DUKE POWER COMPANY
P.O. BOX 33189
CHARLOTTE, N.C. 28242

HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
(704) 373-4531

February 22, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Re: McGuire Nuclear Station
Docket Nos. 50-369, 50-370

Dear Mr. Denton:

In a meeting on September 9, 1981 and in the draft Safety Evaluation Report (SER) of June, 1982, the NRC stated that source-range neutron flux and Reactor Coolant System (RCS) cold leg temperature indication is required for the McGuire Standby Shutdown System (SSS) control room. Duke Power provided justification that this additional instrumentation was not necessary in letters of October 21, 1981 and December 14, 1982. On January 8, 1983, the technical bases for these requirements was unofficially provided to Duke for the first time, and an additional requirement for Reactor Coolant System (RCS) hot-leg temperature instrumentation was added.

Duke has reviewed the technical bases for the NRC positions and has concluded that the requirements for the source-range flux and the hot-leg RCS temperature instrumentation are not justified. Addition of cold-leg RCS temperature instrumentation could be somewhat beneficial; however, cold-leg instrumentation does not uniquely provide plant status indication which cannot be determined from steam generator level and pressure instrumentation. Due to considerations of cost, personnel radiation exposure, and impact on plant availability, Duke proposes to add steam generator pressure instrumentation for the McGuire SSS. (Steam generator level is already provided.)

Attached is a detailed discussion of the bases for the conclusions described above. A proposed schedule for installing the steam generator pressure instrumentation will be provided after notification of NRC agreement with these conclusions.

Please note that the McGuire SSS is installed as required by the McGuire Unit 1 Facility Operating License and will be completely functional before startup after the current Unit 1 outage. If modifications are required as a result of this review, sufficient time should be allowed for implementation without affecting plant availability. As described above, this is Duke's first opportunity to respond to NRC

B021 R. Mattson E. Sylvester
Add: L. Rubenstein M. Duncan
O. Parr R. Birkel
R. Lobel

technical concerns which form the bases for the requirements to add additional instrumentation in the SSS.

If additional information is needed, please contact R. E. Harris at (704)373-8771.

Very truly yours,

H.B. Tucker /RBH

Hal B. Tucker

REH:GBS:jfw
Attachment

cc: Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Senior Resident Inspector
McGuire Nuclear Station

Source Range Flux

(Attachment to Letter of 2/22/83:
H. B. Tucker to H. R. Denton)

The Staff position requiring incorporation of source range flux indication included the following:

1. Monitoring core flux provides the only direct indication for assessing reactor criticality conditions.
2. Dilution events would not be readily detected by other process variables.
3. Boron sampling is inadequate for determining "real time" boron requirements.
4. Should the operators fail to detect a loss of shutdown margin in a timely manner, mitigation might be impaired by loss of equipment due to fire.

Recognizing that the above items might be legitimate concerns, a detailed evaluation was undertaken to assess their validity and to quantify the realistic plant response to the worst case events which might potentially lead to a loss of the shutdown margin.

It cannot be disputed that the only direct indication for assessing reactor criticality conditions is by monitoring core flux. The concern, however, is not reactor criticality; it is maintaining an adequate shutdown margin to prevent nuclear heat generation. Shutdown margin is assured by maintaining the existing boron concentration from power operation at hot standby, and by increasing boron concentration prior to cooling the RCS to below hot standby temperature. The parameter of interest is boron concentration, not source range count rate. Source range count rate is in fact misleading following most reactor shutdowns, since the xenon transient will impact the count rate. The operator might initiate action to a non-event if he was sensitized to this indication. The capability to measure boron concentration must be made available prior to cooldown below hot standby. Cooldown below hot standby is attempted only after restoration of normal plant cooldown capability; cooldown is not performed using the Standby Shutdown System.

Two dilution mechanisms exist at hot standby. Boron could potentially be removed by the Boron Thermal Regeneration System (BTRS). This mechanism is not considered to be credible for the post-fire scenarios of interest since it would require spurious actuation of the entire system. The second mechanism requires a sustained delivery of unborated water into the RCS. The standby makeup pump can only be aligned to the spent fuel pool, and as such cannot create a dilution flowpath. Of the unborated water sources in the plant, only those aligned to pumps which can deliver against the high RCS pressure at hot standby need to be considered. Only the centrifugal charging pumps (CCP) and the positive displacement pump (PDP) can overcome RCS pressure. These pumps take suction from the volume control tank (VCT)

during normal operation, and from the refueling water storage tank (RWST) for emergency boration. Since the RWST is highly borated, only the VCT and the reactor makeup water storage tank (RMWST) that supplies the VCT are sources of unborated water. Following reactor trip the operator is instructed by plant procedures to terminate deboration activities. It is very unlikely that sustained injection of unborated water would occur. The water source for the CCP's and the PDP would be switched to the RWST if the VCT boron concentration was significantly below RCS concentration.

Injection of unborated water into the RCS at hot standby could only occur by a hypothetical spurious actuation of these pumps while aligned to an unborated water source. The plant response to such an event has been realistically evaluated. RCS inventory conservation measures should ensure a very minimal inventory loss from the RCS, such that the inventory addition would be indicated to the operator by an increase in pressurizer level. Contrary to Item 2 above, a dilution event will be promptly indicated by an existing process variable far in advance of any detectable change in source range count rate. Having identified the symptom of the loss of inventory control, the operator will undertake measures to restore pressurizer level control. Upon finding the source of the problem, if it was due to an injection of unborated water the operator would realize that a dilution event had been initiated. In spite of the simplicity of this action, if it is assumed that the dilution continues unmitigated, the entire volume of the VCT injected into the RCS would result in only a 0.87% $\Delta k/k$ decrease in the shutdown margin under worst case assumptions. Sustained delivery of unborated water would have to continue for 106 minutes before losing the shutdown margin. Based on these results, it is apparent that a very sufficient period of time is available for the operator to respond to the worst case boron dilution event at hot standby.

This evaluation demonstrates that hypothetical boron dilution events at hot standby proceed very slowly. There is no necessity for "real time" indication of the neutron flux. An event will most likely be promptly indicated by the increase in RCS inventory on the pressurizer level instrumentation. The source range neutron flux instrumentation could provide a misleading indication of core criticality due to transient xenon effects. Boron measurements are the preferred and normal method for ensuring that the core remains subcritical. The operator will require a boron measurement prior to cooldown below hot standby.

RCS Hot Leg Temperature

The SSF instrumentation available to the operator includes core exit thermocouple indication. Core exit thermocouples provide an equivalent and earlier indication of the status of decay heat removal from the core, when compared to hot leg temperature. Reactor vessel head voids would be indicated by the reactor vessel level instrumentation system. No justification exists for requiring hot leg temperature instrumentation in addition to core exit thermocouples.

RCS Cold Leg Temperature

While maintaining hot standby conditions, there is no need for an explicit indication of the cold leg temperature. Provided that the operator maintains steam generator level, and based on the fact that the steam generators cannot depressurize due to fire (Reference H. B. Tucker letter of January 5, 1983 to H. R. Denton, attachment item Q), T-cold will follow the saturation temperature corresponding to the steam generator pressure. Steam generator pressure is controlled by the pressure relief setpoints of the main steam code safety valves. T-cold is therefore determined a priori by the valve setpoints. Cooldown to cold shutdown conditions is accomplished only after restoration of the normal safe shutdown controls and instrumentation.

PTS and Appendix G considerations are not applicable with the steam generator pressure controlled by the main steam code safety valves and the reactor maintained at hot standby. The primary-to-secondary heat transfer is not excessive. In addition, delivery of cold injection water directly into the RCS is minimal; therefore, RCS cooldown cannot be effected in this manner.

Monitoring the difference between the core exit thermocouples and the cold-leg temperature would provide a means of verifying natural circulation. Since cold-leg temperature will follow the saturation temperature corresponding to steam generator pressure, cold-leg temperature can be easily determined if steam generator pressure is known. Accurate indication of steam generator pressure is desirable rather than assuming pressure equals the steam generator code safety valves setpoint. Therefore, either cold-leg temperature or steam generator pressure instrumentation together with core exit thermocouples will provide indication of natural circulation cooling.

Installation of cold-leg RCS temperature at McGuire in accordance with Appendix R criteria would require new thermowells and sensors. Because of this, the cost of adding this instrumentation is estimated to be approximately 100 times greater than the cost of adding steam generator pressure instrumentation. Additionally, personnel radiation exposure would be significant during installation of cold-leg RCS temperature. An extended outage, such as a refueling outage, would be required to accomplish the installation, since new thermowells will involve drilling into reactor coolant piping. In contrast, installation of steam generator pressure instrumentation can be accomplished external to containment with significantly lower cost, lower radiation exposure to personnel, and less effect on plant availability.

In summary, cold-leg RCS temperature is not justified for the McGuire SSS on the basis of PTS and Appendix G concerns. Either cold-leg temperature or steam generator pressure together with core exit thermocouples can provide indication of a natural circulation cooling mode. Due to significant differences in cost, personnel radiation exposure, and plant availability, Duke proposes to add steam generator pressure in the McGuire SSS.