 | 05 | 2016 | FACILITY NAME: NA | DOCKET NUMBER: 5000 |

| 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) |
| | ☐ 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) |
| 100 | ☐ 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)* |
|---|---|
| David Haile, Regulatory Affairs Lead Engineer | (864) 873-4742 |

**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

| CAUSE | SYSTEM | COMPONENT | MANU-FACTURER | REPORTABLE TO ICES | CAUSE | SYSTEM | COMPONENT | MANU-FACTURER | REPORTABLE TO ICES |
|---|---|---|---|---|---|---|---|---|---|
| | OEM | CBL | | Yes | | | | | |

| 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)*

At approximately 0820 on 12/07/2015, an Auxiliary Operator was conducting the daily inspection of the unit startup transformer conductors and observed a severed conductor associated with the Unit 3 Startup Transformer (CT-3). The broken conductor was reported to Operations supervision and was subsequently confirmed to render all required offsite sources and one emergency power path as inoperable. The Unit 3 SRO declared CT-3 inoperable at 0847.

Prior to the operator's observation, the only other emergency power path for Unit 3 had been declared inoperable, but was restored to operable at 0841. From 0820 until 0841, the combination of the broken conductor and the other emergency path being declared inoperable, resulted in all Unit 3 power sources credited in Technical Specification 3.8.1 being inoperable, which meets the reporting requirement of 10 CFR 50.73(a)(2)(v) "Event or Condition that Could Have Prevented Fulfillment of a Safety Function."

The failure was determined to be fatigue related. The connection was repaired and there is a planned action that will replace the conductor.

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*Narrative*

## EVALUATION:

Background

The Oconee Nuclear Station (ONS) electrical power system design credits two hydroelectric units within the owner controlled area of the station as its emergency power sources.

The Keowee Hydroelectric Units (KHUs) [EK] consist of two units, each rated at 87,500kVA. Upon a loss of power at the Oconee Nuclear Station (ONS), emergency power can be supplied from either of the KHU units through two separate and independent routes, (i.e., an overhead and underground path).

The basic design criterion for the electrical portion of the emergency electric power system of a nuclear unit, including the generating sources, distribution system, and controls is that a single failure of any component, passive or active, will not preclude the system from supplying emergency power when required. Special provisions have been employed to accomplish this at ONS which include a double bus-double breaker distribution system, redundant circuit breaker trip coils and circuits, diverse protective relaying for each circuit breaker, redundant load shedding and transfer logic equipment, physical separation and other features.

The ONS Limiting Condition for Operation (LCO) for Technical Specification (TS) 3.8.1 "AC Power Sources" contains the following:

The following AC electrical power sources shall be OPERABLE:

1. Two offsite sources on separate towers connected to the 230 kV switchyard to a unit startup transformer and capable of automatically supplying power to one main feeder bus; and
2. Two Keowee Hydro Units (KHUs) with one capable of automatically providing power through the underground emergency power path to both main feeder buses and the other capable of automatically providing power through the overhead emergency power path to both main feeder buses.

The Unit 3 start-up transformer [EB] is designated as CT-3. The alignment of all TS required offsite sources and the overhead emergency power path for Unit 3 require CT-3 as part of the power path. In response to IER L2-12-14 operators have been trained and the operator rounds procedure revised to check the condition of the connections on CT-3 daily. This daily operator check led to the discovery of the broken conductor described below.

EVENT DESCRIPTION

At 0500 on 12/07/15 the Unit 3 KHU underground path was declared inoperable for planned maintenance because the tag-out removed 1 of the 2 required supply breakers to one of the Main Feeder buses from service. The LCO for TS 3.8.1 requires both supply breakers to redundant feeder buses to be inservice for the underground path to be considered operable.

At approximately 0630 the STA made the Shift Manager aware of tag-out implementation issues with the planned maintenance. The tag-out for this maintenance had reached the point where the automatic function of the supply breaker to one of the Main Feeder Buses was placed in manual, but the tag-out was not complete. No physical work had been performed. The Shift Manager directed the STA to determine if a success path was practical to enable the work to proceed, or if the KHU underground path should be restored.

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***Narrative***

At approximately 0820 the outside Auxiliary Operator (AO) was conducting a daily inspection, associated with IER L2-12-14, of the unit startup transformer conductors. He observed a severed conductor [CBL] that ran between the overhead switchyard power line and a connection on the CT-3 transformer and reported it to the operations Work Control Center(WCC). The WCC sent an SRO to CT-3 to confirm the observation. The SRO confirmed the conductor was severed, but because the line splits into 2 lines and 2 terminations and only one termination was affected, technical expertise was needed to determine the effect of the broken conductor. In light of this observation and the earlier issues identified with the KHU underground planned maintenance, the STA recommended that the Unit 3 KHU Underground supply breaker for MFB #1 be restored and the Shift Manager concurred. At 0841, the KHU underground path for Unit 3 was returned to operable.

Meanwhile, a transmission subject matter expert inspected the affected connection and confirmed to the Shift Manager that the broken conductor was the power supply line for the Y-phase of the transformer and that the transformer was disabled by this condition. CT-3 was declared inoperable at 0847.

The timeline above describes a situation where the KHU underground power path was declared inoperable and concurrently, the broken conductor creates a disabled power path for all offsite supplies and the KHU overhead power path. Therefore, all power paths required by TS 3.8.1 were either disabled or inoperable.

Although one subcomponent (the supply breaker to Main Feeder Bus #2) of the KHU underground path was available to supply emergency loads, the KHU underground had to be declared inoperable because it could not meet the LCO for TS 3.8.1. The 10 CFR 50.73(a)(2)(v) reporting criteria requires one of the "AC Power sources" to be operable and available in order to be credited for fulfilling the system's safety function. NRC clarifications on this reporting criteria presumes that without TS operability, a SSC's capability is at a point where a reasonable expectation of reliable performance can no longer be assumed. Therefore, because the KHU underground was declared inoperable, the availability of MFB #2 cannot be credited for fulfilling the system safety function under this reporting criteria.

The combination of having KHU underground declared inoperable during a time when CT-3 was known to be inoperable, resulted in all power sources required by TS 3.8.1 to be unable to perform their safety function for approximately 21 minutes, and therefore meets the requirements of 10 CFR 50.73(a)(2)(v) to be reported as an LER.

CAUSAL FACTORS

The failure of the drop line conductor occurred at the connection point to the transformer bushing and was due to fatigue cracking/shearing. Over the span of the plant's commercial operation, environmental conditions created occurrences of overhead bus line movement which was transmitted to the drop line and created the fatigue loading that caused the failure.

A cause investigation is being finalized at the time this LER is issued. If the investigation final results produce a substantial change in the characterization of the cause, a supplemental report to revise this LER will be submitted.

CORRECTIVE ACTIONS

Immediate:

1. KHU underground was restored to operable,
2. Appropriate power related equipment was administratively protected.

Subsequent:

1. The broken Y-phase conductor was repaired and the conductors to the other two phases were trimmed and re-terminated. All the connections were tested.
2. Similar connections for other transformers were inspected and re-terminated as needed, as part of extent of condition actions.
3. CT-3 was returned to operable at 0755 on 12/8/15.

Planned:

1. The drop line conductors to each startup transformer will be replaced during their next respective refueling outage.
2. Additional actions will be implemented as identified via the causal analysis being performed in accordance with the Corrective Action Program.

SAFETY ANALYSIS

The scope of the reportability criteria applicable to this LER is limited to the safety function of a system, in this case, the AC Power Sources system. The safety of the plant is based on multiple systems that operate with diverse and overlapping functions to create a defense in depth design for addressing safety challenges. Although, all power sources required by TS 3.8.1 were inoperable, there was one source of power to emergency loads that remained available for the entire duration of the event. In addition, there are multiple alternate power sources that can supply equipment that allows safe shutdown of the units without the power supplies of TS 3.8.1.

A qualitative review was conducted which determined that this condition had a negligible effect on the health and safety of the public. As discussed above, the supply breaker to power MFB #2 remained operable and in "Auto". In the unlikely event that the breaker for MFB #2 failed to close, a simple manual action could return the supply breaker for MFB #1 to service by procedure. Even in the event the KHU underground path was lost and was not quickly restored, the plant could still reach and maintain a safe condition using the Standby Shutdown Facility (SSF) or the Protected Service Water (PSW) facilities, which have independent power supplies that were operable while the CT-3 condition existed. These additional proceduralized options for preventing core damage and the very short time frame that the condition existed (21 minutes) further reduce the impact of the event, resulting in a negligible risk impact.

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***Narrative***

ADDITIONAL INFORMATION

Similar Events: A search of the Oconee Corrective Action Program (CAP) database was conducted for the preceding three year period ONS submitted two LERs in the past 3 years under the same 10 CFR 50.73(a)(2)(v) criteria, but neither were similar in cause. One LER was due to an inadequate design of heat removal equipment related to emergency power sources. The other LER was due to inadvertent closing of a valve in one train when the other train was inoperable. No other LERs were found related to transformer failure/inoperability or loss of TS required power sources.

Energy Industry Identification System (EIIS) codes are identified in the text as [XX]. There were no releases of radioactive materials, radiation exposures in excess of limits or personnel injuries associated with this event.