Progress Energy

Crystal River Nuclear Plant
Docket No. 50-302
Operating License No. DPR-72

Ref: 10 CFR 50.73

December 14, 2005
3F1205-02

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: LICENSEE EVENT REPORT 50-302/2005-004-00

Dear Sir:

Please find enclosed Licensee Event Report (LER) 50-302/2005-004-00. The LER discusses a motor-operated Main Feedwater Isolation Valve being inoperable due to oxidation/corrosion of the motor rotor magnesium fans and shorting ring. This report is being submitted pursuant to 10CFR50.73(a)(2)(i)(B).

No new regulatory commitments are made in this letter.

If you have any questions regarding this submittal, please contact Mr. Paul Infanger, Supervisor, Licensing and Regulatory Programs at (352) 563-4796.

Sincerely,

Jon A. Franke
Plant General Manager
Crystal River Nuclear Plant

JAF/dwh

Enclosure

xc: Regional Administrator, Region II
Senior Resident Inspector
NRR Project Manager

IE22

Progress Energy Florida, Inc.
Crystal River Nuclear Plant
15760 W. Powerline Street
Crystal River, FL 34428

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 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 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@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 reverse for required number of digits/characters for each block)

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4. TITLE
Motor-Operated Main Feedwater Isolation Valve Inoperable Due To Motor Rotor Oxidation/Corrosion

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	28	2005	2005	- 004 -	00	12	14	2005	FACILITY NAME: N/A	DOCKET NUMBER: 05000

9. OPERATING MODE
1

10. POWER LEVEL
51%

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)
Dennis W. Herrin – Lead Engineer (Licensing & Regulatory Programs)	(352) 563-4633

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
X	SJ	MO	R165	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)

At 19:10, on October 28, 2005, Progress Energy Florida, Inc., Crystal River Unit 3, was in MODE 1 (POWER OPERATION) at 51 percent RATED THERMAL POWER when the breaker for a B Train motor-operated Main Feedwater Isolation Valve motor tripped soon after the valve started cycling closed. This occurred during power reduction in preparation for a refueling outage. Technical Specification 3.7.3 requires two Main Feedwater Isolation Valves in each Feedwater System flow path to be operable with at least one Main Feedwater Isolation Valve capable of isolating Feedwater within the required isolation time while in MODES 1, 2 and 3. The Main Feedwater Isolation Valve was determined to be inoperable for a period longer than allowed by Technical Specifications. The cause for the motor-operated valve failure was oxidation/corrosion of the motor rotor magnesium fans and shorting ring. The motor-operated valve motor has been replaced. Other motor-operated valve motors have been found with rotor magnesium and shorting ring damage. This report is being submitted pursuant to 10CFR50.73(a)(2)(i)(B). The redundant Main Feedwater Isolation Valves were operable. This condition does not represent a reduction in the public health and safety. No previous similar occurrences have been reported.

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17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

EVENT DESCRIPTION

At 19:10, on October 28, 2005, Progress Energy Florida, Inc. (PEF), Crystal River Unit 3 (CR-3) was operating in MODE 1 (POWER OPERATION) at 51 percent RATED THERMAL POWER when the breaker for B Train motor-operated Main Feedwater Isolation Valve (MFIV) [SJ, ISV] FWV-29 motor [SJ, MO] tripped soon after the valve started cycling closed. This occurred during power reduction in preparation for a refueling outage. At the time, CR-3 was being shutdown in accordance with Operating Procedure OP-209A, "Refueling Outage Plant Shutdown and Cooldown."

The MFIVs for each Once Through Steam Generator (OTSG) [AB, SG] consist of the Main FW pump suction valve, the main/startup/low load block valves (in parallel) and the Main FW pump discharge cross-connect valve. FWV-29 is the B Train main block valve.

Improved Technical Specification (ITS) 3.7.3, "Main Feedwater Isolation Valves," requires two MFIVs in each FW System flow path to be operable with at least one MFIV capable of isolating FW within the required isolation time while in MODES 1, 2 and 3. With FWV-29 inoperable, the Required Actions of ITS 3.7.3 were entered for Condition A, "One or more MFW flow paths with one MFIV inoperable." Required Action A.1 requires that the affected flow path(s) be isolated within 72 hours. Required Action A.2 requires that the affected flow path(s) be verified as isolated once per 7 days.

At 21:03, on October 28, 2005, FWV-29 was manually closed. This action isolated the affected MFW flow path and satisfied Required Action A.1 of ITS 3.7.3. At 15:59, on October 29, 2005, MODE 4 (HOT SHUTDOWN) was entered. This action made Required Action A.2 of ITS 3.7.3 no longer applicable.

The cause for failure of FWV-29 to automatically close was initially unknown. Therefore, FWV-29 was considered to have become inoperable when it failed. No 10CFR50.72 or 10CFR50.73 reportability criteria were determined to be applicable. Potential reportability was re-visited upon receipt of a failure report dated November 11, 2005, that was provided by an electric motor repair facility. That failure report supported a conclusion that FWV-29 became inoperable and would not have been able to perform its intended function for some unspecified period of time prior to the actual failure.

In order for this event to be determined not reportable, FWV-29 would have had to become inoperable on or after 19:10 on October 25, 2005. Based on engineering judgment, FWV-29 became inoperable at some point prior to that time. Therefore, FWV-29 is considered to have been inoperable for a period of time longer than the 72 hours allowed by ITS 3.7.3, Condition A, Required Action A.1. This condition is reportable under 10CFR50.73(a)(2)(i)(B).

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SAFETY CONSEQUENCES

The safety functions of the FW System are as follows: (1) provide isolation capability for the secondary side of the OTSGs following a Main Steam Line Break (SLB) accident and (2) provide isolation of the FW System lines that penetrate the Reactor Building (RB) [NH] during a high pressure event inside the RB caused by a Loss of Coolant Accident or a SLB accident. If a break in a FW System or Main Steam (MS) [SB] line occurs and causes either or both OTSGs to depressurize to ≤ 600 pounds per square inch gauge (psig), then the Emergency Feedwater Initiation and Control System [JE] will initiate a Main Feedwater Isolation (MFWI) [JB] signal. The purpose of the MFWI is to limit the overcooling and depressurization of the Reactor Coolant System [AB], which would result in positive reactivity addition to the reactor core and a subsequent increase in reactor power. This is accomplished by isolating the affected (faulted) OTSG(s). The affected train(s) FW block valves, FW System pump suction valve, and the FW System cross-tie valve receive a close signal and the affected trains(s) Main FW pump [SJ, P] is tripped to eliminate FW System flow to an OTSG which has lost the ability to maintain its pressure.

Although FWV-29 did not close when required on October 28, 2005, the redundant B Train MFIVs and the A Train MFIVs operated as required during the manual reactor trip initiated on October 29, 2005, upon loss of both Main FW pumps. Additionally, damage to the motor-operated FWV-29 valve motor did not preclude the capability of closing the valve manually and placing it in the post-accident position.

Based on the above discussion, PEF concludes that inoperability of FWV-29 for an unspecified period of time prior to October 28, 2005, did not represent a reduction in the public health and safety. Since no loss of safety function occurred, this event does not meet the Nuclear Energy Institute definition of a Safety System Functional Failure (NEI 99-02, Revision 2).

CAUSE

The cause for the failure of the motor-operated FWV-29 motor was oxidation/corrosion of the motor rotor magnesium fans and shorting ring. After disassembly, the motor rotor shorting ring and fan blades were found discolored, distorted, with pieces broken off the shorting ring and fan blades. The degradation was noted by the appearance of a grayish-black powdery residue on the destroyed pieces. Corrosion of the magnesium alloy is believed to be the result of exposure to high temperatures and high humidity.

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During the course of the failure, portions of the shorting ring and fan degraded and distorted. As the magnesium rotor swelled, the rotor fans came into contact with the motor winding endturns, progressively contacting and nicking the windings. This condition resulted in a locked rotor condition. As a result of the locked rotor condition, motor current increased and produced excessive heating in the stator windings. The increase in current resulted in a breakdown of the insulation system. Once the insulation broke down, failure of the windings occurred. The initial failure was most likely a turn-to-turn short in one of the areas where the rotor fans came into contact with the stator windings. The turn-to-turn short resulted in excessive currents and localized heating that began to break down the coil insulation until a phase-to-phase or phase-to-ground short developed in the slot.

A contributing factor for failure of the motor-operated FWV-29 motor was inadequate preventive maintenance due to applicable Operating Experience not being incorporated into the CR-3 Motor Operated Valve Program Manual. Failure of motor-operated valve motors associated with magnesium rotors has been documented in the following: (1) NRC Information Notice 86-02, "Failure of Valve Operator Motor During Environmental Qualification Testing," dated January 6, 1986; (2) IEEE Transactions on Energy Conversion, Volume 3, Number 1, "An Investigation of Magnesium Rotors in Motor Operated Valve Actuators," dated March 1988; and, (3) NUREG/CR-6205, "Valve Actuator Motor Degradation," dated December 1994.

The motor-operated FWV-29 motor is manufactured by the Reliance Electric Company (Serial # SYZ00762-A1-PT) and is used in a Limitorque Corporation Model SMB-4T-150 actuator.

CORRECTIVE ACTIONS

1. A review of applicable motor-operated valve motors with magnesium rotors has been performed. There are nine safety-related motor-operated valves with magnesium rotors that meet this criterion at CR-3. Five of these motor-operated valve motors have been inspected (visual inspection with a boroscope and an electrical Polarization Index (PI) inspection). Based on the results of these five inspections and corresponding installation history, the three remaining motor-operated valve motors (Decay Heat Removal System (DH) valve DHV-3, FWV-15, FWV-30) will not be inspected at this time due to the comparatively short time these motors have been in service (see next page).

Tag#	Frame Size	Start Torque	Installed Date	Inspection Results	Action
DHV-3	215TY	80ftlb	05/2001	Not inspected	Inspect later
DHV-4	215TY	80ftlb	06/1992	PI-sat/Boroscope-unsat	Replaced
DHV-5	256TY	100ftlb	04/1984	PI-sat/Boroscope-sat	None required
DHV-6	256TY	100ftlb	04/1984	PI-sat/Boroscope-unsat	Replaced
FWV-14	215R2	80ftlb	12/1997	PI-sat/Boroscope-sat	None required
FWV-15	210TY	80ftlb	01/1998	Not inspected	Inspect later
FWV-28	256TY	200ftlb	04/1996	PI-unsat/Boroscope-unsat	Replaced
FWV-29	256TY	150ftlb	1990	Motor failed	Replaced
FWV-30	256TY	150ftlb	10/2003	Not inspected	Inspect later

2. Other actions associated with this event are being addressed in CR-3 Corrective Action Program Nuclear Condition Report NCR 174428.

PREVIOUS SIMILAR EVENTS

Based on a keyword search of the CR-3 electronic Licensee Event Report database, no previous similar events involving failure of a motor-operated valve motor due to rotor oxidation/corrosion have been reported to the NRC by CR-3.

ATTACHMENTS

Attachment 1 - Abbreviations, Definitions, and Acronyms
Attachment 2 - List of Commitments

ATTACHMENT 1

ABBREVIATIONS, DEFINITIONS AND ACRONYMS

CFR	Code of Federal Regulations
CR-3	Crystal River Unit 3
DH	Decay Heat Removal System
DHV	Decay Heat Removal Valve
FW	Main Feedwater System
FWV	Main Feedwater Valve
ITS	Improved Technical Specifications
MFIV	Main Feedwater Isolation Valve
MFWI	Main Feedwater Isolation
MS	Main Steam System
NCR	Nuclear Condition Report
NEI	Nuclear Energy Institute
OP	Operating Procedure
OTSG	Once Through Steam Generator
PEF	Progress Energy Florida, Inc.
PI	Polarization Index
RB	Reactor Building
SLB	Main Steam Line Break

NOTES: Improved Technical Specifications defined terms appear capitalized in LER text {e.g., MODE 1}

Defined terms/acronyms/abbreviations appear in parenthesis when first used {e.g., Reactor Building (RB)}.

EIIS codes appear in square brackets {e.g., reactor building penetration [NH, PEN]}.

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ATTACHMENT 2

LIST OF COMMITMENTS

The following table identifies those actions committed to by PEF in this document. Any other actions discussed in the submittal represent intended or planned actions by PEF. They are described for the NRC's information and are not regulatory commitments. Please notify the Supervisor, Licensing & Regulatory Programs, of any questions regarding this document or any associated regulatory commitments.

RESPONSE SECTION	COMMITMENT	DUE DATE
	No regulatory commitments are being made in this submittal.	