UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W., SUITE 2900
ATLANTA, GEORGIA 30323

Report No.: 50-302/92-11

Licensee: Florida Power Corporation
3201 -34th Street, South
St. Petersburg, FL 33733

Docket No.: 50-302 License No.: DPR-72

Facility Name: Crystal River 3

Inspection Conducted: May 5-8, 1992

Inspector: for Frank Jape 5/19/92
M. Thomas Date Signed

Approved by: Frank Jape 5/19/92
F. Jape, Chief Date Signed
Test Programs Section
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope:

This special announced inspection was conducted to review the circumstances involving the failure of Emergency Feedwater valve EFV-14 to close completely during a differential pressure test performed on October 13, 1991, as recommended by Generic Letter, GL 89-10, "Safety-Related Motor Operated Valves Testing and Surveillance."

Results:

In the area inspected one apparent violation was identified involving failure to take prompt corrective action prior to restart. This violation is being considered for escalated enforcement (paragraph 4).

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*R. L. McLaughun, Nuclear Regulatory Specialist
*M. J. Fitzgerald, Supervisor, Nuclear Plant System Engineering
J. J. Miele, Nuclear Project Engineer
*G. M. Williams, Senior Nuclear Mechanical Engineer
A. M. Steam, Senior Nuclear Mechanical Engineer
*E. E. Froats, Manager, Nuclear Compliance
P. V. Fleming, Senior Nuclear Licensing Engineer
*W. L. Russfeld, Manager, Site Nuclear Services
*G. H. Halnon, Manager, Nuclear Plant Systems Engineering
*G. A. Becker, Manager, Site Nuclear Engineering Services
*J. G. Brandely, Manager, Nuclear Scheduling
*J. Alberdi, Manager, Nuclear Plant Operations
*P. F. McKee, Director, Nuclear Plant Operations

NRC Personnel

*F. Jape, TPS Chief
*P. Holmes-Ray, Senior Resident Inspector
*R. Freudenberger, Resident Inspector

*Attended exit interview

2. System Description

The emergency feedwater system, EFS, consists of two full capacity, independent systems, which includes two pumps and associated valves and piping. (See Figure I) The system automatically supplies emergency feedwater to one or both steam generators, OTSG, to provide decay heat removal for normal reactor cooldown and a number of analyzed events.

The EFS is controlled by the Emergency Feedwater Initiation and Control System, EFIC. Upon an initiating event the EFIC system isolates any faulted SG and controls the EFS flow to the operable OTSG. There are four normally open, modulating solenoid-operated control valves and four normally open isolation valves in the four parallel pump flow paths to the OTSGs. The EFS isolation valves are 6" gate valves; two are Velan and two are Chapman. All are operated with a Limitorque Motor Operated Actuator type SMB-0, 125V DC.

The EFS control valves are 4 inch, Target Rock, Globe Modulating solenoid valves. These are powered by 125V DC. The four isolation valves and the four control valves are safety grade components.

The EFS is intended to cooldown the reactor coolant system until the decay heat removal system is placed into service and for a number of events. When considering a failure of an isolation valve, a steam line break is considered to result in the most severe transient. In the event of a steam line break, the isolation valves automatically close to isolate the faulted OTSG.

It was determined by dp testing on 10/13/91, that EFV-14 would not close fully against a dp of 1445 psid. This failure along with an assumed failure of its associated control valve, EFV-58, was reviewed to determine if the EFS system remained operable. The results indicated degraded EFS. The EFIC logic would control the remaining three control valves, EFV-56, -55 and -57 and would provide appropriate signals to the other isolation valves, EFV-11, -33 and -32. These isolation valves are expected to close properly since the dp would be approximately 600 psid. The valves have demonstrated acceptable performance at a dp of 1265 psid.

3. MOV Testing Program

MOV EFV-14 was first dp tested under functional test procedure for Modification Approval Record (MAR) MAR 87-07-01-01, TP#2, Differential Pressure Testing EFV-14. Per the MOV data report provided by MOVATS for MOV EFV-14, the valve opened satisfactorily against a dp of 620 psid on September 19, 1987, and closed satisfactorily against a dp of 1265 psid on September 22, 1987.

The B&W document 51-1164140-00, dated May 5, 1986, which was prepared for FPC to address NRC Bulletin, IEB 85-03 valves specified a maximum closing dp for EFV-14, -11, -32, -33 as 1364 psid. The valves were successfully tested to a lesser value as stated above.

In accordance with GL 89-10, EFV-14 was tested in October 1991 along with eight other MOVs. EFV-14 was tested under performance test procedure PT-405B, EVF-014 MOVATS closing D/P Test. The valve failed the test on October 13, 1991, at a dp of 1445 psid. A problem report, PR91-0025, was written and approved on October 16, 1991. EFV-14 was tested on October 11, 1991, for the opening position under PT-405A, EFV-014 MOVATS opening D/P Test. The valve passed the test with a opening stroke time of 27.056 seconds under dp conditions.

The problem report contained a corrective action plan which was primarily to re-review the dp data and re-evaluate the assumptions used to arrive at the worst case dp. The completion date was established as the end of Refueling Outage RF8. All calculations were to be issued by March 15, 1992, and valves scheduled to be tested during RF8 were prioritized. The calculation for EFV-14 was scheduled to be completed by January 31, 1992. On February 5, 1992, the FPC system engineer concluded a worst case dp for EFV-14 and -11 to be 1219 psid for closing and 546 psid for opening. At this value the valve was believed to be fully operable. But during the verification process of this calculation, questions were raised and a re-review was initiated.

The result was a higher dp of 1501 psid was determined for closing and 546 psid for opening. These values were approved on April 28, 1992. On this date, April 28, 1992, the licensee reported the event to the NRC as a discovery of the calculated dp to be greater than original plant design basis. The event report stated that this discovery was also being applied to EFV-11 because it was of similar design, even though it had not been tested. Also, the event report stated that these valves would be administratively controlled in the closed position. The valves were closed on April 28, 1992 immediately after the dp of 1501 psid was approved by FPC management. The valves receive an open signal upon actuation of the EFS and EFV-14 was tested satisfactorily in the open direction. CR-3 shut down on April 30, 1992 for RF8.

4. EFV-14 Failure - Corrective Action

On October 13, 1991, during the closing dp test on EFV-14, the valve failed to close with a dp of 1445 psid. A problem report, PR-91-0025, was issued that day. At that time the failure was classified as a significant problem, and not reportable to the NRC. The dp used for the test was calculated and documented in FPC calculation E90-1019 which was based on a B&W Document 51-1164140-00. The licensee reviewed the test results and the calculation and determined that the calculation had some apparent problems and discrepancies. The questionable areas are summarized below:

1. In the narrative, the accident assumed to give worst case dp during a Steam Generator Tube Rupture. It is stated that this accident depressurized the OTSG and will cause the FOGG logic to be imposed.

   This was believed to be incorrect. The OTSG Tube Rupture will not depressurize the OTSG unless RCS pressure is less than secondary pressure. This assumption was either in error or some accident scenario assumptions were not obvious.

2. In the calculation input parameters for each component, the value of 3100 feet was used at 1175 gpm. This number is the total head added by the pump.

   The Technical Manual pump curve shows a head of 2450 feet at 1175 gpm. This translates into reduction in dp of approximately 20%.

3. A conservative assumption was made to neglect line losses or elevation changes. The flow path contains two check valves and several branch connections. The cumulative effects will reduce the worst case dp. The magnitude of such a reduction would need to be calculated.

4. The calculation utilized in determining the discharge pressure of the pump subtracted the height of water on the suction side from the total dynamic head. The calculation is incorrect and equates to a dp value lower than it should be. The dp, if calculated as shown, equates to 1264 psid.

To further add to the questions, the actual operation of the FOGG logic was not taken into consideration. The effects of the downstream control valve reducing the dP across the block valve is expected to be significant. The control valve will be at some intermediate position thus increasing the pressure between the block valve and the control valve. This will work to decrease the dP across the block valve.

The flow limiter circuit will cause the control valves to close from the full open position to the 50% open position upon EFIC actuation. This circuit is designed to limit the condition in which a single EFW pump is feeding OTSGs or conditions of low OTSG pressure caused by steam or feed leaks.

Subsequently, the circuit enables additional closure from 50% up to 80% when the total OTSG flow changes from 0 to 100% of its range. From 600 gpm to 1000 gpm, control valve position will decrease from 50% to 80% closed further reducing the dp across the block valve.

From the above, the licensee determined that more thought and evaluation was needed to be factored into the determination of worst case dp for the EFW block valves. It was also stated that further testing at high, unverified dp values runs the risk of damaging both the valve and operator. During an earlier test for IEB 85-03, performed in March 1987 EFV-14 was successfully tested at a dp of 1265 psid. During the outage in October 1991, EFV-14 also failed a test to close at 1320 psid. The difference of 55 psi between these two tests indicates that there is very little margin in the actuator to close the valve.

A six point, corrective action plan, listed below, was developed specifically for EFV-14 on October 13, 1991. The completion date was established as end of RF8. (Late June 1992)

Summary of Corrective Action Plan:

Specific for EFV-14:

1. Evaluate actual assumptions for determination of worst case dp.
2. Calculate the worst case dp.
3. Revise test procedure to establish actual test assumptions and dp.
4. Evaluate previous test data to verify valve operator is adequate.
5. Test valve operator to new actual worst case dp values.
6. An option may be exercised to replace this operator with one that will allow a higher margin to maximum.

At the same time, an action plan to cover all GL 89-10 valves was established as follows:

Other Actions:

1. Include calculation E90-1019 in the scope of problem report SYPR 91-0025 to cover all Generic Letter 89-10 valves.
2. Perform detailed review by the System Engineer of all valve dp calculations prior to any further dp testing.
3. Revise dp tests as necessary.

All actions were scheduled to be satisfied by the end of Refuel 8 (late June 1992). The action plan was initiated and on February 5, 1992, a revised dp for EFV-14 and EFV-11 was determined to be 1219 psid. This calculation was further reviewed by FPC, and on April 27, 1992, and it was revised to 1501 psid.

The failure to perform a prioritized repair of EFV-14 following the test in October 1991, is considered to be a violation of 10 CFR 50, Appendix B, Criterion XVI. This criterion states that conditions adverse to quality are to be promptly identified and corrected. The reactor was restarted on November 26, 1991, without resolving the questions about the EFV isolation valve. An internal memorandum was issued on November 17, 1991 to the Superintendent of Nuclear Operations from the Senior Nuclear Licensing Engineer providing a basis for restart. The basis was that the calculations establishing the worst case differential pressure contained questionable assumptions and incorrect arithmetic results. However, additional calculations providing the actual dp were not generated, rather, the knowledge that the calculations of record were flawed served as the calculation basis for restart.

This position was explained to NRC inspectors during the GL 89-10 MOV inspection conducted January 6-10, 1992 as documented in Inspection Report 50-302/92-01. In that report, the inspectors acknowledged that the re-review was underway of the B&W supplied dp calculations. It was also recognized that EFV-14 had failed its dp test on October 13, 1991. The failure of EFV-14 was attributed, in part, to an incorrect determination of design basis dp. No action was taken by the inspectors at that time, other than to note the issue within the report.

5. Exit Interview

The inspection scope and results were summarized on May 8, 1992, with those persons indicated in paragraph 1. The inspectors described the areas inspected and discussed in detail the inspection results and the apparent violation. Proprietary information is not contained in this report. Dissenting comments were not received from the licensee with respect to prompt corrective action. The licensee briefly described the reasons why the EFS was operable after the block valve failure.

6. Acronyms and Initialisms

EFS	Emergency Feedwater System
OTSG	Once Through Steam Generator
EFIC	Emergency Feedwater Initiation and Control
dp	Differential Pressure
psid	Pounds Per Square Inch Differential
MOV	Motor Operated Valve
MAR	Modification Approval Record
RF	Refueling Outage
B&W	Babcock and Wilcox
FPC	Florida Power Corporation
FOGG	Feed Only Good Generator
EFW	Emergency Feedwater
RCS	Reactor Coolant System

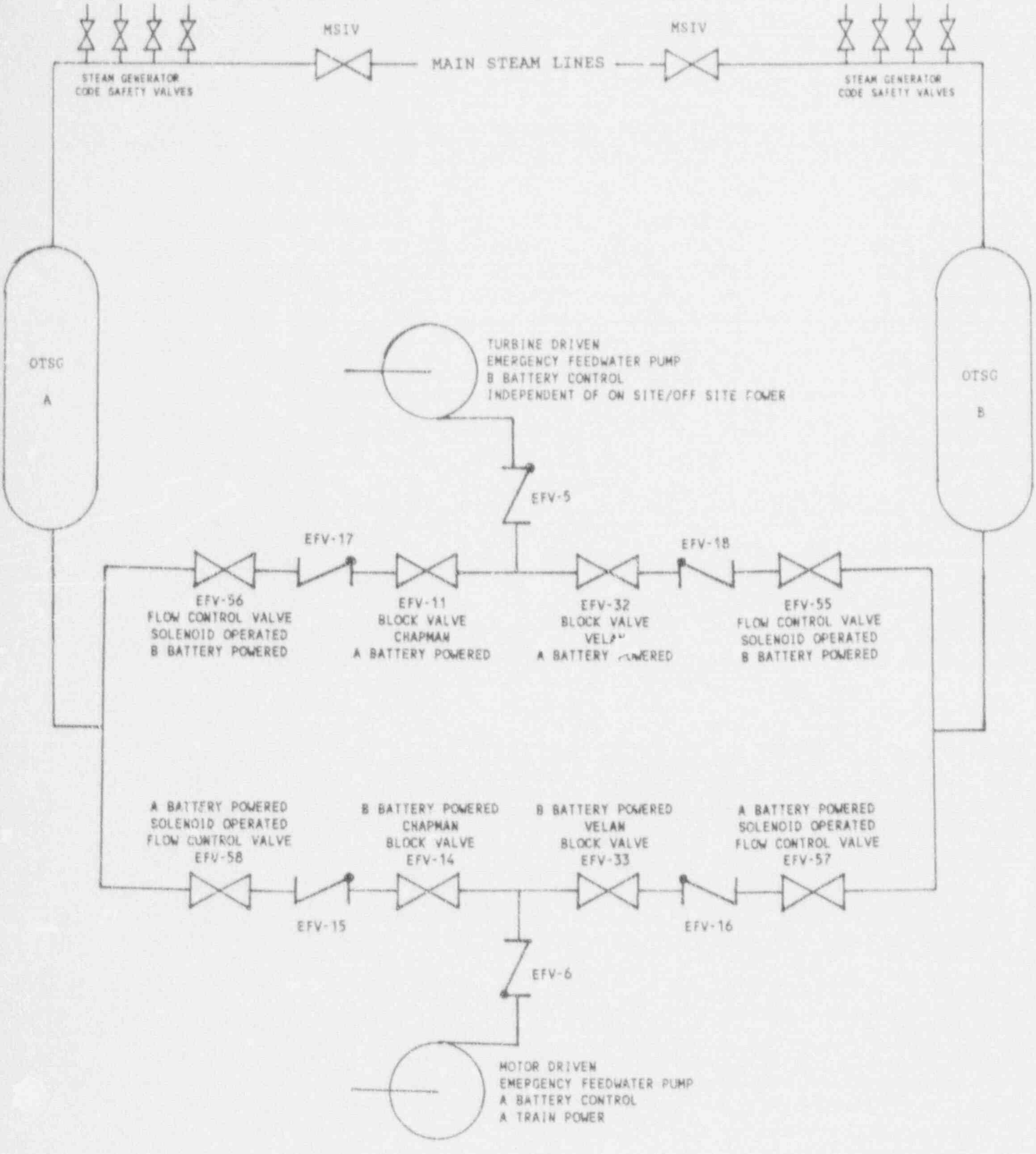

FIGURE 1. CRYSTAL RIVER UNIT 3 EMERGENCY FEEDWATER SYSTEM