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SOUTHERN COMPANY
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Vogtle Electric Generating Plant
Response to Followup Questions from Staff from Teleconference Held on May 11, 2006
Regarding the Use of W(z) Factors in the Unit 1 Core Operating Limits Report

Ladies and Gentlemen:

Following the return-to-power from the recent Southern Nuclear Operating Company (SNC) Vogtle Electric Generating Plant (VEGP) Unit 1 outage, the core axial offset (AO) deviated from the expected AO and was found to be outside the range of validity of the W(z) factors in Section 2.6.5 of Revision 2 of the Unit 1 Core Operating Limits Report (COLR). The W(z) factors are used to demonstrate compliance with the transient heat flux hot channel factor FQ(z) limit of Technical Specification LCO 3.2.1.

A flux map was taken on May 1, 2006 and evaluated. Recognizing that the core AO was not within the range of validity for the W(z) factors in the COLR, a conservative penalty was applied to the W(z) factors based on vendor guidance to demonstrate continued margin to the FQ(z) limit. This was documented in an operability determination applying the guidance of NRC RIS 2005-20.

The Staff raised questions about the use of the vendor guidance and whether the vendor guidance was within the bounds of NRC approved methodology. Two teleconferences were held between the Staff and SNC on May 3, 2006, and on May 11, 2006, to discuss Staff questions. Following the May 11, 2006 teleconference, followup questions were provided by the Staff to SNC. Attached to this letter are SNC's responses to these followup questions.

This letter contains no NRC commitments. If you have any questions, please advise.

Sincerely,

Don E. Grissette

DEG/RJF/daj

Enclosure: Responses to NRC Questions of May 11, 2006 on W(z)

cc: Southern Nuclear Operating Company
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U. S. Nuclear Regulatory Commission
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Mr. G. J. McCoy, Senior Resident Inspector – Vogtle

Enclosure

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## RESPONSE TO NRC QUESTIONS OF 5/11/06 ON W(z)

**NRC Question #1:**

*How does the measured FQ(z) compare to the calculation of the FQ(z) using the previous COLR process? This gives the NRC staff insight into the safety significance of the issue.*

**Response to NRC Question #1:**

In the responses below, the Westinghouse Axial Offset (AO) Validity Criteria referred to come from a Westinghouse document "Axial Offset Validity Criteria Revision 3" dated June 30, 2005. This document is a Westinghouse proprietary document issued to Westinghouse customers.

For comparison purposes, the May 1, 2006 flux map has been processed using the W(z) factors from the previous Vogtle-1 Cycle 13 Core Operating Limits Reports (COLRs) (Revision 0, March 2005; Revision 1, November 2005); the current COLR (Revision 2, January 2006); the current COLR applying the guidance of Revision 3 of the Westinghouse AO Validity Criteria; and the W(z) factors to be included in Revision 3 of the COLR to be implemented prior to the next scheduled surveillance.

Minimum transient FQ(z) margin is shown in the table below. It is seen that the results are essentially the same for previous COLRs as well as the application of Revision 3 of the Westinghouse AO Validity Criteria. The revised W(z) factors to be included in Revision 3 of the COLR provide an additional 3% margin.

**Minimum FQ(z) Transient Margin (with Penalty Factor) Comparison with Different W(z) Factors for 5/1/06 Flux Map**

| COLR Revision | Transient FQ(z) Margin to Limit |
|---|---|
| Revision 0 | 7.54% |
| Revision 1 | 7.54% |
| Revision 2 | 7.74% |
| Revision 2 with application of AO validity criteria | 7.74% |
| Revised W(z) factors to be included in COLR Revision 3 | 10.82% |

**NRC Question #2:**

*Provide a description of the AO validity criteria, and the basis and results for calculating the FQ(z) values using the AO validity criteria to determine the W(z) values.*

**Response to NRC Question #2:**

The AO validity criteria document provides Westinghouse recommendations to utilities on what actions to take when the measured steady-state axial offset is significantly different from the predicted steady-state axial offset. Occasionally, differences between measured and predicted axial offset in excess of historical agreement have occurred. The AO validity criteria were established to make sure that these differences are considered in the reload licensing process, and Technical Specification surveillances.

Historically, measured and predicted AO have agreed reasonably well for cores without operational anomalies such as Crud Induced Power Shift (CIPS), or burnable absorber induced axial offset deviation (AOD). CIPS has also been referred to as Axial Offset Anomaly (AOA). Typical observed agreement has been +/-3% (WCAP-8385, "Power Distribution Control and Load Following Procedures"). When one considers known conservatisms in peaking factor uncertainties, conservatisms in the RAOC methodology, and typical plant operating practices, the corresponding impact of 3% delta AO on core peaking factors can be accommodated within the RAOC analysis. In addition, it is typical engineering practice to establish the RAOC AFD bands with an additional 3% AFD conservatism, in order to ensure that there is sufficient margin to the FQ(z) limit in future cycles.

Operating with a significant difference between measured and predicted AO can affect the validity of the FQ(z) surveillance factors, W(z). W(z) is defined as the ratio of peak transient FQ(z) divided by steady-state FQ(z). The numerator is based on the most limiting of thousands of core power shapes, which are generated in a manner independent of the path taken to achieve each shape. The numerator is a robust quantity that represents the most limiting credible shape or shapes that can be attained by operation anywhere within the allowed operating axial flux difference (AFD) band. The denominator however, is based on a single steady-state core power shape. As such, W(z) factors are sensitive to the steady-state core power shape, and it is implicitly assumed when generating W(z) surveillance factors that the measured steady-state AO will match the predicted steady-state AO within the historical measured to predicted range of AO differences. When this is not the case, for plants with fixed RAOC AFD bands, the W(z) values in the half of the core generating less power than predicted at steady-state conditions can be considered non-conservative, because the ratio of the transient FQ(z) to the measured steady-state FQ(z) is now larger than assumed

in the original W(z) generation. Similarly, the W(z) values in the half of the core generating more power than predicted at steady state can be considered overly conservative, because the ratio of the transient FQ(z) to the measured steady-state FQ(z) is now smaller than assumed in the original W(z) generation.

The AO validity criteria document contains a conservative procedure to determine a W(z) penalty that would apply when the steady-state AO is significantly different than predicted. The penalty is defined based on the relationship of the difference between measured and predicted AO and the impact on steady-state FQ(z). Analytical results from multiple RAOC analyses performed by Westinghouse, using the approved method described in WCAP-10216-P-A (referenced in Vogtle Technical Specification 5.6.5b) were used to determine the penalty. It should be noted that this penalty is applied only as a precautionary measure to the half of the core which is determined to have non-conservative W(z) factors (i.e., the underpowered half of the core). No corresponding "credit" is applied to the half of the core with overly conservative W(z) factors. In fact, the typical situation is that the limiting measured FQ(z) margin still occurs in the half of the core which is generating more power than predicted at steady state, even after application of the above conservative penalty to the underpowered half of the core. Alternatively, a revised set of W(z) values may be issued which account for the as-measured steady-state axial power distribution. These W(z) values are consistent with the approved W(z) formulation in WCAP-10216-P-A.

**NRC Question #3:**

*How does the AO validity criteria relate to the NRC approved RAOC methodology referenced in the Vogtle Technical Specifications (TS 5.6.5.b)? The response to this question is needed by the staff to determine whether the prompt operability determination was conducted in accordance with approved NRC methodologies.*

**Response to NRC Question #3:**

The AO validity criteria are an appropriate application of the approved methodology. It is noted that the NRC approved methodology is not prescriptive in all aspects of the application of the methodology. For example, it is recognized in the application of the methodology, that W(z) is a function of burnup, because the equilibrium power distribution (denominator of W(z)) is a function of burnup. The transient FQ(z) distribution (numerator of W(z)) is also a function of burnup. This burnup-dependence is included in the COLR. As described in Response #2 above, it is also recognized that when the measured AO does not match the predicted AO, the transient FQ(z) surveillance could become non-conservative. This is not explicitly addressed in WCAP-10216-P-A but should be addressed in the appropriate application of the approved methodology.

This issue is addressed in two ways : 1) the W(z)s are recalculated taking the new AO into account, or 2) applying the conservative AO validity criteria to determine the W(z) penalty that would apply when the steady-state AO is significantly different than predicted. In both cases, the revised W(z)s are calculated using the approved formula in WCAP-10216-P-A. This process is based on the application of the approved methodology, where the W(z) penalty is determined based on RAOC calculations that were performed using the approved methodology.

It is concluded that the AO validity criteria are an appropriate conservative application of the approved methodology and are consistent with the approved methodology. Thus the AO validity criteria do not introduce a new methodology and do not require NRC review and approval.

As a further note, the application of the AO validity criteria does not result in a change to the FQ(z) limit in the COLR. In Part B of Westinghouse document NS-EPR-2649 in WCAP-10216-P-A, the use of the W(z) factor is described as being a multiplier applied to the measured steady-state FQ(z). This is to estimate the likely increase in the steady-state FQ(z) that may arise from changes in the power distribution, i.e., transient conditions. The FQ(z) limit itself is the same for both steady-state and transient conditions. The W(z) factor may be used to multiply the measured steady-state FQ(z) or it may be used to be divided into the FQ(z) limit. Both forms are described in this section of WCAP-10216-P-A. This is also acknowledged in the Staff's review and acceptance letter that are also included in WCAP-10216-P-A.

**NRC Question #4:**

*Provide the justification for changing the COLR to adopt the new AO tables and the sentence to contact Westinghouse and follow the AO validity criteria. It is not clear to the NRC staff that this change to the COLR did not introduce a new methodology for calculating the FQ(z) limits in the COLR to assess whether the technical specification limits have been satisfied. Adoption of new methodologies in the COLR requires that the methodologies be reviewed and approved by the staff, then referenced in the admin section of the Technical Specifications.*

**Response to NRC Question #4:**

As stated in the response to Question 3, the AO validity criteria are consistent with the approved methodology and do not introduce a new methodology for revising the COLR. Therefore, they do not require NRC review and approval.