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Brian R. Sullivan
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JAFP-16-0134
August 23, 2016

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

Subject: LER: 2016-004, Transformer Fault Results in Manual Scram and Secondary Containment Vacuum Below Technical Specification Limit

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)(C).

There are no new regulatory commitments contained in this report.

Questions concerning this report may be addressed to Mr. William Drews, Regulatory Assurance Manager, at (315) 349-6562.

Sincerely,

Brian R. Sullivan
Site Vice President

BRS/WD/mh

Enclosure: JAF LER 2016-004, Transformer Fault Results in Manual Scram and Secondary Containment Vacuum Below Technical Specification Limit

cc: USNRC, Region I Administrator
USNRC, Project Manager
USNRC, Resident Inspector
INPO Records Center (ICES)

NRC FORM 366 (06-2016) U.S. NUCLEAR REGULATORY COMMISSION

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

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 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
James A. FitzPatrick Nuclear Power Plant	05000333	1 OF 5

4. TITLE

Transformer Fault Results in Manual Scram and Secondary Containment Vacuum Below Technical Specification Limit

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
6	24	2016	2016	- 004	- 00	8	23	2016	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)*			
	☐ 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)
1	☐ 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)*
Mr. William Drews, Regulatory Assurance Manager	315-349-6562

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
E	EC	XFMR	G080	N					

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 June 24, 2016, at 1205, several 600V electrical busses lost power when James A. FitzPatrick Nuclear Power Plant was operating at 100% power. A fault in transformer 71T-5 caused a trip of circuit breaker 71-10340. Power was lost to 2 of 3 Reactor Building Closed Loop Cooling (RBCLC) pumps and 2 of 3 lube oil pumps for the Motor-Generator (MG) Set for 'A' Reactor Water Recirculation (RWR). The 'A' RWR pump tripped immediately causing reactor power to reduce to approximately 50%. The remaining RBCLC pump was inadequate to maintain the MG Set fluid drive oil temperature for the 'B' RWR pump so Operators initiated a manual scram at 1236. This event is reportable per 10 CFR 50.73(a)(2)(iv)(A).

The power loss also affected Reactor Building Ventilation (RBV). This system supports the requirement of Technical Specification Surveillance Requirement 3.6.4.1.1 for a differential pressure in Secondary Containment. At the loss of RBV, Secondary Containment automatically isolated and the Standby Gas Treatment system was manually initiated. However, during this short transition the differential pressure requirement was not met. This report is being submitted per 10 CFR 50.73(a)(2)(v)(C).

The apparent cause of the 71T-5 fault was inadequate preventative maintenance which allowed the transformer to remain in service beyond expected service life.

NARRATIVE

Background

James A. FitzPatrick Nuclear Power Plant (JAF) 600V electrical distribution system [EIIS identifier: EC] is supplied by stepping down 4160V to 600V through one of twelve transformers (T-5 to T-16). Nonsafety-related electrical busses are supplied by T-5 to T-12 and safety-related electrical buses by T-13 to T16. (See Figure: Electrical Distribution).

A transformer uses a type of cellulose paper insulation between windings. The insulator material must have a large enough dielectric property to prevent electrical breakdown under high voltages. Electrical faults can occur if the insulator material degrades or becomes damaged. Many outdoor transformers are liquid-immersed using a highly refined mineral oil that cools and insulates the windings. Since electrical faults could breakdown the oil into combustible gases, extra fire protection measures are needed when using them indoors. Dry-type transformers use air cooling instead of oil. Both dry-type and liquid-immersed transformers are often self-cooled by natural convection. As power ratings increase, transformers are often cooled by forced-air cooling, forced-oil cooling, water-cooling, or combinations of these. All twelve 4160V to 600V transformers at JAF are dry-type and force-air cooled except T-5 and T-13 which are dry-type and convection cooled.

This licensee event report (LER) addresses an electrical fault in T-5 caused by insulation breakdown.

Event Description

On June 24, 2016, at 12:05, when JAF was operating at 100% power, several 600V electrical busses lost power. A fault in 71T-5 caused breaker 10340 to trip. This breaker connects 4160V to four transformers which each provide power to a 600V bus: 11300 (L-13), 12300 (L-23), 13300 (L-33), and 14300 (L-43). These electric buses provide power to a variety of nonsafety-related plant loads; notable equipment include:

- Reactor Water Recirculation (RWR) [AD], 2 of 3 Motor-Generator (MG) Set lube oil pumps for “A” recirc pump and 1 of 3 MG Set lube oil pumps for “B” recirc pump.
- Reactor Building Closed Loop Cooling (RBCLC) [CC], 2 of 3 pumps
- Fuel Pool Cooling [DA], 1 of 2 recirculation pumps
- Reactor Building Ventilation (RBV) [VA], 2 of 3 supply fans and 2 of 4 exhaust fans
- Service Air [LF], Instrument Air [LD], and Breathing Air [LH], 2 of 3 air compressors
- Reactor Water Cleanup [CE], 1 of 2 pumps

Immediately following breaker 10340 trip “A” RWR pump tripped causing reactor power to decrease to approximately 50%. MG Set fluid drive oil temperature for the “B” RWR pump began to rise because the single RBCLC pump was insufficient to maintain its temperature.

Three of four nonsafety-related 600V electric buses affected by this event were crossed tied to the other four nonsafety-related 600V electric buses. This was not done for L-13 since the source of the fault was not known during the event.

When power was lost to RBV fans, Secondary Containment [NG] automatically isolated and differential pressure began to degrade. Standby Gas Treatment (SBGT) [BH] was manually initiated and differential pressure was restored by 12:19.

At 12:36, Operators initiated a manual scram. The event was reported to the NRC as ENS 52042.

Event Analysis

Secondary Containment

The RBV supports the requirement of Technical Specification Surveillance Requirement 3.6.4.1.1 for a differential pressure in Secondary Containment. With the loss of RBV, Secondary Containment was automatically isolated and the SBGT was manually initiated, as designed. However, during this short transition the differential pressure requirement was not met. This condition could have prevented the fulfillment of a safety function to control the release of radioactive material; reportable per 10 CFR 50.73(a)(2)(v)(C).

System Actuations

Reactor Protection System (RPS) was actuated by a manual scram, resulting in all control rods inserting successfully. This event resulted in the actuation of RPS and containment isolations in multiple systems; reportable per 10 CFR 50.73(a)(2)(iv)(A).

71T-5 Service Life

The insulation system of a dry type transformer under the combined thermal, electrical, mechanical, and environmental stresses undergoes gradual deterioration, which ultimately leads to transformer failure. The life expectancy of insulation decreases with higher temperatures. A typical life span for dry-type transformers is more than 20 years. As discussed in the similar events section, 71T-5 failed in 1992 after 19 years of service. It was refurbished and used for 24 years until the failure described in this LER.

Although 71T-5 loading varies based on operational needs, the typical load is between 700 KVA and 900 KVA with a possibility of exceeding the 1000 KVA limit for short periods from additional intermittent loads. Transformer 71T-5 has the highest continuous load of all the 600 VAC sub-station switchgear transformers at JAF.

The preventive maintenance (PM) of 71T-5 included inspection, cleaning and insulation resistance testing. This PM was last performed in 2002. These PM practices alone would not have mitigated the effects of transformer load on transformer life; however, it may have alerted the station to evidence of load induced overheating as well as provided “cleaning” which, can reduce heat induced failures.

A review of the preventative and predictive maintenance strategies for large dry-type transformers was performed which included EPRI (Electric Power Research Institute), fleet and industry. For the classification of 71T-5, EPRI would not recommend any tasks be performed. However, other industry best practice PM templates included more extensive electrical tests (i.e. Doble test, polarization, exciting current, core ground, surge comparison), annual thermography, and more frequent cleaning, inspecting, and operator walkdowns.

Cause

The direct cause of the manual scram and secondary containment differential pressure excursion was a fault on the primary side windings on 71T-5. The apparent cause of the 71T-5 fault was inadequate preventative maintenance which allowed the transformer to remain in service beyond expected service life.

Similar Events

On June 23, 1992 (LER-92-034-01), 71T-5 failed during relatively high electrical loads after being in service since 1973. The heat from the fully loaded transformer could have contributed to the dielectric breakdown of the insulation due to aging, resulting in faults.

71T-5 was refurbished in August 1992 rather than being replaced with a transformer that included forced air cooling, as was the case for all the other 600 VAC sub-station switchgear transformers (with exception of 71T-13). Replacement with a forced air cooled transformer could have reduced the effects of load on aging. After this event, corrective actions replaced or refurbished other dry-type transformers.

FAILED COMPONENT IDENTIFICATION:

Manufacturer:	General Electric
Manufacturer Model Number:	G-853181A
NPRDS Manufacturer Code:	G080
NPRDS Component Code:	XFMR
FitzPatrick Component ID:	71T-5

Corrective Actions

Completed Actions

- 71T-5 was replaced with forced air cooled dry-type transformer.

Future Actions

- Send failed 71T-5 for vendor failure analysis.
- Replace 71T-13 with forced air cooled dry-type transformer. This is the last remaining 4160/600V transformer without forced air cooling.
- Develop Preventative Maintenance and System Monitoring for all large dry-type (4160/600V) transformers based on adopting industry best practices.

Safety Significance

There was no actual radiological or nuclear safety consequence during this event.

Associated with the plant trip was the catastrophic failure of Condensate Booster Pump “C” (33P-9C). There was no actual industrial safety consequence but it was a potential personnel hazard.

In addition, an environmental consequence related to the plant trip included a hydrogen seal oil discharge to Lake Ontario. This discharge did not include any radiological release.

Although the transformer fault resulted in a manual scram, the only power loss was to non-vital systems. All emergency electrical buses remained available from both off-site and emergency diesel generator power.

The potential for a radiological consequence was only applicable during the time period that Secondary Containment did meet the 0.25 inches vacuum water gauge. A higher Reactor Building pressure could allow for the exfiltration of radioactive material during an accident. However, the release would still be detected by radiation monitors and this would initiate a Secondary Containment isolation. This event did not adversely impact that ability of RBV to isolate or SBGT to initiate and maintain a sufficient differential pressure. Therefore, the capability of Secondary Containment to mitigate the consequence of an accident was not affected by this event.

References

- Condition Report: CR-JAF-2016-02245, Scram Root Cause Evaluation
- LER: LER-92-034-01, Engineered Safety Feature Actuations due to Transformer Failure
- Condition Report: CR-JAF-2016-02246, Catastrophic failure of “C” Condensate Boaster Pump
- Condition Report: CR-JAF-2016-02284, Hydrogen Seal Oil leak

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
James A. FitzPatrick Nuclear Power Plant	05000 – 333	2016	– 004	– 00

Figure: