VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

June 3, 1992

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Serial No.	92-377
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Docket No.	50-280
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Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNIT 1
SPECIAL REPORT
QUADRANT TO AVERAGE POWER TILT
EXCEEDS 2.0% FOR GREATER THAN 24 HOURS

Surry Technical Specification 3.12.B.7.a requires that an evaluation be performed and a special report be issued to the Nuclear Regulatory Commission when the quadrant to average power tilt exceeds 2% for greater than 24 hours and the design hot channel factors for rated power are not exceeded. On May 3, 1992 to May 4, 1992, the Surry Unit 1 quadrant to average power tilt exceeded 2% for greater than 24 hours. A description of the circumstances surrounding the event is provided in the attachment to this letter.

This report has been reviewed and approved by the Station Nuclear Safety and Operating Committee.

Should you have any questions or require additional information, please contact us.

Very truly yours,

J. P. O'Hanlon

for W. L. Stewart
Senior Vice President - Nuclear

Attachment - Special Report-Quadrant to Average Power Tilt Exceeds 2% for Greater than 24 Hours

cc: U. S. Nuclear Regulatory Commission
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Mr. M. W. Branch
NRC Senior Resident Inspector
Surry Power Station

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ATTACHMENT

SPECIAL REPORT
QUADRANT TO AVERAGE POWER TILT EXCEEDS 2% FOR GREATER THAN 24 HOURS

On May 3, 1992, during initial power ascension for Unit 1 Operating Cycle 12, analysis of a flux map taken at 30% power showed an in-core power tilt. The measured high power quadrant based on this flux map was 3.7% higher than the average quadrant power. A manual flux tilt calculation was performed and showed an upper ex-core tilt of 7.18% and a lower ex-core tilt of 6.65%, which exceeded the maximum 2.0% quadrant to average (ex-core) power tilt specified in Technical Specification (TS) 3.12.B.5. With quadrant to average power tilt exceeding 2.0%, TS 3.12.B.6 requires that the hot channel factors be determined within two hours and the power level adjusted as required. If the hot channel factors are not determined within two hours, the power level and high neutron flux trip setpoint must be reduced from rated power 2% for each percent of quadrant tilt. If the power tilt is not corrected to less than 2.0% within 24 hours and design hot channel factors for rated power have not been exceeded, TS 3.12.B.7 requires an evaluation of the cause of the tilt and submittal of a special report to the NRC.

When it was identified on May 3, 1992 at 2130 hours that ex-core tilt exceeded 2.0%, reactor power was 30% and the power range high flux reactor trip setpoint was set at 85% power, thus the requirements of TS 3.12.B.6 were satisfied.

The ex-core tilt was caused by a combination of the ex-core power range nuclear instrumentation calibration and the in-core tilt. The power range detectors are calibrated against a prediction for initial startup following refueling and are re-calibrated using flux maps taken at 30% and 70% reactor power. The high flux trip setpoint and rod stop setpoint are conservatively set at 85% power and 81% power, respectively, to account for any possible nonconservatisms in the initial calibration of the power range detectors. The cause of the in-core tilt has not been conclusively determined. However, it was verified on May 4, 1992 at 1810 hours that design hot channel factors for rated power had not been exceeded. Thus, the in-core tilt was evaluated as acceptable.

On May 4, 1992 at 2320 hours, the power range nuclear instruments were re-calibrated to correct the ex-core tilt. The upper ex-core power tilt was 0.57% and the lower ex-core power tilt was 0.66% following this calibration, satisfying the TS limit of 2.0%. This report is required by TS 3.12.B.7.a since the quadrant to average power tilt exceeded 2.0% for greater than 24 hours and the design hot channel factors were not exceeded.

Our evaluation as to the probable cause of the in-core tilt considered the following:

1. Initial power ascension flux maps were run modeling different axial regions to determine if any rod misalignments were present. No rod misalignments were discovered. (This was investigated during the initial flux map analysis.)

2. Core models were checked for possible errors and different modeling schemes were attempted in an effort to simulate the in-core tilt. No modeling errors were discovered according to current methods. Alternate methods, accounting for asymmetric as-built fresh fuel enrichments and a different reconstituted rod model, increased the maximum predicted positive core tilt (30% power, all rods out, no xenon) from 0.27% to 0.80%, which does not approach the measured in-core tilt of 3.7%. The direction of the predicted tilt was consistent with the measurement.

3. Assemblies loaded with asymmetric burnable poisons (BPs) were investigated to ascertain whether the modeling of these assemblies may have had an impact on the predicted thimble fluxes. Removing these thimbles from the flux map resulted in less than a 0.05% change in the in-core tilt.

4. The full core loading plan was reviewed to ensure that significant asymmetric BPs were properly oriented consistent with modeling in predictive codes. This review confirmed that asymmetric BPs were oriented correctly.

5. The possibility that a fuel assembly misload is responsible for the measured tilt is essentially eliminated by review steps required by procedures in both the Final Core Loading Plan (FCLP) preparation and the core onload verification. The FCLP placement of fuel assemblies and insert components is based on the core models. An independent review of the FCLP development verifies that the FCLP and core models are consistent. Following the actual fuel assembly and insert shuffle, the loaded core is examined to verify consistency with the FCLP. To do this, fuel assembly and insert component identifications are verified for location and orientation. The correct locations and orientations were verified for the Unit 1 Operating Cycle 12 core in this manner.

6. Measured assembly and batch burnups were checked to determine if any asymmetric burnup tilts from previous cycles may have been present. No significant unexpected burnup tilts were discovered.

The results of our investigation indicate that although known fuel effects contribute to the core tilt, they are not the major cause of the observed core tilt. The INCOR computer code that was run to model different axial regions showed that the in-core tilt was similar in all axial regions. This result is consistent with a tilt induced by a loop inlet temperature imbalance. While the core tilt does not prove that such an inlet temperature imbalance exists, it is a potential cause due to the fact that the tilt does not appear to be influenced by a few fuel assemblies in one region, but rather is widely distributed. However, at isothermal conditions and hot full power conditions, there was no measured temperature imbalance.

While the exact cause of the in-core tilt was not determined, the magnitude of the tilt is bounded by the reload safety analysis and poses no operational problem. Analysis of a flux map taken at 100% power on May 11, 1992 indicated the incore tilt had reduced to 1.6%. Flux maps will continue to be taken and analyzed each effective full power month of operation or as required.