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September 8, 1983

1CANØ983Ø3

Director of Nuclear Reactor Regulation
ATTN: Mr. J. F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
Responses to ANO-1 ICC Safety Evaluation Questions

Gentlemen:

Your letter dated August 5, 1983, (1CNAØ883Ø1) requested a schedule for responses to questions raised during the evaluation of our April 15, 1983, (1CANØ483Ø8) and May 4, 1983, (ØCANØ583Ø1) responses regarding our proposed Inadequate Core Cooling (ICC) instrumentation systems.

Complete responses to certain questions will require additional progress in our design and confirmatory testing efforts; other questions can be answered at this time. Attached is a discussion of each question and a commitment for a future response, if required.

Very truly yours,

John R. Marshall
Manager, Licensing

JRM:JK:sl

Enclosure

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ATTACHMENT 1

1. Provide a detailed analysis of the measurement errors in the hot leg level and reactor vessel head 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 associated with the transducer. Explain how the individual errors were combined for the estimate of the overall error. Discuss the error in inventory with respect to the quantity of coolant remaining to cool the core.

   Response

   A detailed analysis of the measurement errors of the proposed level instruments is not available at this time. To perform this analysis it is necessary to know detailed information about each component that comprises the measurement string. The individual error components are then combined by a method determined by the nature of the errors. If the errors are random, they may be combined using a statistical technique. The root-mean-square method is generally accepted in this case. If the individual errors are not random, the components must be algebraically added to allow for the worst case. This information will be available after the confirmatory testing is finished and will be submitted with the final design description, currently scheduled for March 1985.

2. How many sensors are connected by a single heater lead? What is the hest source for the heater?

   Response

   A gamma thermometer probe of the type proposed for the ICC instrumentation system will consist of multiple sensors in a single rod. Each probe will contain a single segmented heater wire with an electrical heat source. At points along the length of the probe where heating is desired, a high resistance segment (possible nichrome) is employed. The interconnecting segments will be a low resistance material providing a continuous path for the heater current. The heater will be operated at a power level well below its design rating. This fact, plus the technique of heater fabrication, makes the heater quite reliable. The exact number of sensors per rod and the details of the heater power supply will be submitted with the final design description.

3. Are the elevations of the sensors shown in Figure 1 and Figure 2 approximately correct?

   Response

   Figure 1 and Figure 2 of our April 15, 1983 submittal (1CAN048308) are conceptual. Although the actual number of sensors and their locations have not been finalized, the figures are representative of the design

concept. The goal of the final design will be to locate a sufficient number of sensors to provide the operator with the best information possible, both above the core as well as in the core. The exact number and location of the sensors will be submitted with the final design description.

4. Discuss the methods proposed for fault and/or failure detection. For instance, will the control electronics include open circuit detection? How will failures be indicated to the operator?

Response

The exact method to be used for failure detection in the ICC instrumentation system has not yet been determined. Providing an indication of failure to the operator will be an important consideration in the final system design. Failure detection methods will be submitted with the final design description.

5. Describe the location of an indication of the state of the reactor pumps with respect to the location of the inventory readouts.

Response

The SPDS computer will be used to provide the primary ICC display. Presently, a SPDS display CRT is located in the control room. The exact location may be subject to change pending the results of the control room design review. Although the display format for the inventory display has not been developed yet, the SPDS provides a great deal of flexibility in giving the operators clear, concise information. The color graphic capabilities of the SPDS will be used. The RCP status can be input to the SPDS in order to clearly mark those portions of the inventory readout which are not valid during pump operation. Location and ICC display information will be submitted with the final design description.

6. Describe how the plenum level indication will be indicated invalid when the coolant pumps are on. (This may be reviewed as part of the final review of the control room display systems.)

Response

See response to question 5.

7. Provide an analysis to show the effects of flashing or dissolved gases in the external water column.

Response

The external water column (stillwell) will incorporate design features to minimize measurement inaccuracies due to voiding caused by entrained gases (both steam and non-condensible gases). The stillwell sensing lines will be sloped such that any entrained gases will migrate toward

the high point vent connection. Further, the stillwell and its sensing lines will be designed such that no pockets or loops are formed for trapping entrained gases.

For the condition of RCP's running, the effects of flashing will not be important as the hot leg level indication will be invalid due to reactor coolant flowing through the stillwell. During natural circulation or loss of natural circulation, the collection of steam and non-condensible gases in the top of the hotleg piping will inhibit flow through the stillwell such that over a period of time the stillwell will cool due to the stagnant flow conditions. During a rapid system depressurization, severe flashing will occur in the hotleg piping as well as the stillwell. Therefore, the level indication will not be available from the stillwell due to an inability to obtain a collapsed level initially. However, as time progresses the stillwell should cool more rapidly than the hotleg due to stagnant flow conditions in the stillwell and, eventually, a useable collapsed level will form as the steam voids present condense and/or migrate to the high point vent connection.

For less severe depressurization events the flashing and voiding will be less severe and the effect on the stillwell probe should be accordingly less severe. The performance of the gamma thermometer probes under a variety of blowdown and depressurization events will be tested and evaluated further during the planned confirmatory testing at ORNL. A more detailed discussion will be contained in the final test report.

8. What is the expected operating temperature of the external water column?

Response

When the RCP's are running, the temperature of the external water column (stillwell) should be very close to the normal hotleg temperature. Under conditions of natural circulation or loss of natural circulation, the initial temperature of the stillwell should be very close to the hotleg temperature immediately preceding the occurrence of either event. Over a period of time the stillwell temperature should gradually decrease to approximately ambient conditions (see response to question 7 above).

9. Figure 2 in the April 15, 1983 submittal is referred to as a "conceptual design." Does this mean that the actual number and location of the sensors has not been finalized? When will such information be available?

Response

See response to question 3.

10. Attachment 1 to NUREG-0737 Item II.F.2 requires that a sufficient number of core exit thermocouples for each quadrant of the reactor core be provided to indicate radial temperature distribution. The intent is to warn the operator of local core problems. The approach taken by ANO-1 is to diagnose local core heating problems using instruments which provide an axial distribution of temperatures. One RADCAL Gamma Thermometer (RGT) per core quadrant is proposed. Each RGT reads three absolute and five differential temperatures along its length. The suitability of this scheme either alone or in combination with other instrumentation should be justified.

Response

Response will be provided by November 4, 1983.

11. The licensee indicated that numerous core exit thermocouples (CET) are presently installed, but that there are no plans to upgrade them. Consideration should be given to upgrading of at least four CETs per quadrant to fulfill the requirements for mapping of radial temperature distributions. Can such upgrading be accomplished during the next refueling outage (Sept.-Dec. 1984). If not, justify the adequacy of the existing CET system to survive the adverse environments which may be associated with the need for an inadequate core cooling monitoring function. Show that the existing CETs, including information displays, are reliable enough to fulfill this need until implementation of the final system in 1986 or later.

Response

Response will be provided by November 4, 1983.

12. Provide the details of the ICC instrumentation system design, particularly regarding readout ranges, alarm arrangements, hardcopying printout and trending capability.

Response

Details of the ICC instrumentation system design will be provided with the final design description.

13. In the current Cycle 6, the central control rod is part of Safety Group 2 and fully withdrawn during full power operation. Will this still be true for Cycle 7 and future cycles?

Response

Response will be provided by November 4, 1983.

14. What are the effects of the control rod removal on shutdown margin and on ejected rod worth from zero power configurations?

Response

Response will be provided by November 4, 1983.

15. Provide schedule dates for completion of the milestones identified in Enclosure 3.

Response

Response will be provided by November 4, 1983.