Entergy

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JAFP-14-0069
June 26, 2014

United States Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Subject: LER: 2012-001-01, Unit Cooler Fan Motor Contactor Low Voltage Test Failure Results in Loss of Safety Function and Condition Prohibited by the Technical Specifications
James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
License No. DPR-59

Reference: 1. Entergy letter to NRC, LER: 2012-001, Unit Cooler Fan Motor Contactor Low Voltage Test Failure Results in Loss of Safety Function and Condition Prohibited by Technical Specifications, JAFP-12-0066 dated June 18, 2012

Dear Sir or Madam:

This letter submits a revision to LER: 2012-001, submitted by letter dated June 18, 2012 [Reference 1]. Reference 1 was submitted in accordance with 10 CFR 50.73(a)(2)(i)(B), "Any operation or condition which was prohibited by the Plant's Technical Specifications" and 10 CFR 50.73(a)(2)(v)(D), "Any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident." This revision clarifies the event reported in Reference 1.

There are no commitments contained in this report. Questions concerning this report may be addressed to Mr. Chris Adner, Manager, Regulatory Assurance at (315) 349-6766.

Sincerely,

Lawrence M. Coyle
Site Vice President

LMC/CMA/ds

Enclosure(s): JAF LER 2012-001-01, Unit Cooler Contactor Low Voltage Test Failure Results in Loss of Safety Function and Condition Prohibited by the Technical Specifications

cc: USNRC, Region 1
USNRC, Project Directorate
USNRC, Resident Inspector
INPO Records Center (ICES)

NRC FORM 366 (01-2014) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 01/31/2017

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, 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.

# LICENSEE EVENT REPORT (LER)

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

| 1. FACILITY NAME | 2. DOCKET NUMBER | 3. PAGE |
|---|---|---|
| James A. FitzPatrick Nuclear Power Plant | 05000333 | 1 OF 8 |

**4. TITLE**

Unit Cooler Fan Motor Contactor Low Voltage Test Failure Results in Loss of Safety Function and Condition Prohibited by the Technical Specifications

| 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 |
| | | | | | | | | | N/A | N/A |
| 01 | 26 | 2012 | 2012 | - 001 | - 01 | 06 | 26 | 2014 | FACILITY NAME: N/A | 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)(i)(C) | ☐ 50.73(a)(2)(vii) |
| | ☐ 20.2201(d) | ☐ 20.2203(a)(3)(ii) | ☐ 50.73(a)(2)(ii)(A) | ☐ 50.73(a)(2)(viii)(A) |
| | ☐ 20.2203(a)(1) | ☐ 20.2203(a)(4) | ☐ 50.73(a)(2)(ii)(B) | ☐ 50.73(a)(2)(viii)(B) |
| | ☐ 20.2203(a)(2)(i) | ☐ 50.36(c)(1)(i)(A) | ☐ 50.73(a)(2)(iii) | ☐ 50.73(a)(2)(ix)(A) |
| **10. POWER LEVEL** | ☐ 20.2203(a)(2)(ii) | ☐ 50.36(c)(1)(ii)(A) | ☐ 50.73(a)(2)(iv)(A) | ☐ 50.73(a)(2)(x) |
| | ☐ 20.2203(a)(2)(iii) | ☐ 50.36(c)(2) | ☐ 50.73(a)(2)(v)(A) | ☐ 73.71(a)(4) |
| 100 | ☐ 20.2203(a)(2)(iv) | ☐ 50.46(a)(3)(ii) | ☐ 50.73(a)(2)(v)(B) | ☐ 73.71(a)(5) |
| | ☐ 20.2203(a)(2)(v) | ☐ 50.73(a)(2)(i)(A) | ☐ 50.73(a)(2)(v)(C) | ☐ OTHER |
| | ☐ 20.2203(a)(2)(vi) | ☑ 50.73(a)(2)(i)(B) | ☑ 50.73(a)(2)(v)(D) | Specify in Abstract below or in NRC Form 366A |

**12. LICENSEE CONTACT FOR THIS LER**

| LICENSEE CONTACT | TELEPHONE NUMBER *(Include Area Code)* |
|---|---|
| Mr. Chris M. Adner, Regulatory Assurance Manager | 3153496766 |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| B | ED | CL | G080 | Y | | | | | |

| 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 1/26/12, a first time low voltage pickup test was performed for 71MCC-163-OE5 (East Crescent Unit Cooler 66UC-22H Fan Motor). The contactor picked up at 102 VAC versus the 90 VAC Level 2(1) Acceptance Criteria. A calculation was performed to determine Level 1(1) Acceptance Criteria for this application. The Level 1 Acceptance Criterion was established as 97 VAC. The Unit Cooler was therefore non-functional, and is assumed to have been non-functional for a period of three years prior to the time of discovery. 66UC-22H is one of five Unit Coolers in the East Crescent Area Ventilation Subsystem. A review of historical plant data identified five occurrences where the non-functional 66UC-22H resulted in the East Crescent Area Ventilation Subsystem being incapable of performing its specified function, and therefore non-functional. The East Crescent Area Ventilation Subsystem is required to support operability of the ECCS equipment located in the East Crescent. This ECCS equipment was therefore inoperable during the five time periods that were identified. This condition is prohibited by plant Technical Specifications, and resulted in the loss of safety function for the single train HPCI System.

Revision 1 is submitted as clarification, and to correct inaccuracies in the original report relative to how the reporting requirements of 10 CFR 50.73(a)(2)(i)(B) are met by this condition.

**NARRATIVE**

## BACKGROUND

In August 2005, during a Nuclear Regulatory Commission (NRC) inspection, the NRC inspection team requested verification that 600 Volts-Alternating Current (VAC) Motor Control Centers (MCC) control circuits [EIIS System Identifier: ED] provided the required minimum pickup voltage to the contactors. On August 10, 2005, JAF-CALC-05-00117 Revision 0 was issued to document the results. This calculation showed that the minimum pickup voltage of the installed General Electric (GE) contactors was at least 85% of the rated contactor voltage of 120 VAC, or 102 VAC. However, based on Stone and Webster calculation E-81, Rev. 0, "Under Voltage Study of Class 1E Equipment" and GE Topical Report NEDC 30694-P, "7700 Series Motor Control Center Qualification Report", which documented that electromechanical devices such as contactors pick up at voltages lower than published, 90 VAC was used as the low voltage pickup setpoint. The selected value provided a minimum of 5 VAC margin below the calculated worst case available voltage across the contactor coils of 95 VAC.

On December 15, 2005, as part of corrective actions, Procedure MP-056.01, Revision 56, "AC Motor Control Center Maintenance and Subcomponent Replacement" was revised to perform low voltage pickup testing of all safety related NEMA size 1, size 2, and size 3 contactors to verify contactor pickup at 90 VAC in the preventative maintenance (PM) program. This testing was scheduled to be performed as part of the James A. FitzPatrick Nuclear Power Plant (JAF) PM program for safety related MCC contactors. All safety related contactors were included as part of this population.

Between December 15, 2005, and January 26, 2012 several contactors were tested using the revised PM strategy for low voltage testing. Condition Reports were initiated documenting nine (9) failures, including the failure described in this LER, to meet the established Level 2 acceptance criterion. Except for the failure described in this LER, each of the other documented failures were classified as non-significant. The previous eight (8) failures were classified as non-significant because either the contactor pickup: 1) met the Level 1 acceptance criterion; 2) did not occur on the contactor required for performance of the Technical Specifications (TS) / safety function; 3) resulted from using incorrect M&TE; or 4) were associated with equipment that is not required to pick up under degraded voltage conditions.

As a result of the failure identified in this LER, an extent of condition review determined that there was an additional failure that was not documented in the corrective action program at the time of failure. When that failure was identified and evaluated, it was determined that the subject contactor would have failed Level 1 criteria. If that failure had been known at the time of the evaluation of this condition, it would have constituted a history of similar failure and this LER would have been submitted at that time.

Revision 1 is submitted as clarification, and to correct inaccuracies in the original report relative to how the reporting requirements of 10 CFR 50.73(a)(2)(i)(B) are met by this condition.

## EVENT DESCRIPTION & ANALYSIS

On January 26, 2012, MP-056.01, Revision 74, was performed on 71MCC-163-OE5, 66UC-22H (M) East Crescent Area Unit Cooler Breaker [BI]. This was the first time the low voltage pickup test had been performed for this contactor. The PM found that the as-found pickup voltage was 102 VAC versus the required value of 90 VAC (Level 2 acceptance criterion). As part of the corrective actions, the contactor was subsequently cleaned, lubricated, and the coil replaced. Return to service testing was satisfactory and the unit cooler was returned to service. To assess the significance of the contactor failure, electrical design engineering calculated the available voltage across the contactor coil for a postulated worst case degraded grid voltage condition concurrent with a design basis, loss of coolant accident (LOCA) (Level 1 Acceptance Criterion). The preliminary calculation determined that 97 VAC would have been available at the contactor. As a result, it was determined that the contactor would not have picked up if required during a design basis LOCA concurrent with a worst case degraded voltage scenario. Therefore, unit cooler 66UC-22H was non-functional.

### Evaluation of the Non-functional East Crescent Area Ventilation as a Support System

66UC-22H is one of five unit coolers in the East Crescent Area. It supports the functionality of the East Crescent Area Ventilation Subsystem (TRO 3.7.C). The Crescent Area Ventilation Subsystem in the East and West Crescent area are required to support operability of the ECCS and RCIC. The condition detailed in this report resulted in the ECCS in the East Crescent Area being inoperable. The inoberability of the ECCS in the East Crescent Area is limited to the five occurrences identified in the past functionality review (discussed below). During these five occurrences, the single train HPCI system was inoperable, resulting in a loss of safety function which is reportable under 10 CFR 50.73(a)(2)(v)(D).

This condition affects only the East Crescent Area; therefore, the Core Spray (CS) and Residual Heat Removal (RHR) Systems [BO] would not experience a loss of safety function because the redundant subsystems in the West Crescent Area would remain operable. Although this condition does not result in the loss of CS and RHR safety function, the 'B' divisions of these two systems are located in the East Crescent Area. Therefore, these two subsystems are rendered inoperable as a result of this condition. TS LCO 3.5.1 states the following, "Each ECCS injection/spray subsystem…shall be OPERABLE." The Required Actions and associated Completion Times of TS LCO 3.5.1 were not met for this condition. Therefore, this report is also being submitted pursuant to 10 CFR 50.73(a)(2)(i)(B) as a condition prohibited by the TS.

### Past Functionality Review

A period of three years prior to the time of discovery was considered for review of past functionality. There are two scenarios when the loss of 66UC-22H resulted in a loss of the East Crescent Area Ventilation Subsystem in the previous three years: (A) two non-functional unit coolers, and (B) one non-functional unit cooler with lake temperatures in excess of the maximum (as established in the most recent thermal performance testing).

(A) Three Unit Coolers

During the period of past functionality review, there were two instances where an east crescent unit cooler was removed from service for planned maintenance. East crescent unit cooler 66UC-22F was out of service for maintenance from May 5, 2010, 0300 through May 21, 2010 0800, a period of 11 days 5 hours. East crescent unit cooler 66UC-22K was out of service for maintenance from March 15, 2011, 1027 through March 25, 2011, 0735, a period of 9 days 21 hours 8 minutes. During these maintenance activities 66UC-22H was in operation and credited as being one of the four functional unit coolers. Since the condition being evaluated assumes 66UC-22H was non-functional there were only three unit coolers that were functional during these two maintenance periods. The TRM Bases require at least four unit coolers to be functional to support functionality of the host Crescent Area Ventilation subsystem. Therefore, the East Crescent Ventilation subsystem was non-functional on these two occasions.

(B) Four Unit Coolers and Maximum Lake Temperature Exceeded

Excluding the time periods detailed above, the loss 66UC-22H resulted in a total of four functional unit coolers in the East Crescent Area. Per the TRM Bases, the functionality of the corresponding Crescent Area Ventilation subsystem under this condition is established by thermal performance testing. Thermal performance testing periodically establishes the maximum lake temperature at which four functional unit coolers can support operability of the ECCS and RCIC. There were three occasions when the lake temperature exceeded the calculated maximum. The East Crescent Ventilation subsystem was non-functional for these three time periods.

| Year | Calculated Max Allowable Lake Temperature (degrees F) | Time that Lake Temperature Was Above Max (days) |
|---|---|---|
| **2009** | 79.56 | 7[(a)] |
| **2010** | 79.92 | 1[(b)] |
| **2011** | 80.95 | <1[(c)] |
| **2012** | 77.80 | 0 |

*[(a)] August 16th – 23rd*
*[(b)] August 5th – 6th Fluctuating temperatures resulted in intermittent excesses*
*[(c)] July 31st Approximate half-hour duration*

**Summary of Facts:**

- The contactor coil picked up at 102 VAC versus the required 90 VAC (Level 2 acceptance criterion).
- The 90 VAC setpoint was established in December 2005 based on input from Stone and Webster Calculation E-81, Rev. 0, “Under Voltage Study of Class 1E Equipment”. This is documented in JAF-CALC-05-00117.
- The 90 VAC setpoint was chosen as the Level 2 acceptance criterion for the initial low voltage pickup test based upon bounding initial calculations. Calculating the voltage required for each of the 179 contactors was not practical as it would be different for each application. Specific calculations to establish Level 1 acceptance criterion were to be performed on an as needed basis.
- For the 71MCC-163-OE5 (MC) failure, engineering calculated the available voltage across the contactor coil in the case of a postulated worst case degraded grid voltage concurrent with a design basis LOCA (Level 1 acceptance criterion). The value was calculated to be 97 VAC.

## CAUSE OF EVENT

### Mechanistic

The most probable mechanistic cause of this event is that a higher coil impedance, consisting of higher than expected resistance and inductance, resulted in lower current within the coil. This reduced current resulted in less magnetic force which required a higher voltage to pickup the contactor. This could have been caused by either a newly installed coil that would not pass the low voltage test or a coil that degraded over time. Since this is a first time PM activity, there is no historical information available to establish if the low voltage pickup test value of 102 VAC had degraded over time or if the originally installed coil would not have satisfied the low voltage acceptance criteria when it was first installed.

### Programmatic

The programmatic cause of this event was inadequate program monitoring or management as evidenced by a lack of program improvement over time (i.e. failure to predict this failure based on the prior 8 failures). Even though the contactors were rated for a pickup voltage of 102 VAC, other contactors of this type had been previously tested as low as 85 VAC which supported the 90 VAC setpoint. As a result, JAF relied on the manufacturing qualification testing to meet its design.

## EXTENT OF CONDITION

The extent of condition review considered all safety related NEMA 1 contactors that have not been tested at least once. This population was further broken down into two groups: (1) Crescent Area Unit Coolers, and (2) All others. The first group for the Crescent Area Unit Coolers is more safety significant because they provide cooling to Emergency Core Cooling System (ECCS) components.

Two coolers (71MCC-153-OE4 (MC) for 66UC-22E and 71MCC-163-OE4 (MC) for 66UC-22F) are manually controlled and are continuously operating. Because these unit coolers are manually controlled the main contactor coil would be energized prior to a design basis LOCA coincident with a degraded voltage condition, so the coils would remain energized and would not have to pick up under the degraded voltage scenario.

All of the unit coolers in East and West Crescent Areas were tested, and this was the only failure.

## FAILED COMPONENT IDENTIFICATION

Description: Main Contactor Coil
Manufacturer: General Electric Company
Model/Part Number: 15D21G22
NPRDS Manufacturer Code: G080
FitzPatrick Component ID: 71MCC-163-OE5(MC), Motor Controller

## CORRECTIVE ACTIONS

### Completed

- Cleaned, lubricated and reused contactor with a new coil. The low voltage test was performed satisfactorily. Complete 1/26/2012
- Performed an extent of condition review to determine which crescent area unit cooler contactors have been tested. Identified results of a failure of a contactor pickup test performed in 2010 which had not been documented in the condition reporting system.
- Performed preliminary calculations to determine the voltage available at the remaining unit cooler contactors.
- The aforementioned preliminary calculation required the other unit cooler contactors below to be tested before the lake reached summer temperatures:
    - 71MCC-163-OE2 (MC) for 66UC-22B
    - 71MCC-153-OE3 (MC) for 66UC-22C
- Reviewed each remaining contactor that had not been tested to determine if its safety function would require an immediate performance of this first time low voltage pickup test.
- Tested the remaining contactors as determined by the results of the above corrective action.

## ASSESSMENT OF SAFETY CONSEQUENCES

The significance of this condition is based on the safety function performed by 71MCC-163-OE5 (MC). This contactor supplies power to safety related 66UC-22H(M), East Crescent Area Unit Cooler Fan Motor. The unit coolers provide cooling to various safety related ECCS and RCIC systems in the East and West Crescent Areas.

### Radiological & Industrial Safety

There were no actual or potential radiological or industrial safety consequences as a result of this condition.

### Nuclear Safety

There were no actual nuclear safety consequences associated with this condition. At no time during previous three (3) years was the coil for 66UC-22H(M) required to pick up under degraded voltage conditions.

The potential nuclear safety consequences are described as follows: if the 115KV offsite voltage remains just above its degraded voltage setpoint with accident loads, the resultant voltage drop in the circuit could have resulted in the inability of the 66UC-22H(M), East Crescent Area Unit Cooler fan to automatically start during an accident concurrent with a worst case degraded voltage. This would have resulted in one known Crescent Area Unit Cooler failure, which could have impacted the ability to ensure cooling to the ECCS equipment located in the East Crescent Area as discussed in the event analysis. The potential safety consequences of this condition are minimized by the redundant design of the ECCS. The ECCS equipment in the West Crescent Area was unaffected by this condition. As stated in FSAR Section 6.5.4 “Emergency Core Cooling System Redundancy,” the integrated performance of the ECCS provides adequate and timely core cooling over the entire spectrum of postulated accidents, including a Design Basis LOCA with concurrent loss of offsite power.

## SIMILAR EVENTS

A review of Entergy condition reports did not identify any relevant information across the Entergy fleet.

A review of Operating Experience on the INPO website, however, identified several related issues. One plant reported loose coil retaining clips. The loose clips could cause a voltage drop across the coil terminal connections. During interviews with JAF electricians there was no report of loose coil retaining clips, which supported the cause determination for this condition. In addition, several plants documented sticking auxiliary contacts and sticking grease. This condition was also not reported during interviews with JAF electricians.

NRC INFORMATION NOTICE 94-50, “FAILURE OF GENERAL ELECTRIC CONTACTORS TO PULL IN AT THE REQUIRED VOLTAGE”, documented an instance at Nine Mile Point Unit 2 where the incorrect coil was installed in certain contactors. This resulted in pickup voltages of 96 VAC. GE stated that special coils should have been installed which would have allowed a lower pickup voltage and that an incorrect or degraded coil would be identified by testing prior to installation. This OE is not applicable at JAF because the correct coils were installed.

## REFERENCES

- JAF Condition Reports: CR-JAF-2005-03427, CR-JAF-2006-01333, CR-JAF-2006-04202, CR-JAF-2006-05358, CR-JAF-2007-02313, CR-JAF-2008-00922, CR-JAF-2008-03340, CR-JAF-2009-02853, CR-JAF-2011-04593, CR-JAF-2012-00584, CR-JAF-2012-2288, CR-JAF-2008-03338
- JAF-CALC-05-00117, Perform 600 Volt MCC Control Circuit Voltage Drop Calculation To Verify The Minimum Pickup Voltage For Selected Contactor Circuits
- Technical Requirements Manual TRO 3.7.C, Crescent Area Ventilation System
- Technical Specification 3.5.1, ECCS – Operating
- Technical Specification 3.5.3, RCIC System
- MP-056.01 AC Motor Control Center Maintenance and Subcomponent Replacement
- GE Topical Report NEDC-30694-P, 7700 Series Motor Control Center Qualification Report for the James FitzPatrick Nuclear Power Plant
- AP 19.01, Surveillance Testing Program
- ST-8Q, Testing of the Emergency Service Water (ESW) System

Endnotes

(1) Definitions – Source: AP 19.01, Surveillance Testing Program

Level 1 Acceptance Criteria:
The measure that defines characteristics of a system or component that, if not met, result in a violation of TS, TRM, ODCM or plant safety design bases as stated in the UFSAR or Procedure EN-DC-167.

Level 2 Acceptance Criteria:
The measure that defines performance expectations of a system or component not addressed in Level 1 Acceptance Criteria. A failure to meet Level 2 criteria may be a precursor to Level 1 failure but should not result in components or systems being inoperative (JTS-94-0378).