February 15, 2000

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SUBJECT: MCGUIRE NUCLEAR STATION AND CATAWBA NUCLEAR STATION RE: DYNAMIC ROD WORTH MEASUREMENT USING CASMO/SIMULATE (TAC NOS. MA6303, MA6304, MA6305 AND MA6306)

Gentlemen:

By letter dated August 16, 1999, Duke Energy Corporation (DEC) submitted a request for NRC approval of the Westinghouse-developed Dynamic Rod Worth Measurement Technique (DRWM) using the Duke DRWM computational method that makes use of the CASMO/SIMULATE codes. This request was supplemented by a letter dated October 19, 1999. The DEC's submittals and the enclosed NRC's safety evaluation apply to both the McGuire and Catawba facilities.

The staff has reviewed the information provided by DEC and finds the request to be acceptable. Specifically, DEC has demonstrated compliance with the five technology transfer criteria for the NRC's approval for a utility to perform their own physics calculations to support the use of DRWM. If you have any questions regarding this transmittal, please contact Frank Rinaldi at (301) 415-1447 or Chandu Patel at (301) 415-3025.

Sincerely,

/RA/

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Docket Nos. 50-369, 50-370, 50-413 and 50-414

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO THE DYNAMIC ROD WORTH MEASUREMENT TECHNIQUE

DUKE ENERGY CORPORATION

MCGUIRE NUCLEAR STATION UNITS 1 AND 2 AND

CATAWBA NUCLEAR STATION UNITS 1 AND 2

DOCKET NOS. 50-369, 50-370, 50-413 AND 50-414

1.0 INTRODUCTION

By letter dated August 16, 1999 (Reference 1), Duke Energy Corporation (Duke) submitted a request for NRC approval of the Westinghouse-developed Dynamic Rod Worth Measurement (DRWM) technique using the Duke DRWM calculational method. The submittal included topical report DPC-NE-2012, "DYNAMIC ROD WORTH MEASUREMENT USING CASMO/SIMULATE." The proposed Duke DRWM computational method makes use of the CASMO/SIMULATE codes, the reactor physics codes currently used by Duke for reload design of McGuire and Catawba cores. By letter dated October 19, 1999 (Reference 2), Duke requested NRC approval of the use of the S3K code for DRWM applications, as part of the NRC approval of the Duke DRWM calculational methodology for McGuire and Catawba. In addition, some replacement pages for DPC-NE-2012, which include additional discussion and updating of the references were included in the October 19, 1999, submittal.

NRC approval to use DRWM in low power physics tests (LPPT) is based on using the technique outlined in the approved version of the Westinghouse Topical Report WCAP-13360-P-A (Reference 3), applying the evaluation criteria and remedial actions contained in Reference 3, and incorporating the corrective actions as outlined in Reference 3. The criteria for technology transfer, by which a utility can perform the DRWM calculations, are set forth in Attachment 1 to a letter from N.J. Liparulo (Westinghouse Electric Corporation) to R.C. Jones (NRC) dated December 9, 1996. This is also included in Reference 3.

2.0 EVALUATION

Compliance with the five technology transfer criteria and notification to the NRC of compliance with the criteria, along with the date(s) of the intended first application of the codes to determine the DRWM physics constants for LPPT, were the conditions specified in Reference 3 for NRC approval for a utility to perform their own physics calculations to support the use of DRWM. The five criteria are: (1) eligibility of codes for DRWM computations, (2) application of procedures to DRWM computations, (3) training and qualification of utility personnel, (4) comparison calculations for the DRWM technique, and (5) quality assurance and change control. Reference 3 states how each criterion is to be met. In the submittals, Duke has addressed all the criteria and provided extensive benchmark data. In addition, Duke has committed to use the acceptance criteria and remedial actions as specified in Reference 3.

2.1 Criterion 1

Only lattice physics codes and methods which have received prior NRC review and approval are eligible to be used in determining the physics constants to be used in DRWM.

Duke uses both the CASMO3 lattice physics and the SIMULATE-3P three dimensional core simulator codes that have been approved by the NRC for use by Duke (Reference 4). The SIMULATE-Kinetics (S3K) code for the dynamic modeling of the DRWM process is a three dimensional transient neutronic version of SIMULATE-3. S3K was approved for Rod Ejection Accident analysis (NRC letter of September 22, 1999, to G.R. Peterson of Catawba Nuclear Station). The S3K code is also necessary for DRWM calculations. The NRC approval of S3K was restricted to Rod Ejection Accident analysis, because benchmarking data was available for only that analysis at the time of review. Duke has supplied extensive DRWM benchmarking data to both Westinghouse predictions and measured data. Based on the good agreement of this data (discussed under Criterion 4), approval to use S3K for DRWM applications for McGuire and Catawba, is acceptable. Thus, Criterion 1 is met.

2.2 Criterion 2

“In a manner consistent with the procedures obtained from Westinghouse, the utility analyses shall be performed in conformance with in-house application procedures which ensure that the use of the methods is consistent with the Westinghouse-approved application of the DRWM methodology.”

Duke incorporated the Westinghouse-provided DRWM computational procedures into an internal procedure to ensure consistency with the NRC approved methodology. This satisfies Criterion 2.

2.3 Criterion 3

This criterion states that the first application of DRWM will be performed by Westinghouse. This will ensure that DRWM is applicable to the specific plant, provide utility personnel with training in the DRWM technique, and be used to meet Criterion 4.

Duke has exceeded this criterion by having Westinghouse perform computations for the first six DRWM applications at Catawba and McGuire. The station personnel received training in the procedure on the use of the Advanced Digital Reactivity Computer (ADRC), and application of the ADRC to performing LPPT using DRWM, prior to testing at Catawba and McGuire. Additional training was received during each of the six applications of DRWM. Duke received calculational procedures from Westinghouse on how to perform DRWM computations. Duke personnel performing computations to support DRWM were initially trained by Westinghouse in these computations. Duke has an established training and qualification program that is used to ensure that only qualified personnel perform reload design calculations. The same training program will be used to ensure that future users of DRWM methodology have the proper working knowledge of the codes and methods. The staff finds this acceptable. Therefore, Criterion 3 is met.

2.4 Criterion 4

"Prior to the first application by a utility using their own methods to perform physics calculations in support of DRWM for LPPT, the utility will demonstrate its ability to use the methods supplied by Westinghouse by comparing its calculated results with the analyses and results obtained by Westinghouse during the first, or subsequent, application(s) of DRWM at the utility's plant. Comparisons of calculated and measured bank worths for individual and total bank worth should be made between the utility values and those of Westinghouse. The criteria of ±2 percent or ±25 pcm were given as acceptance criteria."

The complete set of results for the six benchmark cycles was provided. The ±2 percent or ±25 pcm criterion was met in 114 of the 120 comparisons (54 predicted bank worths, 54 measured bank worths, and six predicted total bank worths and six measured total bank worths). The six comparisons that did not meet the criterion were:

- four predicted bank worths from McGuire 2 Cycle13 (Banks CC, CD, SA and SC)

- two predicted bank worths from Catawba 1Cycle 12 (Banks CB and SA)

The ±2 percent or ±25 criterion was not met in six cases with the maximum deviation being 39.2 pcm. The trend in the predicted bank worth deviations is consistent with the observed differences in the predicted radial Hot Zero Power (HZP) power distribution between Duke and Westinghouse. Relative to Westinghouse, Duke under-predicts the relative power of assemblies located near the core periphery (assemblies containing banks SA, CD, SD, and SC). The measured bank worths for these six banks generally fall between the Duke and Westinghouse predicted bank worths, indicating that this is a bias between predicted bank worths.

The differences between Duke and Westinghouse M2C13 and C1C12 predicted bank worths were larger than the previous cycle comparisons. Both cycles were reexamined by Duke and Westinghouse to understand the differences. No definitive cause was discovered. However, slightly higher differences in the power distribution comparisons were found for assemblies that operated near the periphery for more than one cycle. Both M2C13 and C1C12 contained more assemblies of this type located at or near the control rod locations than in previous cycles, which might explain the observed larger deviations. The six deviations are acceptable because they represent only a small deviation from an extremely tight criterion, and they are a very small percentage of the total benchmarking data.

The differences between the Duke and Westinghouse predicted total bank worths meet the ±2 percent criterion for all six cores analyzed. The differences between the measured bank worths calculated by the Duke and Westinghouse methods met the ±2 percent or ±25 pcm criterion for all banks. The maximum difference was -10.6 pcm for Bank CB in McGuire 2, Cycle 13. The measured total bank worth differences between Westinghouse and Duke for the six cores ranged from -1.0 to -0.3 percent. These results show excellent agreement. The slight differences observed are well within the expected range for a comparison of two independent core methodologies. Westinghouse uses the ALPHA/PHOENIX/ANC and SPNOVA codes while Duke uses the CASMO/SIMULATE/S3K codes. The results of this comparison show that the Duke methodology is a suitable substitute for the Westinghouse DRWM methodology, and that Duke has implemented the DRWM analytical factor methodology consistent with the Westinghouse approved methodology. Thus, Criterion 4 is satisfied.

2.5 Criterion 5

Quality assurance and change control.

The Duke QA program will be used to perform all DRWM computations. As part of the Westinghouse QA procedures regarding technology transfer, they have a requirement to inform utilities of changes to the DRWM process. Therefore, Criterion 5 is met.

3.0 CONCLUSIONS

Based on the evaluation as described in Section 2.0, Duke has met the five criteria for technology transfer of the DRWM methodology. The benchmarking data was sufficient and adequate to provide justification for the use of S3K for DRWM. Therefore, the staff finds it acceptable for Duke to use the DRWM technique for rod worth measurements at the Catawba and McGuire units.

4.0 REFERENCES

1. Letter from M.S. Tuckman, Duke to U.S. NRC Document Control Desk, “Dynamic Rod Worth Measurement Using CASMO/SIMULATE,” dated August 16, 1999.

2. Letter from M.S. Tuckman, Duke, to U.S. NRC Document Control Desk, “Dynamic Rod Worth Measurement Using CASMO/SIMULATE,” dated October 19, 1999.

3. Chao, Y.A., Easter, M.E., Hill, D.J., Chapman. D.M., Grobmyer, L.R., Hoerner, J.A., “Westinghouse Dynamic Rod Worth Measurement Technique,” WCAP-13360-P-A, Revision 1, dated October 1998.

4. “Nuclear Design Methodology Using CASMO3-SIMULATE-3P,” DPC-NE-1104PA, Revision 1, dated December 1997.

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