ASSESSMENT OF CR3

RC LEAK DETECTION

SYSTEM

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I. INTRODUCTION

This report documents the assessment of the leak detection system in Florida Power Corporation's (FPC) Crystal River Unit 3 (CR-3) Reactor Coolant System (RCS). The assessment will also support FPC's leak-before-break application activities (GDC-4 exemption).

II. REGULATORY POSITION

The source of reactor coolant leakage should be identifiable to the extent practical. Reactor coolant pressure boundary leakage detection and collection systems should be selected and designed to include the following:

A. "Leakage to the primary reactor containment from identified sources should be collected or otherwise isolated so that:

1. the flow rates are monitored separately from unidentified leakage, and
2. the total flow rate can be established and monitored."

FPC meets the intent of this position by the following monitoring devices: RCS water inventory balance, makeup tank level, and reactor building sump level.[3-5]

The RCS water inventory balance is used to calculate the amount of identified and unidentified leakage in the RCS during steady state conditions.[1]

The makeup tank level instrumentation indicates a leakage rate of 1 gpm by a decrease in level of 1.9 in/hr during steady state conditions.[4]

The reactor building sump level instrumentation measures the total leakage, both identified and unidentified.[3-5] The identified leakage,

from SP-317, could be subtracted from the reactor building sump level measurement, resulting in the unidentified leakage rate.

The containment iodine radioactivity monitoring system and the containment atmospheric gaseous radioactivity monitoring system are used to detect a RCS leak.[3-5] The radiation monitor A6 (RM-A6) comprises the two systems above. These systems would indicate a 1 gpm leak in 15 minutes with the design basis corrosion products in the reactor coolant.[4]

FPC also has a controlled leakage consisting of leakage from identified pumps and valves, which is collected and monitored separately from any identified or unidentified leakage.[3-4]

B. "Leakage to the primary reactor containment from unidentified sources should be collected and the flow rate monitored with an accuracy of one gallon per minute (gpm) or better."

FPC meets the regulatory position above by having the following four systems:

1. Reactor Building Sump Level

The measurement of 0 to 6 in/hr corresponds to 0 to 142 gal/hr; therefore, 1 inch = 23.6 gallons.[2,4] If the sump level were to rise 1 inch or 23.6 gallons in one hour, the rate would be 23.6 gal/hr or 23.6 gal/hr x 1 hr/60 min. = 0.3944 gpm.

The accuracy of the level indication is ± 0.5 inch.[2] Therefore, the measurement could be incorrect by as much as 1 inch or 23.6 gallons or in a one hour period, by 0.3944 gpm. The accuracy of the sump level is 1 gpm or better when measured during a minimum period of 30 minutes.

2. Radiation Monitor A6 (RM-A6)

Radiation Monitor RM-A6 detects for design basis corrosion products (Table 11-3 of reference 5) of the reactor coolant which are released to the reactor building atmosphere. A one gpm leak from the RCS to the reactor building as vapor would give an alarm in the control room within 15 minutes.[4,5]

3. Makeup Tank Level

The makeup tank level indicates a 1 gpm leak rate by a decreasing level of 1.9 in/hr during steady state conditions.[4]

4. RCS Water Inventory Balance

The calculation performed in the procedure will provide a leak rate with an accuracy of ± 1 gpm.[1]

C. "At least three separate detection methods should be employed and two of these methods should be (1) sump level and flow monitoring and (2) airborne particulate radioactivity monitoring. The third method may be selected from the following:

1. Monitoring of condensate flow rate from air coolers.
2. Monitoring of airborne gaseous radioactivity.

Humidity, temperature, or pressure monitoring of the containment atmosphere should be considered as alarms or indirect indication of leakage to the containment."

FPC meets the regulatory position by employing the following three leakage detection systems:

1. Sump level and flow monitoring.
2. Airborne particulate radioactivity monitoring.
3. Airborne gaseous radioactivity monitoring.[2,4,5]

FPC also measures the pressure in containment as an indirect indication of leakage to the containment.

D. "Additional provisions for monitoring systems connected to the RCPB for signs of intersystem leakage; Methods should include radioactivity monitoring and indicators to show abnormal water levels or flow in the affected area."

FPC meets the regulatory position above by monitoring the systems connected to the RCPB.[3-5,9-11] The systems monitored for intersystem leakage are the following:

1. Secondary System

   A secondary chemical analysis and a condenser off-gas monitor are used to detect primary-to-secondary leakage in a steam generator.

2. Decay Heat Closed Cycle Cooling

   Liquid radiation monitors and chemical analysis are used to detect leakage at the interface to the closed cooling system.

3. Nuclear Services Closed Cycle Cooling

   Liquid radiation monitors and chemical analysis are used to detect leakage at the interface to the closed cooling system.

Flow measurements are also utilized as a method of detecting leakage in each of the interconnected systems.

E. "The sensitivity and response time of each leakage detection system in regulatory position 3 above employed for unidentified leakage should be adequate to detect a leakage rate, or its equivalent, of one gpm in less than one hour."

FPC meets the regulatory position stated above, except for the leakage rate equivalent. FPC's three leakage detection systems stated for position 3 are as follows: (1) sump level and flow monitoring, (2) airborne particulate radioactivity monitoring, and (3) airborne gaseous radioactivity monitoring. All three systems meet the position stated above.

The reactor building sump level can detect a leakage rate of 1 gpm in less than 1 hour. See the reactor building sump level section for position B and references 2 and 4.

The Radiation Monitor A6 includes both the airborne particulate and gaseous radioactivity monitoring systems.[4,5] The RM-A6 will detect a 1 gpm leak rate within 15 minutes and sound an alarm. The alarm setpoint is based on the basis corrosion products in the reactor coolant.[4]

F. "The leakage detection systems should be capable of performing their functions following seismic events that do not require plant shutdown. The airborne particulate radioactivity monitoring system should remain functional when subjected to the SSE."

FPC leakage detection systems are not totally designed for seismic events. All three leakage detection systems (sump level and flow monitoring; airborne particulate radioactivity monitoring; and airborne gaseous radioactivity monitoring) are non-safety systems and are not fully seismically qualified.

FPC's airborne particulate radioactivity monitoring system does not remain functional when subjected to the SSE because FPC's airborne particulate radioactivity monitoring system is non-safety equipment. The piping and tubing used is seismic I, but the cabinet and associated hardware are not seismically qualified.[7-9,12,13]

G. "Indicators and alarms for each leakage detection system should be provided in the main control room. Procedures for converting various indications to a common leakage equivalent should be available to the operators. The calibration of the indicators should account for needed independent variables."

FPC provides alarms and indicators in the main control room for each of the following leakage detection systems: (1) sump level and flow monitoring, (2) airborne particulate radioactivity monitoring, and (3) airborne gaseous radioactivity monitoring. FPC also meets the position for the calibration of those indicators for independent variables.

FPC has no procedures for converting various indicators, specifically radiation monitors, to a common leakage equivalent. However, provisions in Standard Review Plan (SRP) Section 5.2.5, allow the use of charts or graphs for conversion of count rate into gpm. (leak rate)

H. "The leakage detection systems should be equipped with provisions to readily permit testing for operability and calibration during plant operation."

FPC satisfies this requirement since all leakage detection systems are capable of testing and calibration during plant operation.[2,3,6,8,9,11]

I. "The technical specifications should include the limiting conditions for identified and unidentified leakage and address the availability of various types of instruments to assure adequate coverage at all times."

FPC meets this position by including the limiting conditions availability of various types of instruments in the Technical Specification 3/4.4.6 "Reactor Coolant Leakage."[3]

III. SUMMARY

The following summary corresponds to the same alphabetical regulatory position:

A. FPC satisfies the regulatory position of detecting known and unknown leakage.

B. RB sump level measuring devices are capable of measuring flow rate with an accuracy of 1gpm in 1 hour.

C. FPC has the capability to monitor the following:

- Sump level and flow
- Airborne particulate radioactivity
- Airborne gaseous activity
- RB pressure (indirect indication of leakage to containment)

D. FPC additionally monitors the following systems for intersystem leakage:

- Secondary
- Decay heat closed cycle cooling
- Nuclear services closed cycle cooling

E. The CR-3 leak detection system is capable of detecting a leakage rate of one gpm in less than one hour. The SRP allows the use of graphs and/or charts to convert count rate (from airborne particulate/ gaseous monitors) to leak rate.

F. The action statement of Technical Specification 3.4.6.1 describes the times when the leakage detection systems must be operable, or if not operable, the action that must be taken. The action statement of Technical Specification 3.4.6.1 is as follows:

With only two of the above required leakage detection systems, OPERABLE, operation may continue for up to 30 days provided grab samples are obtained and analyzed at least once per 24 hours when the required gaseous and/or iodine radioactivity monitoring system is inoperable; otherwise be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours. The Technical Specification could be used as the basis for complying with the first part of the regulatory position. In the case of a seismic event not requiring plant shutdown, Technical Specification 3.4.6.1 could be used to allow the plant to continue operation even if all of the detection systems were not operable. The Technical Specification must be followed until all three detection systems were again operable. This action would eliminate the necessity of meeting the first part of the regulatory position which states that the leakage detection system should withstand a seismic event not requiring plant shutdown.

An NRC Generic Letter 84-04 exempts the Westinghouse Owners Group plants from requiring the seismic qualification of the airborne particulate radiation monitoring system.[15] After SSE, at least one leakage detection system with a sensitivity capable of detecting 1 gpm

in 4 hours must be operable. A position of using this letter to meet the second part of the regulatory position could be employed.

G. Leak detection system has indicators and alarms in the control room. The SRP allows the use of graphs and/or charts to convert count rate to leak rate.

H. The leak detection system components are capable of being tested and calibrated during plant operation.

I. FPC Technical Specification 3/4.4.6, Reactor Coolant Leakage, includes limiting conditions for identified and unidentified leakage and addresses the availability of various types of instruments to assure adequate coverage at all times.

IV. REFERENCES

1. SP-317 "RC System Water Inventory Balance"
2. SP-175 "Containment Sump Level/Flow Monitoring System Cal."
3. Technical Specification 3/4.4.6 "Reactor Coolant Leakage", Page 3/4 4-13
4. FSAR 4.2.3.8 "Leak Detection"
5. FSAR 11.4 "Radiation Monitoring System"
6. SP-335 "Radiation Monitoring Instrumentation Functional Test"
7. SP-701 "Radiation Monitoring System Surveillance Program"
8. CH-232 "Atmospheric Radiation Monitoring System Calibration Procedure"
9. CH-233 "Liquid Radiation Monitoring System Calibration Procedure"
10. CH-266 "Determination of Primary-to-Secondary Leak Rate"
11. HPP-404 "Area and Main Steam Line Radiation Monitoring system Calibration and Verification"
12. FD-302-693 "Containment Monitoring System"
13. Safety Listing Volume 1, FPC, Rev. 19, 3/4/85, Pages 1-7 & 9
14. FPC's, Environmental and Seismic Qualification Guide Specifications and Date for CR-3, SP-5095
15. NRC Letter, 2/1/84, Subject: Safety Evaluation of Westinghouse Topical Reports Dealing with Elimination of Postulated Pipe Breaks in PWR Primary Main Loops (Generic Letter 84-04)