



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATING TO TOPICAL REPORT MSS-NA1-P SUPPLEMENT 1
"QUALIFICATION OF REACTOR PHYSICS METHODS FOR APPLICATION TO
PRESSURIZED WATER REACTORS OF THE MIDDLE SOUTH UTILITIES SYSTEM"

1.0 INTRODUCTION

By letter dated March 20, 1987, Louisiana Power and Light Company (LPL) requested NRC review of MSS-NA1-P Supplement 1, "Qualification of Reactor Physics Methods for Application to Pressurized Water Reactors of the Middle South Utilities System". This supplement provides comparisons between measurements and predictions for Waterford 3 using the physics methods previously approved by the NRC for use by Middle South Services (MSS) for Arkansas Nuclear One (ANO) Units 1 and 2 (Ref. 1). In the original NRC safety evaluation report of MSS-NA1-P (Ref. 2) the physics methods and reliability factors were not approved for Waterford 3 application because comparisons of predictions to Waterford 3 measurements were not available at the time.

2.0 SAFETY EVALUATION

The model used to analyze the Waterford 3 core is identical to that described in Reference 1. It has been verified against Waterford 3 measurements made during Cycle 1 to quantify the reliability factors to be used in safety related calculations. The term "reliability factor" is used to describe the allowances to be used in safety related calculations to assure conservatism. The reliability factor is always larger than the one sigma uncertainty factor. A bias factor is also applied to the average difference between the measured and calculated value of a parameter. The reliability factors applicable to the important physics parameters are listed in Table 1.

The control rod worth, soluble boron worth, and delayed neutron parameter reliability factors determined in Reference 1 were found to be applicable to Waterford 3. For a single control rod or bank, however, a more conservative value of 0.10 is used for the reliability factor in Waterford 3.

Comparisons of measured and calculated temperature coefficients included six ANO-1 measurements, five ANO-2 measurements and seven Waterford 3 measurements. Data from all 18 measurements were used to determine a reliability factor of 3.4 pcm/°F for the temperature coefficient. Since this is conservatively bounded by the 4.0 pcm/°F reliability factor previously determined (Ref. 1), the staff concurs that a temperature coefficient reliability factor of 4.0 pcm/°F may be applied to Waterford 3.

Since it is not possible to directly measure Doppler coefficients at Waterford 3, calculated Doppler coefficients were compared to two Electric Power Research Institute (EPRI) experiments, resulting in uncertainties of 2.90% and 7.23%. Based on this, the 0.10 Doppler coefficient reliability factor previously used for ANO-1 and ANO-2 is deemed adequate and conservative for Waterford 3.

As in Reference 1, the Waterford 3 model reliability factors for calculating power distributions are based on comparisons of measured and calculated in-core flux detector signals. The Waterford 3 core is instrumented with 280 self-powered rhodium detectors distributed at five axial core levels in 56 different fuel assemblies. The signals from these detectors are corrected for detector sensitivity, depletion, background and leakage. Fifteen core state-points, representative of beginning, middle, and near end of cycle power shapes were used to compare measured and calculated reaction rates.

The local power distribution uncertainty is associated with the calculation of the peak to average fuel rod peaking within an assembly. Since Waterford 3 uses fuel assemblies similar to ANO-2 with a common 16 x 16 fuel rod design, the ANO-2 uncertainty presented in Reference 1 is applicable to Waterford 3.

The power distribution reliability factors include the local linear heat rate peaking factor F_0 and the enthalpy rise hot channel peaking factor F_{AH} . Both are computed for Waterford 3 using the same procedures described in Reference 1. Since a bounding value of 0.096 was found for the F_0 reliability factor for Waterford 3, the proposed use of the more conservative value of 0.10, determined in Reference 1, is acceptable. The reliability factor for F_{AH} was calculated to be 0.046 for Waterford 3. The more conservative value of 0.057 found in Reference 1, however, will be used in the Waterford 3 safety related analyses. This also is acceptable.

3.0 CONCLUSIONS

The staff has reviewed Supplement 1 to MSS-NAI-P which extends the model validation presented in MSS-NAI-P for ANO-1 and ANO-2 to Waterford 3. The staff concludes that this supplement adequately provides comparisons between physics parameter measurements and predictions for Waterford 3 and establishes appropriate calculational reliability factors for Waterford 3 application. However, because of the somewhat limited data base used, the staff recommends that Middle South Services perform periodic reevaluations of the model validity as new data becomes available to provide continuing assurance of its applicability.

Principal Contributor: L. Kopp

Dated:

4.0 REFERENCES

1. "Qualification of Reactor Physics Methods for Application to Pressurized Water Reactors of the Middle South Utilities System", MSS-NA1-P, August 4, 1980.
2. Letter from Robert A. Clark and John F. Stolz (NRC) to William Cavanaugh (APL), dated August 11, 1982 transmitting "Evaluation of Report MSS-NA1-P".

TABLE 1
PHYSICS RELIABILITY FACTORS FOR WATERFORD 3

<u>Physics Parameter</u>	<u>Reliability Factor</u>	<u>Bias</u>
F_Q	0.10	0
$F_{\Delta H}$	0.057	0
Control Rod Worth (Pattern)	0.05	0
Control Rod Worth (Bank or Single Rod)	0.10	0
Temperature Coefficient	4.0 pcm/°F	0
Doppler Coefficient	0.10	0
Doppler Defect	0.20	0
Boron Worth	0.05	0
Delayed Neutron Parameters	0.03	0

May 6, 1987

Docket No. 50-382

Mr. J. G. Dewease
Senior Vice President - Nuclear Operations
Louisiana Power and Light Company
317 Baronne Street, Mail Unit 17
New Orleans, Louisiana 70160

Dear Mr. Dewease:

SUBJECT: REACTOR PHYSICS METHODS TOPICAL REPORT MSS-NA1-P (TAC NO. 65141)

By letter dated March 20, 1987 Louisiana Power and Light Company submitted topical report MSS-NA1-P, Supplement 1. The staff has reviewed this report and concludes that the physics methods and reliability factors previously approved for Arkansas Nuclear One, Units 1 and 2 are also appropriate for application to Waterford 3. However, because of the somewhat limited data base used, the staff recommends that Middle South Services perform periodic reevaluations of the model validity as new data becomes available to provide continuous assurance of its applicability.

Details of the staff's review are contained in the enclosed safety evaluation.

If you have any questions concerning the staff's review, please contact me at (301) 492-9403.

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James H. Wilson, Project Manager
Project Directorate - IV
Division of Reactor Projects - III,
IV, V and Special Projects

Enclosure:
As stated

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Mr. Jerrold G. Dewease
Louisiana Power & Light Company

Waterford 3

cc:

W. Malcolm Stevenson, Esq.
Monroe & Leman
1432 Whitney Building
New Orleans, Louisiana 70103

Mr. E. Blake
Shaw, Pittman, Potts & Trowbridge
2300 N Street, NW
Washington, D.C. 20037

Mr. Gary L. Groesch
Post Office Box 791169
New Orleans, Louisiana 70179-1169

Mr. F. J. Drummond
Project Manager - Nuclear
Louisiana Power & Light Company
317 Baronne Street
New Orleans, Louisiana 70160

Mr. K. W. Cook
Nuclear Support and Licensing Manager
Louisiana Power & Light Company
317 Baronne Street
New Orleans, Louisiana 70160

Resident Inspector/Waterford NPS
Post Office Box 822
Killona, Louisiana 70066

Mr. Ralph T. Lally
Manager of Quality Assurance
Middle South Servies, Inc.
Post Office Box 61000
New Orleans, Louisiana 70161

Chairman
Louisiana Public Service Commission
One American Place, Suite 1630
Baton Rouge, Louisiana 70825-1697

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
Office of Executive Director for
Operations
611 Ryan Plaza Drive, Suite 1000
Arlington, Texas 76011

Carole H. Burnstein, Esq.
445 Walnut Street
New Orleans, Louisiana 70118

Mr. Charles B. Brinkman, Manager
Washington Nuclear Operations
Combustion Engineering, Inc.
7910 Woodmont Avenue, Suite 1310
Bethesda, Maryland 10814

Mr. William H. Spell, Administrator
Nuclear Energy Division
Office of Environmental Affairs
Post Office Box 14690
Baton Rouge, Louisiana 70898

President, Policy Jury
St. Charles Parris
Mahnville, Louisiana 70057



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