Florida
Power
CORPORATION

October 7, 1983
3F-1083-09

Director of Nuclear Reactor Regulation
Attention: Mr. John F. Stolz, Chief
Operating Reactors Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Crystal River Unit 3
Docket No. 50-302
Operating License No. DPR-72
NUREG 0737, Item II.F.2
Instrumentation For Detection Of
Inadequate Core Cooling

Dear Sir:

In response to your letter of September 6, 1983, Florida Power Corporation (FPC) is providing additional information for our proposed inadequate core cooling instrumentation system at Crystal River Unit 3 (Enclosure 1). Because evaluation(s) are required to answer some of your questions, FPC will submit additional information by February 15, 1984.

If you have questions, please contact this office.

Sincerely,

E. C. Simpson
Director, Nuclear Operations
Engineering and Licensing

AND/feb

cc: Mr. James P. O'Reilly
Regional Administrator, Region II
Office of Inspection & Enforcement
U.S. Nuclear Regulatory Commission
101 Marietta Street N.W., Suite 2900
Atlanta, GA 30303

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ENCLOSURE 1

REPLY TO NRC
REQUEST FOR ADDITIONAL INFORMATION
FPC PROPOSED INADEQUATE CORE COOLING INSTRUMENTATION
FOR CRYSTAL RIVER NUCLEAR PLANT - UNIT 3

1. Provide a detailed analysis of the measurement errors in the hot leg level measurement. This analysis should include, besides the overall estimate of the measurement uncertainty, a table with estimates of error, including limits of uncertainty for each contributing factor, i.e., temperature of impulse lines, common mode pressure effects on the differential pressure transducer, and uncertainties associated with the transducer. Explain how the individual errors were combined for the estimate of the overall error. Include a copy of the specifications for the proposed dP transducers.

   RESPONSE

   The measurement errors in the hot leg level measurement loop will be performed as part of the ongoing reactor coolant inventory tracking system (RCITS) design. The information pertaining to the estimate of the error in the hot leg level measurement loop and the dP transmitters will be available for review by February 15, 1984.

2. Provide an analysis of the error that would be expected both with and without temperature compensation on the vertical runs of the hot leg measuring system.

   RESPONSE

   The RCITS will be designed with temperature compensation on the vertical runs of the hot leg. However, the analysis of the error that would be expected with and without temperature compensation will be performed as part of the RCITS design. This analysis will be available for review by February 15, 1984.

3. Suppose an impulse line on one hot leg was broken such that it would tend to drive the dP transducer full scale. How would this condition be detected?

   RESPONSE

   If the impulse line on one hot leg breaks, the dP transmitter will sense maximum dP or full output (20 mA) from the transducer. This will result in a reading of 100 percent level on the control room indicator. The operator would not be able to detect a broken impulse line from this one indicator. If this indication was suspect, the operator could compare it to the level indicator on the other hot leg.

However, if the reactor coolant pumps were on, the level indicators would both read 100 percent level, and the operator would not be aware that a problem existed. If the pumps were off, the good transmitter would indicate a high level, but less than 100 percent. At this time, the operator would suspect that a problem existed because a 100-percent level would still be indicated from the transmitter with the break in the impulse line. But these level indications are for information only and do not affect any control functions. In addition, the operator can compare the information from the hot leg level indicators with other information available to him, such as that from the subcooling margin monitor (SMM) and the core exit thermocouples (CETs).

Other confirmatory information includes containment atmosphere radiation monitors, containment temperature, and containment sump measurements.

4. Provide additional details of the seal chambers on the reference legs of the hot leg level measuring system including a drawing showing the proposed installation.

RESPONSE

The design of the seal chambers used on the reference legs of the hot leg level measuring system will be completed as part of the RCITS design. The details of the seal chambers and the drawing showing the installation will be available for review by February 15, 1984.

5. Provide an analysis to show the effects of flashing or dissolved gases in the impulse lines.

RESPONSE

The analysis to show the effects of flashing or dissolved gases in the impulse lines will be performed as part of the RCITS design. The above analysis will be available for review by February 15, 1984.

6. Discuss the vulnerability of the differential pressure transmitters located in containment. In particular, discuss the ability of the transmitters to withstand a LOCA environment within the containment and be available for post-accident monitoring; consider the loss of the pressurizer transmitters in the TMI-II accident in this discussion.

RESPONSE

The transmitters used in this design will be located inside the containment and will be qualified to withstand the LOCA environment postulated for Crystal River 3 (CR3) and be available for post-accident monitoring.

Transmitter qualification is currently being evaluated for compliance to the temperature, pressure, and radiation environment during and after an accident.

Final transmitter design will be available for review by February 15, 1984.

7. Describe the location of an indication of the state of the reactor pumps with respect to the location of the inventory readouts in the control room.

RESPONSE

See response to Question 10 below.

8. Discuss the tap in the decay heat drain line from the standpoint of a single failure of a line leading to this tap. Consider potential consequences of such a failure, and provide details of design precautions to prevent such a failure.

RESPONSE

As indicated in the ICC study, the tap on the decay heat drain line (named the decay heat drop line at CR3) serves as a common lower connection point for all the dP measurements in the RCITS.

If this common line fails, all the dP measurements in the RCITS will be rendered inoperative. The transmitters will each read minimum dP (4 mA) and will indicate 0-percent level. This condition will exist whether the reactor cooling pumps are running or not. Redundancy does exist for the individual transmitters. However, because of system configuration, only one tap is available to feed these transmitters. If this one line fails, all indication is lost. At this point, the operator would have other information available to him from other sources. Note that this system is not used for control, but is meant to provide the operator with the trend of the reactor coolant level.

Several precautions to minimize such a failure are considered; e.g., seismic support of tubing and test procedures to ensure that the system is properly designed and installed.

9. Describe how the dP measuring system is protected against overpressure during venting or while the reactor pumps are operating.

RESPONSE

As part of the RCITS design, the dP transmitters, tubing, and supports will be designed to withstand overpressure during venting or while the reactor pumps are operating.

10. With reference to the discussion of invalid indications by the dP coolant inventory systems under Item 12 on page 4: describe the rela-

tive locations of the coolant inventory system indicators with respect to indications of the reactor pump status.

RESPONSE

The RCITS indicators are located on the left side of the primary-secondary auxiliary (PSA) panel which is next to the integrated control system (ICS) panel. The reactor pump status indications are located on the left side of the ICS, in proximity to the RCITS indicators. The operator, while looking at the RCITS indicators, need only turn to the right to see the reactor pump status indication.

11. In the July 18, 1983, submittal the licensee states that thermocouples, connectors, and cable are not at present environmentally qualified. It is further stated that in the future environmentally qualified cable and thermocouples will be installed. Clarify that qualified connectors and penetration devices will also be used.

RESPONSE

The response to this question will be provided by February 15, 1984.

12. Provide more detail on the pump power versus void correlation with the supporting test data and the referenced Babcock & Wilcox Document No. 77-1137950-00, dated October 1982, entitled Feasibility Study of Inventory-Trending Methods with RC Pumps Operating. Describe how the data show that the signal is reliable between 15 and 40 percent void fraction. Has degraded pump performance under two-phase flow conditions been accounted for?

RESPONSE

The pump power versus void correlation is discussed in Section 2 of Babcock & Wilcox Document No. 77-1137950-00, Feasibility Study of Inventory-Trending Methods with RC Pumps Operating.

Pump current model represented by Equation No. 30 is used for RC system void estimation. This model is based on the assumption that the pump motor efficiency, voltage input, and power factor remain constant. To account for the variations in the voltage and power factor, pump current in this model is replaced by pump power.

Experimental data for various scale model pumps by different agencies are referred to and discussed in Section 3 of the above document. Figure 11 in this section compares the measured density upstream of pump compared with prediction using pump motor power. The test data and the calculated values indicate a similar profile. Operating characteristics of the typical pump motor, considering a 0 to 40 percent system voiding and degraded pump performance under two-phase flow conditions, are discussed in Section 3. Section 5 describes the significance of the 0 to 15 percent void fraction signal.

However, the system will have a full range of 0 to 100 percent void fraction indication. The void fraction signal will not be limited between 15 and 40 percent void fraction.

Tracking of the coolant inventory with reactor coolant pumps (RCPs) running by monitoring the pump power will be used for trending purposes only. There is no trip circuitry for RCPs associated with this void signal. This void fraction signal will be available whenever the RCPs are running.

13. Your justification for use of nonsafety-grade pump power monitoring channels is based in part on the argument that the RCP motor and its associated electrical circuits are powered from non-Class 1E sources and are not environmentally qualified. However, it is conceivable that pumps may be restarted for improved core cooling late in an ICC transient after the core has uncovered. Provide assurance that the pump monitoring channels are at least as reliable as the RCP motor and electrical circuits and can be expected to function in an environment which will permit RCP restart.

RESPONSE

The pump power transducers will be using the existing RCP motor switchgear current and potential transformer signals and will be self-powered. The transducers are high-quality, commercial-grade components, and are of equal high quality to the currently installed transducers for the motor protection, and are planned to be installed in the same environment as the existing RCP switchgear. Further, one transducer for each pump is planned. This will allow for reactor coolant inventory tracking with less than four pump operation.

The algorithm cabinet, which processes these power transducer signals, is planned to be located in the control complex that has the same or a milder environment. This algorithm cabinet will be powered from a reliable source of power. The algorithm cabinet is backed up by the plant computer which contains the pump power algorithm.