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SUBJECT: Informs that encl design assessment rept (PAR) ups include use of high frequency cutoff procedure inadvertently omitted from previous revision.Encl will be formally documented in next revision to DAR.

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JUL 12 1982

Mr. A. Schwencer, Chief
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Washington, D.C. 20555

SUSQUEHANNA STEAM ELECTRIC STATION
DESIGN ASSESSMENT REPORT (DAR)
ER 100450 FILE 172-01
PLA-1156

Docket Nos. 50-387
50-388

Dear Mr. Schwencer:

Please find attached the DAR write-ups to include the use of the high frequency cutoff procedure which was inadvertently omitted from a previous revision. The vertical lines in the margins indicate the subject changes. The attached will be formally documented in the next revision to the DAR.

Very truly yours,

N. W. Curtis
Vice President-Engineering & Construction-Nuclear

PAF/mks

Attachment

B001

6.6 NSSS CAPABILITY ASSESSMENT CRITERIA

6.1 The capability assessment criteria used for the analysis of NSSS piping systems, reactor pressure vessel (RPV), RPV supports, RPV internal components and floor structure mounted equipment are shown in Table 5-5, Load Combinations and Acceptance Criteria. Table 5-5 is in agreement with a conservative general interpretation of the NRC technical position, "Stress Limits for ASME Class 1, 2 and 3 Components and Component Supports of Safety-Related Systems and Class CS Core Support Structures Under Specific Service Loading Combinations."

Peak response due to related dynamic loads postulated to occur in the same time frame but from different events are combined by the square-root-of-the-sum-of-the-squares method (SRSS). A detailed discussion of this load combination technique is presented in Reference 80.

6.2 The high frequency hydrodynamic (SRV and LOCA) loads originating from the suppression pool of the containment structure require consideration of additional structural spectral responses in addition to the seismic loads. These combined spectra exceed those for which equipment have been qualified based on original seismic loads. However, these high frequency loads have very limited energy content and are non-damaging in nature (see Reference 86). The equipment need not be qualified in the high frequency range beyond a certain cutoff point. A general high frequency cutoff procedure developed by using a threshold spectral limit as defined by Equation 4-3 or Fig. 4.3 of Reference 86 is described in Section 7.1.6.1.4.1.4 for the assessment of equipment for combined seismic and hydrodynamic loads.

6.7 BALANCE OF PLANT (BOP) EQUIPMENT CAPABILITY ASSESSMENT CRITERIA

6.7.1.1. Seismic Category I BOP equipment located within the containment, reactor and control building are assessed for load combinations shown in Table 5-4. In these load combinations, seismic and hydrodynamic loads are generally combined using the absolute sum method.

6.7.1.2 However, for the "marginal" cases the responses of the "dynamic" events (Seismic, SRV, LOCA) are combined by the square root of the sum of the squares (SRSS) method before adding these values to the other loads by the absolute sum (ABS) method. The maximum loading effects of both the horizontal and vertical directions are considered as arising from simultaneous excitation in all three principal directions for all combinations involving dynamic loads as detailed in Subsection 7.1.7.4.1.3.

6.7.1.2 The high frequency hydrodynamic (SRV and LOCA) loads originating from the suppression pool of the containment structure require consideration of additional structural spectral responses in addition to the seismic loads. These combined spectra exceed those for which equipment have been qualified based on original seismic loads. However, these high frequency loads have very limited energy content and are non-damaging in nature (see Reference 86). The equipment need not be qualified in the high frequency range beyond a certain cutoff point. A general high frequency cutoff procedure developed by using a threshold spectral limit as defined by Equation 4-3 or Fig. 4.3 of Reference 86 is described in Section 7.1.7.5 for the assessment of equipment for combined seismic and hydrodynamic loads.

6.7.2 Testing

67.2.1 When equipment is qualified by testing, the test motions have simulated the combinations and damping. The equipment have remained operational and functional, before, during and after such tests.

(a)	OBE	alone	-	1/2% damping
(b)	SSE	alone	-	1% damping
(c)	SRV	alone	-	2% damping
(d)	LOCA	alone	-	2% damping
(e)	OBE+SRV+LOCA		-	2% damping
(f)	SSE+SRV+LOCA		-	2% damping

6.7.2.2 Cases (a) and (b) are covered in the FSAR. Cases (c) and (d) are covered in the test evaluation for (e) and (f). Test requirements are depicted by tests response spectrum (TRS) for a given damping value. Equipment is deemed to be qualified if the equipment did not fail or malfunction during the test and the TRS envelope the required response Spectrum (RRS). The RRS for cases (e) and (f) are obtained by combining the response spectrum of the individual components of each event by adding the larger of the horizontal responses to the vertical responses on an absolute sum basis. However, for marginal cases the square root of sum of the squares (SRSS) method is allowed for the individual dynamic events and components.

7.1.6.1.4.1.3 Combined Analysis and Testing

There are several instances where the qualification of equipment by analysis alone or testing alone is not practical or adequate because of its size, or its complexity, or large number of similar configurations. In these instances a combination of analysis and testing is the most practical. The following are general approaches:

(a) An analysis is conducted on the overall assembly to determine its stress level and the transmissibility of motion from the base of the equipment to the critial components. The critical components are removed from the assembly and subjected to a simulation of the environment on a test table.

(b) Experimental methods are used to aid in the formulation of the mathematical model for any piece of equipment. Mode shapes and frequencies are determined experimentally and incorporated into a mathematical model of the equipment.

7.1.6.1.4.1.4 High Frequency Cut-off

A general procedure for the qualification of equipment for seismic and hydrodynamic (SRV and LOCA) loads using the high frequency cutoff methods recommended in Reference 86 is outlined below:

(a) Superimpose threshold limits, Fig. 4-3 (similar to Fig 4-4) of Reference 86 (displacement = 0.05 in., velocity = 5 in./sec, acceleration = 4.25 g for 2% damping) on the floor response spectra of seismic and hydrodynamic loads combined either by the absolute sum or square root of the sum of the squares (SRSS) for each of the horizontal and vertical directions.

(b) Determine the cutoff frequency at the cross-over point of the threshold curve on the floor response spectra as per item (a). Use 33 Hz as the lower limit for cutoff frequency.

(c) Disregard the response spectra for frequency ranges beyond the cutoff frequency range, except, use the zero period acceleration of all lower frequency inputs (seismic, SRV, etc.) as a minimum beyond the cutoff frequency range.

(d) For the equipment to be qualified by analysis, use the required floor acceleration response spectra derived from (a), (b) and (c) above and analyze the equipment based upon the response spectra method indicated in Section 7.1.7.4.

(e) For the equipment to be qualified by test, compare the TRS with the RRS derived from (a), (b) and (c) above. If TRS is greater than the RRS without any evidence of equipment malfunction, the equipment is qualified.

(f) For the qualification of components and other devices mounted on cabinets, use the cutoff frequency determined on the basis of the floor response spectra as per items (a), (b) and (c) above.

The above procedure of utilization of high frequency cutoff is not used for the qualification of electro-mechanical components such as relays whose functional failures are acceleration sensitive and for which failure modes are verified and qualified by testing.

7.1.6.1.4.1.4 High Frequency Cut-off (continued)

The equipment on Susquehanna project has been qualified for seismic loads defined in FSAR, SRV loads from KWU and LOCA load per GE DFFR loads. Very recently, LOCA loads defined by KWU were accepted to be the project requirement, thus, the above procedure is used only where appropriate, and as an alternative qualification method, to minimize unnecessary additional modifications due to the more conservative new KWU LOCA load definition.

required response spectra (RRS) and the equipment did not malfunction or fail. A new test does not need to be conducted if equipment requires only a very minor modifications such as additional bracings or change in switch model etc. and proper justification is given to show that the modifications do not jeopardize the strength and function of the equipment.

7.1.7.4.3 Combined Analysis and Testing

There are several instances where the qualification of equipment by analysis alone or testing alone is not practical or adequate because of its size, or its complexity, or large number of similar configurations. In these instances a combination of analysis and testing is the most practical. The following are general approaches:

(a) An analysis is conducted on the overall assembly to determine its stress level and the transmissibility of motion from the base of the equipment to the critical components. The critical components are removed from the assembly and subjected to a simulation of the environment on a test table.

(b) Experimental methods are used to aid in the formulation of the mathematical model for any piece of equipment. Mode shapes and frequencies are determined experimentally and incorporated into a mathematical model of the equipment.

7.1.7.5 High Frequency Cutoff

See Subsection 7.1.6.1.4.1.4.

7.1.8 Electrical Raceway System Assessment Methodology

7.1.8.1 General

The FSAR Subsection 3.7b.3.1.6 provides a detailed description of the electrical raceway system design methodology. The analysis and design of supports or Electrical Raceway Systems for non-hydrodynamic loads are in accordance with Reference 3.7b-7 of the FSAR. SRV discharge and LOCA loads are considered similar to the seismic loads by using appropriate floor response spectra for the hydrodynamic loads. A damping value of 7% of critical is used for all raceway systems for abnormal/extreme load condition and a damping value of 3% of critical is used for normal load condition involving SRV discharge loading only.

7.1.8.2 Loads

7.1.8.2.1 Static Loads

The static loads are the dead loads and live loads. For cable trays, the weight of the cable is considered to be 45 lbs/ft and a concentrated live load of 200 lb. applicable at any point or cable tray span is used.

References:

86. R. P. Kennedy, et. al., Lack of Consequences of Exceedance in the High Frequency Range and a General Procedure for High Frequency Cutoff, Structural Mechanics Associates, January 1981.

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