Entergy Nuclear Northeast
Entergy Nuclear Operations, Inc.
James A. Fitzpatrick NPP
P.O. Box 110
Lycoming, NY 13093
Tel 315-349-6024 Fax 315-349-6480

Michael J. Colomb
Site Vice President - JAF

November 15, 2012
JAFP-12-0142

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

SUBJECT: LER: 2012-004, Control Rods Inoperable While Entering Plant Outage
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)(i)(A), "The completion of any nuclear plant shutdown required by the plant's Technical Specifications."

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,

Michael J. Colomb
Site Vice President

MC/CA/mh

Enclosure(s): JAF LER 2012-004, Control Rods Inoperable due to Part 21 Compensatory Actions While Entering Plant Outage

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
James A. FitzPatrick Nuclear Power Plant	05000333	1 OF 5

4. TITLE
Control Rods Inoperable While Entering Plant Outage

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
09	16	12	2012	– 004 –	00	11	15	12	FACILITY NAME: N/A	DOCKET NUMBER: 05000

9. OPERATING MODE
1

10. POWER LEVEL
100

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)(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)
☐ 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)
☐ 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

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

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 September 16, 2012, James A. FitzPatrick Nuclear Power Plant (JAF) was reducing power for its scheduled Refuel Outage 20. During the power reduction, reactor pressure lowered below 800 psig prior to the full insertion of 52 control rods which were within the population for friction test control. These 52 control rods were conservatively declared Inoperable because friction testing was not performed within 14 days. This requirement is in accordance with the General Electric Part 21 notification, SC11-05 Revision 1, for Seismic Input in Channel-Control Blade Interference.
TS LCO 3.1.3 Condition E was entered for greater than 9 control rods declared Inoperable. This requires the plant to be placed in Mode 3 within 12 hours. Mode 3 was entered 2.5 hours later in accordance with the plan to shutdown for the Outage. The control rods remained fully functional and no control rod movement issues were experienced during the shutdown. An NRC notification was made per 10 CFR 50.72(b)(2)(i), initiation of any nuclear plant shutdown required by the plant's Technical Specification. This report is being made per 10 CFR 50.73(a)(2)(i)(A), completion of any nuclear plant shutdown required by the Technical Specifications. The SC11-05 compensatory actions will remain active. New fuel channels will be installed in future refueling outages to reduce the channel to control rod blade friction.

NARRATIVE

BACKGROUND

The **Control Rod Drive** system [AA] function is to insert the control rods and bring the reactor to a safe shutdown condition. With the scram valves open, accumulator pressure is admitted under the control rod drive piston, and the area over the control rod drive piston is vented.

A large differential pressure (initially approximately 1,500 psi and always several hundred psi, depending on reactor pressure vessel (RPV) pressure), produces a large upward force on the control rod. This force gives the rod a high initial acceleration and provides a large margin of force to overcome any possible friction. After the initial acceleration is achieved, the drive continues at a nearly constant velocity. This characteristic provides a high initial rod insertion rate.

Each control rod has a drive accumulator which stores sufficient water capacity to complete a scram in the required time at low RPV pressure. At higher pressures, the accumulator is assisted by RPV pressure. As water is forced from the accumulator, the accumulator discharge pressure falls below RPV pressure. This causes a mechanism to shift RPV pressure under the control rod. Thus, RPV pressure furnishes the force needed to complete the scram stroke at higher RPV pressures. When the RPV reaches full operating pressure, the accumulator is actually not needed to meet scram time requirements.

Cell Friction Metric (CFM) is a parameter for identifying which control rods have a higher probability to develop channel-control blade interference. Contributing factors include: fast fluence gradient-induced channel bow and control-blade shadow corrosion-induced channel bow. The CFM model produces an estimate of friction created by the channel-blade interference. The CFM model is based on channel measurements and operating experience with channel-blade interference.

High neutron exposure contributes to oxidation of the zirconium in the fuel bundle channels which causes it to expand and bow the channel. The channel is the casing placed around each fuel bundle. This contributing factor increases the CFM value over time. Therefore, a higher CFM value is expected at the end of a fuel cycle.

A high CFM indicates a greater potential for channel-control blade interference when RPV pressure is low. Monitoring for control rod friction is necessary prior to initiating a startup sequence or, to a greater degree, prior to a shutdown sequence.

Part 21 Notification: General Electric Hitachi Nuclear Entergy (GEH) reported a 10 CFR 21.21(d) concern, “Failure to Include Seismic Input in Channel-Control Blade Interface Customer Guidance,” SC10-12, on September 2, 2010, describing the potential impact of a seismic event on the ability of control rods to fully insert during a scram with substantial channel to control blade interference present. SC11-05 revision 1 was issued on February 7, 2012, to report the seismic input for channel-control blade interference. This analysis assumed a bounding horizontal acceleration of the fuel bundles (channels) which could prevent control rod insertion during a reactor scram at low RPV pressures.

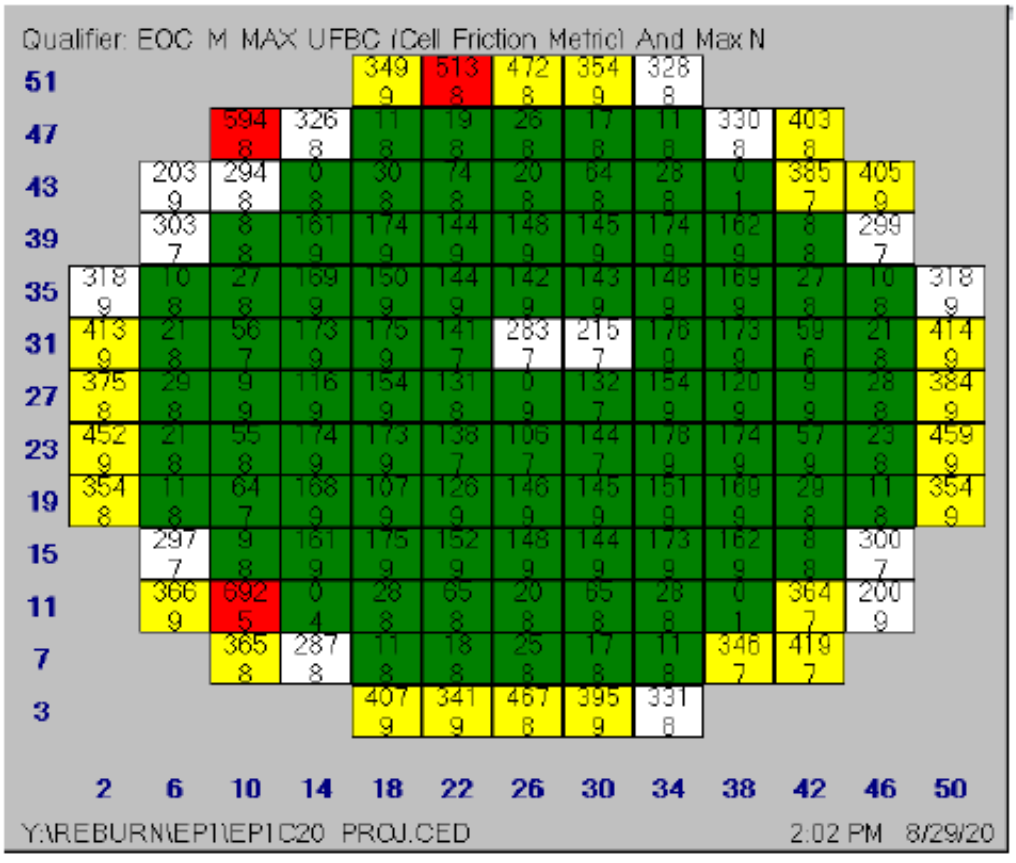
This changed the original CFM model by considering a Safe Shutdown Earthquake (SSE) as the bounding condition. To ensure control rod insertion during a reactor scram coincident with a SSE at low reactor pressures, GEH recommended friction testing of control rods with a high CFM value within 14 effective full-power days (EFPD) of reducing RPV pressure. If friction testing is not completed within the 14 EFPD, then those control rods with a high CFM value must be fully inserted prior to reducing RPV pressure or be declared inoperable.

EVENT DESCRIPTION & ANALYSIS

On September 16, 2012, while JAF was reducing power for its scheduled Refuel Outage 20 (R20), reactor pressure went below 800 psig while 52 control rods within the population of control rods susceptible to channel-control blade interference were not fully inserted. Compensatory actions established in response to SC11-05 were used to conservatively declare these control rods Inoperable. As required by Technical Specifications (TS) limiting condition for operation (LCO) 3.1.3 Condition E was entered for greater than 9 control rods declared inoperable which requires the plant be placed in Mode 3 within 12 hours and Mode 3 was entered 2.5 hours later. The control rods remained fully functional and no control rod movement issues were experienced during the shutdown. A NRC notification was made by ENS 48312 due to 10 CFR 50.72(b)(2)(i), initiation of any nuclear plant shutdown required by the plant's Technical Specification. This report is being made in accordance with 10 CFR 50.73(a)(2)(i)(A), completion of any nuclear plant shutdown required by the Technical Specifications.

Control Rods: 02-27, 26-51, 50-27, 26-03, 02-35, 18-51, 34-51, 50-35, 50-19, 34-03, 18-03, 02-19, 50-31, 02-31, 42-07, 10-07, 18-15, 26-39, 34-15, 18-31, 34-31, 26-23, 50-23, 02-23, 42-47, 10-47, 26-31, 26-15, 18-39, 34-39, 18-23, 34-23, 22-51, 22-03, 46-43, 46-11, 30-27, 14-27, 38-19, 38-35, 22-19, 22-35, 30-03, 30-51, 06-43, 06-11, 14-35, 14-19, 22-27, 38-27, 30-19, 30-35 were declared inoperable. Below is a map of all control rods and their associated CFM values at the time of the event:

Cell Friction Methodology Results for Fitzpatrick Cycle 20 at 15310.7 MWd/St – EOC Maximum



The affected equipment in this event are the fuel channels, which may become distorted and impede control rod insertion. The CRD system must provide sufficient force to overcome any friction. The basic concern with CRD function is: if the friction between control blade to channel were too high, coincident with a seismic event, and there wasn't sufficient reactor pressure to overcome the friction then it may not insert using the accumulator pressure alone.

JAF has never experienced either a "slow to settle" or "no-settle" condition in any control rod tested. However, reduced scram capability due to blade-channel interference occurs when seismic loads are included in the analysis. The seismic basis for GEH's recommendation is bounding horizontal acceleration. For JAF the acceleration is conservative but this new analysis increased the number of control rods which require friction testing prior to the R20 shutdown.

The compensatory measures in place include periodic settle testing to determine if channel bowing exists and full stroke insertion friction testing prior to lowering to the SC11-05 Rev 1 reactor pressure thresholds. Otherwise, the control rod is declared Inoperable and the LCO condition entered prior to startup or shutdown. If friction is detected during testing then control rod operability depends on the amount of measured friction, the reactor pressure, and the rod's accumulator pressure. The compensatory measure requirements are in the Control Room Standing Reactor Engineering instructions. These compensatory measures are expected to continue past RO20 since channel bowing is susceptible in cycle 21 (current cycle). This is a generic issue with Boiling Water Reactors. To reduce the likelihood of channel-control blade interference JAF has ordered new fuel for the past two refuel outages with a fuel channel that is less susceptible to channel-control blade interference. Thus in future operating cycles the probability of channel-control blade interference will be significantly reduced.

Prior to startup after R20, all control rods with a CFM value ≥ 100 were full stroke insertion friction tested with no indication of channel-control blade interference.

CAUSE OF EVENT

All control rods applicable to friction testing were not fully inserted or friction tested prior to reactor pressure going below 800 psig.

EXTENT OF CONDITION

This is an industry issue and it remains an Operations concern for future shutdowns and startups at JAF.

CORRECTIVE ACTIONS

Compensatory Measures

- Declare control rods in cells with CFM≥100 Inoperable upon decreasing below SC11-05 Rev 1 reactor pressure thresholds if a full stroke insertion test has not been performed within 14 EFPD. Enter the appropriate Technical Specification action statement.
- Maintain a channel bow monitoring plan

Future Actions

- New channel material, less susceptible to fluence and shadow corrosion, will be replaced with fuel bundles in future refueling outages. Thereby reducing the number of control rods susceptible to channel-control blade interference

ASSESSMENT OF SAFETY CONSEQUENCES

Radiological & Industrial Safety

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

Nuclear Safety

There was no actual nuclear safety consequences associated with this event. In addition, during the period when the plant was going into shutdown there was no seismic event.

The potential nuclear safety consequences are considered minimal because the calculated CFM values are conservative for JAF. The D-lattice core structure is larger than other designs so there is more margin to control blade-channel interference. Historically, JAF has not experienced control blade-channel interference events.

Voluntary entry into the shutdown LCO action for inoperable rods is an unusual method of resolving a known operating issue, and such entry needs to be justified based on relative safety and risk considerations. Full stroke insertion tests involve a full travel continuous insert of the subject rod from full out so, as with scram time testing because of fuel conditioning, the test must be done at reduced power, and if the control rod is inserted in the normal rod pattern it may need to be shadowed. In a core with many rods to test, such testing would involve a large amount of control rod manipulation and plant system cycling.

Alternatively, the plant may take a manual scram to avoid entry into the LCO condition. A scram can result in undesirable automatic actions due to low water level and create more operator challenges than the initiating event, resulting in vessel/containment isolations, ECCS actuations and reactor recirc pump trips.

These measures (stroke tests or scram) would be taken to avoid the potential for incomplete rod insertion on a scram if an SSE occurs while vessel pressure is less than the threshold. The Probabilistic Risk Assessment group (PRA) was asked for an appropriate measure of the risk significance of entering the inoperable rod Technical Specification action that requires the plant to be Hot Shutdown within 12 hours. PRA responded that if the probability of an SSE occurring while in the LCO condition was $<1x10^{-6}$, then the risk of entering the LCO condition instead of a manual scram was not significant. PRA supplied annual seismic frequency data as a function of acceleration for JAF. The results are given below on an annual basis and show that the probability of an SSE while in the LCO condition is $<1x10^{-6}$ for at least 2 shutdowns per year at JAF.

JAF DBE (SSE) = 0.15g horizontal		
Probability of SSE while in LCO condition		
1 S/D/yr	2 S/D/yr	3 S/D/yr
6.73E-08	1.35E-07	2.02E-07

SIMILAR EVENTS

CR-PNP-2010-03635 – Two control rods failed settle testing.
CR-VTY-2011-04083 – LCO condition entered for Inoperable control rods

REFERENCES

- JAF Condition Reports: CR-JAF-2012-05449, CR-JAF-2011-04144, CR-JAF-2012-00860
- SC11-05 Rev 1, Failure to Include Seismic Input in Channel-Control Blade Interference Customer Guidance.
- JAF TS 3.1.3, Control Rod Operability
- JAF FSAR 3.5.5.3 Control Rod Drive Hydraulic System Operation
- RAP-7.3.39, Channel – Control Blade Interference Monitoring