April 20, 2001

Mr. James F. Klapproth, Manager
Engineering & Technology
GE Nuclear Energy
175 Curtner Ave
San Jose, CA 95125

SUBJECT: REVIEW OF NEDC-32992P, "ODYSY APPLICATION FOR STABILITY LICENSING CALCULATIONS" (TAC NO. MB0373)

Dear Mr. Klapproth:

By letter dated October 26, 2000, GE Nuclear Energy (GENE) submitted Topical Report NEDC-32992P, "ODYSY Application for Stability Licensing Calculations" and requested approval of ODYSY as a replacement for the GENE FABLE/BYPSS code system for both long-term stability solution and new fuel design stability analysis. The staff has reviewed Topical Report NEDC-32992P for application for BWR stability calculations and concludes that the ODYSY code can be used as a replacement for the FABLE/BYPSS code for calculating core wide and channel decay ratios. The staff's safety evaluation is enclosed.

The staff finds that the subject topical report is acceptable for referencing in licensing applications to the extent specified under the limitations delineated in the report and in the associated NRC safety evaluation. The safety evaluation, which is enclosed, defines the basis for acceptance of the topical report.

The NRC requests that GENE publish an accepted version of the revised Topical Report NEDC-32992 within 3 months of receipt of this letter. The accepted version shall incorporate this letter and the enclosed safety evaluation between the title page and the abstract, and add an "-A" (designating accepted) following the report identification number (i.e., NEDC-32992-A).

If the NRC's criteria or regulations change so that its conclusion in this letter that the topical report is acceptable is invalidated, GENE and/or the applicant referencing the topical report will be expected to revise and resubmit its respective documentation, or submit justification for the continued applicability of the topical report without revision of the respective documentation.

Pursuant to 10 CFR 2.790, we have determined that the enclosed safety evaluation does not contain proprietary information. However, we will delay placing the safety evaluation in the public document room for a period of ten (10) working days from the date of this letter to provide you with the opportunity to comment on the proprietary aspects only. If you believe that any information in the enclosure is proprietary, please identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.790.

If you have any questions, please contact Robert Pulsifer, GENE Project Manager, at (301) 415-3016.

Sincerely,

/RA/

Stuart A. Richards, Director
Project Directorate IV and Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 710

Enclosure: Safety Evaluation

cc w/encl: See next page

If you have any questions, please contact Robert Pulsifer, GENE Project Manager, at (301) 415-3016.

Sincerely,
/RA/
Stuart A. Richards, Director
Project Directorate IV and Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 710

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

OF THE GE NUCLEAR ENERGY TOPICAL REPORT

NEDC-32992P, "ODYSY APPLICATION FOR STABILITY

LICENSING CALCULATIONS"

PROJECT NO. 710

1.0 INTRODUCTION

On October 26, 2000, GE Nuclear Energy (GENE) submitted for staff review a Licensing Topical Report entitled, "ODYSY Application for Stability Licensing Calculations" (Reference 1). The intent of this topical report was to obtain staff approval to use ODYSY as a replacement for the GENE FABLE/BYPSS code system for both long-term stability solution and new fuel design stability analysis. These codes are used to predict core wide and channel decay ratios which are representative of the tendency of the fuel to go unstable. These codes are used to demonstrate compliance with General Design Criteria 10 and 12. The staff reviewed this code by evaluating the information presented in the topical report and visiting GENE during the week of March 23, 2001. During the site visit, the staff reviewed the calculation notebooks prepared for the analyses presented in the report and discussed the code's application with GENE personnel.

2.0 DISCUSSION

The ODYSY code is based on the GENE ODYN code which uses a five equation hydraulic solver and a one dimension neutron kinetics model. The ODYSY code is a significant theoretical improvement over the current GENE stability code FABLE/BYPSS which was derived from the REDY code. ODYSY has been validated against both full scale plant and scaled facility decay ratio data. Generally, one can observe that ODYSY is more predictable than FABLE/BYPSS and is somewhat more accurate.

ODYSY calculates core wide and channel decay ratios by evaluating the open loop transfer function of the reactor system. This is accomplished by taking a Laplace Transform of the governing equations and performing the evaluation in the frequency domain. ODYSY has models of both the vessel and the reactor recirculation loops and can handle the geometrical features of modern fuel. ODYSY also has improved fuel heat transfer models.

2.1 CSAU Methodology

GENE applied the CSAU methodology to ODYSY (Reference 2). This method gives code developers and reviewers a tool by which to measure a code's ability to predict important

phenomena. For this application, one of the most important parts of the CSAU method is the Phenomena Identification and Ranking Table (PIRT). This is a table developed by a group of experts of relevant phenomena which have to be modeled to predict decay ratios. These phenomena were then ranked and for the ODYSY code, GENE required that all medium ranked phenomena be modeled in ODYSY. The staff reviewed the PIRT and found it to be complete and its rankings appropriate.

2.2 Plant Demonstration Analyses

In order to demonstrate that ODYSY can be used as a replacement of FABLE/BYPSS for the generation of long-term stability exclusion regions, GENE performed three plant analyses using both FABLE/BYPSS and ODYSY. These calculations showed that as long as ODYSY is used as discussed below in Section 3, it generates results that are generally consistent with FABLE/BYPSS. One notable trend is the performance of ODYSY at the high flow control line. For two plants, FABLE/BYPSS and ODYSY compare well, but for the other one there is a small difference in the predicted exclusion region. Based on discussions with GENE, this difference appears to be caused by the fact that ODYSY predicts new fuel with part length rods better than FABLE/BYPSS.

3.0 STABILITY LICENSING APPLICATION PROCEDURE

The application procedure is as follows:

a. Calculations will be performed on the highest flow control line and the natural circulation line.

b. The calculations are exposure dependent.

c. ODYSY is used with nominal inputs.

d. A 0.15 adder is added to the ODYSY predicted core wide decay ratios.

e. The decay ratios are plotted on the currently approved stability criterion map.

f. Using the currently approved generic shape function, an exclusion region is plotted on the power to flow map.

4.0 NEW FUEL LICENSING

As previously discussed, GENE also proposed to replace FABLE/BYPSS as the code to evaluate the relative stability performance of new fuel using the Amendment 22 to GESTAR-11 process. This process stipulates that new fuel needs to be as or more stable than previous fuel. If this cannot be demonstrated, then it must be shown that the exclusion region on the power/flow map is unchanged. This is judged by comparing the core wide and channel decay ratios. The demonstration analyses previously discussed show that ODYSY is capable of performing these types of assessment and predicts results which agree well with FABLE/BYPSS.

5.0 CONCLUSION

The staff has reviewed the use of ODYSY as a complete replacement of the FABLE/BYPSS code for use in both long-term stability solution applications and new fuel licensing as specified in Amendment 22 to GESTAR-II. This review included an on-site visit to review the design record files documenting the analysis presented in the LTR. This review allowed the staff to evaluate the effectiveness of the application procedure. The use of ODYSY as a replacement for FABLE/BYPSS does not change the methodology of the approved long-term stability solutions.

The staff considers the use of ODYSY as a replacement of FABLE/BYPSS acceptable for all currently approved long-term stability solution FABLE/BYPSS applications and for new fuel licensing. The staff's conclusions are based on the conservative nature of the proposed ODYSY application procedure and the qualification studies which show that ODYSY is acceptable for decay ratio predictions to within the 20 percent core wide and channel decay ration uncertainties that are used in the application procedure. It is, therefore, acceptable that the ODYSY code can be used as a replacement for the FABLE/BYPSS code for calculating core wide and channel decay ratios.

6.0 REFERENCES

1. J. Post and A. Chung, "ODYSY Application for Stability Licensing Calculations," GE Nuclear Energy, October 2000.

2. B. Boyack, et. al., "Quantifying Reactor Safety Margins: Application of Code Scaling, Applicability, and Uncertainty Evaluation Methodology to a Large Break Loss of Coolant Accident," NUREG/CR-5249, December 1989.

Principal Contributor: A. Ulses

Date: April 20, 2001