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AUTH.NAME AUTHOR AFFILIATION
CURTIS,N.W. Pennsylvania Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
YOUNGBLOOD,B.J. Licensing Branch 1

SUBJECT: Forwards documents re facility seismic-hydrodynamic program for qualification of safety-related equipment,per NRC request.Documents will support Seismic Qualification Review Team Site audit scheduled for 810316-0320.

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NORMAN W. CURTIS
Vice President-Engineering & Construction-Nuclear
770-5381

MAR 9 1981

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Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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U.S. NUCLEAR REGULATORY COMMISSION

SUSQUEHANNA STEAM ELECTRIC STATION
SEISMIC QUALIFICATION REVIEW TEAM
TRANSMITTAL OF REQUESTED DOCUMENTS
ER 100450 FILE 843
PLA-655

Dear Mr. Youngblood:

Enclosed are the following documents relative to the Susquehanna Steam Electric Station Seismic-Hydrodynamic Program for Qualification of Safety-Related equipment. These documents were requested by your Mr. Arnold Lee in support of the Seismic Qualification Review Team Site audit now scheduled for the week of March 16 through 20, 1981.

1) The GE NSSS response to NRC FSAR Question 123.1, .3, .4, .5, .6, .7, and .9.

2) The previous response to NRC FSAR Question 110.42 concerning load combinations for the NSSS qualification of equipment. Refer to our letter to NRC PLA-536.

3) Part of previous transmittal of slides from PP&L-NRC SQRT meeting of December 18, 1980. Refer to our letter to NRC PLA-602, January 2, 1981.

4) Bechtel Specification 8856-G-22, Revision 4, "General Project Requirements for Design Assessment and Qualification of Seismic Category I Equipment and Equipment Supports for Seismic and Hydrodynamic Loads for Susquehanna Steam Electric Station Units 1 and 2."

5) A summary of our 3/4/81 telephone conversation with Dr. Lee.

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By separate transmittals, we have, on February 26 and 27 delivered the following PROPRIETARY documents to your Mr. Richard Stark and Mr. Morris Reich (BNL):

8103130421

A

MAR 9 1981

a) A. Javid, C.V. Subramanian, M.E. Tanner, G.O. Usry, Seismic Qualification Review Team (SQRT) Technical Approach for Re-Evaluation of BWR 4/5 Equipment", General Electric Company, May, 1980 PROPRIETARY NEDE-24788.

b) A. Javid, P.H. Gooding, "Generic Criteria for High Frequency Cut-Off of BWR Equipment", General Electric Company, January, 1980 PROPRIETARY: NEDE-25250.

The documents in this letter complete the information requested by the Seismic Qualification Review Team. All final SQRT forms (3 page forms for NSSS and 4 page forms for BOP) for the audited equipment have been transmitted to you.

Very truly yours,

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

CTC/mks

Enclosures

cc: R. M. Stark NRC
M. Reich BNL

QUESTION 123.1

Pursuant to General Design Criterion 2, safety-related structures, systems and components are to be designed for appropriate load combinations arising from accidents and severe natural phenomena. With regard to the vibratory loads attributed to the feedback of hydrodynamic loads from the pressure suppression pool of the containment, the staff requires that safety-related mechanical, electrical, instrumentation and control equipment be designed and qualified to withstand effects of hydrodynamic vibratory loads associated with either safety relief valve (SRV) discharge or LOCA blowdown into the pressure suppression containment combined with the effects of dynamic loads arising from earthquakes.

The criteria to be used by the staff to determine the acceptability of your equipment qualification program for seismic and dynamic loads are IEEE Std. 344-1975 as supplemented by Regulatory Guides 1.100 and 1.92, and Standard Review Plan Sections 3.9.2 and 3.10. State the extent to which the equipment in your plant meets these requirements and the above requirements to combine seismic and hydrodynamic vibratory loads. For equipment that does not meet these requirements provide justification for the use of other criteria.

RESPONSE

The GE SQRT Program specifically adresses both seismic and hydrodynamic loads using the criteria found in IEEE-STD-344-1975; R.G. 1.92, R.G. 1.100; SRP 3.2 and SRP 3.10. NSSS equipment is not considered acceptable unless it is qualified to the above requirements. Equipment not found qualified to the above requirements will be requalified before it is considered acceptable.

QUESTION 123.3

Identify those items of nuclear steam supply system and balance-of-plant equipment requiring reevaluation and specify why reevaluation is necessary (i.e., because the original qualification used the single frequency, single axis methodology, because equipment is affected by hydrodynamic loads, or because both of the above conditions were present) for each item of equipment.

Response (NSSS Only)

SYSTEM	MPL #
Safety Relief Valve	B21F013
MSIV	B21F022/F028
Flow Element	B21N051/52/53/54
Recirc. Pump Motor	B31C001
Gate Valve	B31F023/31/32
HCU	C12D001
CRD Valves	C12F009/10/11/12
SLC Storage Tank	C41A001
SLC Accumulator	C41A003
SLC Pump	C41C001
SLC Explosive Valve	C41F004
RHR Heat Exchanger	E11B001
RHR Pump	E11C002
Flow Orifice Assembly	E11N012/N014
LPCS Pump & Motor	E21C001
Flow Orifice Assembly	E21N002
MSIV Heater	E32B001
MSIV Blower	E32C001/C002
HPCI Pump	E41C001
HPCI Turbine	E41C002
Flow Orifice Assembly	E41N007
RCIC Pump	E51C001
RCIC Turbine	E51C002
Flow Orifice Assembly	E51N001
Fuel Prep Machine	F18E001
Gen. Purpose Grapple	F18E011
Dryer & Separator Sling	F19E008
Head Strong Back	F19E009
Control Rod Grapple	F20E002
Refueling Platform	F21E003
In Vessel Rack	F22E006
Def. Fuel Storage Cont.	F22E009
Fuel Storage Vault	F22E012

Question 123.3

SYSTEM	HPL #
CONTROL ROOM PANELS	
Reactor Core Cooling BB	H12-P601
Power Range Monitoring Cabinet	H12-P608
RPS Div. 1 and 2 Log VB	H12-P609
RPS Div. 2 and 3 Logical VB	H12-P611
NSSS Temperature Recorder VB	H12-P614
Feedwater & Recirculation Instrument Panel	H12-P612
NSSS Process Instrument Panel	H12-P613
Div 1 RHR/HPCI Relay VB	H12-P617
Div 2 RHR/HPCI Relay VB	H12-P618
ADS Ch A Relay VB	H12-P628
MSIV Leakage Control Div 2 VB	H12-P654
HPCI Relay VB	H12-P620
RCIC Relay VB	H12-P621
Inboard Valve Relay Board	H12-P622
Outboard Valve Relay VB	H12-P623
Div 1 CS Relay VB	H12-P626
Div 2 CS Relay VB	H12-P627
ADS Ch B Relay VB	H12-P631
MSIV Leakage Control Div 1 VB	H12-P655
Radiation Monitoring Instrument Panel A	H12-P606
Radiation Monitoring Instrument Panel B	H12-P633
Operating BB	H12-P680
Termination Cabinets	H12-P700 Series
Plant Operation Benchboard	H12-P853
NUCLEAR BOILER	
Condensing Chamber	B21-D002
Condensing Chamber	B21-D004AB
Condensing Chamber	B21-D006AD
Condensing Chamber	B21-D007AD
Condensing Chamber	B21-D008AD
Condensing Chamber	B21-D009AD
LOCAL PANELS	
Reactor Water Clean-Up	H23-P002
Reactor Vessel Level And Pressure (A)	H23-P004
Reactor Vessel Level And Pressure (B)	H23-P005
Recirculation Pump A	H23-P009
Jet Pump B	H23-P010

Question 123.3

PL#		SYSTEM
		LOCAL PANELS
-P014		High Pressure Coolant Injection B
-P017		Reactor Core Isolation Cooling A
-P018		Residual Heat Removal Channel A
-P021		Residual Heat Removal Div. 2 Channel B
-P022		Recirculation Pumps
-P057		Drywell Pressure Local Panel A
-P058		Drywell Pressure Local Panel B
-P074	Div. 2	Main Steam Isolation Valve Leakage Control
-P001		Core Spray Local Panel A
-P011		Standby Liquid Control
-P015		Main Steam Flow A/B
-P016		High Pressure Coolant Injection Leak Det.
-P019		Core Spray Channel B
-P025		Main Steam Flow C/D
-P036		High Pressure Coolant Injection
-P038	Div. 2 (B)	Reactor Core Isolation Cooling Leak Det.
-P041		Main Steam Flow A/B
-P042		Main Steam Flow C/D
-P073	Div. 1	Main Steam Isolation Valve Leakage Con.
P034		High Pressure Coolant Injection Div. 1 A
P037		Reactor Core Isolation Cooling Div. 2 B
P030/31/32/33		SRM/IRM

QUESTION 123.4

Describe the methods and criteria used to determine the acceptability of the original equipment qualification to meet the required response spectra of Item 123.2 (iii).

RESPONSE

The methods and criteria used to determine the acceptability of the original equipment qualification may be found in General Electric Company's Proprietary reports: NEDE-24788, "Seismic Qualification Review Team (SQRT) Technical Approach for Re-Evaluation of BWR 4/5 Equipment"; and NEDE-25250 "Generic Criteria For High-Frequency Cutoff of BWR Equipment".

QUESTION 123.5

Describe the methods and criteria used to address the vibration fatigue cycle effects on the affected equipment due to required loading conditions.

Response

Vibration fatigue cycle effects for NSSS equipment designed to ASME code requirements was reviewed at GE by NRC consultants from Battelle Pacific Northwest Laboratories on October 7, 1980. The consultants stated satisfaction with the GE approach which encompasses OBE, SRV, thermal and pressure cycles.

Non ASME Code components qualified by test address the "strong motion" phase of seismic and SRV dynamic motion sufficient to generate maximum equipment response these loads are controlling. GE testing generally consist of 5 upset and 1 faulted test of 30 seconds each which is about 50% greater than required to address strong motion vibration.

Non ASME Code components qualified by analysis generally have not, in the past, had to address vibration fatigue cycle effects. In most cases such effects are not now part of the qualification record.

If there are any problems please contact Dahvidah at 8*408/925-2609

This is the ninth of 9 pages

QUESTION 123.6

Based on the methods and criteria described in Items 4 and 5, provide the results of the review of the original equipment qualification with identification of (1) equipment which has failed to meet the required response spectra and required requalification, and (2) equipment which was found acceptable, together with the necessary information to justify the adequacy of the original qualification.

Response

Refer to the Response to Question 123.3 for the list of equipment reevaluated by GE on the Susquehanna SQRT Program. All of the equipment listed is qualified to SQRT Criteria with the exception of the following:

B21-F022/F028	MSIV	Data required from vendor
B31-F031/F032	Gate Valve	Operability deflection analysis required
C12-F009/F010 F011/F012	CRD Valve	Operability deflection analysis required
C41-A003	SLC Accumulator	A/E pipe accelerations required
C41-F004	SLC Explosive Valve	A/E pipe accelerations required
E32-B001	MSIV Heater	Test required
E41-C002	HPCI Turbine	Test required
E51-C002	RCIC Turbine	Analysis of lube oil piping required
F22-E006	Invessel Rock	Analysis required
F22-E009	Def. Fuel Storage Cont.	Analysis required
H12-P608	Power Range Monitoring Cabinet	Test required
H23-P030 -P031 -P032 -P033	SRM/IRM Panels	Test required
163C1158	Flow Transmitter on H23-P074	Test required
272A8005	Switch on H12-P853	Test required
272A8006	Switch on H12-853	Test equired

Information to justify qualification of the equipment selected by the NRC for the Site Audit will be available at the site for NRC inspection. Information to justify qualification of the remainder of the equipment is available for NRC audit at GE-San Jose.

QUESTION 123.7

Describe procedures and schedule for completion of each item identified in Item 123.6 (1) that requires requalification.

RESPONSE

The response to Question 123.6 lists the equipment found by GE to require requalification along with a statement defining the work to be performed. All requalification will be completed on a schedule sufficient to permit NRC review prior to fuel load.

QUESTION 123.9

To confirm the extent to which the safety related equipment meets the requirements of General Design Criterion 2, the Seismic Qualification Review Team (SQRT) will conduct a plant site review. For selected equipment, SQRT will review the combined required response spectra (RRS) or the combined dynamic response, examine the equipment configuration and mounting, and then determine whether the test or analysis which has been conducted demonstrates compliance with the RRS if the equipment was qualified by test, or the acceptable analytical criteria if qualified by analysis.

The staff requires that a "Qualification Summary of Equipment" as shown on the attached pages be prepared for each selected piece of equipment and submitted to the staff two weeks prior to the plant site visit. The applicable should make available at the plant site for SQRT review all the pertinent documents and reports of the qualification for the selected equipment. After the visit, the applicable should be prepared to submit certain selected documents and reports for further staff review.

RESPONSE

GE submitted "Qualification Summary of Equipment" forms to PP&L on February 20, 1981 for the items of equipment selected by the NRC for the site audit. All pertinent documents and reports required to show qualification of this selected equipment to the SQRT Criteria will be available at the site for the audit.

ATTACHMENT 2

QUESTION 110.42:

FSAR Sections 3.9.3, 3.9.4 and 3.9.5 reference several tables (3.9-2, 3.9-6, 3.9-17, 3.9-27, etc.) that describe the various loading combination considered in the design of ASME Class 1, 2, and 3 components, component supports, core support structures, control rod drive components, and other reactor internals.

We have had discussions with the Mark II Owner's Group concerning the load combinations appropriate for the design of BWR Mark II plants. Our position with respect to load combinations has been documented as Attachment A to Enclosure 5 of the NRC Mark II Generic Acceptance Criteria for Lead Plants. This staff position is repeated here as Enclosure 110-2. These loading combinations are applicable to the Susquehanna plant.

Therefore, provide a commitment that all ASME Class 1, 2, and 3 components, component supports, core support structures, control rod drive components, and other reactor internals have been or will be analyzed or otherwise qualified in accordance with Enclosure 110-2, as modified by the following two clarifications:

(a) For load cases 1 and 2 all ASME Code Service Level B requirements are to be met, including fatigue usage factor requirements, and should take into account all SRV discharge load effects (initial actuation and continuous suppression pool vibratory) taken for the number of cycles consistent with the 40 yr. design life of the plant.

(b) For load case 10, SRV_x should be assumed to be one SRV.

RESPONSE:

I. Non-NSSS

For load cases 1 and 2 as identified in Question 110.42, enclosure 110-2, all ASME Code Service Level B requirements, including fatigue consideration for Class 1 components, are met for piping in non-NSSS's scope.

For load case 10, SRV_x (one SRV) is not considered in combination with DBA induced loads. However, the loads resulting from condensation oscillation and chugging are considered in combination with the effects of SRV_{ADS}.

FSAR Tables 3.9-17, 3.9-18, 3.9-23 and 3.9-27 are revised to reflect the loading combinations and acceptance criteria that are used for ASME Code Class 1, 2 and 3 components and their supports.

II. NSSS

Load Case 1 combinations meet the cited staff position.

General Electric believes that the loading combination OBE + SRV_{All} (Load Case 2) ought to be considered as an Emergency condition. The classification of this low probability combination of loads as Emergency (Service Level C requirements) is consistent with 1) the encounter frequency of the OBE, 2) the number of combined stress cycles expected over the plant lifetime, and 3) the intent of the ASME code. However, response to continued regulatory staff inquiry, GE agreed to meet Upset Limits (Service Level B requirements) without fatigue analysis. The considerations for not conducting the fatigue analysis involve the same technical justifications enumerated above. For load case 10, SRV_x (one SRV) is not considered in combination with DBA induced loads.

TABLE 110.42-1

ACCEPTANCE CRITERIA FOR NSSS PIPING & EQUIPMENT

Load Case	N	SRV_x	SRV_{ADS}	OBE	SSE	IBA(5)	DBA(5)	Acceptance Criteria
1	X	X						B(1)
2	X	X		X				B(6)
3	X	X			X			D(3)
4	X		X			X(2)		C
5	X		X		X	X(2)		D(3)
6	X				X		X(2)	D(3)
7	X							A
8	X			X				B
9	X	X		X		X		C(3)

NOTES:

(1) For load case 1, all ASME Code Service Level B requirements are to be met, including fatigue usage. All SRV discharge load effects will be combined with mechanistically associated loads and taken for the number of cycles consistent with the 40 yr. design life of the plant.

(2) Loading due to DBA/SBA/IBA is determined from rated steady-state conditions.

(3) Piping functional capability will be assured for essential piping per Enclosure 110-2 or NEDE 21985.

(4) Not used.

(5) IBA and DBA includes all associated loads such as annulus pressurization, pool swell, chugging, etc.

(6) For load case 2, all ASME Code service requirements are to be met, excluding fatigue usage.

(7) For specific load combinations refer to Table 3.9-2.

ATTACHMENT 3

LOAD COMBINATIONS AND ALLOWABLE STRESSES

(BASIS: SECT. 3.10c.1.4 & 3.10c.1.5 OF FSAR TABLE 5.4 OF DAR _____)

CASES	ALLOW STRESSES
OBE	1.25 FS
OBE + SRV	1.25 FS
SSE	1.50 FS
OBE + SRV + LOCA	1.50 FS
SSE + SRV + LOCA	1.50 FS

FS = ALLOWABLE STRESS FOR NORMAL CONDITIONS (EX.: AISC ALLOW)

NOTE: DEAD LOADS AND OTHER OPERATING LOADS ARE ADDED TO THE ABOVE CASES.

SELECTION OF RESPONSE SPECTRA

- ENVELOPE FLOOR RESPONSE SPECTRA
- COMBINED SPECTRA OF VARIOUS DYNAMIC LOADS (OBE/SSE, SRV, LOCA)
  - ABS SUM
  - SRSS
- EXAMPLE (NEXT TWO VIEW-GRAPHS)

ATTACHMENT 4

Specification 8856-G-22
Revision 4

SUSQUEHANNA SES
ER 100450
FILE No. 975 G-22

GENERAL PROJECT REQUIREMENTS

FOR

DESIGN ASSESSMENT AND QUALIFICATION
OF
SEISMIC CATEGORY I EQUIPMENT AND EQUIPMENT SUPPORTS
FOR
SEISMIC AND HYDRODYNAMIC LOADS
FOR
SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 AND 2

PENNSYLVANIA POWER & LIGHT COMPANY
ALLENTOWN, PENNSYLVANIA

RECEIVED
NOV 17 1980
SUSQUEHANNA PROJ.

RECEIVED
NOV 13 1980
NUCLEAR REC. SYS.

BECHTEL POWER CORPORATION
San Francisco, California

No	DATE	REVISIONS	BY	CH'K	DESIGN SUPV	ENG'R	PROJ ENGR	APPR
4	11/05/80	Deleted last sentence of Section 1.1, Revised wording of Section 1.2.1 and Paragraph 3 of Section 6.0.	P. [illegible]	RSR	[illegible]	n/a	EP/[illegible]	
3	10/15/79	Added Sections 1.2.4 and Appendix A	RSR	M.M.	[illegible]	n/a	[illegible]	
2	6/6/79	Incorporated Chief Engineer's Comments and reissued for project use.	RSR	M.M.	M.M. [illegible]	n/a	[illegible]	
1	5/2/79	Incorporated Client's Comments and Rev. as shown. Reissued for Project use (PLB-9357)	RSR	[illegible]	[illegible]	n/a	JS/[illegible]	
C	11/6/78	Issued for Project use	RSR	M.M.	[illegible]	n/a	JS/[illegible]	
B	9/27/78	Rv & R'sued for Proj & Chief Eng Rev.	RSR	[illegible]	[illegible]	n/a	JS/[illegible]	
A	7/26/78	Issued for Project & Chief Eng. Review	[illegible]	M.M.	[illegible]	n/a	JS/[illegible]	

SCALE | DESIGNED | DRAWN | CHIEF ENGR

JOB No. 8856

SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2
PENNSYLVANIA POWER & LIGHT COMPANY

SPEC/DES GUIDE NO. 8856-G-22 | REV. 4

SHEET 1 OF 25

8856-S-13 (8/73)

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INDEX TO
GENERAL PROJECT REQUIREMENTS
FOR
DESIGN ASSESSMENT AND QUALIFICATION
OF
SEISMIC CATEGORY I EQUIPMENT AND EQUIPMENT SUPPORTS
FOR
SEISMIC AND HYDRODYNAMIC LOADS

1.0	Scope
2.0	Equipment Classification
3.0	Equipment Location
4.0	Dynamic Loads and General Design Criteria
5.0	Load Combinations and Allowable Stresses
6.0	Qualification Methods
7.0	Dynamic Analysis
8.0	Testing
9.0	Combined Analysis and Testing
10.0	Evidence of Compliance
11.0	Certification of Compliance
Appendix A	Equipment Qualification Report Summary

NOTE: The applicable RESPONSE SPECTRA, Load Combinations and Acceptance Criteria are included with the Material Requisition or Technical Specification covering that item.

GENERAL PROJECT REQUIREMENTS FOR DESIGN ASSESSMENT AND QUALIFICATION OF SEISMIC CATEGORY I EQUIPMENT AND EQUIPMENT SUPPORTS FOR SEISMIC AND HYDRODYNAMIC LOADS

1.0 SCOPE

1.1 General

This Specification covers design assessment and qualification of seismic Category I equipment, equipment supports and systems for seismic and hydrodynamic loads by analysis and/or testing for the Susquehanna Steam Electric Station Units 1 and 2 in accordance with methods and procedures specified herein. Wherever the word "equipment" occurs, it shall include equipment, equipment supports, equipment anchorages, and systems furnished by the Seller.

4

1.2 Work Included

1.2.1 Submitting details for reviews and approval of all methods, policies, and procedures to be employed to assure compliance with the seismic and hydrodynamic requirements as defined herein. 4

1.2.2 Furnishing of all labor, material, equipment, supervision, and the performance of all operations and incidentals necessary for dynamic analysis, design, and/or testing of the equipment as required herein.

1.2.3 Furnishing of calculations and/or dynamic test data for the equipment as required herein.

1.2.4 Furnishing the interface reactions due to all required load combinations at the support points where the Seller's items are supported. 3

1.3 Work Not Included

Furnishing of calculations or test data to insure the adequacy of equipment supports provided by the Buyer.

1.4 Definitions

Seismic Category I Equipment: Equipment that is essential to emergency reactor shutdown, or otherwise is essential in preventing significant release of radioactive material to the environment or is necessary to keep the plant in safe shutdown condition.

Safe Shutdown Earthquake: The earthquake which is based upon an evaluation of the maximum earthquake potential. It is that earthquake which produces the maximum vibratory ground motion for which Category I structures, systems and components are designed to remain functional.

Operating Basis Earthquake: That earthquake which could reasonably be expected to affect the plant site during the operating life of the plant; it is that earthquake which produces the vibratory ground motion for which those features of the nuclear power plant necessary for continued operation without undue risk to the health and safety of the public are designed to remain functional.

Response Spectrum: A plot of the maximum responses of single degree-of freedom linear systems of different natural frequencies at given damping values subject to the same specified base motion.

Floor Response Spectrum: The response spectrum of a floor motion. There are, in general, response spectra for two perpendicular horizontal directions and one vertical direction.

Required Response Spectrum (RRS): The response spectrum of a motion for which a piece of equipment or system is required to be qualified. This motion is that defined at the equipment support.

Test Response Spectrum (TRS): The response spectrum of the test input motion.

Dynamic Degree of Freedom: Coordinates for which accelerations are considered in the equations of motion.

Narrow Band Response Spectrum (NBRS): A response spectrum which has a high peak caused by existence of a large amount of harmonic motion at some frequency, usually caused in floor spectra by the response of a building in one of its modes. Narrow band response spectra shall be designated as such by the Buyer on the spectra furnished by the Buyer to the Seller.

Natural Frequency: The frequency at which a body vibrates freely, without the application of external forces in one of its natural modes.

Natural Mode: One of the characteristic shapes of a body in which in free vibration all points describe a synchronous motion.

Floor Acceleration: The accleration of a particular building floor (or equipment mounting) resulting from a given motion applied to the foundation level of the building. The maximum floor acceleration can be obtained from the floor response spectrum, as the acceleration at high frequencies (in excess of 33 Hz for seismic loads and 80 Hz. for hydrodynamic load), and is sometimes referred to as the zero period acceleration (ZPA).

Ground Acceleration: The acceleration of the ground resulting from a seismic event. The maximum ground acceleration can be obtained from the ground response spectrum as the acceleration at high frequencies.

Malfunction: The loss of capability to initiate or sustain a required function or the initiation of undesired spurious action.

Sine Beat: A continuous sinusoid of one frequency, amplitude modulated by a sinusoid of a lower frequency.

Transfer function: A complex function of frequency which represents the transmissibility of a system between the output motion at a given point and the input motion.

1.5 References

1.5.1 "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations" IEEE Std. 344-1975.

1.6 Bibliography

1.6.1 "Seismic Qualification of Electric Equipment for Nuclear Power Plants" U.S. NRC Regulatory Guide 1.100.

1.6.2 "General Project Requirements for Aseismic Design and Analysis of Class I Equipment and Equipment Supports for the Susquehanna Steam Electric Station Units 1 and 2". Specification 8856-G-10 Revision 3.

1.6.3 "Seismic Qualification - Philosophy and Methods" by C. W. Roberts and G. D. Shipway. Journal of the Power Division, Proc. of ASCE, Vol. 102, No. PO1, Jan. 1976 pp. 113-120.

2.0 EQUIPMENT CLASSIFICATION

All plant equipment is classified as either Seismic Category I or Non-Seismic Category I. The equipment technical specification will designate the classification of specific equipment. This Specification 8856-G-22 is not applicable for equipment which are not Seismic Category I.

3.0 EQUIPMENT LOCATION

Equipment are located within the several buildings which comprise the Susquehanna Steam Electric Station. The Response Spectra corresponding to the equipment location are issued with the equipment technical specification.

4.0 DYNAMIC LOADS AND GENERAL DESIGN CRITERIA

All equipment under this specification shall withstand dynamic loads resulting from (a) Seismic Loads and (b) Hydrodynamic Loads in addition to all other applicable loads. The method of combination of these dynamic loads and acceptance criteria are provided in the equipment technical specification. The functions of the equipment instrumentation and controls or other parts, which

are necessary for the functional requirements of the equipment shall not be impaired when these dynamic loads are applied simultaneously in accordance with the applicable load combinations. The functional requirements of the equipment are stated in the equipment technical specification.

4.1 Seismic Loads

Seismic Category I equipment shall withstand simultaneously the horizontal and vertical Components of Support motion caused by the "Operating Basis Earthquake" (OBE) and the "Safe Shutdown Earthquake" (SSE)

The Seller shall be responsible for assuring that the equipment is designed for the following conditions:

(a) To remain functional so that a safe and orderly shutdown of the plant can be achieved and maintained after experiencing a SSE which has been preceded by OBE's.

(b) To remain operational and to perform its functions as required for the continued operation of the plant during and after experiencing an Operating Basis Earthquake (OBE).

The functional requirements of the equipment during and after SSE or OBE are stated as above unless otherwise stated in the equipment specification.

Qualification (testing and/or analysis) shall be done for required load combinations specified in the equipment specification for both the OBE and SSE.

4.2 Hydrodynamic Loads

The equipment and equipment supports shall withstand dynamic loads associated with Main Steam Safety relief valve (MSRV) discharge thermo-hydrodynamic phenomena and Loss-of-Coolant accident (LOCA) hydrodynamic phenomena in addition to seismic and all other applicable loads according to load combinations given in the equipment technical specification.

4.2.1 Loads Due to SRV Actuation

Loads due to SRV actuation is considered as a normal operating condition loading. Response spectra due to symmetric and asymmetric SRV discharge loads shall be considered in the equipment assessment.

4.2.2 Loads Due to LOCA Related Loads

LOCA induced loads on the SSES containment structure are characterized by loads associated with poolswell, condensation oscillation and chugging loads as well as long term LOCA loads (due to air bubble pressure). Response spectra due to all these conditions shall be considered in the equipment qualifications.

The above hydrodynamic loads are developed in the suppression pool of the containment structure; however, all structures that are in contact with the containment structure at the foundation or any other level will also be affected by these loads.

The appropriate response spectra for hydrodynamic loads for the subject equipment are contained in the equipment technical specification. These response spectra are developed based upon a finite element dynamic analysis of the containment structure and adjacent buildings, subjected to input motion generated from the containment response.

5.0 LOAD COMBINATIONS AND ALLOWABLE STRESSES

All Seismic Category I equipment shall be designed for the loads and load combinations given in the material requisition or the equipment technical specifications. For all load combinations involving dynamic loads, the effect of both horizontal and vertical dynamic loads shall be considered as arising from excitation in all three principal directions and combined as specified for the particular method of qualification.

Stresses and deformations due to the combined loads shall be within the limits specified in the material requisition or the equipment technical specifications. The stresses and deformations due to the maximum effect of the combined loads shall remain within such limits that the requirements of Section 4.0 regarding the dynamic loads and the functional requirements of the equipment as specified in the technical specification are met.

6.0 QUALIFICATION METHODS

In the absence of more specific directions in the equipment specification, the Seller shall prove the adequacy of the design of the equipment by one of the following:

a. Dynamic analysis (Section 7.0)

b. Testing under simulated conditions. (Section 8.0)

c. Combination of testing and analysis. (Section 9.0)

The choice shall be based on the practicality of the method for the function, type, size, shape, and complexity of the equipment and the reliability of the qualification.

4 For the qualificaion of electrical, control systems, and instrumentation equipment, requirements outlined in the IEEE-344-75 shall also be followed, in addition to the requirements of this specification.

The Seller shall clearly justify the selection of the method of qualification.

The Seller may elect to consult with the Buyer with respect to setting up a qualification program.

7.0 DYNAMIC ANALYSIS

7.1 Methods and Procedures

The dynamic analysis of various equipment can be classified into three cases according to the relative rigidity of the equipment based on the magnitude of first natural frequency as below.

(a) Structurally simple equipment - that equipment which can be adequately represented by one degree of freedom system.

(b) Structurally rigid equipment - that equipment whose fundamental frequency is:

(i) greater than 33 Hz for the consideration of seismic loads.

(ii) greater than 80 Hz for the consideration of hydrodynamic loads.

(c) Structurally Complex equipment - are those which cannot be classified as structurally simple or structurally rigid.

When the equipment is structurally simple or rigid in one direction but complex in the other, each direction may be classified separately to determine the dynamic loads.

7.1.1. Response Spectrum Analysis

The appropriate response spectra for specific equipment are issued with the equipment specification for OBE, SSE; and hydrodynamic loads. Response spectra are based upon the dynamic analyses of the supporting structure and represent the dynamic response of a single degree of freedom system at a particular location within the structure. Response spectra plotted in terms of acceleration versus frequency, correspond to various locations within the buildings and are identified with respect to the points noted on the mathematical model for each direction of vibration to be considered. This may include the vertical as well as both the N-S and E-W horizontal directions. In addition, each response spectrum corresponds to a particular damping ratio, i.e., the ratio of damping of the single degree of freedom system to critical damping.

The horizontal seismic response spectra provided have been generated with respect to a maximum horizontal ground acceleration of 0.05g corresponding to the OBE, and a maximum horizontal ground acceleration of 0.10g corresponding to the SSE unless otherwise noted. The vertical response spectra are based on ground accelerations which are 2/3 of the horizontal accelerations.

7.1.1.1 Structurally Simple Equipment

For equipment which is structurally simple the dynamic loading (either seismic or hydrodynamic) shall consist of a static load corresponding to the equipment weight times the acceleration selected from the appropriate response spectrum.

The acceleration selected shall correspond to the equipment's natural frequency, if the equipment's natural frequency is known. If the equipment's natural frequency is not known, the acceleration selected shall correspond to the maximum value of the response spectra.

7.1.1.2 Structurally Rigid Equipment

For equipment which is structurally rigid the seismic load shall consist of a static load corresponding to the equipment weight times the acceleration at 33 Hz, selected from the appropriate response spectrum and the hydrodynamic loading shall consist of a static load corresponding to the equipment weight times the acceleration at 80 Hz., selected from the appropriate response spectrum.

7.1.1.3 Structurally Complex Equipment

(a) For the purposes of analysis of structurally complex equipment, the equipment may be idealized by any mathematical model which adequately predicts the dynamic properties of the equipment. The model shall be adequate to define the dynamic behavior of the equipment within the frequency range of interest. The mass and stiffness of both equipment appendages and supports shall be considered in the mathematical model of the equipment if the interaction effect is significant. All properties shall reflect the in-service operating conditions as closely as possible. The frequencies and mode shapes shall be determined. The effects of coupling between vibrations of the equipment in all three global directions shall be considered, if significant.

(b) The dynamic model shall include sufficient number of modes so that the inclusion of additional modes does not result in more than 10 percent increase in the response.

(c) The sloshing effect of any contained liquids shall be included, if significant.

(d) The spectral acceleration per mode shall be obtained from the appropriate response spectrum, which has been provided for the appropriate damping value. In determining the spectral acceleration from the response spectrum shall be the largest value on the curve when the frequency in question is varied by ±10%.

(e) Dynamic response in terms of inertia forces, shears, moments, stresses, and deflections shall be determined for response to dynamic excitation in each of the global directions for each mode. The results of the individual modes shall be combined by the square root of the sum of the squares method except the following procedure shall be used for closely spaced modes: for two consecutive modes which have frequencies that do not differ by more than 10% or less of the lower frequency, the responses of these modes shall be combined by the sum of the absolute values method before combining with other modes by the square root of the sum of the squares method.

(f) In the particular case where there is more than one equipment frequency located within the frequency range of a widened narrow band response spectrum, the floor spectrum curve is to be applied in accordance with the criterion described below. This is based on the fact that the actual structural resonant frequency can possibly assume only one single value at one time, anywhere within the frequency range defined by $f_j \pm \Delta f_j$, but not a range of values. Consequently,

only one, and not all of these equipment modes can be in resonant response at one time, with a magnitude indicated by the peak spectral value.

The criterion is illustrated by the following example:

Let there be three equipment frequencies, $(fe)_1$, $(fe)_2$, and $(fe)_3$, that are within the frequency range of a spectral peak on the floor spectrum curve shown in Figure 7-1 (page 25). Following the reasoning previously given, this spectrum curve is not to be used directly to obtain the modal accelerations, e.g., A_1, A_2, and A_3, but is to be used according to one of the three possible ways indicated by Figures 7-1(b) to (d). The one that produces the largest total response shall be used for design.

7.1.1.4. Three Components of Dynamic Motions

The responses such as internal forces, stresses and deformations at any point from the three principal orthogonal directions of the dynamic loads shall be combined as follows:

The response value used shall be the maximum value obtained by adding the response due to vertical dynamic load with the larger value of the responses due to one of the horizontal dynamic loads by the absolute sum method.

7.1.1.5 Static Coefficient Analysis

This is an alternative method of analysis which is acceptable for verifying structural integrity of frame type structures such as members physically similar to beams and columns that can be represen-

ted by a simple model. No determination of natural frequencies is made but, rather, the response of the equipment is assumed to be the peak of the response spectrum at damping values as per Section 7.1.1.6. This response is then multiplied by a static coefficient of 1.5 to take into account the effects of both multifrequency excitation and multimode response. In this analysis, the dynamic forces on each component of the equipment are obtained by multiplying the values of the mass and the acceleration. The resulting force should be distributed over the component in a manner proportional to its mass distribution. The stress analysis may then be performed in a normal manner.

7.1.1.6 Appropriate Damping Values

Unless otherwise approved by the buyer the following damping values shall be used for the design assessment:

1) Load Combinations involving OBE but not hydrodynamic loads.	- 1/2%
2) Load Combinations involving SSE but not hydrodynamic loads.	- 1%
3) Load Combinations involving hydrodynamic loads, or seismic and hydrodynamic loads.	- 2%

The response spectra will be attached to the material requisition or the equipment specification.

If the Seller has evidence (such as test results) that the actual damping value of the equipment is different than that specified by the Buyer, the Seller may submit the evidence and request the Buyer's approval to use a different damping value.

7.1.2 Time History Analysis

This analysis shall be done by an applicable numerical integration technique. The dynamic input shall be the time history motion at the equipment support location(s). If a time history analysis is necessary, the Seller shall request the Buyer to furnish the time history at the required locations.

7.1.3 Non-Linear Analysis

If a non-linear analysis is necessary, a request for permission to perform such an analysis shall be made by the Seller to the Buyer and the procedure for the analysis shall be submitted to the Buyer for approval prior to the performance of such an analysis.

7.2 Equipment-Piping Interaction Effects

The interaction between the equipment and the attached piping can be significant under dynamic loadings.

To determine the effect of the equipment on the piping the Seller shall furnish the mathematical model(s) of the equipment as described in Section 7.1, when the fundamental frequency of the equipment is in the non-rigid range, as defined in Section 7.1.

The model shall include structural members at each piping connection of significance so that the stiffnesses of all six degrees-of-freedom at the pipe connection are described. The stiffness and mass matrices of the mathematical model shall also be included.

7.3 Nozzle Loads from Buyer Supplied Piping

In some cases piping furnished by the Buyer may attach to the equipment (for pumps, tanks, heat exchangers, etc.) furnished by the Seller. The equipment shall be designed to withstand the loads imposed upon it by the attached piping. In addition to the applicable pressure loads, the equipment shall be capable of resisting the following nozzle loads which are due to mechanical (non self-limiting) loading of the piping system, in accordance with the criteria stated in the material requisition or equipment specification:

Load Type	(1) Normal and Upset Loads (except pressure)	(2) Emergency and Faulted Loads (except pressure)
Axial Force	0.03 SA	0.06 SA
Shear Force	0.06 SA	0.09 SA
Bending Moment	0.30 SZ	0.50 SZ
Torsional Moment	0.15 SZ	0.25 SZ

where "A" and "Z" are the axial area and section modulus of the attached piping. "S" is the allowable stress value for the piping material at the operating temperature, according to table I-7.1 or I-7.2 of the ASME Boiler and Pressure Vessel Code, Section III. To account for the effects of all self-limiting loads such as the thermal expansion etc., besides the above loads the nozzle shall withstand an additional load of $\frac{T-70}{250}$ (Q) where 'T' is the temperature of the nozzle in degrees Fahrenheit and 'Q' is the respective values of Column (1) above. Unless otherwise stated in the material requisition or specification, the mechanical nozzle loads, pressure loads, and self-limiting loads are considered to occur simultaneously. The Seller shall state if he cannot meet the nozzle load requirements given in this section. Alternate methods of providing for nozzle loads must then be provided. In either case, the calculated loads which are based on the analyses of the actual piping systems will be provided to the Seller for concurrence at a later date.

8.0 TESTING

8.1 General Criteria

In lieu of performing dynamic analysis, dynamic adequacy may be established by providing dynamic test or previous dynamic environmental (performance) data which demonstrates that the equipment meets the dynamic design criteria as designed in Section 7.0 of this specification. Such data shall conform to one of the following:

1. Performance data of equipment which, under the specified conditions, has been subjected to equal or greater dynamic loads than those to be experienced under the specified dynamic conditions.

2. Test data from previously tested comparable equipment which, under similar conditions, has been subjected to equal or greater dynamic loads than those specified.

3. Actual testing of equipment in operating conditions simulating as closely as possible the actual installation, the required loadings and load combinations.

In general, horizontal and vertical components of motions shall be used in all three principal directions. Alternatively, a series of biaxial or uniaxial tests may be used to simulate simultaneous input in all three principal directions.

The minimum time duration for each condition and direction shall be 30 seconds, and, in no case, less than required to produce desired amplification. The equipment selected for testing shall be the actual purchased equipment or identical equipment unless specifically approved by Buyer prior to test. The Seller shall submit to the Buyer the test program for review prior to testing of the equipment.

8.2 Acceptable Test Methods

The continuous sinusoidal test, sine beat test, or decaying sinusoidal test superimposed on random motion, is acceptable when the applicable floor acceleration spectrum is a narrow band response spectrum. Otherwise, random motion test (or equivalent) with broad frequency content shall be used. See Section 8.5 for test acceptability.

8.3 Mounting

The equipment to be tested shall be mounted in a manner that simulates the actual service mounting. The orientations of the equipment during the test shall be documented. The method of mounting the equipment to the vibration generator shall be documented and shall include a description of any interposing fixtures. The effects of such fixtures must be evaluated if they are only used during qualification and not for in-service mounting.

8.4 Monitoring

Sufficient monitoring equipment shall be used to evaluate the performance of the equipment before, during, and after the test. In addition, enough vibration monitoring equipment shall be provided at the location which simulates the base of the equipment mount to allow determination of the magnitude, frequency and/or time history of the applied motion depending on the type of test.

8.5 Test Acceptability

With the appropriate test method selected in accordance with Section 8.2, the equipment can be qualified if the test response spectra (TRS) envelopes the required response spectra (RRS) attached with the equipment technical specification, for the appropriate damping values (see Section 7.1.1.6). The maximum acceleration of the shake table motion should be at least equal to the zero period acceleration (ZPA) of the RRS.

8.6 Device Testing

△2 A device is defined as any single piece of equipment mounted, either singly or in a group with other devices, on a larger equipment unit or support.

Devices shall be tested in an operational mode to levels at least as high as the levels dictated by service requirements. Devices may be tested either by itself on a shaking table, or as part of an assembly test.

If the device is tested by itself, the shaker table motion for the test shall be determined in one of the two following ways:

a. Direct monitoring of the device support motion in an assembly test in which the assembly support motions satisfy all of the requirements previously stated in this section 8.0.

b. Determination of the assembly transfer function for the device support location and application of this transfer to an assembly support motion which satisfies all the requirements for a test motion previously stated in this section 8.0.

8.7 Assembly Testing

An assembly is defined as two or more devices sharing a common mounting, or supporting structure.

Assemblies may be tested in an inoperative mode with actual or simulated devices installed. The dynamic properties of the devices shall be simulated with sufficient accuracy to yield the same dynamic properties for the assembly with the actual devices installed. Assembly testing shall meet all the requirements for testing stated in this Section 8.0.

8.8 Post Test Inspection

The tested item shall be thoroughly inspected for any damage sustained during testing. A detailed description of damage and repair, accompanied by illustrations, and/or replacement shall be included in the test report.

8.9 Equipment Malfunction

If the equipment fails or malfunctions or will not operate after the test, the Seller shall redesign the system and resubmit to the Buyer drawings and data for approval. A new test shall be conducted on the redesigned equipment to show compliance with the specification at no additional expense to the

Buyer. The Seller shall resubmit the test program to the Buyer for approval prior to retesting, if the testing program is altered.

2 Modifications not affecting the function may be made to the equipment during the testing process and revised drawings, justifications and other documentation resubmitted based on the final acceptable test on the modified equipment. Such modifications are subject to acceptance by the Buyer.

9.0 COMBINED ANALYSIS AND TESTING

There are several instances where the qualification of equipment by analysis alone or testing alone, may not be 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 could be most practical. The following are general approaches:

(a) An analysis could be 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 would be removed from the assembly and subjected to a simulation of the environment or a test table.

(b) Experimental methods may be used to aid in the formulation of the mathematical model for any piece of equipment. Mode shapes and frequencies may be determined experimentally and incorporated into a mathematical model of the equipment. The model and subsequent analysis shall meet all the requirements of Section 7.0

For those equipment which have already been qualified for seismic loads, the combined analysis and testing approach can be used for qualifying the equipment for combined seismic and hydrodynamic loads. In such cases, the Seller shall submit a procedure to the Buyer for approval prior to adopting such a procedure.

10.0 EVIDENCE OF COMPLIANCE

The Seller shall submit evidence that his seismic Category I equipment satisfies the requirements of this specification. The evidence of compliance is subject to approval by the Buyer prior to fabrication (or prior to shipment of standard off-the shelf items) of the equipment. The Seller shall submit the "Equipment Qualification Report Summary" shown in Appendix A with the qualification report. The evidence of compliance shall be of one of the following forms:

10.1 Analysis Qualification Report

The report for equipment qualified by analysis shall be presented in a step-by-step form which is readily auditable by persons skilled in such analysis.

a. Description
A general description of the equipment shall be given with drawings, figures and photographs as necessary. The information shall include a description of how the equipment functions during operations.

b. Design Criteria
The design criteria shall be documented, stating allowables and referencing applicable codes. The deformation limits required to keep the equipment functional shall also be stated where applicable.

c. Loading Conditions
The specific loads and load combinations used in the analysis and the design of the equipment shall be stated.

d. Mathematical Model
This section shall summarize the mathematical model, assumptions and properties. A justification shall be provided for any damping values used in the analysis that are different from those in Section 7.1.1.6. If the equipment is supported at two or more locations, a statement shall be made indicating how the effect of the differential support displacements is considered.

e. Computer Programs
A description of all computer programs used in the analysis shall be provided, together with the program capabilities, its name and source.

f. Analysis Techniques
The report shall state the techniques used to analyze the mathematical model of the equipment, and shall show calculations.

g. Analysis Results
This section of the report shall summarize the individual loadings considered and also the combined results.

The applicable design response spectra, time histories, or maximum 'g' levels shall be identified for all three major equipment directions, (two horizontal and one vertical). If modal analysis is used, mode shapes, frequencies and modal responses shall be presented.

h. Summary of the Analysis
This section shall summarize why the equipment is acceptable, based on comparison of predicted responses and allowables. The calculated deformations which may affect functionally shall be compared to values which would cause malfunction. The section shall also include a summary and a conclusion with reference to the analysis where information for the conclusions can be reviewed.

10.2 Test Qualification Report

The report for equipment qualified by testing shall be presented in a step-by-step form which is readily auditable by persons skilled in the review of such reports.

a. Description
A general description of the equipment shall be given with drawings, figures and photographs as necessary. The information shall include a description of how the equipment functions during operation.

b. Design Criteria
The design criteria shall be documented, showing allowables and referencing applicable codes. The deformation limits required to keep the equipment functional shall also be stated where applicable.

c. Loading Conditions
The specific loads and load combinations used in the qualification of the equipment shall be documented. If any of the loadings and load combinations of the equipment specification are not used, a justification shall be provided. The applicable design response spectra, time histories, or maximum 'g' levels shall be identified for all three major equipment directions, (two horizontal and one vertical).

d. Test Facility
The report shall include a description of the test facility which conducted the test and/or prepared the test report. It shall include the name and the location of the facility.

e. Equipment Mounting
The mounting of the equipment on the vibration machine shall be described. This should include photographs.

f. Equipment Location and Orientation
The equipment location and orientation relative to the forcing functions (response spectra, time histories, etc.) shall be described.

g. Classification
Non-Seismic Category I devices and parts in Seismic Category I assemblies shall be identified by the Seller.

h. Operational Settings
The operational settings (or range of settings) for adjustable type devices shall be described. Tests for different settings shall also be described.

i. Monitoring System
The report shall include a full description of the monitoring system used during the test, including the location, type, calibration, etc. of all monitoring devices (accelerometers, strain gages, etc.).

j. Test Method
The report shall include a complete description of the test method used to qualify the equipment, including excitation durations, vibrational amplitudes, etc., as specified in Section 8.0

k. Test Data
The test data shall include calibration histories of the test equipment, photographs of the equipment during testing, test response spectra and other relevant data from the test.

l. Results and Conclusions
The results and conclusions from the test shall be briefly summarized. The results shall be compared with performance requirements for the equipment.

10.3 Combined Analysis/Test Report

The report for combined analysis/test qualifcation of equipment shall meet all of the applicable requirements of Sections 10.1 and 10.2. The report shall be presented in a step-by-step form which is readily auditable by persons skilled in the review of such reports.

11.0 CERTIFICATION OF COMPLIANCE

All test data, design calculations, data, and certifications submitted shall be signed and approved for compliance to the specification under the seal of the registered professional engineer in the State of Pennsylvania or the state in which the equipment was manufactured prior to final acceptance.

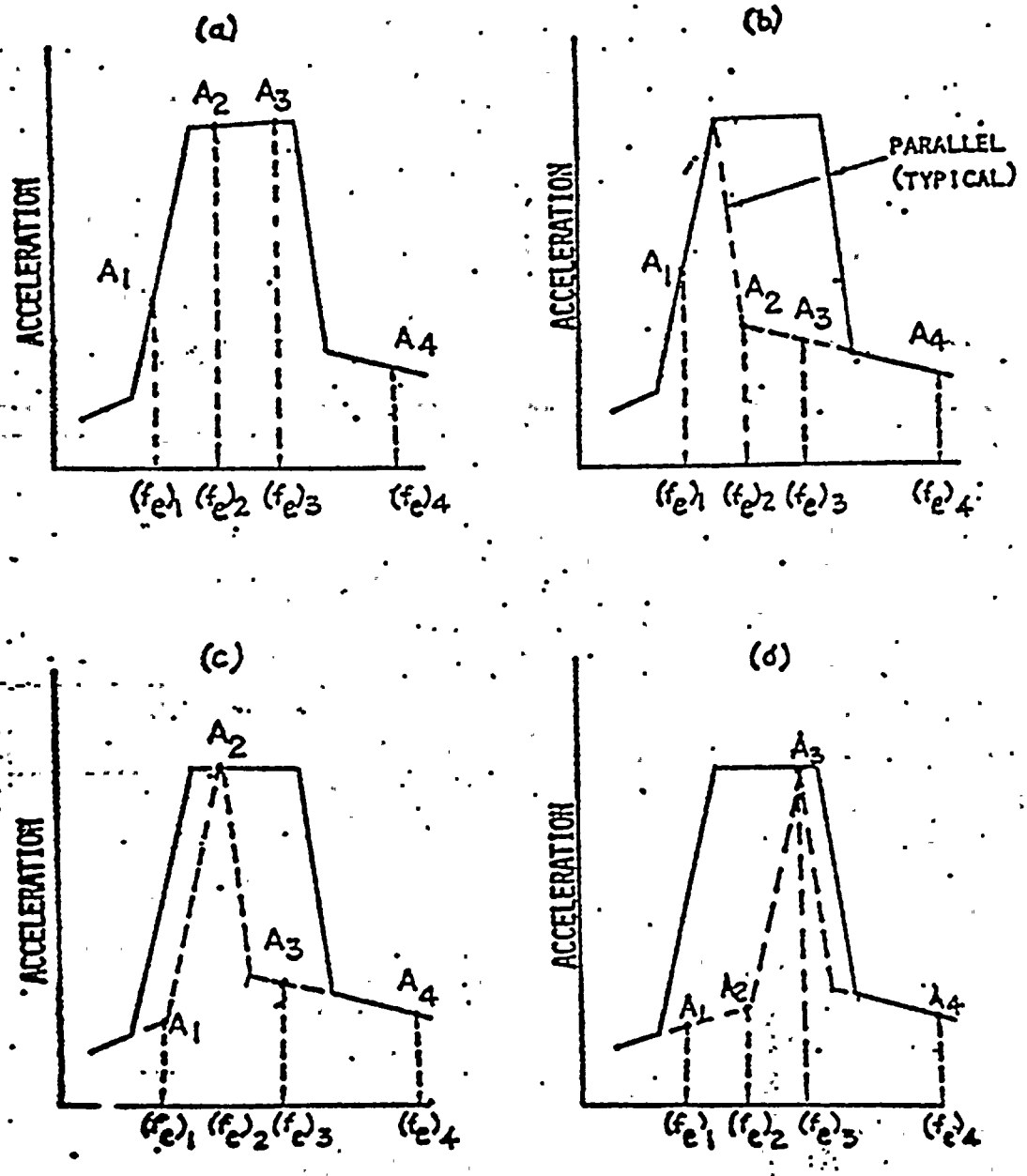

Figure 7-1 Diagrams Illustrating the Use of Floor Spectrum Curve When More Than One Equipment Frequency is Within the Widened Spectral Peak.

APPENDIX - A

EQUIPMENT QUALIFICATION REPORT SUMMARY

EQUIPMENT QUALIFICATION REPORT SUMMARY

No.	Item	Reference Pg/Sht No*
1.	Report No._____, Rev._____, Dated_____	
2.	Equipment name_____ Tag No._____	
3.	Equipment Specification No._____, Rev._____, Seismic Category_____	
4.	Certification and signature of an authorized person that the equipment is qualified to the required levels.	
5.	Seismic qualification specification used_____	
6.	Spectrum curve used (Figure No.):_____	
7.	Origin of dimensions, loads and material properties (dwgs., specs., codes, etc. as applicable).	
8.	Equipment is stock item____or specially designed item____	
9.	Equipment is qualified by analysis _____, testing_____ or combination_____.	
10.	Equipment is mechanical_____, electrical_____, instrumentation_____, other (specify)_____.	
11.	Equipment is a motor_____, pump_____, fan_____, panel_____, switchhear_____, instrument_____, other (specify)_____.	
12.	Schematic sketch of the complete unit.	
13.	Description of method of operation and control of equipment.	
14.	Criteria for behavior during a dynamic event including operating and dynamic load combination.	
15.	Equipment is located in the_____ Building at elevation_____, and is attached to the floor_____, wall_____, ceiling_____, other (specify)_____.	
16.	Description of the analytical approach (such as mathematical model rigid or flexible system, single or multidegree of freedom system, etc.)	
17.	Summary table of equipment frequencies as determined by anlysis or experimentally (by scanning) and as used to qualify the equipment.	

Equipment Qualification Report Summary (cont'd)

18. Damping factors used in the analysis.

19. Justification for use of damping factors other than those permitted by the specification.

20. Description and verification of computer programs used.

21. Description of the testing approach (such as biaxial, triaxial testing, simulated plant operation, testing frequency range, frequency interval, type of frequency wave from inputs, etc.).

22. Name and location of testing facility.

23. Method of monitoring and locations of monitors during testing of equipment.

24. Functioning of equipment during and after testing.

25. Test levels of component locations shown to equal or exceed specified test response spectra.

26. Codes, standards and specifications and the extent of their compliance when qualifying equipment by testing.

27. Effects of equipment mounting assumed in analysis or used during testing as compared to actual mounting.

28. Summary table showing computed stresses and deflections for operating, seismic and combined seismic and hydrodynamic conditions for equipment components and anchorage components, compared with allowable stresses and deflections.

29. Reactions at equipment supports.

30. Material designation (ASTM, etc.) for equipment components considered in analysis.

*(Refer to report page or sheet number in this column. If not applicable, specify "N.A.")

PP&L

LOAD COMBINATIONS:

These were transmitted to the NRC on 8/28/80 as Page 3 of Attachment N to PLA-536. This was in response to NRC Question 110.42, and the entire response will be telecopied to Arnold Lee.

IMPLEMENTATION OF LOAD COMBINATIONS:

The GE SQRT Program uses outputs from the GE Equipment Adequacy Evaluation Program which combines dynamic loads by SRSS as accepted by the NRC in NUREG-0484.

The individual items associated with the load combinations are added as described below:

Steady State Events (e.g., Dead Load, Pressure) - Absolute Sum

Time Varying Components (e.g., Maximum Seismic, Maximum Hydrodynamic) - SRSS

Components of Events (e.g., Maximum X-Load Due to Y-Earthquake) - SRSS

Modal Response-SRSS, except for closely spaced modes where effects are combined by Absolute Sum, Double Sum, or Grouping.

Details for each item of equipment are contained in that equipment's Design Record File which is available for audit.

FJL/kes
3/4/81