ENCLOSURE 1

SAFETY EVALUATION REPORT

WESTINGHOUSE ANALOG ROD POSITION INDICATION FOR SHUTDOWN MODES

Introduction

Task Interface Agreement (TIA) 82-49 states that DSI will evaluate the bases for Westinghouse PWR rod position indication system accuracy requirements during plant operation in Modes 3, 4, and 5 (shutdown modes).

In a memorandum dated September 3, 1982 ORAB provided recommendations regarding rod position indication accuracy requirements to DSI.

The subject of the analog rod position indication system in Westinghouse PWR's has been under review for the last year and one half. We have reviewed ORAB's recommendations and the material submitted by two licensees, Beaver Valley and Sequoyah, including the Beaver Valley Power Station Unit 1 Analog Rod Position Indication (RPI) System Special Report. We have met with Westinghouse on this subject several times and are currently reviewing their report on the Analog RPI System.

Background

The RPI system was originally installed so that there would be an accurate means of telling the location of individual control rods during power operation in order to avoid misaligned rods. The Westinghouse safety analysis shows that a control rod misalignment of $\pm$24 steps is acceptable. Since there is a 12 step uncertainty, this leaves a requirement for no more than a $\pm$12 step indicated misalignment. Thus the Technical Specification requirement for individual control rods to be aligned with their banks within $\pm$12 steps. The RPI system was not originally intended to be used in the shutdown modes.

Calibration of the RPI system has been a problem both during power operation and in the shutdown modes. Various solutions to the calibration problems for Modes 1 and 2 (power operation) have been worked out and presently the licensees have the ±12 step accuracy requirement for Modes 1 and 2.

The RPI for each individual rod is calibrated at beginning of cycle at operating temperature. The calibration of the RPIs is highly temperature sensitive. Thus as the reactor cools down in Modes 3, 4, and 5, the hot calibration becomes inaccurate and may be off as much as 60 steps (total rod is 228 steps). Thus the Technical Specification which states that the RPIs and group demand counters must agree within ±12 steps cannot be met as the plant cools down unless there were calibrations as a function of temperature.

If the plants wanted to operate in Modes 3, 4, and 5 only with all the rods fully inserted the Technical Specification could be met because it does not apply to rods fully inserted. However, many plants prefer to operate with the shutdown banks "cocked" in order to have reactivity available if needed. They cannot meet the ±12 step accuracy unless they recalibrate as temperature decreases.

Evaluation

To prevent inadvertent criticality from Modes 3, 4, and 5, the licensee is required to maintain the reactor in a sub-critical condition with $k_{eff} \leq 0.99$. This is accomplished thru boron concentration and insertion of control rods. Calculation of the necessary boron concentration takes into account the position of the control rods.

While it would be extremely useful to have the RPI system indicating rod positions, it is not possible to use the system accurately in Modes 3, 4, and 5. ORAB recommended a Technical Specification that required the group demand counters and the RPIs to be operating in Modes 3, 4, and 5. The licensees indicates that there was problem with the interpretation of the specification and that it led to unnecessary LERs.

Westinghouse has proposed a specification which requires only the group demand counters be operable and capable of determining rod position for Modes 3, 4, and 5. In this way the analog system is used for the Modes 1 and 2 where it was intended to be used and is not required for Modes 3, 4, and 5.

The group demand counters have proven to be extremely reliable over the 15 years they have been used. They have proved to be the most accurate means of determining rod position and are in fact used to calibrate the RPIs. In addition, the requirement that $k_{eff} \leq 0.99$ for Modes 3, 4, and 5 provides margin to inadvertent criticality.

Conclusion

Based on our review we find that the safety consideration of maintaining adequate sub-criticality can be accomplished by requiring that the group demand counters be used for rod position indication. The requirement to maintain a 12 step accuracy with the RPIs is not necessary. We conclude that the enclosed Technical Specification which requires only the group demand counters for the shutdown modes is the best solution for plants having the analog RPI system.

REACTIVITY CONTROL SYSTEMS

POSITION INDICATION SYSTEM-SHUTDOWN

LIMITING CONDITION FOR OPERATION

3.1.3.3 The group demand position indicator shall be OPERABLE and capable of determining within ± 2 steps the demand position for each shutdown, control or part length rod not fully inserted.

APPLICABILITY: MODES 3*#, 4*# and 5*#

ACTION:

With less than the above required group demand position indicators(s) OPERABLE, immediately open the reactor trip system breakers.

SURVEILLANCE REQUIREMENTS

4.1.3.3 Each of the above required group demand position indicator(s) shall be determined to be OPERABLE by movement of the associated control rod at least 10 steps in any one direction at least once per 31 days.

* With the reactor trip system breakers in the closed position.
# See Special Test Exception 3.10.5