

ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATING TO THE TASK INTERFACE AGREEMENT
ON EXCORE-INCORE CALIBRATION AT SALEM UNIT 2
DOCKET NO. 50-311

1.0 INTRODUCTION

The excore power range detectors are used to monitor the core power level, axial flux imbalance and azimuthal flux tilt. The calibration of the excore nuclear instrumentation (NIS) is accomplished by comparing the excore detector signals to measurements of incore power distribution. The usual calibration process requires three flux maps taken during the calibration - thus it is called the 3-point calibration. The report describes a revision to the calibration method which requires only one incore flux map. A description of the excore detection system and a safety evaluation of the revised calibration procedure are included in the report.

2.0 EVALUATION

The excore power range detector system consists of four discrete but identical channels. Each channel consists of an upper and lower flux detector and associated electronics to interpret the signals.

The excore detector response to the in-core power distribution is a combination of response to the upper and lower portions of the core. In other words, each excore detector "sees" both the upper and lower core regions. This cross contribution causes a duality in detector response and must be taken into account when the excore system is calibrated.

The response of the excore top and bottom detectors can be written in terms of core power, axial offset and 2 coefficients for each detector. The licensee has used a theoretical analysis to show that one of the coefficients for each detector is nearly a constant for all reactor cycles. The degree of variation is on the order of 2% about a mean value. The measurement uncertainty is much larger than this. Historical measurements have shown this to be true. Thus using 1 flux map, the other coefficient for each detector can be calculated and the calibration performed.

The licensee has determined the overall accuracy of the 3 point calibration by comparing incore flux map measurements to the interpretation of simultaneous excore signals. A total of 85 flux maps over 4 reactor cycles were used. The RMS error for ΔI calibration was found to be 1.2% (in ΔI units). The RMS errors in the tilt calibrations was found to be 1.2% (in % tilt units). A similar analysis was performed using the 1 point calibration for the same data set. The RMS errors were 1.1% for the ΔI calibration and 1.2% for the tilt calibration. Based on this comparison, the licensee concluded that the two procedures would give equivalent results.

3.0 CONCLUSIONS

Based on our review of the licensee's report "The Calibration of Excore Power Range Detectors," we find the "1 point" excore-incore calibration process to be acceptable. The bases of this conclusion is that both historically and theoretically two of the coefficients are nearly constant. In addition, the overall accuracy of the 1 point calibration has been shown to be as good as that of the 3 point calibration.