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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Subject: Catawba Nuclear Station, Units 1 & 2, Docket Nos. 50-413 and -414
McGuire Nuclear Station, Units 1 and 2, Docket Nos. 50-369 and 370
Response to RAI - Seismic Analysis Methodology

By letters dated March 16 and June 30, 1995, Duke Power Company requested approval for use of alternative seismic methodologies. By letter dated July 6, 1995, the NRC provided a Request for Additional Information which contained eight questions on the CREST program.

A meeting was held on July 27, 1995 on the North Carolina State University Campus. The purpose of this meeting was to address the eight questions and to identify any remaining areas of NRC Staff concern. Responses to the eight questions are provided in Attachment 1. Two additional verification problems will be provided at a later date in response to Question 3.

Please contact R. O. Sharpe at (704) 382-0956 if you have any questions.

Very truly yours,

M. S. Tuckman

M. S. Tuckman

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Attachments

xc: (w/Att 1 only)

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Attachment 1

Duke Power Company
Steam Generator Replacement Project

Response to Request for Additional Information

1. Provide a copy of the current version of the CREST User's Manual. This document should include a detailed description of the program input and output. All options available to the piping analyst should be identified.

Response:

A copy of the CREST User's Manual is provided as Attachment 2.

2. Provide a copy of the CREST Theoretical Manual or equivalent document. This document should provide a clear step-by-step description of the analytical procedures used to determine the response of a piping system. Key assumptions and any approximate or empirical solution methods should be identified and justified.

Response:

A description of CREST is provided in Attachments 3 and 4 and in References 1, 2 and 3.

3. Provide the information necessary to describe and verify the CREST program in accordance with the requirements of SRP 3.9.1, Subsection II.2. A summary comparison of the CREST results to the results using the NRC-accepted computer code or methodology should be provided for all verification problems. The complete computer printout of the input and the solution for the piping benchmark problems should be submitted for review.

Response:

The description and theoretical basis of CREST are addressed above. SRP 3.9.1 applies to structural analysis programs for piping that is decoupled from the supporting structures. Specifically, the benchmark problems referenced cannot be used directly with the CREST methodology for coupled analysis because they do not include any information on the supporting structures.

In the case being reviewed, the piping analysis is performed on PIPESTRESS which has been verified using the benchmark problems referenced in SRP 3.9.1. The coupled analysis methodology implemented in CREST, has been verified consistent with SRP 3.8.1, Subsection II.4.e , ANSI N45.2.11 and 10CFR50, Appendix B.

Furthermore, three additional verification problems are being analyzed for the purposes of verification. The models and input for these additional problems were selected based on input from the NRC staff and their contractors. The first of these problems is now complete and is presented in Attachment 6. The two remaining problems will be submitted separately upon completion.

4. Does the CREST program perform the complete piping analysis or is it used in conjunction with a piping analysis program? If so, please describe the procedure.

Response:

The piping analysis program that is currently being used with CREST is the commercial program PIPESTRESS, as described in Attachment 2.

5. Reference [2] discusses recent improvements to the CREST-IRS program. Does the licensee plan to use CREST or CREST-IRS in the main steam line analysis? Is the information in Reference [2] applicable to the proposed version of CREST as well as to CREST-IRS?

Response:

CREST IRS is a related but separate program that is not used in the application being reviewed. The theoretical basis for CREST has been clarified in Question 2.

6. Explain how the peak broadening requirements for floor response spectra given in R. G. 1.122 are satisfied when the CREST methodology is applied.

Response:

The objective of peak broadening of floor response spectra to evaluate the effect of the uncertainty of structure frequencies on the piping, will be addressed by applying the spectra shifting procedure described in the

Catawba FSAR, Section 3.7.2.9 to the primary system frequencies input to CREST. For a particular direction, this will result in three or more different coupled analyses, with modified primary system (building structure) frequencies. The envelope of the results of the secondary system (piping system) will be used.

7. Identify any known limitations on the applicability of the program and its results.

Response:

See Attachment 2, Introduction

8. Provide a sample problem to illustrate the application of the CREST methodology. If the main steam line preliminary analysis is available, please provide the complete input and output.

Response:

The preliminary main steam analysis is included as Attachment 5.

References

1. Gupta, A. K., *Response Spectrum Method*, Blackwell, 1990, CRC Press, 1992; Chapter 5: Article 5.6; Chapter 6: Articles 6.1 - 6.5

2. Gupta, A. and Gupta, A. K., *Recent Improvements in the CREST-IRS Program*, Center for Nuclear Power Plant Structures, Equipment and Piping, December, 1993; Sections 2, 3 and 4.

3. Gupta, A. and Gupta, A. K., *Coupled Analysis of Piping Systems Including the Effect of High Frequency Modes*, Center for Nuclear Power Plant Structures, Equipment and Piping, 1994.

Additional Attachments

Attachment 2 - CREST Users Manual

Attachment 3 - Coupled piping System Analysis Using CREST

Attachment 4 - Presentation to NRC and BNL

Attachment 5 - Main Steam Piping problem

Attachment 6 - Validation of CREST