SYSTEM ENERGY RESOURCES, INC.

OLIVER D. KINGSLEY, JR.
Vice President
Nuclear Operations

May 13, 1988

U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Document Control Desk

Gentlemen:

SUBJECT: Grand Gulf Nuclear Station
Unit 1
Docket No. 50-416
License No. NPF-29
SRV Fatigue Evaluation - Additional Information
AECM-88/0100

Reference: SRV Fatigue Evaluation, O. D. Kingsley, Jr. to Harold R. Denton, letter dated October 23, 1986 (AECM-86/0334)

In a telephone conversation on March 29, 1988 Mr. L. L. Kintner and H. Shaw of the NRC Staff requested additional information to support the NRC review of the GGNS Safety Relief Valve (SRV) Fatigue Evaluation submitted via the referenced letter.

Attached is System Energy Resources, Inc.'s response to the NRC request. This response provides additional justification for the exclusion of line mounted equipment including valves that were static load tested. Assumptions used to evaluate random motion effects are also included. If additional information is needed to support your review, please contact this office.

Yours truly,

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Attachment

cc: (See Next Page)

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cc: Mr. T. H. Cloninger (w/a)
Mr. R. B. McGehee (w/a)
Mr. N. S. Reynolds (w/a)
Mr. H. L. Thomas (w/o)
Mr. R. C. Butcher (w/a)

Dr. J. Nelson Grace, Regional Administrator (w/a)
U. S. Nuclear Regulatory Commission
Region II
101 Marietta St., N. W., Suite 2900
Atlanta, Georgia 30323

Mr. L. L. Kintner, Project Manager (w/a)
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Mail Stop 14B20
Washington, D.C. 20555

GGNS SRV Fatigue Evaluation - Additional Information

I. Background

In response to Grand Gulf Nuclear Station (GGNS) Operating License Condition 2.C.(10)(a), System Energy Resources, Inc. (SERI) submitted a report entitled "GGNS SRV Fatigue Evaluation", Revision 0, under cover of AECM 86/0334 dated October 23, 1986 (Ref. 1). The report documented the evaluation of a large group of safety-related devices for the effect of safety relief valve (SRV) actuation induced fatigue and no adverse effects were predicted. Based on this positive result, SERI concluded that the tracking of cumulative damage factors (CDFs) at GGNS was not necessary. In Reference 1, SERI requested the NRC to review and concur with this position.

II. NRC Questions

Based on a review of the subject report, the NRC informally contacted SERI with certain questions concerning the report which are summarized as follows:

1) The population of equipment evaluated in the report specifically excluded the evaluation of line mounted equipment including valves that were subjected to static load testing alone. Concern was raised regarding how this class of equipment was to be justified for SRV actuation induced fatigue by the report (Ref. 1) since it excluded all consideration of the equipment.

2) One class of equipment, Rosemount Transmitters, was evaluated considering the fatigue effect of supplementary random motion shaker table testing by using the methodology presented in Section 3.1 of Ref. 2. A question was raised concerning the validity of the assumptions noted in this reference that were required to be made to evaluate random motion effects. The assumption in question was that the stress response of a single degree of freedom (SDOF) system to broad band white noise will be a narrow band stationary process with the resultant peak stress taking the Rayleigh distribution.

The above questions were considered and action was taken in regard to each as noted below.

III. Response to Question 1

GGNS maintains a Seismic Qualification Central File Index as a controlled document, listing GGNS equipment seismic qualification information. The data base was sorted to list master parts list (MPL) numbers for line mounted equipment. This included valves and sensing or indicating devices located inside the containment or drywell. Approximately 400 individual devices were considered utilizing one of the following methods.

A. High Frequency Exemption

Justification for not considering SRV actuation fatigue effects for equipment which had a fundamental mode above 50 Hz was developed. Representative building power spectral density functions for SRV single valve actuations show that virtually no energy is concentrated above 40 Hz. In addition, estimates of spectral amplification due to equipment flexibility showed that increased response would be insignificant. Based on these arguments, approximately 61% of the total population were determined to be adequate to resist the affects of SRV actuation induced fatigue.

B. Critical Stress Evaluation

This method is identical to that referred to in Sections 2.3 and 5.3 of the GGNS SRV Fatigue Evaluation Report (Ref. 1). The most critical stress for all load conditions was assumed to occur 1820 times and the 40 year CDF was calculated. This method was employed for about 20% of the total population. No CDFs $\geq$ 1.0 were calculated.

C. Effects of Preliminary Testing

This method is identical to that referred to in Sections 2.1 and 5.1 of the GGNS SRV Fatigue Evaluation Report. The fatigue effect of preliminary sine sweep tests was calculated and found to envelope the expected SRV fatigue environment for six devices or approximately 1% of the total population.

D. SRV Aging Tests

Approximately 16% of the devices evaluated have already been subject to testing specifically for the purpose of simulating the effect of the GGNS vibrational environment due to SRV actuations. This equipment is acceptable on this basis.

E. Other Methods

Approximately 2% of the total equipment population could not be evaluated by the above methods alone. For this equipment, the resonance was $<$ 50 Hz but $>$ 40 Hz. In Method A, a 50 Hz high frequency exemption was conservatively established. However, as noted above, a 40 Hz limit is also justified. This limit was evaluated and shown to be nearly identical to the 50 Hz limit. On this basis, the equipment was deemed acceptable.

IV. Response to Question 2

The equation used by Nutech in Ref. 2, Section 3.1 was taken from "Dynamics of Structures" (Ref. 3) by Penzien & Clough, page 503, equation 24-71. According to the text, this equation is valid when the probability distribution of peak stress is of the Rayleigh form as represented by a narrow band process. This assumption is confirmed and clarified in Ref. 5, page 409.

In discussing Gaussian and Rayleigh distributions as they relate to random vibration, Ref. 5 notes that when a wide band stationary random record is passed through a narrow band filter or resonance system, the resultant wave form is essentially a constant frequency oscillation with slowly varying amplitude and phase. The probability distribution for the instantaneous values is Gaussian but the absolute values of its peaks will have a Rayleigh distribution. This fact was assumed by Nutech to be true of the random motion shaker table test wave form.

In Ref. 4, Nutech provided a supplementary explanation and restated the assumption by noting that the input excitation is assumed to be white noise that induces a stationary narrow band Gaussian stress process where peak stresses had a Rayleigh distribution. They also listed a number of other restrictions and assumptions requiring elastic behavior, absence of residual stress, well defined fundamental frequency without closely spaced modes, linear S-N curve on a log-log scale, and an assumed linear accumulative damage model.

In principle, the method as used by SERI in Calculation CC-Q1111-86009, Rev. 0, to justify the adequacy of the Rosemount transmitters is correct. However, certain of the necessary assumptions recently supplied by Nutech are difficult to verify from the available test data. Therefore, the calculation was revised to provide other justification for the transmitters. The transmitters were shown in the original issue of the calculation to have a fundamental mode > 50 Hz. Therefore, they were determined to be adequate to withstand the affects of the GGNS SRV actuation induced fatigue environment for the reasons stated under Method A of the response to question 1 above.

Conclusions

The above actions are considered to completely address the concerns raised in the above questions. Calculation CC-Q1111-86009, Rev. 2, was generated in support of this response. The conclusions of Ref. 1, Sections 7.1 and 7.2, that GGNS safety related equipment located in the containment or drywell will not be adversely affected when subject to repetitive SRV-induced dynamic loads and that tracking of CDF's at GGNS is not required are still considered valid.

References

1. AECM 86/0334, October 23, 1986 (GGNS SRV Fatigue Evaluation Report)

2. Nutech Report MPL-02-032, "Equivalent Usage Factor for Equipment Qualification Testing"

3. Clough, Ray W.; Penzien, Joseph, "Dynamics of Structures", 1975, McGraw-Hill

4. Nutech Letter, MPL-09-017, April 7, 1988

5. Thompson, William T., "Theory of Vibration with Applications", Second Edition, Prentice-Hall, 1981