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Michael J. Colomb
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December 4, 2012
JAFP-12-0148

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

SUBJECT: LER: 2012-005, Transformer Installation Error Causes Loss of Off-Site Power
James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
License No. DPR-59

Dear Sir or Madam:

This report is submitted in accordance with 10 CFR 50.73(a)(2)(iv)(A) and 10 CFR 50.73(a)(2)(v)(A).

There are no commitments contained in this report.

Questions concerning this report may be addressed to Mr. Chris Adner, Licensing Manager, at (315) 349-6766.

Sincerely,

for MJC

Michael J. Colomb
Site Vice President

MC/CA/mh

Enclosure(s): JAF LER 2012-005, Transformer Installation Error Causes Loss of Off-Site Power

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

NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2013

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 Records and FOIA/Privacy Service 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)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
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4. TITLE

Transformer Installation Error Causes Loss of Off-Site Power

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	05000
10	05	12	2012	– 005 –	00	12	4	12	FACILITY NAME N/A	DOCKET NUMBER 05000

9. OPERATING MODE

5

10. POWER LEVEL

0

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☐ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☒ 50.73(a)(2)(iv)(A)
- ☒ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Mr. Chris Adner, Licensing Manager	(315) 349-6766

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
A	FK	IT	S188	Y					

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 10/5/12 at 1301, the James A. FitzPatrick Nuclear Power Plant experienced a loss of off-site power. This event occurred after both Reserve Station Service Transformers, 71T-2 and 71T-3, were replaced during Refueling Outage 20. Several hours after installation a maintenance activity which applied a load to the transformer caused a trip of 71T-3 resulting in the loss of off-site power. Investigation identified that the phase A differential protection relay, 71-87-A-1RSSA01, for 71T-3 tripped because the shorting bars (a factory setting) were not removed during installation. The loss of off-site power resulted in a loss of Reactor Protection System power which caused an automatic Primary Containment Isolation System isolation of Reactor Water Clean-Up and Drywell floor and equipment drains. The Emergency Diesel Generators started but one EDG output breaker did not close. In addition, the loss of power caused a loss of Emergency Response communications response capability. This event was reported to the NRC by ENS 48386. The root cause was determined to be not following the work order instructions as written. A contributing cause was an incorrect design drawing.

NARRATIVE

BACKGROUND

Reserve Station Service Transformer Description:

The function of the Reserve Station Service Transformers (RSST) is to provide a means for taking power from the offsite 115kV power grid (115kV Lines 3 and 4) via the 115kV switchyard [EIIS System Identifier: FK] and stepping it down to the 4160V level required by the plant AC distribution system. During plant operation, the auxiliary plant loads are normally supplied by transformer 71T-4 (Normal Station Service Transformer), while 71T-2 and 71T-3 (RSSTs) supply power during accident, refueling/shutdown, and startup conditions.

In the design basis Loss of Coolant Accident (LOCA), the 115 kV transmission lines must maintain adequate voltage after a generator trip to allow the RSSTs connected to the 115 kV system to power all connected loads, including Emergency Core Cooling System (ECCS) loads; without the need for the Emergency Diesel Generators (EDG) [EK] energizing the emergency buses. Post-contingency voltage is monitored frequently by the 115 kV system operator, using a predictive model to confirm that, after a generator trip with the expected emergency loads started and supplied from the RSSTs, the voltage will not decrease sufficiently to cause the emergency busses (71-10500 or 71-10600) to separate from the RSSTs. If power is lost to the emergency busses then an under voltage signal is received and the EDGs are used to energize the busses.

Transformer Replacement:

JAF identified that under certain postulated 115kV grid conditions, Lighthouse Hill Line #3 cannot provide adequate voltage to supply normal and emergency electrical loads. Prior to Refuel Outage 20 (R20), the RSSTs did not have on-load tap changing capability; therefore, the station could not adjust 4160V levels on the station AC power system to cope with varying voltage levels on the 115kV offsite power system. To address this condition, JAF established an agreement with the system operator, National Grid, to maintain minimum 115kV voltage levels above the New York Independent System Operator (NYISO) allowed value. Based on this condition, replacement of the RSSTs became a recommended solution.

Engineering Change (EC) 12703, “Replace Reserve Station Service Transformers,” was created to evaluate the transformer replacement. The transformers selected for replacement of 71T-2 and 71T-3 were purchased to design, material, manufacturing codes and standards that meet or exceed the original specification requirements of the pre-R20 transformers. The transformers were sized to ensure they meet the capacity requirements of the RSST application with margin for future load growth, while utilizing the existing RSST foundations and associated infrastructure.

EVENT DESCRIPTION & ANALYSIS

At 13:01 on 10/5/2012, JAF experienced a loss of off-site power when 71T-3 tripped. This event occurred after both RSSTs, 71T-2 and 71T-3, were replaced during R20. Several hours after installation a maintenance activity which applied a load to the transformer caused a trip of 71T-3 resulting in the loss of off-site power. Investigation identified that the phase A differential protection relay, 71-87-A-1RSSA01, for 71T-3 tripped because the shorting bars (a factory setting) were not removed during installation. In addition, the loss of power caused a Reactor Protection System actuation and a loss of emergency response communication capability. This event was reported to the NRC by ENS 48386. This event is reportable under 10 CFR 50.73(a)(2)(iv)(A), system actuation and 10 CFR 50.73(a)(2)(v)(A), loss of safety function.

System actuation:

The loss of off-site power resulted in an instantaneous loss of Reactor Protection System (RPS) power. This caused an automatic Primary Containment Isolation System (PCIS) isolation of Reactor Water Clean-Up (RWCU) [CE] and Drywell [VB] floor and equipment drains. There were no complications with the valves' isolation actuations. The plant was in Mode 5 due to R20 with all control rods [AA] were already inserted.

The Emergency Diesel Generators (EDG) started due to an emergency bus under voltage signal. JAF has two EDGs per division and two divisions. The division 1 EDG-A and EDG-C supply loads on the 71-10500 bus and the division 2 EDG-B and EDG-D supply loads on the 71-10600 Bus. All four EDGs started as designed but EDG-A output breaker, 71-10502, did not automatically close. The breaker was manually closed by Operators.

The design for a loss of off-site power event is for the EDGs to start and force parallel both EDGs within each division for both divisions. The JAF design provides for a single failure-proof supply of on-site AC power adequate for the safe shutdown of the reactor following postulated accidents. For events other than a LOCA, a single generator provides sufficient power through its output breaker to supply the required loads. During this event, EDG-C successfully closed onto the 71-10500 bus to supply the required necessary safe shutdown loads for division 1. It should also be mentioned that the division 2 EDGs (EDG-B & EDG-D) successfully force paralleled and loaded onto the emergency bus 71-10600. In conclusion, both the 71-10500 and 71-10600 emergency buses had sufficient power to energize the safe shutdown loads needed while the reactor was shutdown in Mode 5 for R20. The apparent cause of EDG-A not closing to the emergency bus was misalignment of the 71-10502 breaker.

Transformer trip:

During this event, inappropriate fault conditions were sensed causing relay 71-87-1RSSA01 to actuate. This energized one lockout relay and several auxiliary trip relays. When the 115kV switchyard is in a normal lineup and the auxiliary trip relays actuate, a trip signal is supplied to both of the 115kV off-site supply circuit breakers, 71-10012 and 71-10022. Tripping these circuit breakers on the initial fault signal de-energized the faulted piece of equipment minimizing damage. This resulted in the loss of 115kV off-site power.

At this point, both the 71-10012 and 71-10022 breakers should reclose following their respective re-closure time delay. Due to a failure documented in CR-JAF-2012-06739 two days prior to this event (10/3/2012), the reclose timer for the 71-10022 breaker had been removed, therefore, the re-closure function of the 71-10022 breaker was not available. 71-10012 did reclose as expected and re-energized the 115kV switchyard and the 71T-2 transformer.

Off-site power was then restored by establishing a backfeed through the Normal Station Service Transformer (71T-4). At 0308 on 10/6/12, Operations completed the restoration of 345kV backfeed and restored off-site power. By 0512 on 10/7/12 the deficiency was corrected and the RSSTs were returned to service.

Current transformers:

Current transformers (CT) are instrumented transformers that are used to supply a reduced value of current to meters, protective relays, and other instruments. They are sub-components of the RSSTs. CTs provide isolation from the high voltage primary, permit grounding of the secondary for safety, and step-down the magnitude of the measured current to a value that can be safely handled by the instruments.

The transformer CT lead connections are made in the transformer control panel on shorting terminal blocks. These shorting terminal blocks are equipped with a conductive bar (shorting bar), which is isolated from the block's termination points.

The shorting bar is grounded at one end and equipped with holes over each termination point. The holes are used to allow the installation of a machine screw to connect the shorting bar to a termination point, thereby grounding the CT. See Figure below:

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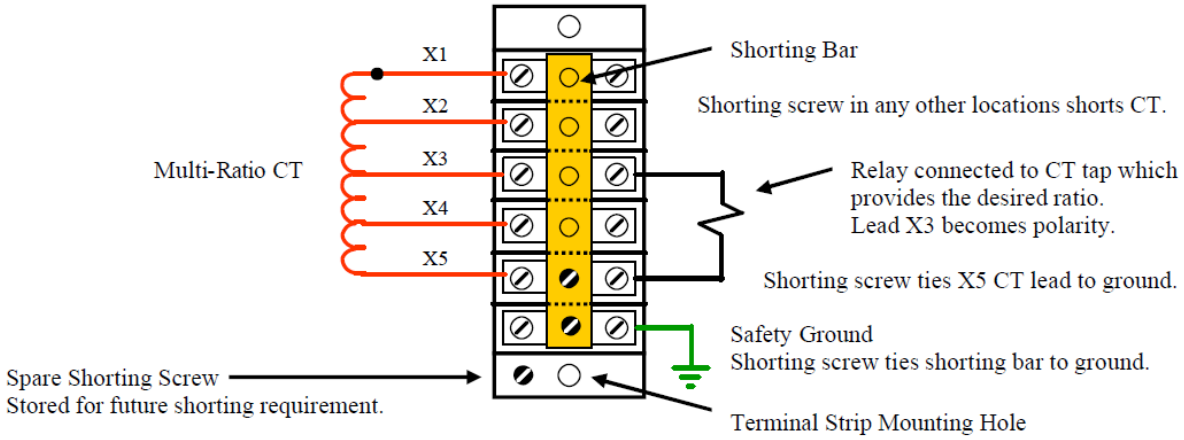

Figure: CT Termination Block

The transformers are shipped from the factory with the CT shorting bars installed. The manufacturer installed the shorting bars to in order to prevent the generation of high voltages in the CT. This precaution protects equipment and personnel safety during transport and storage. The drawing with this factory configuration was included with the work order package used during installation.

Installation instructions:

Separate contracting companies were used for preparation of the Engineering Change and installation of the RSST. The preparers and reviewers of the Engineering Change (EC) 12703 knew and understood that the CTs were shipped with the shorting bars installed. The EC preparer instructed the removal of the shorting bars in the EC topic notes.

The drawing given to the installing contractor was incorrect and showed the shorting bars installed in the CTs. The work order however, contained the appropriate step to remove the shorting bars on the CT terminal blocks for CTs that would be placed in service. Workers questioned this discrepancy and after some review, were directed by the responsible JAF engineer to install the transformer per the drawing. The supervisor for the installing contractor subsequently signed off the work order step indicating the shorting bars were removed and that the step had been verified by engineering.

CAUSE OF EVENT

The root cause of this event was an individual not performing the work order steps as written. The contributing causes were conflicting information between the drawing and the work order instructions; inadequate verbal communication between the project manager and the responsible engineer; and inadequate review of the engineering change in accordance with new requirements specified in revision 6 of EN-DC-149, “Acceptance of Vendor Documents.”

EXTENT OF CONDITION

The extent of condition review found that this condition existed in both RSSTs, 71T-2 and 71T-3.

A review of other transformers on site was also performed. It was determined that the Normal Service Station Transformer (71T-4) was not affected because it was original plant equipment and has been functioning properly since installation. The main transformers, 71T-1A and 71T-1B, were also not affected because a similar condition involving the CTs was corrected in 2008.

CORRECTIVE ACTIONS

Completed Actions

- Performance counseling was performed by the contractor companies for individuals involved with this event.
- The drawing has been updated to reflect the current operational configuration.
- The CT configuration for both RSSTs, 71T-2 and 71T-3, was corrected.

Future Actions

- Coach the contractor Preparer, Reviewer, and Supervisor on the standards and level of detail required by procedure when preparing Engineering Change Packages.
- During Design Engineering Department Stand-down Meeting, discuss the requirements of EN-DC-149, “Acceptance of Vendor Documents” and how use of that procedure could have prevented the drawing error.
- Revise EN-HU-104, “Engineering Task Risk and Rigor” by adding a requirement to consider all modes of operation when evaluating the risk factors outlined in the procedure.
- Conduct performance counseling for individuals involved with this error.

ASSESSMENT OF SAFETY CONSEQUENCES

Radiological & Industrial Safety

During the event a loss of plant lighting occurred. All personnel exited the affected areas without incident. There were no personal injuries or damage to plant equipment. No other industrial safety concerns occurred during the event.

This event had no impact on radiological safety. At no time during the event were radiological conditions affected in the facility. Radiological conditions were unchanged throughout this event and radiological safety was not compromised or reduced for the general public or for the plant staff at JAF.

Nuclear Safety

At the time of the loss of off-site power, the plant was in Mode 5 (Refuel) with reactor water level raised to the refueling cavity weirs and the spent fuel pool gates removed. The Decay Heat Removal (DHR) system and the Spent Fuel Pool Cooling system were in service maintaining the reactor temperature in an 80° to 100°F temperature band.

Entergy Nuclear procedure EN-OU-108, Shutdown Safety Management Program (SSMP), and JAF Administrative Procedure AP-10.09, Outage Risk Assessment, defines the fleet and site specific shutdown safety assessment requirements to ensure nuclear safety is maintained at all times during the shutdown mode of operation.

In accordance with AP-10.09, the following outage risk states were in effect prior to the loss of off-site power:

Decay Heat Removal:	Green
Inventory Control:	Green
Reactivity:	Green
Containment:	Green
Electrical Distribution:	Yellow (due to A Station Battery Testing)

The loss of power resulted in the following outage risk states:

Decay Heat Removal:	Yellow (only one of two required reactor coolant temperature indications available)
Inventory Control:	Orange (Core Spray B available but only one source of power available)
Reactivity:	Green
Containment:	Green
Electrical Distribution:	Red (Tech Spec 3.8.2 – AC Sources Shutdown – not met. No offsite power available)

The ability to remove decay heat from the reactor core and spent fuel pool was not compromised because both the “A” and “B” trains of the DHR system remained available during the course of the event. In addition, Reactor Level was greater than or equal to 22’ 2” above the Reactor Pressure Vessel flange with the fuel pool gates removed and the decay heat load demonstrated to be within the capacity of the DHR system.

The DHR system power supplies were not compromised. The 13.2kV Lake Road supply and the DHR Diesel Generator were not affected by the loss of 115kV Off-Site Power.

Power was restored by reestablishing 345kV backfeed, the power source used during the transformer replacement.

At no time during the event was the health and safety of the public challenged.

SIMILAR EVENTS

10/07/2008: During backfeed of the new AREVA main transformers it was observed that the watt meter had negative indication. Upon review of the indication it was discovered that some of the Current Transformer wiring for the 10052 breaker was wired incorrectly. After further investigation, the design drawings were found to be incorrect and had to be corrected for CT polarity (CR-JAF-2008-03826).

04/18/2010: Shorting screws installed on CTs of a new Unit Auxiliary Transformer were identified prior to placing in-service. After discussions with a relay specialist and contractor representatives, it was confirmed that the removal of shorting screws was required. Contractor representatives indicated that they would take the input from the conference call and revise future connection diagrams to note the shorting screws are required to be removed when placing the CT in service (CR-ANO-1-2010-01885).

04/30/2009: During a main generator replacement, one CT was rewired incorrectly, reversing the polarity. This caused a differential to be sensed by the sensing relay, resulting in a main generator trip at 7% reactor power. During the troubleshooting phase, a computer and an electrical source were used to test polarity of the CTs, leading to the discovery or the incorrect wiring. The apparent cause determined that a post-maintenance test to determine correct wiring was not included in the work order, and would have identified the issue (CR-PLP-2009-02488).

A common theme found during the OE review was incorrect design drawings provided by vendors. With the specific event being documented in this LER, it was determined that not following the work order instructions as written was the cause. A more thorough engineering review may also have prevented this event from occurring. EN-DC-149, “Acceptance of Vendor Documents” did not historically require a rigorous review of vendor prepared documents. However, due to quality issues with vendor products, EN-DC-149 was revised to require a more rigorous review by design engineering prior to acceptance.

REFERENCES

- JAF Condition Reports: CR-JAF-2012-06866, CR-JAF-2012-06868, CR-JAF-2012-06739, CR-JAF-2005-00109
- JAF TS 3.8.1, AC Sources
- JAF FSAR 8.3.2 115 kV System Connections
- Engineering Change 12703, Replace Reserve Station Service Transformers