NUREG/CR-1429

Seismic Review Table

Prepared by M. Subudhi, M. Reich, B. Koplik, J. Lane

Department of Nuclear Energy
Brookhaven National Laboratory

Prepared for
U. S. Nuclear Regulatory Commission

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Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
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ABSTRACT

The Seismic Review Table is a summary of Engineering Design parameters that were employed in the seismic analysis and design of nuclear power plants. The table covers 71 reactors licensed to operate by the U.S.N.R.C. The information contained is listed plant by plant and consists of OBE and SSE "g" Level and Modified Mercalli Intensity; Earthquake Time History used to develop the ground response spectra or as input in the dynamic analysis; Number of Earthquake Components used and Method of Combining Them; Method of Modal Combination; Type of Ground Design Spectra; Method of Generation of Floor Response Spectra; Type of Foundation and Depth; Type, Thickness, Shear Wave Velocity and Shear Modulus Profile of the Surrounding Subgrade Soil and Bedrock; Ground Water Table Depth; nearby Dams; Modelling Method used for soil-structure interaction; Material Damping of Soil; Limitation on Modal Damping . Damping Values; and Loading Combinations, and Acceptance Criteria for Category I Structures, Mechanical Equipment, Piping, and Electrical systems. The goal of the Seismic Review Table is to provide a reference of the available information relevant to the seismic design of currently licensed nuclear power plants.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

The authors wish to acknowledge their indebtedness and gratitude to various people consulted during the preparation of the Seismic Review Tables. Particular thanks are due to our Department Librarians, Mrs. Helen Todosow and Mrs. Catherine Green for their help in gathering and obtaining the various FSAR's, amendments, etc. and to Dr. C. P. Tan of the Structural Engineering Branch, NRC, for the Containment Vessel data shown in Table I of this report. Grateful acknowledgement is also due to Larry Shao, Acting Assistant Director of Engineering Programs, Division of Operating Reactors and Assistant Director for General Reactor Safety Research, NRC, and Dr. P. T. Kuo, Section Leader, Seismic Review Group, NRC, for their constructive criticism and advice regarding the contents of the review tables. Finally to Miss Joan Murray who with patience typed and retyped the corrected drafts, our sincerest gratitude is due.

INTRODUCTION

The intent of this report is to enable a quick reference of the major seismic design parameters inherent in the 71 currently licensed nuclear power plants. All of the presented data was obtained from the existing Final Safety Analysis Reports (FSAR) and their associated amendments. The results are tabulated for each plant in a five page "Seismic Review Table." The major headings in the table are:

A) Earthquake data

B) Method of combination (e.g., modes and earthquakes directional components

C) Design spectra

D) Foundation and liquefaction assessment

E) Soil-structure interaction

F) Damping, load combination and acceptance criteria and allowable stresses for:

   1) Category I structures

   2) Mechanical Equipment and piping

   3) Electrical equipment

Table I lists all of the plants together with the names of the owners, the location, the principal reactor contractor, the plant architectural engineers, the type of plant (PWR, BWR, HTGR), the type of containment vessel, and the electrical and thermal power output. FSAR's for all the plants listed in the table have been reviewed and the tabulated results are given in this report. For completeness Figure 1 depicting the geographical locations of the operational plants is also included.

PROGRAM TASKS AND ACCOMPLISHMENTS

Efforts under this program can be subdivided into three distinct stages: Stage 1 involved the determination and collection of all available plant FSAR's and related questions, answers, and amendments. Next, under Stage 2, the collected information was reviewed in detail for relevance to the information needed for the Seismic Review Table. Finally, under Stage 3, the pertinent parameters were assembled and summarized in tabular form.

With reference to the work carried out under Stage 1, it should be realized that the documented information contains numerous sections, subsections, and amendments per plant which were compiled over a span of many years. This information had to be reviewed to ascertain which documents were available and which had to be ordered. This was accomplished by carrying out a careful review of the documents and comparing the information contained within the documents against the information compiled in the following reference reports:

Title Listing of Civilian Power Reactor Docket Literature in Nuclear Science Abstracts, volumes 21-26 (1967-1972), TID-3354 R1. U.S. Atomic Energy Commission, Technical Information Center, April 1973.

Title Listing of Civilian Power Reactor Docket Literature in Nuclear Science Abstracts, volumes 27 (Jan.-June 1973), TID-3324-R1-S1. U.S. Atomic Energy Commission, Technical Information Center, September 1973.

Title Listing of Power Reactor Docket Information, PRDI-74-12. U.S. Atomic Energy Commission, Technical Information Center, December 1974.

Power Reactor Docket Information, Annual Cumulation, NUREG/PRDI-75/12. U.S. Energy Research and Development Administration, Technical Information Center, December 1975.

Power Reactor Docket Information, Annual Cumulation, NUREG/PRDI-76/12/P1. U.S. Energy Research and Development Administration, Technical Information Center, December 1976.

Power Reactor Docket Information, Annual Cumulation, NUREG/PRDI-77/12/P1. U.S. Dept. of Energy, Technical Information Center, December 1977.

Power Reactor Docket Information, Annual Cumulation, NUREG/PRDI-78/12/P1. U.S. Dept. of Energy, Technical Information Center, December 1978.

Since there was no specific standardized FSAR format until 1975-76, each FSAR had to be examined on an individual basis. In a number of cases the FSAR was actually defined as an amendment to the PSAR. Once it was determined what information was missing and what part of the missing information involved seismic design criteria, the necessary steps were taken to obtain the required documents.

Once the material needed for the review was compiled, Stage 2 efforts were initiated. For each plant assembled FSAR's were first reviewed for the pertinent seismic information. These were available either in "hard cover" or in "microfiche" form. Next, the amendments which include various questions and answers about the plant raised over a period of many years were reviewed and the gathered information was then compiled and referenced for section and page number.

Under Stage 3, the compiled reference material of Stage 2 was prepared and extracted for insertion into the Seismic Review Tables. The information given in the table thus reflects the data up to an including the latest amendments available at time of publication. The tables are numbered according to the numbering scheme shown in the first column of Table I. For each number, a set of five pages comprising the Seismic Review Table is presented with the page number appearing in the lower right hand corner in sequence. As an example, page 8-2 would indicate the eighth entry on Table I, with the number 2 representing the second page of the five-page review table.

Referring to the Seismic Review Tables, the first item assembled is on page 1 of the five-page table. The name of the plant with reactor unit numbers (if more than one), the type of reactors, and containment, Nuclear Steam System Supplier (NSSS), the architect engineer, and the CP/OL issue dates. Next, under the heading of earthquake data, information pertaining to OBE, SSE, and earthquake time-history was assembled. The OBE and SSE information was further broken down into horizontal and vertical "g" values and Modified Mercalli Intensity values. Reference pages, sections, and amendment numbers are listed in the tables for all assembled information. Under the time history column, names of the earthquake records used are given. These records in turn are used either for the development of the ground design spectra or are modified so that their response spectra envelopes the specified ground design spectra. Generally speaking, this information was available for most of the plants. However, some of the early plants, such as Yankee Rowe, did not have this information in the reviewed dockets, and thus the term "not available" is written in the table. For those cases where the available information was unclear, the term "unclear information" appears in the table, together with the pertinent page numbers where the unclear information is given so that the reader can look up the information for further insight.

Returning to headings OBE and SSE, in many plants the vertical components were equal to two-thirds of the horizontal, with OBE values typically one-half of the SSE. For the earthquake time-history, the older plants usually used El Centro or Taft, while the newer plants used synthetic time-histories.

Methods of combinations were assembled under the subheadings "Number of Earthquake Components Used and Its Combination" and "Modal Combination." The information under these headings includes such items as the the number of horizontal and vertical components used for the analysis, the number of modes considered, and how they were combined, e.g., absolute sum, SRSS, or algebraic sum. It is to be noted that the term "modal combination used" in the table refers to the response spectrum analysis.

The final item on page 1 involves the design spectra with the two subheadings entitled "Type of Ground Design Spectra" and "Method of Generation of Floor Response Spectra." Ground design spectra includes the Housner, Newmark, and Regulatory Guide 1.60 response spectra or any other method specified in the FSAR's. The most commonly used method for generating the floor response spectra was the time-history method. When information regarding the input time-history was available, it was also included under this heading. For some of the older plants, the ground design spectra was directly used with some amplification factor.

Turning to page 2 of 5 of the table, the major headings are "Foundation and Liquefaction Assessment" and "Soil-Structure Interaction." The first item contains four subtopics: "Type of Foundation," "Bearing Information" (including information related to the type, thickness, and shear velocity profile), "Groundwater Table," and "Dams." Foundation description and bedrock characteristics are listed for the containment building. Information regarding structures on pile foundations is also given under this heading. Bearing Information lists such items as type of rock (dolomite, glacial fill, sandstone, etc.), the thickness of the various soil deposits, and shear wave velocities. Groundwater Table information and the existence of nearby dam locations were obtained from the site geological survey.

"Soil Structure Interaction" consists of four subtopics. "Method of Modelling" lists the mathematical model chosen for generating the floor response spectra of the reactor building and the soil beneath it. Usually the structure is modeled as a conventional stick model while the soil is represented as either a lumped spring or finite element model. It is to be noted that a number of plants have their foundation on bedrock. When reviewing the soil structure interaction modelling method, it was found that for some plants a fixed base method was employed. For these cases, the notation fixed base method appears. For cases where no statement was found as to the type of modelling used, the term "not available" was entered in the table. The term "not available" should only be interpreted as a statement of fact with reference to the material presented in the FSAR; it only means that no information about the particular item was found. Other subtopics include the "Soil Shear Strength Modulus Profile," "Material Damping of Soil," and the "Limitation on Modal Damping."

Pages 3, 4, and 5 of the Seismic Review Table are devoted respectively to Category I--structure, mechanical, piping and electrical equipment. Each of these pages have common headings that include "Damping Values" (OBE/SSE) and "Design Criteria," with the latter heading containing subheadings for load combination and acceptance criteria/allowable stresses. "Method of Qualification" (testing or analytical) was included for the mechanical equipment, piping and electrical equipment given on pages 4 and 5. Generally, very little information was available for electrical equipment.

The information listed for the 11 SEP plants (Big Rock Point, Dresden 1 and 2, Ginna, Haddam Neck, LaCrosse, Millstone 1, Oyster Creek, Palisades, San Onofre 1, and Yankee Rowe) was partly obtained through the use of unpublished docket search reports supplied to us by the Systematic Evaluation Program Branch, DOR. This information supplements what was obtained by Brookhaven staff members in their docket search.

In conclusion, this report contains much information covering a wide range of seismic topics. It is possible that some relevant information has been inadvertently overlooked. The Structural Engineering Branch of the Division of Engineering has the responsibility for maintaining these tables and would appreciate any contribution from interested parties as to additions or modifications which might be made to improve it.

The information contained here comprises a data base which will be used to evaluate conformance of the operating reactors with current seismic design guidelines.

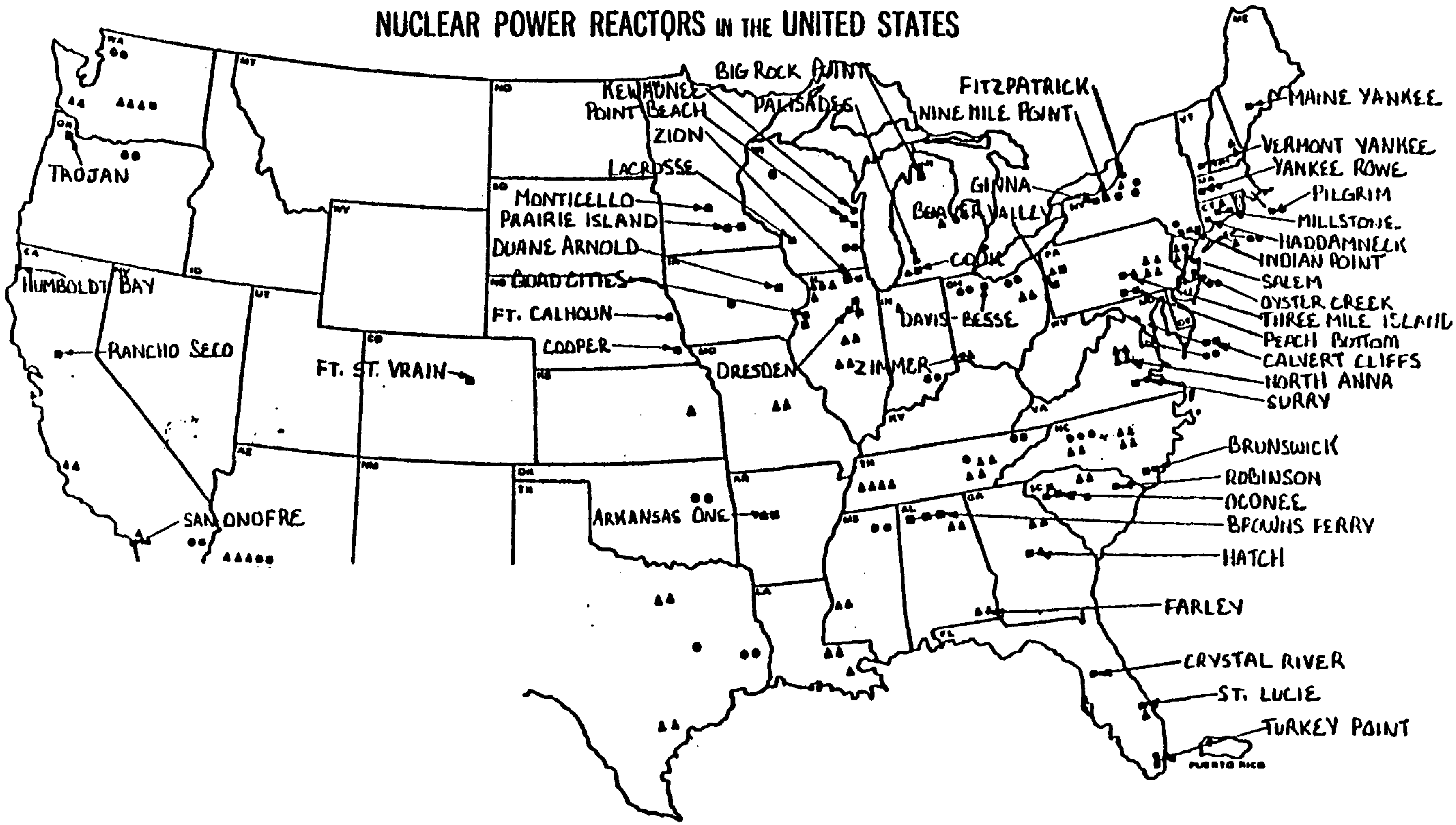
NUCLEAR POWER REACTORS IN THE UNITED STATES
TROJAN
HUMBOLDT BAY
RANCHO SECO
SAN ONOFRE
FT. ST. VRAIN
KEWAUNEE
POINT BEACH
ZION
LACROSSE
MONTICELLO
PRAIRIE ISLAND
DUANE ARNOLD
QUAD CITIES
FT. CALHOUN
COOPER
ARKANSAS ONE
DRESDEN
ZIMMER
BIG ROCK POINT
PALISADES
BEAVER VALLEY
COOK
DAVIS-BESSE
GINNA
NINE MILE POINT
FITZPATRICK
MAINE YANKEE
VERMONT YANKEE
YANKEE ROWE
PILGRIM
MILLSTONE
HADDAMNECK
INDIAN POINT
SALEM
OYSTER CREEK
THREE MILE ISLAND
PEACH BOTTOM
CALVERT CLIFFS
NORTH ANNA
SURRY
BRUNSWICK
ROBINSON
OCONEE
BROWNS FERRY
HATCH
FARLEY
CRYSTAL RIVER
ST. LUCIE
TURKEY POINT
PUERTO RICO

FIGURE 1

CONTENTS

Seismic Review Table No.	Name and/or owner	Location	NSSS Manufacturer **	Architect Engineer **	Reactor Type	Containment Type *	Power Unit Size Net MW(e)	Power Reactor MW (t)
1-1	Arkansas Nuclear One, Unit 1 (Arkansas Power & Light Co.)	Russellville, Ark.	B&W	Bechtel	PWR	(11)	850	2,568
2-1	Arkansas Nuclear One, Unit 2 (Arkansas Power & Light Co.)	Russellville, Ark.	Comb.	Bechtel	PWR	(11)	912	2,815
3-1	Beaver Valley Power Station, Unit 1 (Duquesne Light Co., Ohio Edison Co., and Pennsylvaina Power Co.)	Shippingport, Pa.	West.	S&W	PWR	(7)	852	2,652
4-1	Big Rock Point Plant Nuclear (Consumer Power Co.)	Big Rock Point, Mich.	GE	Bechtel	BWR	(1)	72	240
5-1	Browns Ferry Nuclear Power Station, Unit 1 (Tennessee Valley Authority)	Decatur, Ala.	GE	TVA	BWR	(2)	1,065	3,293
[illegible]-1	Browns Ferry Nuclear Power Station, Unit 2 (Tennessee Valley Authority)	Decatur, Ala.	GE	TVA	BWR	(2)	1,065	3,293
[illegible]-1	Browns Ferry Nuclear Power Station, Unit 3 (Tennessee Valley Authority)	Decatur, Ala.	GE	TVA	BWR	(2)	1,065	3,293
6-1	Brunswick Steam Electric Plant, Unit 1 (Carolina Power & Light Co.)	Southport, N.C.	GE	UE&C	BWR	(5)	821	2,436
6-1	Brunswick Steam Electric Plant, Unit 2 (Carolina Power & Light Co.)	Southport N.C.	GE	UE&C	BWR	(5)	821	2,436
7-1	Calvert Cliffs Nuclear Power Plant, Unit 1 (Baltimore Gas & Electric Co.)	Lusby, Md.	Comb.	Bechtel	PWR	(10)	845	2,700
7-1	Calvert Cliffs Nuclear Power Plant, Unit 2 (Baltimore Gas & Electric Co.)	Lusby, Md.	Comb.	Bechtel	PWR	(10)	845	2,700
8-1	Cooper Nuclear Station (Nebraska Public Power District and Iowa Power and Light Co.)	Brownville, Nebr.	GE	B&R	BWR	(2)	778	2,381
9-1	Crystal River Nuclear Plant, Unit 3 (Florida Power Corp`)	Red Level, Fla.	B&W	Gilbert	PWR	(10)	825	2,452

TABLE I: CURRENTLY LICENSED REACTORS IN UNITED STATES

Seismic Review Table No.	Name and/or owner	Location	NSSS Manufac-turer **	Architect Engineer **	Reac-tor Type	Containment Type *	Power Unit Size Net MW(e)	Power Reactor MW (t)
10-1	Davis-Besse Nuclear Power Station, Unit 1 Cleveland Electric Illuminating Co.)	Oak Harbor, Ohio	B&W	Bechtel	PWR	(4)	906	2,772
11-1	Donald C. Cook Nuclear Power Plant, Unit 1 (Indiana and Michigan Electric Co.)	Bridgman, Mich.	West.	AEP	PWR	(6)	1,054	3,250
11-1	Donald C. Cook Nuclear Power Plant, Unit 2 (Indiana and Michigan Electric Co.)	Bridgman, Mich.	West.	AEP	PWR	(6)	1,100	3,391
12-1	Dresden Nuclear Power Station, Unit 1 (Commonwealth Edison Co.)	Morris, Ill.	GE	Bechtel	BWR	(1)	200	700
13-1	Dresden Nuclear Power Station, Unit 2 (Commonwealth Edison Co.)	Morris, Ill.	GE	S&L	BWR	(2)	794	2,527
13-1	Dresden Nuclear Power Station, Unit 3 (Commonwealth Edison Co.)	Morris, Ill.	GE	S&L	BWR	(2)	794	2,527
14-1	Duane Arnold Energy Center, Unit 1 (Iowa Electric Light & Power Co., Central Iowa Power Cooperative, and Corn Belt Power Cooperative)	Palo, Iowa	GE	Bechtel	BWR	(2)	538	1,593
15-1	Edwin I. Hatch Nuclear Plant, Unit 1 (Georgia Power Co.)	Baxley, Ga.	GE	Bechtel	BWR	(2)	786	2,436
16-1	Edwin I. Hatch Nuclear Plant, Unit 2 (Georgia Power Co.)	Baxley, Ga.	GE	Bechtel	BWR	(2)	795	2,436
17-1	Fort Calhoun Station, Unit 1 (Omaha Public Power District)	Fort Calhoun, Nebr.	Comb.	G&H	PWR	(9)	457	1,420
18-1	Fort St. Vrain Nuclear Generating Station (Public Service Co. of Colorado)	Platteville, Colo.	GA	S&L	HTGR	(9)	330	842
19-1	Haddam Neck Plant (Connecticut Yankee Atomic Power Co.)	Haddam Neck, Conn.	West.	S&W	PWR	(8)	575	1,825
20-1	H. B. Robinson Plant, Unit 2 (Carolina Power & Light Co.)	Hartsville, S. C.	West.	Ebasco	PWR	(9)	700	2,200

CURRENTLY LICENSED REACTORS IN UNITED STATES (continued)

Seismic Review Table No.	Name and/or owner	Location	NSSS Manufacturer **	Architect Engineer **	Reactor Type	Containment Type *	Power Unit Size Net MW(e)	Power Reactor MW (t)
21 -1	Humboldt Bay Power Plant, Unit 3 (Pacific Gas & Electric Co.	Eureka, Calif.	GE	Bechtel	BWR	(1)	63	242
22 -1	Indian Point Station, Unit 1 (Consolidated Edison Co. of New York, Inc.)	Buchanan, N.Y.	B&W	UE&C	PWR	(3)	265	615
23 -1	Indian Point Station, Unit 2 (Consolidated Edison Co. of New York, Inc.)	Buchanan, N.Y.	West.	UE&C	PWR	(8)	873	2,758
24 -1	Indian Point Station, Unit 3 (Power Authority of New York)	Buchanan, N.Y.	West.	UE&C	PWR	(8)	965	2,760
25 -1	James A. FitzPatrick Nuclear Power Plant (Power Authority of the State of New York)	Scriba, N.Y.	GE	S&W	BWR	(2)	821	2,436
26 -1	Joseph M. Farley Nuclear Plant, Unit 1,2 (Alabama Power Co.)	Dothan, Ala.	West.	Bechtel	PWR	(11)	821	2,652
27 -1	Kewaunee Nuclear Power (Wisconsin Power & Light Co., Wisconsin Public Service Co. and Madison Gas & Electric Co.)	Carlton, Wis.	West.	Pioneer	PWR	(4)	535	1,650
28 -1	La Crosse (Genoa) Nuclear Generating Station (Dairyland Power Cooperative)	La Crosse, Wis.	AC	S&L	BWR	(1)	50	165
29 -1	Maine Yankee Atomic Power Plant (Maine Yankee Atomic Power Co.)	Wiscasset, Maine	Comb.	S&W	PWR	(7)	790	2,500
30 -1	Millstone Nuclear Power Station, Unit 1 (Northeast Nuclear Energy Co.)	Waterford, Conn.	GE	Ebasco	BWR	(2)	660	2,011
31 -1	Millstone Nuclear Power Station, Unit 2 (Northeast Nuclear Energy Co.)	Waterford, Conn.	Comb.	Bechtel	PWR	(11)	830	2,560
32 -1	Monticello Nuclear Generating Plant (Northern States Power Co.)	Monticello, Minn.	GE	Bechtel	BWR	(2)	545	1,670
33 -1	Nine Mile Point Nuclear Station, Unit 1 (Niagara Mohawk Power Corp.)	Scriba, N.Y.	GE	S&W	BWR	(2)	610	1,850

CURRENTLY LICENSED REACTORS IN UNITED STATES (continued)

Seismic Review Table No.	Name and/or owner	Location	NSSS Manufacturer **	Architect Engineer **	Reactor Type	Containment Type *	Power Unit Size Net MW(e)	Power Reactor MW (t)
34-1	North Anna Power Station, Unit 1 (Virginia Electric & Power Co.)	Mineral, Va.	West.	S&W	PWR	(7)	907	2,775
35-1	Oconee Nuclear Station, Unit 1 (Duke Power Co.)	Seneca, S. C.	B&W	Utility & Bechtel	PWR	(10)	887	2,568
35-1	Oconee Nuclear Station, Unit 2 (Duke Power Co.)	Seneca, S. C.	B&W	Utility & Bechtel	PWR	(10)	887	2,568
35-1	Oconee Nuclear Station, Unit 3 (Duke Power Co.)	Seneca, S. C.	B&W	Utility & Bechtel	PWR	(10)	887	2,568
36-1	Oyster Creek Nuclear Power Plant, Unit 1 (Jersey Central Power & Light Co.)	Toms River, N.J.	GE	B&R	BWR	(2)	650	1,930
37-1	Palisades Nuclear Plant, Unit 1 (Consumers Power Co. of Michigan)	South Haven, Mich.	Comb.	Bechtel	PWR	(10)	805	2,530
38-1	Peach Bottom Atomic Power Station, Unit 2 (Philadelphia Electric Co., Public Service Electric & Gas Co., Atlantic City Electric Co., and Delmarva Power & Light Co.)	Peach Bottom, Pa.	GE	Bechtel	BWR	(2)	1,065	3,293
38-1	Peach Bottom Atomic Power Station, Unit 3 (Philadelphia Electric Co., Public Service Electric & Gas Co., Atlantic City Electric Co., and Delmarva Power & Light Co.)	Peach Bottom, Pa.	GE	Bechtel	BWR	(2)	1,065	3,293
39-1	Pilgrim Nuclear Power Station, Unit 1 (Boston Edison Co.)	Plymouth, Mass.	GE	Bechtel	BWR	(7)	655	1,998
40-1	Point Beach Nuclear Plant, Unit 1 (Wisconsin Electric Power Co. and Wisconsin Michigan Power Co.)	Two Creeks, Wis.	West.	Bechtel	PWR	(10)	497	1,518
40-1	Point Beach Nuclear Plant, Unit 2 (Wisconsin Electric Power Co. and Wisconsin Michigan Power Co.)	Two Creeks, Wis	West.	Bechtel	PWR	(10)	497	1,518

CURRENTLY LICENSED REACTORS IN UNITED STATES (continued)

Seismic Review Table No.	Name and/or owner	Location	NSSS Manufacturer **	Architect Engineer **	Reactor Type	Containment Type *	Power Unit Size Net MW(e)	Power Reactor MW (t)
41-1	Prairie Island Nuclear Generating Plant, Unit 1 (Northern States Power Co.)	Red Wing, Minn.	West.	Pioneer	PWR	(4)	530	1,650
41-1	Prairie Island Nuclear Generating Plant, Unit 2 (Northern States Power Co.)	Red Wing, Minn.	West.	Pioneer	PWR	(4)	530	1,650
42-1	Quad-Cities Station, Unit 1 (Commonwealth Edison Co. and Iowa-Illinois Gas & Electric Co.)	Cordova, Ill.	GE	S&L	BWR	(2)	789	2,511
42-1	Quad-Cities Station, Unit 2 (Commonwealth Edison Co. and Iowa -Illinois Gas & Electric Co.)	Cordova, Ill.	GE	S&L	BWR	(2)	789	2,511
43-1	Rancho Seco Nuclear Generating Station, Unit 1 (Sacramento Municipal Utility District)	Clay Station, Calif.	B&W	Bechtel	PWR	(11)	918	2,772
44-1	Robert Emmett Ginna Nuclear Power Plant, Unit 1 (Rochester Gas & Electric Co.)	Ontario, N.Y.	West.	Gilbert	PWR	(9)	490	1,520
45-1	Salem Nuclear Generating Station,Unit 1,2 (Public Service Electric & Gas Co., Philadelphia Electric Co., Atlantic City Electric Co., and Delmarva Power & Light Co.)	Salem, N.J.	West.	UE&C	PWR	(8)	1,090	3,338
46-1	San Onofre Nuclear Generating Station, Unit 1 (Southern California Edison and San Diego Gas & Electric Co.)	San Clemente, Calif.	West.	Bechtel	PWR	(3)	436	1,347
47-1	Shippingport Atomic Power Station (DOE and Duquesne Light Co.)	Shippingport, Pa.	West.	B&R,S&W	PWR	(3)	60	236
48-1	St. Lucie Plant, Unit 1 (Florida Power & Light Co.	Fort Pierce, Fla.	Comb.	Ebasco	PWR	(4)	802	2,560
49-1	Surry Power Station, Unit 1 (Virginia Electric & Power Co.)	Gravel Neck, Va.	West.	S&W	PWR	(7)	822	2,441

CURRENTLY LICENSED REACTORS IN UNITED STATES (continued)

Seismic Review Table No.	Name and/or owner	Location	NSSS Manufacturer **	Architect Engineer **	Reactor Type	Containment Type *	Power Unit Size Net MW(e)	Power Reactor MW (t)
49 -1	Surry Power Station, Unit 2 (Virginia Electric & Power Co.)	Gravel Neck, Va.	West.	S&W	PWR	(7)	822	2,441
50 -1	Three Mile Island Nuclear Station, Unit 1 (Metropolitan Edison Co.)	Middletown, Pa.	B&W	Gilbert	PWR	(10)	819	2,535
51 -1	Three Mile Island Nuclear Station, Unit 2 (Metropolitan Edison Co.)	Middletown, Pa.	B&W	B&R	PWR	(10)	906	2,772
52 -1	Trojan Nuclear Plant, Unit 1 (Portland General Electric Co., Eugene Water & Electric Board, and Pacific Power & Light Co.)	Prescott, Oreg.	West.	Bechtel	PWR	(12)	1,130	3,411
53-1	Turkey Point Plant, Unit 3 (Florida Power & Power Co.)	Florida City, Fla.	West.	Bechtel	PWR	(10)	693	2,200
53 -1	Turkey Point Plant, Unit 4 (Florida Power & Power Co.)	Florida City, Fla.	West.	Bechtel	PWR	(10)	693	2,200
54 -1	Vermont Yankee Nuclear Power Station (Vermont Yankee Nuclear Power Corp.)	Vernon, Vt.	GE	Ebasco	BWR	(2)	514	1,593
55 -1	Yankee-Rowe Nuclear Power Station (Yankee Atomic Electric Co.)	Rowe, Mass.	West.	S&W	PWR	(3)	175	600
56 -1	Zion Nuclear Plant, Unit 1 (Commonwealth Edison Co.)	Zion, Ill.	West.	S&L	PWR	(10)	1,040	3,250
56 -1	Zion Nuclear Plant, Unit 2 (Commonwealth Edison Co.)	Zion, Ill.	West.	S&L	PWR	(10)	1,040	3,250

* Containment types:
(1) Pre-Mark (Steel)
(2) Mark I (Steel)
(3) Dry Containment-Spherical (Steel)
(4) Dry Containment-Cylindrical (Steel)
(5) Mark I (Reinforced Concrete)
(6) Ice Condenser (Reinforced Concrete)
(7) Sub-Atmospheric (Reinforced Concrete)
(8) Atmospheric (Reinforced Concrete)
(9) Without Buttresses (Pre-Stressed Concrete)
(10) 6 Buttresses With Shallow Dome (Pre-Stressed Concrete)
(11) 3 Buttresses With Shallow Dome (Pre-Stressed Concrete)
(12) 3 Buttresses With Hemispherical Dome (Pre-Stressed Concrete)

** Manufacturers and Engineers
AC = Allis-Chalmer Mfg. Co.
AEP = American Electric Power Service Corp.
B&R = Burns & Roe, Inc.
B&W = Babcock & Wilcox Co.
Comb. = Combustion Eng., Inc.
GA = General Atomic
GE = General Electric Co.
G&H = Gibbs & Hills, Inc.
S&W = Stone & Webster Eng. Corp.
S&L = Sargent & Lundy Engineers
TVA = Tennesse Valley Authority
UE&C = United Engineers & Constructors
West. = Westinghouse Electric Corp.

CURRENTLY LICENSED REACTORS IN UNITED STATES (continued)

SEISMIC REVIEW TABLE

Docket Number
50-313

NAME AND NSSS TYPE OF THE PLANT	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
CP/OL ISSUE DATE	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
ARKANSAS NUCLEAR UNIT No. 1 Reactor type: PWR Containment type: 3 buttresses with shallow dome (prestressed concrete) NSSS Manufacturer: Babcock & Wilcox Arcitect Engineer: Bechtel	0.10	0.067	VII	0.20	0.133	A synthetic time history is generated so that its response spectra envelops the ground design spectrum.	Three components: 2 horizontal & 1 vertical. Each horizontal was combined with the vertical, assuming simultaneous occurrences.	SRSS (No closely spaced modes).	Housner	Time-history method Vertical ground response spectrum was used for equipment design (no vertical floor response spectra generated).
12-68/5-74	Sec. 5.1.1.2.5 p. 5-28a		p. 2-19	Sec. 5.1.1.2.5 p. 5-28a		p. 5.A-6 Amend. 28	Sec. 5.A.4.1 p.5.A-5 Amend. 28	Sec. 5.A.4.2 p. 5.A-7	Sec. 5.A 4.1 p. 5.A-5 Figs. 5.A-1 and 5.A-2	Sec. 5.A 4.2 p. 5.A-6 p. 5-28c Amend. 23

8/18/72

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Flat Slab 9 feet "All Class I structures utilize the shale bedrock as a foundation"	Bedrock which consists of Pennsylvanian McAlester formation shale.	13 ft to 24 ft.	Properties of shale, 10,000 to 14,500 fps.	Most wells drilled into bedrock are less than 150 ft.	Not available.	Stick model with soil springs, as indicated in Fig. 5A-3 Fig. 5A-4 Fig. 5A-5	Not available	Unclear information	Not available
Sec. 5.1.1.1 p. 5.1 Sec. 2.7.2 ~~p. 2-16~~	p. 2-24	p. 2-16	Table 2-5 p. 2-28	Sec. 2.5.3 p. 2-7a				Sec. 5.1.1.5.6 p. 2-28a	

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE		**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
	(% critical damping)	Y = 1/ϕ (1.25 D + 1.0 R + 1.25 E)	ACI-318-63 Code
Welded steel plate assemblies	1.0/1.0	Y = 1/ϕ (1.25 D + 1.25 H + 1.25 E) Y = 1/ϕ (1.25 D + 1.25 H + 1.25 W)	AWS D12.1-61
Welded steel framed structures	2.0/2.0	Y = 1/ϕ (1.0 D + 1.8 E) (For structural element carrying mainly earthquake forces.) Y = 1/ϕ (1.0 D + 1.0 R + 1.0 E')	Ultimate strength design
Bolted or riveted steel framed structure	2.5/2.5	Y = 1/ϕ (1.0 D + 1.0 H + 1.0 E') (0.9 D is used where dead load subtracts for critical stress in the first three equations.)	"Design of Protective Structures", Dept. of Navy, NP-3726, August 1950.
Reinforced concrete equipment supports	2.0/3.0	Y = yield strength. D = dead load. R = force or pressure on structure due to rupture of any pipe.	
Reinforced concrete frames and buildings	3.0/5.0	H = force on structure due to thermal expansion. E = design earthquake load. E' = maximum earthquake load.	
Prestressed concrete structure	2.0/5.0	W = tornado load ϕ = 0.9 for reinforced concrete, 0.85 for shear, bond. Anchorage in reinforced concrete. 0.75 for spirally reinforced concrete component members. 0.70 for tied component members. 0.90 for fabricated structural steel, and 0.90 for reinforced steel (not prestressed) in direction of tension.	
Sec. 5.A.4 p. 5.A-6		Sec. 5.A.3 p. 5.A-3 p. 5.A-4	Sec. 5.A.3 p. 5.A-3 p. 5-38a Amend. 28

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
(% critical damping) Steel piping 0.5/0.5	Analytical and/or testing	L. C. for Internals, vessels, integral support attachments and piping: L.C. — Stress Limit Design loads + design earthquake loads — $P_M \le 1.0\ S_M$; $P_L + P_B \le 1.5\ S_M$ Design loads + SSE — $P_M \le 1.2\ S_M$; $P_L + P_B \le 1.2\ (1.5\ S_M)$ Design loads + pipe rupture — $P_M \le 1.2\ S_M$; $P_L + P_B \le 1.2\ (1.5\ S_M)$ Design loads + SSE — $P_M \le 2/3\ S_u$; $P_L + P_B \le 2/3\ S_u$	ASME BPVC, Section III ANSI B31.7 Nuclear Power piping code -
Sec. 5A.4 p. 5.A-6	Sec. 5.A,4,2 p. 5A-6 p. 5A-8	Sec. 4.1,2 p. 4-4	Sec. A-.3 p. A-2

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Class I electrical equipment is seismic qualified in accordance with the IEEE Guide for seismic qualification of Class I electrical equipment for nuclear power generating stations, JcNPS/Sec. 5 (to be designated IEEE 344). Sec. 8.1 p. 8-1, Amendment No. 22, December 14, 1971

SEISMIC REVIEW TABLE

Docket Number
50-368

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Arkansas Nuclear One Unit No. 2 Reactor type: PWR Containment type: 3 buttresses with shallow dome (prestressed concrete) NSSS Manufacturer: Combustion Engineering Architect Engineer: Bechtel	0.10	0.067	VII	0.20	0.133	Synthetic time history	Three components: two horizontal and one vertical. Each horizontal was combined with the vertical, assuming simultaneous occurrence.	SRSS	Design response spectra generated from time-histories as per AEC Reg. Guide 1.60 (BC-TOP-4)	Time-history method using synthetic earthquake acceleration time history
12-72/9-78	p. 2.5-25	p. 3.7-7		p. 2.5-25	p. 3.7-7	pg. 3.7-1	p. 3B-1	p. 3.7-9	p. 3.7-1	p. 3.7-3

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION: TYPE	BEARING INFORMATION: THICKNESS	BEARING INFORMATION: V_s PROFILE	GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
Reinforced concrete flat circular slab. Depth not available. p. 3.8-46	Moderate to stiff, plastic, red and tan clay with occasional zone of silty clay, which overlies black, dense, horizontally bedded shale and interbedded shale and sandstone of the McAlester formation. p. 2.5-9	70 ft to 90 ft. p. 2.5-8	Not available.	About 10 ft below ground surface. p. 2.5-11	Ozark Dam Dardanelle Dam Robert S. Kerr Dam p. 2.4-6 to 2.4-8	Stick model with fixed base p. 3.7-3	Not available.	No soil damping p. 3.7-2	Not available.

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE	DESIGN CRITERIA	
	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
(% critical damping) Welded steel frame structures 2.0/5.0 Bolted and riveted steel 3.0/5.0 Reinforced concrete structure and equip ment supports 3.0/5.0 Prestressed concrete structures 2.0/5.0 Bolted or riveted steel frame structures 2.5/2.5 p. 3.7-15	A. Design loading case: 1) $D+L+F+T_o$ 2) $D+L+F+P+T_A$ B. Factored loading case: 1. $C = 1/\phi\ ((1.0+0.05)\ D + 1.5\ P + 1.0\ T_A + 1.0\ F)$ 2. $C = 1/\phi\ ((1.0+0.05)\ D + 1.25\ P + 1.0\ T_A + 1.25\ H + 1.25\ E + 1.0\ F)$ 3. $C = 1/\phi\ ((1.0+0.05)\ D + 1.25\ H + 1.0\ R + 1.0\ F + 1.25\ E + 1.0\ T_o)$ 4. $C = 1/\phi\ ((1.0+0.05)\ D + 1.0\ F + 1.25\ H + 1.0\ W' + 1.0\ T_o)$ 5. $C = 1/\phi\ ((1.0+0.05)\ D + 1.0\ P + 1.0\ T_A + 1.0\ H + 1.0\ E' + 1.0\ F)$ 6. $C = 1/\phi\ ((1.0+0.05)\ D + 1.0\ H + 1.0\ R + 1.0\ E' + 1.0\ F + 1.0\ T_o)$ C = Required capacity of the containment D = Dead loads. E = Operating basis earthquake loads. E' = Design basis earthquake loads. F = Prestress loads. H = Pipe expansion loads. L = Live loads. P = LOCA pressure loads. R = Pipe rupture loads T = LOCA thermal loads. T_o= Operating thermal loads. W'= Tornado wind and tornado missile loads. ϕ = Capacity reduction factors. p. 3.8-7 to 3.8-8	ACI 318-63 AISC 1969 Supplement 1, 2, November 1970 and December 1971. p. 3.8-3

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE		METHOD OF QUALIFICATION	DESIGN CRITERIA	
			LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
(% critical damping)				
Steel piping	0.5/0.5	Analytical	Loading combination 1: normal operating loads + OBE loads. Loading combination 2: normal operating loads + DBE loads. Loading combination 3: normal operating loads + DBE loads + pipe rupture loads.	ASME BPVC Section III
Vital piping	0.5/1.0			
Welded steel plate assemblies	1.0/1.0			
p. 3.7-15		p. 3.6-6	p. 3.6-4	p. 3.6-4

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Equipment supplied by NSSS vendor: Combustion Engineering Topical Report CENPD-61 Equipment supplied by other than NSSS vendor: IEEE Standard 344-1971 p. 3-10.2

SEISMIC REVIEW TABLE

Docket Number
50-334

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Beaver Valley Power Station Unit No. 1 Reactor type: PWR Containment type: Sub-atmospheric (Reinforced concrete) NSSS Manufacturer: Westinghouse Architect Engineer: Stone & Webster	0.06	0.04	IV	0.125	0.085	Compared with El Centro 1940 and Taft 1952, Golden Gate 1957.	Three components. Combination is simultaneous.	SRSS	Housner response spectra was generated which enveloped El Centro, Taft and Golden Gate time histories. Performed by Dr. R. V. Whitman	Time-history method.
6-70/7-76	Sec.2.5.3 p. 2.5-4	Sec.2.5.3 p. 2.5-4	Sec.2.5.3 p. 2.5-3	Sec.2.5.3 p. 2.5-4	Sec.2.5.3 p. 2.5-4	Sec. 2.6.4.2 p. 2.6-11	Q. 3.15-5 Amend. 5 10/10/73 App. B.1-3	Q. 3.15-1 Amend. 1 4/23/73	Figs. 2.5-1 and 2.5-2 P. 2.5-3 App. 2D	

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete mat 10 ft thick	Gravel terrace	100 ft	Varying from 800 to 1250 psf	10 ft to 50 ft average 30 ft below surface.	3.1 miles downstream from Montgomery Lock and Dam 19.6 miles upstream from New Cumberland Rock and Dam.	Stick model with soil springs.	(1) Containment structure G = 22,000 psi (2) Fuel building, auxiliary building and other near surface building G = 17,000 psi (3) Intake structure G = 17,000 psi	Not available.	5% OBE 7% DBE
Sec. 2.6.3.1 p. 2.6-3	Sec. 2.4 p. 2.4-2	Sec. 2.4 p. 2.4-2	Sec. 2.6.2.3 p. 2.6-3	Sec. 2.3.2.1.1 p. 2.3-3	Sec. 2.3.1 p. 2.3-1	Sec. 2.6.4.4 p. 2.6-15	Sec. 2.5.3 p. 2.5-5		App. B pg. B.1-3

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE	(% critical damping)	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Containment structure	5.0/7.0	Concrete structure D.L. + L.L. D.L. + L.L. + OBE D.L. + L.L. DBE D.L. + L.L. + TOR D.L. + L.L. + F	Using working stress design ACI 318-63
Steel reinforced concrete (no cracking)	0.5 to 1.0		
Welded steel, well reinforced concrete (with slight cracking)	2.0	Steel structure D.L. + L.L. D.L. + L.L. + OBE D.L. + L.L. + DBE D.L. + L.L. + TOR D.L. + L.L. + F	Steel structure, AISC-63, Part I Specified minimum yield strength for structural steel.
Reinforced concrete (with considerable cracking)	2.0		
Bolt steel	5.0		
Welded steel	5.0		
Reinforced concrete	5.0		
Bolted steel	7.0		
Amendment I, Sec. B.1.2, Table B.1-3, p. B.1-3 4/23/73		Amendment VII, p. B.1-6 (3/29/74)	Amendment VII, P. B.1-7 3/29/74

MECHANICAL & PIPING				
DAMPING OBE/SSE (% critical damping)		METHOD OF QUALIFICATION	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Piping	0.5/1.0	Analytical and testing.	Pressure piping 1. Normal conditions (a) $P_m \leq S$ (b) P_m (or P_L) $\leq S$ 2. Upset conditions (a) $P_m \leq 1.2\ S$ (b) $P_m + P_B \leq 1.5\ S$ 3. Emergency conditions (a) $P_m \leq 1.2\ S$ (b) $P_m + P_B \leq 1.5\ (1.2\ S)$ Pressure vessel 1. Normal conditions (a) $P_m \leq S_m$ (b) $P_m + P_B \leq 1.5\ S_m$ (c) $P_m + P_B + Q \leq 3\ S_m$ 2. Upset conditions (a) $P_m \leq S_m$ (b) $P_m + P_B \leq 1.5\ S_m$ (c) $P_m + P_B + Q \leq 3\ S_m$ 3. Emergency conditions (a) $P_m \leq 1.2\ S_m$ (b) $P_m + P_B \leq 1.5\ (1.2\ S_m)$	Piping ANSI, B31.1 pressure piping code with diameters of 6 in. NPS and below. ASME BPVC, Section III (1968 edition)
Amendment I, Table B.1-3 4/23/73			For further details refer to Table B.3-4	Question 3.22-1

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Testing for mounted components	"Class I instrumentation and electrical equipment are designed to maintain their capability to: 1. Initiate a protective action during DBE and OBE 2. Withstand seismic disturbances during post accident operation	IEEE STD 344-1971 "Seismic Qualification of Class I Electric Equipment for NPP Generating Station". p. B. 2-14

SEISMIC REVIEW TABLE*

Docket Number
50-155

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Big Rock Point Nuclear Plant Reactor type: BWR Containment type: Pre-Mark (steel) NSSS Manufacturer: General Electric Architect Engineer: Bechtel 5-60/8-62	Not used	Not used	Not available	.05 and 0.025 (see last column of this page) 0.12 for RDS only. Sec. 2-11	not used	not used	one horizontal component 3 directions with SRSS for reactor depressurization system only Sec. 2-11	SRSS for RDS only	Not used	The lateral concrete loads for design of internal concrete structures were determined from U.B.C. requirements. A seismic factor of 0.025 was used for the equivalent lateral coefficient for these structures as well as other major structures, e.g. turbine building, 240 ft. high stack, control room and waste storage building. RDS reanalyzed in 1974 using R.G. 1.60, floor response spectra by Kapur method.

*Information obtained from BNL Docket search and SEPB Report prepared by LLL; EDAC Report #175-130.04, January 1979.

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
The lower segment of the spherical steel vessel is embedded in concrete and the structure extends 27 ft. below grade. The foundation consists of a combination of a 3-foot thick concrete mat and reinforced concrete footings from 38 ft. to 8 ft. below grade.	Rock	Not available	Not available	Not available	Not available	Not used	Not available	Not used	Not avail- able

SEISMIC REVIEW TABLE

STRUCTURES		
	DESIGN CRITERIA	
DAMPING OBE/SSE (% Critical damping)	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Containment: used in 1974 reanalysis of reactor depressurization system to acceleration equal to 0.12g. 4.0 RDS components assumed to have damping values of R.G. 1.61.	Containment: Seismic (0.05g) + DL + snow Internal Concrete Structure: Seismic (0.05g) + DL + equipment NSSS: Seismic (0.05g) + DL + pressure NSSS Piping: Seismic (0.025g) + pressure + equipments Turbine Building: Seismic (0.025g) + DL + equipment Sec. 3-3	Containment: ASME B and PV Sec. VI, VIII, IX UBC - 1958 ACI - 318-56 Sec. 2-11

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
		DESIGN CRITERIA	
DAMPING OBE/SSE (% Critical damping)	METHOD OF QUALIFICATION	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Not available	Containment/Reactor Vessel: ASME BPVC Sec. II, VI, VIII, IX, 1958 Piping and Supports: ASA B 31.1 1955

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE (% Critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
	Test		MIL-STD-167, Mechanical vibration of shipbord equipment MIL-STD-901C, Requirements for shock test. "Seismic qualification of RDS for BRP plant". Amend. 8, Docket 50155-50

SEISMIC REVIEW TABLE

Docket Number
50-259, 260, 348

NAME AND NSSS TYPE OF THE PLANT	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
CP/OL ISSUE DATE	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Browns Ferry Nuclear Plant Unit Nos. 1, 2, & 3 Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Tennessee Valley Authority	0.10	0.067	VII	0.20	0.13	Design spectra compared with the El Centro, May 1940, N-S component, normalized to maximum acceleration. El Centro time history enveloped ground spectrum and was used in time-history analyses	Three components: Each horizontal component combined with vertical component simultaneously. "A vertical acceleration is considered to act simultaneously (with horizontal) and to increase or decrease the vertical load, whichever is most conservative.	SRSS	Housner design spectra	Time-history method.
Unit 1: 5-67/6-73 Unit 2: 5-67/6-74 Unit 3: 7-68/8-76	Sec. 2.5.4 p. 2.5-6	p.12.2-2	p. 2.5-6	Sec. 2.5.4 p. 2.5-6	p.12.2-2	Sec. 2.5-4 pp. 2.5-7, 2.5-8, 2.5-12	p. 12.2-32 Sec. C.3-2 p. C.0-3	Sec. C.3-2 p. C.0-3	Figs. 2.5-15 and 2.5-16, 2.5-17 p. 2.5-7	Sec. 12.2.2.8 p. 12.2-12

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Base slab with a circular mass of concrete at the center supporting the drywell.	Bedrock Tuscombia formation Fort Payne formation	Average depth 54 ft (41 to 69 ft) 50 ft below bed rock 145 ft below Tuscombia	Not available.	Ground water is derived from precipitation.	Wheeler Dam Wilson Dam	Lumped mass model with soil springs	2,300,000 psi bedrock	Not available	5% for all modes
Sec. 12.2.2.1 p. 12.2-1	Sec. 2.5. pp. 2.5-	2.3.2 1&2.5-2		Sec. 2.4.2.1 p. 2.4.1	p. 2.4-3	Sec. 12.2.2.8 p. 12.2-11 p. 12.2-69 Fig. 12.2-78	Sec. 2.5.2.4.2 p. 2.5-5	p. 12.2-69	Sec.12.2.28 p. 12.2-31

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE	(% critical damping)	**DESIGN CRITERIA** — **LOAD COMBINATION**	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Steel structure Concrete Sec. 12.2.2 p. 12.2-4	1.0 5.0	These loads are considered in the following combinations: Reactor building Case 1. Prestartup - DL+LL+P Case 2. Operating - DL+LL+P+THERM+RESTR Case 3. Operating + Earthquake -A. DL+LL+P+THERM+RESTR+OBE -B. DL+LL+P+THERM+RESTR+DBE where DL = dead load LL = live load P = pressure transmitted through polyurethane foam at operating temperature OBE = Operating Basis Earthquake (0.1 g) DBE = Design Basis Earthquake (0.2 g) THERM = thermal load at operating temperatures RESTR = restraint to thermal growth of shield by pools For more details: refer to Tables 12.2-1 through 12.2-43 Sec. 12.2.2.2.3 p. 12.2-4	ACI-318-63 N.O. + OBE $\leq 0.5\ f_y$ N.O. + DBE $\leq 0.85\ f'_c$ or $0.9\ f_y$ Ultimate strength method AEC Q. 12.2-10 p. 12.2-4

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE	(% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
			LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Piping Equipment	0.5 1.0	Analytical	Deformation limit — Table C.0-1 Primary stress limit — Table C.0-2 Buckling stability limit — Table C.0-3 Fatigue limit — Table C.0-4 For details refer to Tables C.0-1 to C.0-7.	Piping ANSI B31.1.0 ANSI B31.7 Vessel ASME BPVC, Section III
Sec. C.3-2 p. C.0-3		Appendix C Section C.3	Section C.2-6 p. C.0-2	Appendix C Section C.4-1

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

Docket Number
50-324, 325

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Brunswick Steam Electric Plant Units 1 & 2 Reactor type: BWR Containment type: Mark I (Reinforced concrete) NSSS Manufacturer: General Electric Architect Engineer: United Engineers & Constructors	0.08	0.053	VII (SSE)	0.16	0.107	1940 N-S El Centro spectrum normalized by a factor was used for developing the design spectra.	Three components, each horizontal was combined with the vertical, resulting in two distinct load cases.	For piping equipment by SRSS C.4.3.2 For structure absolute sum. Comment C-10	The envelope of the Housner spectra and the El Centro spectra was termed as the smoothed 1940 N-S El Centro normalized spectrum. Fig. 2.6-7 Fig. 2.6-9	Time-history method
Unit 1: 2-70/10-76 Unit 2: 2-70/12-74	Sec. 2.6 p. 2.6-6	Sec. 2.6 p. 2.6-10	Sec. 2.6 p. 2.6-11	Sec. 2.6 p. 2.6-7	Sec. 2.6 p. 2.6-11	Sec. 2.6.6.1 p. 2.6-10	C4.3.2 p. C-56	MC.10-1 Amend. 14 1972	Sec. 2.6 p. 2.6-9 Fig. 2.6-7	Comment C.3, P.MC.3-1 Amend. 13 (Sept. 72)

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete mat foundation, founded on a strata of very dense-fine to medium-coarse sand. Depth not available.	Sand and clay. Limestone Hard calcareous clay and cretaceous rock. Crystalline	115 ft 115 ft down to 1500 ft	Thick. (ft) — V_s (ft/sec) 35 — 750 30 — 1400 43 — 5500 127 — 4500 1290 — 3000	Table M.2.17-1 gives ground water details.	Not available.	Lumped mass with soil springs. See design reports 4, 9, and 10.	Not available	Soil structure interaction damping .04/.07 critical damping for OBE/DBE.	Not available.
Sec. 12.2.1 p. 12.2-1	Sec. 1.5 p. 1.5-2	Sec. 1.5 p. 1.5-2	Fig. 2.6-7	Comment 2.17 PM2.17-1 Amend. 14, 11/72		C.57, p. MC.57-1		Table C-1	

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE	(% critical damping)	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Reinforced concrete: **Primary containment** **Other Class I structures**	 4.0/7.0 4.0/7.0	Primary containment (Drywell & Suppression Chambers) $U_1 = (1.0 \pm 0.1)\ D + 1.50\ P + 1.0\ T_{1.5} + 1.0\ R$ $U_2 = (1.0 \pm 0.1)\ D + 1.25\ P + 1.0\ T_{1.25} + 1.25\ E + 1.0\ R$ $U_3 = (1.0 \pm 0.1)\ D + 1.00\ P + 1.0\ T_{1.00} + 1.00\ E' + 1.0\ R$ $T_p = (1.0 \pm 0.1)\ D + 1.15\ P$ (Pressure test condition)	Codes ACI 318-63, Part IV B Ultimate strength design AISC (1963) specification for the erection of structural steel Plant stack design, ACI 307-69
Steel structures: **(Reactor building and other Class I structures)** **Bolted or riveted** **Welded**	 5.0/10.0 2.0/5.0	Class I Structures $U = 1.5\ D + 1.8\ L + 1.0\ T + R + Pr$ $U = 1.5\ D + 1.5\ L + 1.5\ E + 1.0\ T + R + Pr$ $U = 0.9\ D + 1.5\ W + 1.0\ T + R + Pr$ $U = (1.0 \pm 0.1)\ D + 1.0\ E' + 1.0\ T + R + Pr$ $U = (1.0 \pm 0.1)\ D + 1.0\ W' + 1.0\ T + R + Pr$ $U = 1.5\ \overline{D} + 1.5\ L + 1.5\ W + 1.0\ T + R + Pr$	
Table C-1		Sec. C.2.6.1 p. C-9	Comment 22 p. MC.22-1 Amendment 13 (Sept. 1972) C-5

SEISMIC REVIEW TABLE

MECHANICAL & PIPING						
DAMPING OBE/SSE	(% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA			
			LOAD COMBINATION			ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
			Piping Design condition	Load combination	Stress limits	
Equipment	1.0/2.0	Analytical and testing	Design, normal and upset	Pressure	S_h	ANSI B31.1 - 1967 Power piping ASME BPVC, Sec. III
Piping	0.5/2.0			Pressure; dead weight	S_h	Valves ANSI-B31.1-67 ANSI-B16.5
				Pressure, dead weight, OBE	1.25 S_h	
				Pressure, dead weight, thermal	S_n+S_h	Pumps ANSI-B31.1-67 ASME Sec. III. Class C
			Emergency	Pressure, dead weight, DBE	1.8 S_h	
Table C-1		Sec. 2.2 C-4	Table C-7 through C-29 Amendment 13, Comment 4.3, p. M4.3-1			Amendment 13 (Sept. 1972) p. M4.1-1 Sec. A.1.1, p. 2

p. MC.18-3

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Analytical and Testing	OBE Combined stresses $\leq 0.6\ S_y$. DBE Combined stresses $\leq 0.9\ S_y$.	IEEE 344-1971 Equip — Max. Hor. "g" Voltage pre-amp — 8.5 Temp. control switch — 12 Intermediate range monitor — 1.5 see Table C-30
	Sec. 2.2 p. C-4	Comment 7.8, p. M7.8-5 Amendment 13 (Sept. 1972)	Table C-30 Comment 7.8 p. M7.8-2 Amendment 13 (Sept. 1972)

SEISMIC REVIEW TABLE

Docket Number
50-317, 318

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Calvert Cliffs Nuclear Power Plant Units No. 1 & 2 Reactor type: PWR Containment type: 6 Buttresses with shallow dome (prestressed concrete) NSSS Manufacturer: Combustion Engineering Architect Engineer: Bechtel	0.08	0.053	VII	0.15	0.10	Compared with digitalized El Centro earthquake 1940 (E-W) normalized to: 0.08 g horizontal 0.053 g vertical	Horizontal and vertical components combined simultaneously.	SRSS including closely spaced modes.	1. Housner spectra for frequency >0.33 cps. 2. Newmark spectra for frequency <0.33 cps (Figs. 2.6-4, and 2.6-5)	"Digitized El Centro was used in the analysis of Class I equipment. Class 2 structures use UBC Zone 3. AEC TID 7024 "Nuclear Reactors and Earthquakes".
Unit 1:7-69/7-74 Unit 2:7-69/11-76	Sec. 2.6.5.2 p. 2.6-9	Sec. 2.6.5.2 p. 2.6-9	←	Sec. 2.6.5.3 p. 2.6-9	→	Sec. 2.6.5.4 p. 2.6-10	Sec. 5A.3.1.4 p. 5A-5	Sec. 5.1.3.2(b) p. 5-22	Sec. 2.6.5.4 p. 2.6-10	p. 2.6-10 p. 5A-6

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Foundation for containment: 10 ft thick reinforced concrete slab. Sec. 5.1.2.1 p. 5.2	Major structure: Miocene sandy and clay silts of Chesapeake group. Appurtenant structure: surficial pleistocene silt which overlies the miocene sediments. Sec. 2.6.5.1 p. 2.6-9	200 ft Sec. 2.4.1 p. 2.4-1	1600 fps Sec. 2.6.4.4 p. 2.6-7	Varies from 8 ft to 82 ft. Sec. 2.5.3.3 p. 2.5-9	Not available.	Stick model with soil springs. Sec. 5.1.3.2 p. 5-21	Not available.	Soil: % critical damping OBE: 2% SSE: 3% E′ 7% Rocking Motion Prestressed concrete 7% Rocking Motion Reinforce concrete Sec. 5A.3.1.4 p. 5A-5, p. 5A-6	Not available

SEISMIC REVIEW TABLE

<table>
<tr><th colspan="4">STRUCTURES</th></tr>
<tr><th colspan="2" rowspan="2">DAMPING OBE/SSE (% critical damping)</th><th colspan="2">DESIGN CRITERIA</th></tr>
<tr><th>LOAD COMBINATION</th><th>ACCEPTANCE CRITERIA & ALLOWABLE STRESSES</th></tr>
<tr><td>(translational)
1. Welded steel framed structure
2. Bolted or riveted steel framed structure
3. Reinforced concrete frames and buildings
4. Prestressed concrete structures

(rotational)
1. Rocking motion for prestressed concrete structures
2. Rocking motion for reinforced concrete structures</td><td>
1.0/1.0
2.5/2.5
3.0/5.0
2.0/5.0

5.0/7.0
5.0/7.0</td><td>$Y \geq 1/\Phi\ (1.05\ D + 1.5\ P + 1.0\ T_A + 1.0\ F)$
$Y \geq 1/\Phi\ (1.05\ D + 1.25\ P + 1.0\ T_A + 1.25\ H + 1.25\ E + 1.0\ F)$
$Y \geq 1/\Phi\ (1.05\ D + 1.25\ H + 1.0\ R + 1.0\ F + 1.25\ E + 1.0\ T_o)$
$Y \geq 1/\Phi\ (1.05\ D + 1.25\ H + 1.0\ F + 1.25\ W + 1.0\ T_o)$
$Y \geq 1/\Phi\ (1.0\ D + 1.0\ P + 1.0\ T_A + 1.0\ H + 1.0\ E' + 1.0\ F)$
$Y \geq 1/\Phi\ (1.0\ D + 1.0\ H + 1.0\ R^A + 1.0\ E' + 1.0\ F + 1.0\ T_o)$

Y = Yield strength.
D = Dead load.
E = OBE
E' = SSE
W = Tornado wind load.
P = LOCI pressure load.
F = Final prestress load.
T_A = Thermal load incident temperature gradient through walls and expansion liner
R = Force or pressure on structure due to rupture of one pipe.
H = Thermal expansion force.
T_o = Thermal load due to normal operating temperature gradient through walls.
Φ = Reduction factor.</td><td>ACI-318-63, when Φ is taken as 1.</td></tr>
<tr><td colspan="2">Sec. 5A.3.1.4
pp. 5A-5 and 5A-6</td><td>Sec. 5A.3.1.2
pp. 5A-3 and 5A-4</td><td>Sec. 5A.3.1.2
p. 5A-3</td></tr>
</table>

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA** — **LOAD COMBINATION**	**DESIGN CRITERIA** — **ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
(% critical damping) (Translational) Steel piping 0.5/0.5 Welded steel plate assemblies 1.0/1.0	Analytical	Vessels / Piping 1. Design loading + OBE: Vessels: $P_m \le S_m$, $P_B + P_L \le 1.5\ S_m$; Piping: $P_m \le S_m$, $P_B + P_L \le 1.5\ S_m$ 2. Normal operating + SSE: Vessels: $P_m \le S_D$, $P_B \le 1.5\ [1 - (\frac{P_m}{S_D})^2]\ S_D$; Piping: $P_m \le S_D$, $P_B \le \frac{4}{\pi} S_D \cos(\frac{\pi}{2} \cdot \frac{P_m}{S_D})$ 3. Normal operating + SSE + pipe rupture: Vessels: $P_m \le S_L$, $P_B \le 1.5 \left[1 - (\frac{P_m}{S_L})^2\right] S_L$; Piping: $P_m \le S_L$, $P_B \le \frac{4}{\pi} S_L \cos(\frac{\pi}{2} \cdot \frac{P_m}{S_D})$ P_m = Calculated primary membrane stress. P_B = Calculated primary bending stress. P_L = Calculated primary local membrane stress. S_m = Allowable stress limit ASME BPVC III. S_Y = Yield at temperature ASME BPVC III. S_D = Design stress. S_L = S_Y + 1/3 $(S_U - S_Y)$ S_U = Tensile strength at temperature.	Reactor vessel: ASME BPVC III Piping: ASME BPVC III (1967) USAS B 31.7, Class I (Code cases 83, 1477 are included).
Sec. 5A.3.1.4 p. 5A-5	p. 5A-5	Sec. 4.2.1, Table 4-2 pp. 4-5 to 4-7	Sec. 4.2.1, Table 4-2 p. 4-7

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	"All electrical-systems and components vital to plant safety, including the emergency diesel generators, are designed as Class I so their integrity is not impaired by the design basis earthquake, high winds, or disturbances on the external electrical system". pg. 8.1	Not available

SEISMIC REVIEW TABLE

Docket Number
50-298

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Cooper Nuclear Station Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Burns & Roe, Inc.	0.10	0.05	VII	0.20	0.10	The accelerogram of the N69W component of the July 21, 1952 Kern County earthquake recorded at Taft, California was used to develop response spectra	Three components: two horizontal and one vertical. Each horizontal was combined with the vertical simultaneously.	Reactor vessel internals: SRSS for response spectrum method; algebraic sum for time-history method	Design spectrum response curves generated from 1952 Taft earthquake	Time-history method.
6-68/1-74	Vol.1 Sec. 5.2.3 p.II-5-4	Vol. 1 Sec. 5.2.3 p.II-5-4	Vol. 1 Sec. 5.2.1 p. II 5-3	Vol. 1 Sec. 5.2.3 p.II-5-4	Vol. 1 Sec.5.2.3 p.II-5-4	Vol. 1 Sec. 5.2.4 p. II-5-4	App. C Sec. 3.3.3 p. C-3-12	Vol. 1 Sec.3.5.3 p.III-3-12	Vol. 1, Sec. 5.2.4 p. II-5-4, Figs. II-5-7 to II-5-10	Vol. VII Amend 9 Q.12.35

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Mat foundation. Depth not available. Vol. I Sec. 5.2.3 p. II-5-4	Dense structure fill extending from the bedrock surface to the mat foundation. Silty sand, sand silt, silt clay, clay. Vol. I Sec.5.1.4, p. II5.3	Dense structure: not available. Silty sand: 10 to 25 ft. Vol. I Sec. 5.1.4,p.II-3	Not available.	Not available.	Not available.	Stick model with rocking springs. No vertical or horizontal soil springs were included Vol. VII Amend 13 Q.12.55	Not available	5% Vol. V Appendix C p. C-2-7	Not available.

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE	(% critical damping)	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Reinforced concrete structures.	5.0/7.0	D+E D+R D+R+E D+E+Flood D+T D+R+E'	ACI-318-63 for reinforced concrete. AISC Manual of Steel Construction (Sixth Edition)
Steel frame structures.	2.0	D = Dead load of structure and equipment. R = Loads resulting from jet forces and pressure and temperature due to rupture of a single pipe. E = OBE E' = SSE Flood = Loads due to flooding. W = Wind loads. T = Tornado loads.	
Welded assemblies.	1.0		
Bolted and riveted assemblies	2.0		
Vol. IV, p. XII-2-16 Table XII-2-5		Appendix C Sec. 2.2 p. C-2-1	Vol. V Sec. 2.4 p. C-2-3

SEISMIC REVIEW TABLE

MECHANICAL & PIPING					
DAMPING OBE/SSE	(% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA		
			LOAD COMBINATION		ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Vital piping system	0.5	Analytical and Testing	Deformation limit Primary stress limit Buckling stability limit Fatigue limit Loading criteria	Table C-3-2 Table C-3-3 Table C-3-4 Table C-3-5 Table C-3-7	Reactor vessel ASME BPVC, Sec. III Vol. V, Table C-3-7, p. C-3-14 Piping USAS, B31.1.0
Vol. IV, p. XII-2-16 Table XII-2-5		Vol. V, Sec. 3.3.26 & 3.3.2, p. C-3-11 & C-3-12. Appendix C Vol. VII p. 12.61.1	p. C-3-3, p. C-3-14, Table C-3-7 App. C, Table C-3-7		Vol. V, Table C-3-7, p. C-3-28

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

Docket Number

50-302

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Crystal River Nuclear Generating Plant, Unit 3 Reactor type: PWR Containment type: Mark I (steel) NSSS Manufacturer: Babcock & Wilcox Architect Engineer: Gilbert Associates 9-68/12-76	0.05 Sec. 5.2.1.2.9 p. 5-12	0.033	V Sec. 2.5.4.1 p.2-31 Amend. 34 (11-15-73)	0.10 Sec. 5.2.1.2.9 p. 5-12	0.067	Response spectrum method was used in design. Floor response spectra generated with either 1940 N-S El Centro, 1952 N21E Taft or other time-history. Ref. Sec. 5.4.5 p.5-65A Amend. 26 (5-25-73) and Sec. 2.5.4.1 p. 2-31	Three components: Each horizontal combined with the vertical by absolute sum, although "structural response due to vertical input was assumed to be insignificant". Sec. 5.4.5 p.5-65 Amend. 26 (5-25-73)	SRSS Sec. 5.4.5.2 p.5-66 D Amend. 32 (10-1-73)	Spectra developed were estimated by two methods: Housner and Estere and Rosenblueth p. 2-32	Approximate method not based on time-history GAI Topical 1729 Sec. 5.4.5 p. 5-65A Amend. 26 (5-25-73)

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
For reactor building Mat foundation thickness 12.5 ft.	Natural soil: Laminated orgainc sandy silts and clays, interspersed with a pleistocene marine deposits. Underlying limerock Sec 2, p.2.1	Average of thickness of approximately 4 ft.	Not available	Depth of approximately 10 ft. below ground surface. Based on a ground datum of 100 ft. groundwater levels were recorded to rise approximately 1.5 ft. at peaks of high tides.	Not available.	Stick model with fixed base. Soil spring model was used to check accuracy of fixed base model.	Not available.	"Sum of material and radiation damping was assumed as small as 5%."	Not available.
	Bedrock: biogenic carbonates of tertiary age.	Approximately 20 ft. beneath the present ground surface.							
Sec. 2.5.7 p. 2-36 and Sec. 5.2, p.5-7 Amend.26,(5-25-73)				Sec. 2.5 p. 2-20 and Sec. 2.5.3.5 p. 2-29 and p.2-30		Sec. 5.4.5.2 p. 5-66 and Sec. 5.4.5 p. 5-65 and p. 5-65a Amend. 32 (10-1-73)		p. 5-65a	

Sec. 2.5.3
p. 2-22

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE	(% critical damping)	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Reactor building shell	2.0	a) c= (1.0 ± .05) D + 1.5P + 1.0T b) c= (1.0 ± .05) D + 1.25P + 1.0T′ + 1.25 (E or W) c) c= (1.0 ± .05) D + 1.0P + 1.0 $\underline{T}$ + 1.0E′ d) c= (1.0 ± .05) D + 1.0 W_T + 1.0 P_t	Reactor building: R. C. ACI 318-63 Structure concrete ACI 301-66 Structure steel AISC. 1963.
Concrete support: Structure (Inside reactor building)	2.0		
Steel assemblies and structure a) bolted b) welded	 2.5 1.0	D= Dead load P= Design accident pressure load E= Seismic load based on 0.05g. E′= Seismic load based on 0.10g. W_T= Wind load based on Tornado P_t= Pressure load based on external pressure drop of 3 psig between inside and outside of reactor building.	
Other concrete structure (Above ground)	5.0		
p. 5-42		Sec. 5.2.3.2.1 p. 5-32	Sec. 5.2.3.1 p. 5-31

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Vital piping systems. 0.5 , p. 5-42	Analyses and test. Details. Ref. Table 5-5 p.5-86 AMEND. 17 (4-10-72) Sec. 5.4.5 p. 5-65 AMEND. 40 (7-3-74) p.5-64b AMEND. 45,(7-14-75)	For piping: primary stress + OBE $\leq$ 1.2 x S_h thermal stress $\leq S_A$ where S_A = t $(1.25 S_c + 0.25 S_h)$ S_A = allowable stress S_h = basic material allowable stress at max. (hot) temp. S_c = basic material allowable stress at min. (cold) temp. p. 5-641 Amend. 45(7-11-75) and p. 5-63	Reactor coolant system: ASME, boiler and pressurizer Vessel code, Sec. III, Art. 9 Summer, 1967 For piping (belongs to reactor coolant) USAS Sec. B31.7 Amendment 48,(3-16-76) p. 5-64a

Case	Load Combination	Stress Limits
I)	Design loads + design earthquake loads	$P_m \leq 1.00\ S_m$ $P_L + P_b \leq 1.5\ S_m$
II)	Design loads + maximum hypothetical earthquake loads	$P_m \leq 1.2\ S_m$ $P_L + P_b \leq 1.2\ (1.5\ S_m)$
III)	Design loads + pipe rupture loads	$P_m \leq 1.2\ S_m$ $P_L + P_b \leq 1.2\ (1.5\ S_m)$
IV)	Design loads + maximum hypothetical earthquake loads	$P_m \leq 2/3\ S_y$ $P_L + P_b \leq 2/3\ S_y$

P_L = Primary local membrane stress intensity
P_m = Primary general membrane stress intensity
P_b = Primary bending stress intensity
~~S_m = Allowable membrane stress intensity~~
S_u = Ultimate stress for unirradiated material at operating temperature

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Test or protype test or calculation. Ref. Sec. 7.1.3.1.4 p. 7-9b Amend. 32 (10-1-73)	Not available.	IEEE Standard. 314-1971 Sec. 7.1.1.8 p. 7-2b and p. 7-26 Amend. 45 (7-11-75)

SEISMIC REVIEW TABLE

Docket Number
50-346

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Davis-Besse Nuclear Power Station, Unit 1 Reactor type: PWR Containment type: Dry containment -cylindrical (steel) NSSS Manufacturer: Babcock & Wilcox Architect Engineer: Bechtel	0.08	.053	VII	0.15	0.10	E-W component of Helena Earthquake of October 31, 1935 was used as the basis for developing accelerograms of the OBE & DBE.	3 components: each horizontal combined with the vertical resulting two seismic load cases.	SRSS	Design spectrum response curves were developed by Newmark's method modifying the spectral amplification factors.	Time-history method.
	Vol. 1, Append. 2C Sec.D p. 2C-36	Vol. 1 Append.2C Sec. D p. 2C-36	Vol. 1, Append. 2C, p. 2C-31	Vol. 1, Append. 2C, p. 2C-31	Vol. 1, Append. 2C, p. 2C-39	Vol. 1, Append. 2C, p. 2C-39	Vol. 2C, Sec. 3.7.1.6 p. 3-51	Vol. 2 Sec. 3.7.3.3 p. 3-63 Fig. 3-24	Vol. 1, Append. 2C, p. 2C-41 to 45	Vol. 2 Sec. 3.7.2 p. 3-54

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION: TYPE	BEARING INFORMATION: THICKNESS	BEARING INFORMATION: V_s PROFILE	GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
Main structure: Mat footings & Auxiliary building: Pier footings bearing on bed- [redacted] Depth not available.	Soil: Glaciolagustrine and a till deposit.		For bedrock 5,700 fps to 7,500 fps	Prior to construction 571 ft. to 572 ft. (I.G. L.D.) During construction 525 ft. (I.G. L.D.)	Not available.	Stick model with fixed base for the containment and the auxiliary building	Soil: For OBE: 10 $KIPS/ft^2$ For SSE: 12 $KIPS/ft^2$	Soil: For OBE: 0.04 For SSE: 0.05	Not available.
	Bedrock: Tymochtee formation which consists of argillaceous dolomite with interbedded gypsum, anhydrite and shale strata.	8 ft. to 10 ft.					Bedrock: For OBE: 150 $KIPS/ft^2$ For SSE: 180 $KIPS/ft^2$	Bedrock: For OBE: 0.01 For SSE: 0.02	
Vol. 1 Sec. 2.5.1.10.2 p. 2-126 to 128			Vol. 1 Sec. 2.5.1.7 p. 2-123	Vol. 1 Sec. 2.5.1.5 p. 2-122		Vol. 2 Sec. 3.7.2 p. 3-52 to 55	Vol. 1, Sec. 2.5.1.8, p. 2-124	Vol. 1 Sec. 2.5.1.8 p. 2-124	

Vol. 1,
Sec. 2.5.1.8,
p. 2-123 and p. 2-124

SEISMIC REVIEW TABLE

STRUCTURES

DAMPING OBE/SSE (% critical damping)

	$< 1/4\ \sigma_y$	$1/2\sigma_y$	σ_y	$>\sigma_y$
Welded steel	1.0	2.0	5.0	7.0
Bolted and Riveted steel	1.0	5.0	10.0	20.0
Reinforced concrete	1.0	2.0	7.0	10.0

Vol. 2, Table 3-7, pg. 3-50

D= Dead load of structure and equipment plus other permanent loads, e.g., soil or hydrostatic loads
L=Live load and piping loads
R=Force or pressure on structure due to pipe rupture
T_o=Thermal loads due to temp. gradient, operating
H_o=Force due to thermal expansion of pipes, operating
T_a=Thermal loads due to temp. gradient, accident
H_a=Force on structure due to thermal exp., accident
E=force due to OBE
E'=force due to SSE
W=Wind load–wind velocity 90 mph at 30 ft. above gr.
W'=Tornado loads including differential pressure

DESIGN CRITERIA

LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Class I Structures: Operation during normal and OBE conditions	
Concrete	Concrete
$U=1.5D + 1.8L$	A.C.I. Code. 318-63
$U=1.25(D + L + H_o + E) + 1.0\ T_o$	Ultimate strength method
$U=1.25(D + L + H_o + W) + 1.0\ T_o$	
$U=0.9D + 1.25(H_o + E) + 1.0\ T_o$	
$U=0.9D + 1.25(H_o + W) + 1.0\ T_o$	
Structural steel	Structural steel
$D + L$	f_s
$D + L + T_o + H_o + E$	$1.25f_s$
$D + L + T_o + H_o + W$	$1.33f_s$
During accident and SSE conditions:	
Concrete:	
$U=1.0D + 1.0L + 1.25E + 1.0T_a + 1.0H_a + 1.0R$	
$U=1.0D + 1.25E + 1.0T_a + 1.0H_a + 1.0R$	
$U=1.0D + 1.0L + 1.0E' + 1.0T_o + 1.25H_o + 1.0R$	
$U=1.0D + 1.0L + 1.0E' + 1.0T_a + 1.0H_a + 1.0R$	
$U=1.0D + 1.0L + 1.0W' + 1.0T_o + 1.25\ H_o$	
Structural Steel	
$D + L + R + T_o + H_o + E'$	$1.5f_s$
$D + L + R + T_a + H_a + E'$	$1.5f_s$

Vol. 2, Sec. 3.1.1.3, pg. 3-76   Vol. 2, Sec. 3.8.1.1.6, pg. 3-72

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
<table><tr><td></td><td>< $1/4\sigma_y$</td><td>$1/2\sigma_y$</td><td>σ_y</td><td>> σ_y</td></tr><tr><td>Vital piping</td><td>0.5</td><td>0.5</td><td>2.0</td><td>—</td></tr><tr><td>Piping</td><td>0.5</td><td>1.0</td><td>2.0</td><td>5.0</td></tr></table>	analytical	Code Class I Pressure Vessels **Condition** / **Stress Intensity** Normal: $P_M \leq S_M$ P_M (or P_L) + $P_B \leq 1.5\ S_M$ P_M (or P_L) + P_B + Q ≤ 3.0 S_M P_M (or P_L) + P_B + Q + F ≤ S_E Emergency: $P_M \leq 1.2\ S_M$ or S_Y whichever is larger P_M (or P_L) + $P_B \leq 1.5\ (1.2\ S_M)$ or 1.5 S_Y whichever is larger or 0.8 C_L	ASME BPVC, Section III, Class "A" 1968 edition for reactor vessel, steam generator, pressurizer, reactor coolant pump, casing. ANSI B 31.7 - 1968 for piping
Vol. 2, Table 3-7, p. 3-50	Vol. 2 Sec. 3.7.2.1 p. 3-52	See Table 5-13 for upset and faulted condition Tables 5-12,13,14,15,16,17, 18 p. 5-79 through 5-85	Tables 5-10, p. 5-77

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	IEEE 344-1971 and IEEE 336-1971 Vol. 2, Sec. 3.10, p. 3-176, Vol. 2 Append. 3D, p. 3D-85

SEISMIC REVIEW TABLE

Docket Number
50-315, 316

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE							
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g	EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
Donald C. Cook Nuclear Plant Units No. 1 & 2 Reactor type: PWR Containment type: Ice Condenser (Re[redacted] concrete) NSSS Manufacturer: Westinghouse Architect Engineer: American Electric Power Service Corporation	0.10	0.067	VII	0.20	0.133	El Centro (as presented in TID 7024) Normalized to the recommended ground acceleration was used to develop response spectra.	Two-thirds of horizontal taken as vertical and combined with the full horizontal response. No further details available.	SRSS	Response spectra as shown in Figs. 2.5-2 and 2.5-3 were generated from El Centro earthquake.	Time-history method.
3-69/10-74	Vol. I Sec. 2.8.6 p. 2.8-2	Vol. I Sec. 2.8.6 p. 2.8-2		Vol. I Sec. 2.8.6 p. 2.8-2	Vol. I Sec. 2.8.6 p. 2.8-2	Vol. I Sec. 2.5.2 p. 2.5-5	AEC Question 5.74 p. 5.74-1	Vol. IX Amend. 9 Q.5.72-1	Vol. I Sec. 2.5.2 p. 2.5-5	Amend. 16 Question 5.71 p. 5.71-6

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Mat foundation Depth not available.	Compact sand, recompacted sand or stiff clay deposits on shale bedrock.	120 to 200 ft	900 fps	ground water elevation 593 ft	Not available.	Stick model with soil springs.	Not available.	Not available.	Not available.
Sec. 2.5.2 p. 2.5.2	Sec.2.3.2 p. 2.3-4	Sec. 2.3 Fig.2.3-2	Vol. IX, Amend. 19, p. 5.85-2	Vol. I, Sec. 2.4.2 p. 2.4-4		Amend. 16. Question 5.71 Fig. 5.71-1			

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE	(% critical damping)	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Containment structure: (with DBA)	4.0/7.0	For containment: $C = (1.0+0.05) D + 1.5 P = 1.0 (T+TL) + 1.0 B$ $C = (1.0 \pm 0.05) D + 1.25 P + 1.0 (T'+TL') + 1.25 E + 1.0 B$ $C = (1.0 \pm 0.05) D + 1.0 P + 1.0 (T''+TL'') + 1.0 E' + 1.0 B$ $C = (1.0 \pm 0.05) D + 1.0 (T'''+TL''') + 1.0 B + 1.0 W' + 1.0 P$ $C = (1.0 \pm 0.05) D + 1.0 (T'''+TL''') + 1.0 B$ $C = (1.0 \pm 0.05) D + 1.15 P$	ACI-318-63, Ultimate strength design.
(without DBA)	2.0/5.0		
Welded steel structure	1.0/1.0		
Bolted or rivited steel assemblies	2.0/2.0		
Amend. 9 Question 5.85, p. 5.85-2		Sec. 5.2.2.3 p. 5.2-18	Amendment 9, Question 5.1-1 Appendix B-9

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Piping 0.5/0.5	Analytical and Testing	For pressure vessels: 1. (a) $P_m \leq S_m$ (b) P_m (or P_L) + $P_B \leq 1.5\ S_m$ (c) P_m (or P_L) + P_B + Q $\leq 3.0\ S_m$ } Normal condition 2. (a) $P_m \leq S_m$ (b) $P_m + P_B \leq 1.5\ S_m$ (c) $P_m + P_B + Q \leq 3.0\ S_m$ } Upset condition For pressure piping: 1. (a) $P_m \leq S$ (b) $P_m + P_B \leq S$ } Normal condition 2. (a) $P_m \leq 1.2\ S$ (b) $P_m + P_B \leq 1.2\ S$ } Upset condition	1. ASME BPVC, Section III 2. USAS.1, B31.1 code (power piping)
Amendment 19, Q. 5.85 p. 5.85-2	Amendment 25 Q. 4.31-1	Tables 1 and 2, p. B-18 and p. B-19.	

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE *

Docket Number
50-010

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Dresden Nuclear Power Station Unit 1 Reactor type: BWR Containment type: Pre-Mark (steel) NSSS Manufacturer: General Electric Architect Engineer: Bechtel 5-56/9-59	None used (0.10)**	None used (0.067)**	None used	None used (0.20)**	None used (0.13) **	None used	None used Two comps.,** vertical + worst case horizontal	None used SRSS **	None used	No floor response spectra generated UBC, 1955 used for containment (Zone 2) and internal concrete structure (Zone 1) Housner spectra Times 2 used for ECCS and Core Spray System.

* Data are obtained from FHSR Docket 50-010 and SEPB Report "Seismic Design Bases and Criteria for Dresden Unit 1 Nuclear Generating Station," EDAC 175-130.03, January 1979.

** Used for ECCS and Core Spray System only.

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Circular concrete foundation 37 ft. below grade.	Limestone Shale Dolomited Limestone	20-45 ft. 70 ft. 100-400 ft.	Not used, bedrock site	"Groundwater found @ various levels beneath the site".	Dresden Dam	No SSI model used	Not used	Not used	Not used

SEISMIC REVIEW TABLE

STRUCTURES		
	DESIGN CRITERIA	
DAMPING OBE/SSE (% Critical damping)	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	<u>Internal Concrete Structures</u>: E + pressure + equipment (E = 0.025g)	UBC, 1955 ACI, 318-55 AISC, 1955

SEISMIC REVIEW TABLE

MECHANICAL & PIPING					
DAMPING OBE/SSE	(% Critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
			LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Vital piping	0.5	None	Containment: 1.) 0.033g 2.) pressure + snow + wind	Steel Containment Sphere and NSSS: ASME Section VIII (1955 ed.) and UBC, 1955
Welded assembly	1.0		NSSS: 1.) 0.025g 2.) operational transients	Piping and ECCS, Core Spray: ANSI B31.7, and ASME Sec. III, (1974 ed.)
Bolted assembly	1.0		ECCS: 1.) earthquake + operational + blowdown	

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Not available	Not available

SEISMIC REVIEW TABLE*

Docket Number
50-237,249

NAME AND NSSS TYPE OF THE PLANT	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
CP/OL ISSUE DATE	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Dresden Nuclear Power Station Unit 2 and 3 Reactor type: BWR Containment type: Mark-I (steel) NSSS Manufacturer: General Electric Architect Engineer: Sargent and Lundy Engineers.	0.10	0.067	VII	0.20	0.133	N-S component of the El Centro Earthquake (May, 1940) normalized to a maximum ground acceleration of 0.1g was used for time history analysis.	2 comp., greater horizontal + vertical, absolute method	SRSS (reactor, turbine bldg., and drywell analyzed by time history method)	Housner-(El Centro T-H envelops the Housner spectra except for high frequency end.)	Equipment and piping analyzed by either response spectrum or equivalent static method. Floor response spectra for pressure vessel, isolation condensor, turbine building, control room, etc. are derived by factoring up the Housner Ground Response Spectra to account for the maximum floor acceleration determined from the time history analysis. Static coefficients were also used for APCI and Core Spray Equipment. Floor response spectra from Brown's Ferry used for recirculating Loop Piping, feed-water and mainsteam lines.
Unit 2: 1-66/12-69 Unit 3: 10-66/1-71	p. 12.1-9	p. 12.1-9	p. 12.1-9	p. 12.1-9	p.12.1-9	Question II.A.1 Docket 50237-16 (microfiche)				

*Information was obtained from BNL Docket Search and SEPB Report "Seismic Review of Dresden Unit 2 for the Systematic Evaluation Program", NUREG/CR-0891, July 1979.

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE (calculated)	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE (calculated)						
Reinforced concrete mat founded on competent rock p. 12.1-10	The site consists of an upper layer of Pennsylvanian Pottsville sandstone of variable thickness which is 40-50 ft. Next below is a layer of about 15 to 35 ft. of Ordovician Maquoketa Divine limestone based on a 65 ft. layer of Maquoketa p. III-1-3	dolomitic shale. The Ordovician system has a total thickness approaching 1000 ft. with the Cambrian system next below. Brecciated rock is found on same cross sections and is indicative of ancient faulting.	Sandstone = 2,600 fps Limestone = 8,600 fps Argillaceous Dolomite = 4,700 fps Shale = 3,900 fps Dolomite Shale = 4,700 fps p. III-2-21	Not available	Dresden Dam p. 2.5-1	Fig. 12.1.8 and Fig. 12.1.9 indicate stick model with fixed base. p. 12.1-12 Lumped mass and stick model (torsional effects not considered.)	Sandstone = 18.7×10^4 psi Limestone = 250×10^4 psi Argillaceous Dolomite = 68×10^4 psi Shale = 44×10^4 psi Dolomite Shale = 74×10^4 psi p. III-2-21	Not available	Not available

SEISMIC REVIEW TABLE

STRUCTURES

DAMPING OBE/SSE	(% critical damping)
Reinforced concrete structures	5.0
Steel frame structures	2.0
Welded assemblies	1.0
Bolted and Riveted assemblies	2.0
Reactor and turbine building	5.0
Ventilation stack	5.0
Drywell	5.0
Control room	5.0

Amend 13 - Unit 2-SAR
Amend 14 - Unit 3-SAR

DESIGN CRITERIA	
LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Reactor building + all other Class I structures a) D + R + E	a) Normal allowable code stresses, AISC for structural steel, ACI-318-63 without increase for seismic
b) D + R + E′	Stresses are limited to the minimum yield pt. as a general case. In this case an analysis, using the limit-design approach, is made to determine the energy absorption capacity which should be such that it exceeds the energy input. AEC publication TID-7024 "Nuclear Reactor and Earthquake" Sec. 5.7.
Primary containment (including penetrations) a) D + P + H + T + E	a) ASME, Sec. III, Class B, without the usual increase for seismic loadings.
b) D + P + R + H + T + E	Same as (a), above except local yielding is permitted in the area of jet force where the shell is backed up by concrete. In areas not backed up by concrete, primary local membrane stresses at the jet force <0.9 x yield pt. of material at 300°F.
c) D + P + R + H + T + E′	Primary membrane stresses, in general, do not exceed the yield pt. of the material. If the total stresses exceeded yield pt. an analysis was made to determine that the energy absorption capacity exceeded the energy input from the earthquake. The same criteria as in (b), above, is applied to the effect of jet force for this loading condition.

D = Dead load of structure and equipment plus any other permanent loads contributing stress.
P = Pressure due to loss-of-coolant accident, R = Jet force on pressure on structure due to rupture of any one pipe,
H = Force on structure due to thermal expansion of pipes under operation conditions, T = Thermal loads on containment due to loss-of-coolant accident, E = Design earthquake load.

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE (% critical damping)		METHOD OF QUALIFICATION	DESIGN CRITERIA	
			LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Suppression chamber	2.0	Analytical model	<u>Reactor Primary Vessel Internals</u> a) D + E	a) ASME, Sec. III Class A vessel
Feedwater lines	0.5		b) D + E′ — b) The secondary and primary plus secondary stresses are examined on a rational basis taking into account elastic and plastic strains. These strains are limit to preclude failure by deformation which would compromised any of the engineered safeguards or prevent safe shut-down of the reactor.	
Vital piping systems	0.5			
Reactor pressure vessel	2.0			
Recirculation loop piping	0.5		c) P + D	c) ASME, Sec. III, Class A
Main steam lines	0.5		<u>Reactor Primary Vessel Supports</u> a) D + H + E	a) AISC for structural steel ACI for reinforced concrete
Suppression chamber ring header	0.5		b) D + H + R + E	b) Stresses do not exceed: - 150% of AISC allowable for structural steel - 90% of yield stress for reinforcing bars - 85% of ultimate stress for concrete
		Question 2.16 Amend. 7,8	c) D + H + E′ p. 12. 1-6	c) The design is such that energy absorption capacity exceeds energy input.

<u>ECCS</u>: a.) D + T + H + E — a.) Piping - ASA B 31.1 (1955 ed.) and code cases
Pumps - ASME Sec. III, Class C
Shellside - ASME Sec. III, Class C and TEMA C
Tubeside - ASME Sec. VIII, TEMA C

b.) D + T + H + E′ — b.) Same as P + D above

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Analysis and Generic Testing	Battery racks - No structural design calculations Instrumentation and control room panels - GE generic tests* Motor Control Center - Cutler Hammer Co. Generic Tests ** - Vibration test and analysis of 7700 Line Motor Control Center, # 70ICS100, 8-70 Transformers - No tests or calculations Cable trays - S. and L. Engrs., Specs, for Cable Pans and Hangers, Spec. K-2197	Not available

* GE - "Seismic Testing of Instrumentation" Dresden 2, 1-71
** Wyle Labs - "Seismic Simulation Test Report for Modified Unitrol Motor Control Center, Report 43746-1, 10-77

SEISMIC REVIEW TABLE

Docket Number
50-331

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Duane Arnold Energy Center Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Bechtel 6-70/2-74	For structures on bedrock or loft fill: 0.06 For structure on 30-50 ft. of soil: 0.09. Sec. 2.6.2.1.1 p. 2.6-24 Table 2.6-2	For structure on bedrock: 0.05 For structure on soil: 0.06 Sec. 2.6.2.1.1 p. 2.6-24 Table 2.6-2	Not available.	For structures on bedrock or 10 ft. of fill: 0.12 For structure on 30-50 ft. of soil: 0.18 Sec. 2.6.2.1.1 p. 2.6-40 Table 2.6-3	Structure on rock: 0.10 Structure on 30-50 ft. of soil: 0.12 Sec. 2.6.2.5.3 p. 2.6-40	1. 1935 Helena, Montana earthquake. 2. 1952 Taft, California earthquake. Sec. 2.6.2.5.3 p. 2.6-40	The earthquake conditions were applied to the structure in the direction of each of their principal axes. Sec. C.5.2.3.1 p. C.5-5	Direct addition (Time history) SRSS (Spectrum analysis) p. C.5-5 p. C.5-13	Response spectra developed for stuctures on: (1) Bedrock: 1935 Helena, Montana earthquake, (2) Compact fill and/or soil overlying bedrock: 1952 Taft, California earthquake. Sec. 2.6.2.5.3 p. 2.6-40	Time history method using developed earthquake time history. Sec. C.5.2.3.1 p. C.5-6

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reactor building: mat foundation on bedrock. Depth: not available.	Surficial deposits of clayey silt, sand, and gravel. Glacial till. Wapsipinicon formation (limestone and dolomite.	25 feet to more than 100 feet thick. About 67 feet thick.	V_s value computed: Surficial deposit: 500 fps Glacial till: 1800 fps. Limestone: 8600 fps.	About 8 feet below the existing ground surface.	"There are 12 low head dams."	Figure C.5-5 indicates stick model with soil springs.	Alluvial sand: 0.5×10^6 psf Glacial till: 0.7×10^6 psf Rock: 200×10^6 psf	Foundations, rock, soil: OBE and DBE: 5.0% of critical damping.	Not available.
Sec. 2.6.3.1.1 p. 2.6-46	Sec. 2.6.1.1.1 p. 2.6-1 Fig. 2.6-9	Sec. 2.6.1.1.1 p. 2.6-1 Fig. 2.6-9	Fig. 2.6-9	Fig. 2.6-12	Sec. 2.5.1 p. 2.5-1,2	Sec. C.5.2.3.1 p. C.5-5	Table 2.6-4 p. 2.6-80	Table C.5-1	

SEISMIC REVIEW TABLE

STRUCTURES		
	DESIGN CRITERIA	
DAMPING OBE/SSE (% critical damping)	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Containment structure and all internal concrete structures: 2.0/5.0 **Other conventionally reinforced concrete structures, such as shear walls or rigid frames:** 5.0/5.0 Table C.5-1	(1) Normal loads + operating basis earthquake (2) Normal loads + maximum probable flood (3) Normal loads + design basis earthquake (4) Normal loads + tornado loads (5) Normal loads + design basis loss-of-coolant accident reference For further information refer to Sec. 12.4.2, p. 12.4-1. p. 12.4-3	ACI-318-63 Ultimate strength design. p. 12.4-7

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE	(% of critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Welded structural steel assemblies: Bolted or riveted steel assemblies: Piping systems:	1.0/1.0 2.0/2.0 0.5/1.0	Analytical and testing.	Table C.2-1 (partial) Summary of Loading Conditions and Criteria Reactor Pressure Vessel - Normal - ASME Code, Special Criteria Upset - ASME Code, Special Criteria (Table C.2-2) Emergency - ASME Code, Special Criteria (Table C.2-2) Faulted - ASME Code, Special Criteria (Table C.2-2) Piping - Normal - Industry Codes, Table C.2-2 Upset - Industry Codes, Table C.2-2 Emergency - Industry Codes, Table C.2-2 Faulted - Industry Codes, Table C.2-2	ANSI B31.1.0-1967 B31.7 ASME, BPVC
Table C.5-1		Sec. C.5.2.3-1 p. C.5-6,7	Tables C.2-1 through C.2-25,p. C.2-11 through C.2-73	Sec. A.1.2 p. A.1-3

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Analysis or testing. Sec. C.5.2 .3.1 p. C.5-6, 7	GE equipment: "All instrumentation required for nuclear safety is capable of performing all functions important to safety during normal operation, during DBA and post-accident operation. Qualification is achieved by test and/or analysis at acceleration values of 1.5g horizontal and 0.5g vertical over a frequency of 0.25 to 33 Hz". Bechtel supplied equipment: "Purchase specifications will require that each type of Class 1 device be individually qualified by vibration test or suitable analysis. The methods ... will meet the general requirements of IEEE Standard 344-1971. For futher information refer to: Appendix M: Section M.3.3, p. M.3-27 through p. M.3-34	IEEE 344-1971

SEISMIC REVIEW TABLE

Docket Number
50-321

NAME AND NSSS TYPE OF THE PLANT	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
CP/OL ISSUE DATE	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Edwin I. Hatch Nuclear Power Plant Unit No. 1 **Reactor type: BWR** **Containment type: Mark I (steel)** **NSSS Manufacturer: General Electric** **Architect Engineer: Bechtel**	0.08	0.053	VII	0.15	0.10	N-S component of 1940 El-Centro earthquake.	2 components: Worst horizontal component plus vertical combined simultaneously	SRSS including closely spaced modes.	Conform to the average spectra by G.W. Housner for T $\leqq 4$ s. Normalized to the peaks (horizontal) of OBE and SSE.	Time-history method Class II UBC
9-69/8-74	Sec. 12.3.3.2 p. 12-8		Sec. 2.5.9 p. 2-33	Sec. 12.3.3.2 p. 12-8	Sec. 12.3.3.2 p. 12-8	Sec. 12.6.2.1 p. 12-21	p. C-13	Sec. 12.6.2.1 p. 12-20	Sec. 2.5.9 p. 2-33 Fig. 2.5-5 and 6	Sec. 12.6.2.1 p. 12-21

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete mat foundations for the following buildings: reactor, turbine, control, diesel generator, and radwaste. The foundation for the main stack is a reinforced concrete mat on steel H-piles.	Duplin: (cemented clay-sand grading to sandy clay). Beneath: (sand, sandy-clay) Clay, sand, gravel, etc. Crystalline basement rock.	135 ft 10 to 70 ft 65 ft 4000 ft	2450 fps	Summary of domestic well study is given in Table 2.4-3, pp. 2-18 and 2-19 of Section 2.4.6.2. Summary of Piezometer Installation Data is given in Table 2.4-4, pp. 2-20 and 2-21 of Section 2.4.6.2 No liquefaction potential has been found.	Not available.	Stick model with soil springs.	23,300 ksf Amendment 14, 4/72 Vol. VIII of FSAR Table Q 12.3.3.2.4-1 of Question 12.3.3.2.4	Translation and rotation of foundation soil - 4.5%OBE - 5.5%DBE	Unclear information Ref: PSAR Sec. XII-31
Sec. 12.5 p. 12-18	Sec. 2.7.4 p. 2-41		Amend. 14 (4/72) p. 12.3.3.2.4-2	Sec. 2.7.7 p. 2-45		Amendment 12 12/72 Sec. 12.6.2.1 p. 12-20 Fig. 12.6-1		Table 12.3-2 p. 12-10	

SEISMIC REVIEW TABLE

<table>
<tr><th colspan="4">STRUCTURES</th></tr>
<tr><th colspan="2" rowspan="2">DAMPING OBE/SSE (% critical damping)</th><th colspan="2">DESIGN CRITERIA</th></tr>
<tr><th>LOAD COMBINATION</th><th>ACCEPTANCE CRITERIA & ALLOWABLE STRESSES</th></tr>
<tr>
<td>Reinforced concrete structures:

Steel frame structures:

Bolted and riveted assemblies:

Welded assemblies:

Vital piping:

Translation and rotation of foundation soil:

Amendment 12, 2/72, Vol. III
Sec. 12, Table 12.3-2
p. 12-10</td>
<td>3.0/5.0

3.0/5.0

3.0/5.0

2.0/3.0

0.5/1.0

4.5/5.5</td>
<td>Class I structures
1. Primary containment.
(a) D+L+H+T+E (b) D+L+H+P+R+T+E
(c) D+L+H+P+R+T+E' (d) D+E+F
2. Reactor pressure vessel support.
(a) D+L+H+E (b) D+L+H+R+P+T
(c) D+L+H+T+P+T+E (c) D+L+H+R+P+T+E'
3. Reactor building and all other Class I structures.
(a) D+L+H+E (b) D+L+H+W
(c) D+L+H+E' (d) D+L+H+W'
4. Reactor building crane structure.
(a) D+L+C+I (b) D+L+C+E
(c) D+L+C+E' (d) D+L+C+W
(d) D+L+C+W'

Class II structures: designed according to applicable codes and standards.

NOTE: D = dead load, L = live load, C = crane load, I = impact load, P = pressure due to LOCA, R = jet force, T = thermal load, E = OBE, E' = SSE, W = wind, W' = tornado wind, and F = hydrostatic.

Sec. 12.4, p. 12-15</td>
<td>They are classified according to the load combination case. For details, see Sec. 12.4, pp. 12-15 and 12-16.

Generally used: ASME, Sec. III, Class B.
For steel structures, AISC.
For concrete structure: ACI 318-63 and 307-69</td>
</tr>
</table>

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Piping: 0.5/2.0 Sec. A.3.1.4 p. A-4	Analytical and testing. Amendment 13 3/72 Sections C.1.1 and C.12, p. C-1	Reactor vessel: 1. Normal + OBE 2. Normal + piping rupture or normal + SSE 3. Normal + SSE + piping rupture Piping: Dead loads + external loads + thermal loads. 1. Dead + pressure 2. Dead + pressure + OBE 3. Dead + pressure + thermal (1–3: USAS B31.1.10) 4. Dead + pressure + SSE 5. Dead + maximum pressure + OBE 6. Dead + maximum pressure + SSE (4–6: Low probability of occurrence) More details on Table C-3.1 of Section: NSSS Equipment Loading Design on FSAR, Vol. IV, pp. C-14 to C-46.	ASME, BPVC, Section III, Nuclear Vessels, 1965 Edition and Winter 1966 Addenda with additions listed on page I-1 of Appendix I of Reactor Pressure Vessel Report. pp. C-10, C-12

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

Docket Number
50-366

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Edwin I. Hatch Nuclear Power Plant Unit No. 2 Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Bechtel	0.08	0.053	VII	0.15	0.10	Modified Taft 1952 horizontal component was used for developing synthetic acceleration time history.	3 components: Each horizontal combined with the vertical simultaeously, resulting in two separate seismic cases.	SRSS with close modes summed absolutely.	Modified Newmark design spectra.	Time-history method.
9-69/8-74	Sec. 2.5.2.11 p. 25-26	Sec. 2.5.2.11 p. 25-26	Sec. 2.5.2.10 p. 25	Sec. 2.5.2.10 p. 25	Sec. 2.5.2.10 p. 25	Sec. 3.7A.1.2 p. 3.7A-1	Sec. 3.7A.3.7 Sec. 3.7B.3.7 p.9	Sec. 3.7A.2.1.1 Sec. 3.7A.2.2 Sec. 3.7A.3.7	Sec. 3.7A.1.1 Figs. 3.7A1-3.7A6	Sec. 3.7B.2.6 Sec. 3.7B.2.3 Sec. 3.7B.2.8

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete mat 27'2" thick at middle dry well and 12'4" thick at other sections. Sec. 3.8.5.1b p. 3.8-76 Fig. 3.8-31 & 32	Major and minor struct: Upper Miocene Dublin locally cemented sand to sandy clay Upon Hawthorne sandy clay. Sec. 2.5.2.1 p. 23 Sec. 2A. p. 4 Figures 2A-2 thru 2A-3EE	To a depth of 135' (ft). Below Dublin down 10'-70' (ft). Sec. 2.5.2.1 p. 23 Sec.2A.2 p. 4 Figures 2A-2 thru 2A-3EE	2450 $\pm$ 200 fps Sec. 2A.1.4 p. 2A.1-3 Fig. 2A-5 and 2A-6	el. 70 to el. 75 ft. Sec. 2.5.4.6 p. 2.5-30	2 upstream of plant, Caltamaha River Basin 1) Sinclair Dam on Oconee Riv. 2) Lloyd Shoals Dam, Ocmulgee River.	Stickmodel with soil springs Sec. 3.7A.2.4 Sec. 3.7A.2.5 p. 5	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

STRUCTURES			
		DESIGN CRITERIA	
DAMPING OBE/SSE	(% critical damping)	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Reinforced concrete structure: Steel frame structures: Bolted and riveted assemblies: Welded assemblies: Translation and rotation of soil: (NSSS)- Drywell-building (coupled): Suppression chamber: Reactor pressure vessel, support skirt, shroud head, separator and guide tubes: Fuel: Table 3.7A-1 and 3.7B-1	3.0/5.0 3.0/5.0 3.0/5.0 2.0/3.0 4.0/5.0 3.0/5.0 2.0/3.0 2.0/3.0 7.0/7.0	Steel containment (a) Initial and final testings (1) $D+L+P_t+T_t+E$ (2) $D+L+P_t+T_t+E'$ (b) Normal operating (1) $D+L+T_o+R_o+E$ (2) $D+L+T_o+R_o+E'$ (3) $D+L+T_e+R_e+P_e+E$ (4) $D+L+T_e+R_e+P_e+E'$ (c) Refueling (1) $D+L+E$ (2) $D+L+E'$ (d) Accident (1) $D+L+T_a+R_a+P_a+E$ (2) $D+L+T_a+R_a+P_a+E'$ (3) $D+L+T_a+R_a+P_a+Y_r+Y_j+Y_m+E'$ (e) Flood (1) $D+L+E+F$ Sec. 3.8.2.3 p. 7 Sec. 3.8.3.3 p. 47 Sec. 3.8.4.3 p. 58 Sec. 3.8.5.3 p. 78	ASME, BPVC, Sec. III AISC 1969 Ed. ACI 318-63 Sec. 3.8.2.2 p. 4 Sec. 3.8.3.2 p. 45 Sec. 3.8.4.2 p. 57 Sec. 3.8.5.2 p. 78

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE	(% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
			LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Vital piping systems Fuel	0.5/1.0 7.0/7.0	Analytical and supplementary testing (NSSS) Secs. 3.7B.2.1 3.7B.2.1.6.1 3.7B.2.1.6.2 3.7B.2.1.7.1 3.7B.2.1.7.2 3.7B.2.1.8	Load combination definitions are according to ASME Sec III NB-3200 through NB-3600. For details see tables below, e.g., Table 3.9-4, "Reactor Pressure Vessel Internals and Associated Piping." Table 3.9-4, through 3.9-64	ASME, BPVC, Section III Table 3.9.-1, 3.9-2 Sec. 3.9.1.6 p. 3.9-8

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Not available.	Analytical and testing. Secs. 3.7A, A.3.1 3.7A, A.3.2 Table 3.9-23	Not available.	Seismic class I electrical equipment IEEE Std. 344-1971 p. 3.7A.A-1 to 3.7A.A-6 Tubing- ASME BPVC Section III

SEISMIC REVIEW TABLE

Docket Number
50-285

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM.	HOR. g	VERT. g					
Fort Calhoun Station Unit #1 Reactor type: PWR Containment type: Without Buttresses (Prestressed Concrete) NSSS Manufacturer: Combustion Engineering Architect Engineer: Gibbs & Hill, Inc.	0.08	.053	Unclear information	0.17	.0113	Time history—1940 El Centro and 1952 Taft normalized to the ground acceleration of the maximum hypothetical earthquake are used for developing floor response spectra.	3 components. Combination not available.	SRSS	Response spectra conform to the average spectra developed by Housner for frequency > 0.33 HZ and Newmark for frequency < 0.33 HZ.	Time history method.
6-68/5-73	Sec. 2.4 p. 2.4-3	Sec. 2.4 p. 2.4-3	Sec. 2.4 p. 2.4.1	Sec. 2.4 p. 2.4.3	Sec. 2.4 p. 2.4.3	Sec. F.2.2.4 p. F-10	App. F Sec. F.2.5 p. F-12	App. F Sec. F.2.2.3 p. F-9	App. F Sec. F.2.1.4 p. F-6	App. F Sec. F.2 p. F.10 & F.14

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
High strength concrete mat supported by pile foundation resting on bedrock (containment, auxiliary bldg.)	Compact granular. Fluvial deposits on lime-stone. Bedrock underlain by rock strata.	60 ft 4-8 ft 19-21 ft	Not available.	Missouri River Valley. Domestic wells depth 20 ft to 35 ft. Commercial wells depth 50 ft to 75 ft.	Gavin Point Fort Randall Big Bend Oahe Garrison Fort Peck	Stick model with soil springs.	Not available.	Not available.	0.05 SSE 0.02 OBE
Sec. 5.1 p. 5.1.1 Covering letter "Dames & Moore" App. C p. 10	Sec. 5.1 p. 5.1.1 App. C p. 6	Sec. 5.1 p. 5.1.1 App. C p. 6		Sec. 2.7.2 p. 2.7-6	Sec. 2.7 p. 2.7-1	Sec. F.2.2.3 p. F-8			Sec. F.2.2.3 p. F.9

SEISMIC REVIEW TABLE

STRUCTURES				
		DESIGN CRITERIA		
DAMPING OBE/SSE	(% critical damping)	**LOAD COMBINATION**		**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Containment structure:	2.0/2.0	1. D+L+S+T'''		Ultimate strength method ACI 318-63
Concrete support structures for reactor vessel and steam generators:	2.0/2.0	2. D+L+S+T'''+W or E		Modified ultimate strength design
Steel Assemblies:		3. D+L+P+S+T+W or E		No loss of function design for extreme environmental loading
Bolted or riveted	2.0/2.0	where:		
Welded	1.0/1.0	D	= Dead load including equipment weights and hydrostatic loading	
		L	= Live load	
Vital piping systems:	0.5/0.5	S	= Post-tensioning load (which varies with time)	
		P	= Accident design pressure	
Rigid vault type concrete structures:	2.0/5.0	T	= Thermal loads based on a temperature corresponding to pressure P	
		W	= Wind load	
Framed concrete structures:	5.0/7.0	E	= Design earthquake	
		T'''	= Thermal loads based on normal operating temperature	
		For further details refer to section 5.5.		
Sec. F-2.1.3 p. F-6		Sec. 5.5 p. 5.5-1 to 5.5-5a		Sec. F.2.1.1 p. 5.5-1 Sec. 5.5 p. F.3

SEISMIC REVIEW TABLE

MECHANICAL & PIPING

DAMPING OBE/SSE	(% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Mechanical equipment: **Piping:** **Appendix F** **Sec. F.2.1.3** **p. F.6** **Table F.2**	2.0/2.0 0.5/0.5	Analytical and testing. Appendix F Sec. F.2.2.2 p. F-7C	Reactor vessel: 1. Design loading + OBE: $P_m \leq S_m$; $P_b + P_L \leq 1.5 S_m$ 2. Normal operation + SSE: $P_m \leq S_d$; $P_b \leq 1.5 \left[1 - \left(\frac{P_m}{S_d} \right)^2 \right] S_d$ 3. Normal operation + SSE + pipe rupture: $P_m \leq S_L$; $P_b \leq 1.5 \left[1 - \left(\frac{P_m}{S_L} \right)^2 \right] S_1$ where $S_L = S_y + (1/3)\ (S_u - S_y)$ $S_d = 1.2 S_m$ Piping: 1. Design load + OBE: Applicable code allowable 2. N.O. + SSE: $P_m \leq S_d$; $P_b \leq 4/\pi\ S_d \cos\left(\frac{\pi}{2} \cdot \frac{P_m}{S_d} \right)$ 3. N.O. + SSE + pipe rupture: $P_m \leq S_L$; $P_b \leq 4/\pi\ S_L \cos\left(\frac{\pi}{2} \cdot \frac{P_m}{S_L} \right)$ For reactor vessel and piping Sec. F.2.1.2 Table F.1, p. F.4 and F.5, Appendix F	ASME, BPVC, Section III USAS, B31.1 and B31.7 Appendix F Sec. F.2.1.1 p. F.3

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Shop test, prototype test, field test or seismic analysis to meet Class I seismic criteria. Appendix F Sec. 6.14 Sec. F.2.2.2 p. 6.1-4 p. F.7.C, 7d	"Special seismic restraints will be installed at the electrical cable trays. The cable will be supported vertically and horizontally so as to meet the stress criteria under all conditions including postulated earthquakes." Sec. F.2.2.2 p. F.7.C	According to IEEE 344 "Guide for Seismic Qualification of Class I Equipment for Nuclear Power Generating Station" Sec. F.2.2.2 and Sec. 7.2.2 p. F.7.C and p. 7.2.1

SEISMIC REVIEW TABLE

Docket Number
50-267

NAME AND NSSS TYPE OF THE PLANT	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
CP/OL ISSUE DATE	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Fort St. Vrain Nuclear Generating Station (Unit 1) Reactor type: HTGR Containment type: Prestressed Concrete NSSS Manufacturer: Gulf General Atomic Architect Engineer: Sargent and Lundy Engineers	0.05	0.033	VII	0.10	0.067	TID-7024, "Nuclear Reactors and Earthquakes",AEC, 8/63	The horizontal results from spectral analysis were combined simultaneously with the vertical	PCRV: "Linear superposition of all modal contributions". All other Cat. I struct: SRSS	Response spectra were developed as recommended in AEC TID-7024. Housner	TID-7024
9-68/12-73	Amend. 14 Sec. 5.2.1.1 p. 5.2-4	Amend. 14 Sec. 5.2.1. p. 5.2-4		Amend. 14 Sec. 5.2.1.1 p. 5.2-4	Amend. 14 Sec. 5.2.1.1 p. 5.2-4	p. 14.1-1, App. E.13	p. 5.3-33	p. 14.1-4	Fig. 14.1-1 Sec. 14.1 p. 14.1-1, 14.1-3	p. 14.1-1 App. E.13

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION: TYPE	BEARING INFORMATION: THICKNESS	BEARING INFORMATION: V_s PROFILE	GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
1. Reactor, turbine buildings and heavy equipment, as well as the main and service water cooling towers. Straight shaft piers. drilled into the claystone bedrocks.	The major plant facilities will be founded on Pierre Shale bedrock (dark gray, silty	shale). 44 to 54 ft. p 1.2-2	Not available	Ground water level was well below proposed foundation level, except reactor building which extends below the water level.	V_S= 1200 fps @ 20 ft. V_S= 2400 fps @ 65 ft. Boring UH1	Lumped mass model with soil springs	G_S = 850 psi @ 20 ft. G_S = 104,000 psi @ 65 ft. Boring UH1	Not available	Not available
2. Miscellaneous light equipment. Spread footings. Sec. 2.6 p. 2.6-20	Above it lies St. Vrain Platte River alluvia sands and gravel	p. 1.2-2		Sec. 2.6 p. 2.6-21	Table 3-1	p. E. 37-12 Fig. E.13-1	Table 3-1 p. 3-8		

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE (% Critical damping)		DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Reinforced concrete: **PCRV. (prestressed concrete reactor vessel)** **Welded steel** **Bolted steel** **Amend. 16, p. 14.1-3**	2.0/5.0 2.0/5.0 2.0/5.0 2.0/10.0	PCRV: DL + 1.23 NWP + E′ + TL DL + 1.23 NWP + 1.5 TL NWP = Normal working pressure DL = Dead load E′ = SSE earthquake loads TL = Temperature loads Table E.1-1	For reactor core support structure: Concrete. ACI 318-63 Metal. ASME B and PV Code Sec. III. Class A Stress Criteria: Operating Principal Comp. $0.45\ Cf'_c$ Principal tension $3\sqrt{f'_c}$ Bearing tendon area $0.6f'_c\ 3\sqrt{ab'/ab'} < f'_c$ Bearing: Shear Anchors $0.6f'_c$ average Table E.1-1 Sec. 3.2, p. 3.2-2

MECHANICAL & PIPING				
DAMPING OBE/SSE (% critical damping)		METHOD OF QUALIFICATION	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Vital steel piping Amend. 16, p. 14.1-3	0.5/0.5	Dynamic seismic method for Class I System and piping based on Fig. "SSE" ground acceleration Sec. 1.4 p. 1.4-3 and Tests for Class I systems, Q. 5.1, Amend. 16 Attachment A, p. 5.1-1 and Q. 5.11, Amend. 16 Attachment A p. 5.11-1 and Amend. 1 Attachemnt A p. 5.11-9	For PCRV Internal Steel Structure: a) D. L. + Operating mechanical load $\leq$ 0.667 F_y b) D. L. + Operating mechanical load + Design seismic loads $\leq$ F_y c) D. L. + Operating mechanical + twice design seismic load $\leq$ No loss of safety function Amend. 16, p. 5.21-1, Table 3.2-1	For all piping systems: ANSI B.31.1.0-1967. For containment tank: ASME Code Sec. III-C For coolers: ASME Code Sec VIII Sec. 4.2, p. 4.2-10 Sec. 4.2, p.4.2-28 Sec. 4.2, p.4.2-35

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Tests and inspections. For auxiliary electrical system. Amend. 25 p. 8.4-1	Not available	Not available

SEISMIC REVIEW TABLE*

Docket Number
50-213

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Haddam Neck Nuclear Power Plant, Unit 1. Reactor type: PWR Containment type: Reinforced Concrete Cylindrical NSSS Manufacturer: Westinghouse Architect Engineer: Stone and Webster Engineering Corp. 5-64/6-67	Not used	Not used	Not used	0.17 (For safety related structures, e.g., reactor vessel, reactor coolants system safety injection system, spent fuel storage pit). 0.03 (for non-safety related). 12.5-4	0.11 12.5-4	Not used	For the reactor containment a vertical acceleration component equal to 2/3 the horizontal was assumed to act non-concurrently. Resulting stresses were lower than those from the horizontal component and so vertical accelerations were neglected.	No modal combinations - reactor containment analyzed as one degree of freedom system. For complex systems, the maximum acceleration from the damped Housner curve was used, otherwise primary period value was used. 2.5-4	Housner (JEMD, ASME, Oct. 1959) Fig. 2.5-1	No floor response spectra generated. Housner's "Average Acceleration spectrum" was used for all elevations.

*Information obtained from BNL Docket search and SEPB Report prepared by LLL, EDAL Report # 175-130.01, January 1979.

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Containment- 9 ft. mat. Spent fuel pit founded on bedrock with lowerside walls embedded in rock and earth. Major structures are founded directly on the granitic gneiss bedrock. Minor structures are founded either on rock on piles drived to rock or on spread footings in compacted granular fill.	SAMPLE: Boring	L-11	Not available	21 ft. MSL is yard grade. Calculated site flood stage is 15.1 MSL GWL: - 8 ft. MSL	Not available	Fixed base with single degree of freedom (containment).	Not available	Not used	Not used
	Loose loam	EL+7.0 to	+ 5.0						
	Firm fine sand and gravel	+ 5.0 to	-2.0						
	boulder	-2.0 to	-8.0						
	schist	-8.0 to	-30.0						
2.4-2	Fig. 2.4-4			2.3-3					

SEISMIC REVIEW TABLE

<table>
<tr><th colspan="3">STRUCTURES</th></tr>
<tr><th rowspan="2">DAMPING
OBE/SSE (% critical damping)</th><th colspan="2">DESIGN CRITERIA</th></tr>
<tr><th>LOAD COMBINATION</th><th>ACCEPTANCE CRITERIA & ALLOWABLE STRESSES</th></tr>
<tr><td>R/C containment: Include mat 7.0

R/C framed structure 5.0

Steel framed structures, include support. structure and foundation

bolted 2.5
welded 1.0

Table 2.5-2</td><td><u>Reinforcing steel - primary plus secondary</u>
operating + incident - 33.3 ksi
operating + .03g hor. - 26.7 ksi
operating + .03g hor. + incident - 33.3 ksi
operating + incident + 0.17g hor. - 40.0 ksi

- wind loads up to 150 mph
- 30 psf snow and ice (not included in combination)

p. 3.2-2<hr><u>Non-safety related systems</u>:

E (=Ø.Ø3g): No loss of function</td><td>ACI and ASME Codes plus Rayleigh method and equivalent static loads for seismic

p. 3.2-2</td></tr>
</table>

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA		
		LOAD COMBINATION		ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Piping:	Analytical	Reactor coolant Safety Injection System:	Component	Design Code
Carbon steel 0.5		Operating loads + E < working Stress (E = 0.17g)	Steam generator-	ASME Section VIII (1956 ed.)
Stainless steel 1.0			Reactor Coolant Pumps-	ASME Section VIII (1956 ed.)
			Reactor Coolant Piping -	ASA B31.1 (1955 ed.)
			Pressurizer	ASME Section VIII (1956 ed.) and Code Case Nos. 1224 and 1234
Reactor internals and CRD		Main Steam Piping:	Safety and Relief Valves	ASME Section I (1956 ed.) and Code Case Nos. 1224 and 1234
welded 1.0		Operating loads + E < Working Stress (E= 0.03g)		
bolted 2.0			Loop Stop Valves	ASA B16.5 (1957 ed.)
Mechanical equipment includes pumps and fans 2.0			Loop Check Valves	ASA B16.5 (1957 ed.)
			Pressure Control and Relief System Piping	ASA B31.1 (1955 ed.)
			Low Pressure Surge Tank	ASME Section VIII (1956 ed.)
Table 2.5.2				

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE (% Critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Not available	No testing	Not available	Not available

SEISMIC REVIEW TABLE

Docket Number
50-261

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
H. B. Robinson Nuclear Steam Electric Plant Unit No. 2 Reactor type: PWR Containment type: without buttresses (prestressed concrete) NSSS Manufactuer: Westinghouse Architect Engineer: Ebasco	0.10	0.067	VII	0.20	0.133	Not used.	X and Y (vertical) or Z and Y (vertical) applied together. Combination not available.	Absolute sum.	Housner spectra.	No floor response spectra generated. Housner spectra used for components.
4-67/8-70	p. 5.1.2-6	p. 5.1.2-6		p. 5.1.2-6	p. 5.1.2-6	p. 5A-4	Question III A 11	Question IIA	Figures 2.9-2 9.9-3 p. 2.9-9	p. 5A-4

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
A 144 ft. diameter circular reinforced concrete slab 10 ft. in thickness supported by 923 steel pile. p. 5.1.2-20 TYPE (cont.) * over 430 ft. middendorf formations. Sec. 2.8.3 p. 2.8-6 Dock. 50261-104	The piedmont crystalline basement rock at the site is overlaid with 460 ft. of unconsolidated coastal plain sediment. These sediments are comprised: 30 ft. of surface alluvium * (cont.)	The middendorf is made up of sands, silty and sandy clay, sandstone and mudstone. Fig. 2.8-2 Basement Rock Middendorf 430ft. Alluvium 30ft.	Not available.	Not available.	Earth dam at the site has a central vertical clay core and supporting shells of compacted sand. The crest of the dam is at El. 230, the normal pool is at El. 220 and the dam has a maximum height of 50 ft. The crown width of dam is 15 ft. and side slopes are 1(vertical): **	Not available **DAM (cont.) 3(horizontal) on upstream side and 1 (vertical): 2.5(Horizontal) on downstream with 15 ft. berm at El. 200. Sec. 2.9.8 p. 2.9-10 Dock. 50261-104	Not available.	Not available.	The modal analysis was performed utilizing the same damping factor for each mode. Question III A4

SEISMIC REVIEW TABLE

STRUCTURES			
		DESIGN CRITERIA	
DAMPING OBE/SSE	(% critical damping)	**LOAD COMBINATION**	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Containment structure: Concrete support structure of reactor vessel: Concrete structures above ground: (a) Shear wall (b) Rigid frame Table 5A.1-1 p. 5A-5	2.0 2.0 5.0 5.0	For containment structure: (a) $C=1.0D\pm0.05D+1.5P+1.0(T+TL)+1.0B$ (b) $C=1.0D\pm0.05D+1.25P+1.0(T'+TL')+1.25E+1.0B$ (c) $C=1.0D\pm0.05D+1.0P+1.0(T''+TL'')+1.0E'+1.0B$ (d) $C=1.0D\pm0.05D+1.0P_T+1.0(T_T+TL_o)+1.25WT+1.0B$ (e) $C=1.0D\pm0.05D+1.15P_D$ Symbols used in these formulas are defined on p. 5.1.2-9. p. 5.1.2-8	For containment structure using ACI 318-63 Ultimate strength design.

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA** — **LOAD COMBINATION**	**DESIGN CRITERIA** — **ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Vital pipe systems: 0.5 Steel assemblies: (a) Bolted or riveted 2.5 (b) Welded 1.0 Table 5A.1-1 p. 5A-5	Analytical	**Vessels** / **Piping** 1. Normal loads — Vessels: $P_m \leq S_m$, $P_L+P_B \leq 1.5S_m$; Piping: $P_m \leq S$, $P_L+P_B \leq S$ 2. Normal + design earthquake loads — Vessels: $P_m \leq S_m$, $P_L+P_B \leq 1.5S_m$; Piping: $P_m \leq 1.2S$, $P_L+P_B \leq 1.2S$ 3. Normal + assumed hypothetical earthquake loads — Vessels: $P_m \leq 1.2S_m$, $P_L+P_B \leq 1.2(1.5S_m)$; Piping: $P_m \leq 1.2S$, $P_L+P_B \leq 1.2(1.5S)$ 4. Normal + pipe rupture loads — Vessels: $P_m \leq 1.2S_m$, $P_L+P_B \leq 1.2(1.5S_m)$; Piping: $P_m \leq 1.2S$, $P_L+P_B \leq 1.2(1.5S)$ P_m = primary general membrane stress; or stress intensity. P_L = primary local membrane stress; or stress intensity. P_B = primary bending stress; or stress intensity. S_m = stress intensity value from ASME, BPVC Code, Section III S = allowable stress from USAS B31.1 Code for pressure piping. Table 5A.3-1	Pressure piping: USAS B31.1 Pressure vessel: ASME,BPVC p. 5A-3

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Circuits and equipment were subjected to vibration tests which simulated the seismic conditions for the "low seismic" class of plants. p. 7.5-13	Not available.	Electrical equipment: WCAP 7397-L p. 7.5-14 Amendment 10

SEISMIC REVIEW TABLE

Docket Number
50-133

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Humboldt Bay Power Plant, Unit 3 Reactor type: BWR Containment type: Pre-mark (steel) NSSS Manufacturer: General Electric Architect Engineer: Bechtel	0.25	0.17	VIII	0.50	0.333	Time-histories given in BC-TOP-4A	BC-TOP-4A	BC-TOP-4A	Reg. Guide 1.60, Rev. 1, 1973	Time history BC-TOP-4A
11-60/8-62	p. 1-1	p. 1-1	FHSR Amend. 11 p. 125	FHSR, Amend. 11, p. 162		p. 5-3				p. 5-1

Information gathered from FHSR Amend. 11 (50133-1), Amend. 13 (50133-3)
FSAR Supp. (50133-59), FSAR proposed Amend (50133-124), FSAR Supp. Emergency Plant (50133-183)
and Summary Report of Seismic Design Review, Rev. 3, 1977.

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Not available	Sand and alluvium overlaying strata of Hookton and Carlotta formation which are more or less consolidated sands. Gravels and clays and conclomerates with good structural properties.	Not available	Not available	Not available	Not available	2 dimensional finite element model which includes embedded reactor caissions p. 5-1		BC -	TOP 4A

FHSR, Amend 11,
Sec. I, p. 155

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE	**DESIGN CRITERIA**	
	LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
R. G. 1.61 (BC-TOP-4A)	Accident Condition Concrete structures: $U = D + L + T_A + H_A + R + 1.5\ P$ $U = D + L + T_A + H_A + R + 1.25\ P + 1.25\ E$ $U = D + L + T_A + H_A + R + P + E'$ $U = D + L + T_o + H_o + E'$ Steel Structures Elastic working stress $1.6S = D + L + T_A + H_A + R + P$ $1.6S = D + L + T_A + H_A + R + P + E$ $1.6S = D + L + T_A + H_A + R + P + E'$ Plastic $0.9\ Y = D + L + T_A + H_A + R + 1.5\ P$ $0.9\ Y = D + L + T_A + H_A + R + 1.25\ P + 1.25\ E$ $0.9\ Y = D + L + T_A + H_A + R + P + E'$ App. B-3	AWS D1.1-74 welded steel tanks for oil storage, API 650, 1973 BC-TOP-9A, Design of structures for missile impact, Rev. 2, 1974 UBC - 1973 ACI -214 - 65 ACI -318 - 71 AISC - 1969 p. C-1 p. C-2

SEISMIC REVIEW TABLE

MECHANICAL & PIPING						
DAMPING OBE/SSE	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**				
		LOAD COMBINATION				**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Reg. Guide 1.61 (BC-TOP-4A)	Test or Analysis	Piping System				BN-TOP-2, Design for pipe break effects
		Plant Operating Condition	Loading Condition	ASME SEC.III Ref.	Allowable Stress	
		Normal	P + W	Eq.(8) of NC-3652.1	S_H	
		Upset	P + W + OBE P + W + FV*	Eq.(9) of NC-3652.2	1.2 S_H	
		Faulted	P + W + SSE	Eq.(9) of Code Case 1606 NC-3652.2	2.4 S_H	
		Normal & Upset	TH	Eq.(10) of NC-3652.3(a)	S_A	
			P + W + TH	Eq.(11) of NC-3652.3(b)	$S_A + S_H$	
		Vessel Loading Conditions				
		Upset	P + W + OBE	NC-3300 Sec. VIII Code Case 1607	$P_M \leq 1.10$ S $(P_M$ or $P_L) + P_B \leq$	1.65 S
		Faulted	P + W +SSE	NC-3300 Sect. VIII, Div. 1	$P_M \leq 2.0$ S $(P_M$ or $P_L) + P_B \leq$	2.4 S
	Table 6.1	p. B-5,6				

*Applies to main steam line

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Test and/or analysis Table 6.1, p. 9-1	Not available	Recommended practices for seismic qualification of Class 1E equipment for NPP, IEEE 344, Jan. 1975. Table 6.1 p. 8-1

SEISMIC REVIEW TABLE

Docket Number
50-3

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA: OBE HOR. g	EARTHQUAKE DATA: OBE VERT. g	EARTHQUAKE DATA: SSE INTENSITY MM	EARTHQUAKE DATA: SSE HOR. g	EARTHQUAKE DATA: SSE VERT. g	EARTHQUAKE TIME HISTORY	METHOD OF COMBINATION: NO. OF EARTH. COMP. USED AND ITS COMB.	METHOD OF COMBINATION: MODAL COMB.	DESIGN SPECTRA: TYPE OF GROUND DESIGN SPECTRA	DESIGN SPECTRA: METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
Indian Point Nuclear Generating Station, Unit No. 1 Reactor type: BWR Containment type: Dry containment-spherical (steel) NSSS Manufacturer: Babcock and Wilcox Architect Engineer: United Engineers and Constructors 5-56/3-62	None	None	Not available	0.10g for containment structure (including steel sphere and interior structure), nuclear service bldg., chemical systems bldg., fuel handling bldg., stack J. Blume p. vi,	.090g for screenwell house 0.03g for superheater bldg. 0.05g for vertical analysis	Synthetic Time History "Earthquake Analysis of Piping Systems." 9-12-69 J. Blume Report, p. 1-2	Each horizontal combined with vertical simultaneously Sheet* 161.1 p. D.2-2	SRSS Sheet 10.1 p. 1-6	Synthetic design spectra TID-7024 Housner "Earthquake and Tornado Analysis of Structures" 9-5-69 J. Blume Report p.1-2	Time-history method J. Blume Report on Piping Systems, p. 1-2 Class I structure Sheet 10.1, p. 1-4, 5 Piping Sheet 11.1, p. 1-2, 5 Reanalyzed, Sheet 4.30, p. 1,2,3

* "Sheet" refers to microfiche Sheet #

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete mat. Sheet 10.1 p. 2-1	Hard, well-bedded dolomitic limestone, bedrock is extremely jointed and fractured joint systems extend at near right angles to bedding, other systems are irregular. The intensity is almost brecciation.	Foundation sits on bedrock Sheet 10.1 p. 2-1	Not available	Not available	Not available	Stick model with foundation rigidly fixed to bedrock. Sheet 10.1 p. 2-1	Not available	No damping assumed Sheet 10.1 p. 2-1	Not available

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE (% critical damping)	**DESIGN CRITERIA** — **LOAD COMBINATION**	**DESIGN CRITERIA** — **ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Reinforced concrete 5.0/5.0 **Structural steel - bolted** 2.0/2.5 **- welded** 1.0/1.0 Sheet 10.1, p. 1-2 Sheet 430, p. 1	First analysis- C = (1.0 ± 0.05) D + (E or W) C = Required load capacity; E = earthquake loads D = Normal loads (dead load of structure, plus any normal operating live loads) Sheet 10.1, p. 1-3 Reanalysis- $U = D + L + F_{eqs} + T_a = P_A$ - steel containment $U = D + L + T_a + F_{eqs}$ - Biological shield $U = D + L + F_{eqs}$ - other Class I structures D = Dead loads; L = live loads T_a = Thermal loads; P_A = pressure loads F_{eqs} = SSE loads Sheet 4.30, p. 1 and 2 Sheet 114.2, Question 7	ACI Standard- ACI 318-63 "Ultimate Strength Design" ASME BPVC, Sec. VIII Sheet 4.1, p. 1-4 Sheet 10.1, p. 1-3 and Sheet 10.2

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE (% critical damping)		METHOD OF QUALIFICATION	DESIGN CRITERIA	
			LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Piping	0.5/0.5	Analytical	Reanalysis $U = D + P + P_A' + F_{eqs}$ - piping $U = D + L + F_{eqs}$ - component supports D = Dead doads L = Live loads P = Internal pressure loads P_A' ="Load on safeguard systems in the event of LOCA" F_{eqs} = SSE loads	ASME - USA Standards , code for pressure piping, nuclear power piping, USAS B31.7 also ASME BPVC, Sec. III
Sheet 11.1, p. 1-3 Sheet 430,p. 1		Sheet 5 Sec. 2.1.2.1 p. 4	Sheet 430 p. 1 and 2	Sheet 11.1 p. V. and Sheet 5, Sec. 3.0 p. 8

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Not available	Not available

SEISMIC REVIEW TABLE

Docket Number
50-247

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Indian Point Nuclear Generating Station, Unit No. 2 Reactor type: PWR Containment type: Atmospheric (Reinforced Concrete) NSSS Manufacturer: Westinghouse Architect Engineer: United Engineers & Constructors	0.10	0.05	VI	0.15	0.10	None used	Horizontal and vertical. acting simultaneously	SRSS	Housner	No floor response spectra generated; ground response spectra used for piping and components.
10-66/10-71	Sec. 1.2.2 p. 1.2-9		Sec. 2.8 p. 2.8-1	Sec. 1.2.2 p. 1.2-9		App. A	p. A-3	Q. 1.3-2 Suppl. 9 (5/70)	Fig. A.1-2	Sec. 3.1.5 p. 3.0-9 Supp. 6 (2/70)

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION: TYPE	BEARING INFORMATION: THICKNESS	BEARING INFORMATION: V_s PROFILE	GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
Mat foundation 9ft. thick. Sec. 1.3.0 p. 1.0-4 Supp. 6 (2/70)	Hard, wellbedded dolomitic limestone. This bedrock is extremely jointed and fractured. Joint systems extended at near right angles to bedding, other systems are irregular. The intensity may be described almost as brecciation. Sec. 2.7 p. W-4	Not available.	Not available.	Stony Point: about 35ft. depth Rockland County 100ft. to 300ft. depth At the fringe of Westchester County depth less than 50ft. Vol. 1, Sec. 2.5, p. 5-10	Not available.	Structure: Stick Model Fixed base Sec. 3.1.5, p. 3.0-9, Suppl. 9	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE	**(% critical damping)**	**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Containment structure	2.0 *	a) C = 1.0D ± 0.05D + 1.5P + 1.0 (T + TL) b) C = 1.0D ± 0.05D + 1.25P + 1.0 (T′+ TL′) + 1.25E c) C = 1.0D ± 0.05D + 1.0P + 1.0 (T" + TL") + 1.0E′ C = Required load capacity section D = Dead load of structure and equipment loads P = Accident pressure load T = Load due to maximum temperature gradient through the concrete shell and mat based upon temperature associated with 1.5 x (accident pressure) TL = Load exerted by the liner based upon temperature associated with 1.5 x (accident pressure) T′ = Load due to maximum temperature gradient through the concrete shell and mat based upon temperature associated with 1.25 x (accident pressure) TL′ = Load exerted by the liner based upon temperature associated with 1.25 x (accident pressure) E = Load resulting from operational basis earthquake T" = Load due to maximum temperature gradient through the concrete shell, and mat based upon temperature associated with the accident pressure TL" = Load exerted by the liner based upon temperature associated with the accident pressure E′ = Load resulting from design basis earthquake	ACI 318-63
Concrete support structure of reactor vessel	2.0		
Steel assemblies:			
(a) bolted or riveted	2.5		
(b) welded	1.0		
Concrete structures above ground			
(a) shear wall	5.0		
(b) rigid frame	5.0		
* One damping value is given, but not clear whether for O.B.E. or D.B.E.			
Sec. 5.1.3.8, p. 5.1.3-6		Sec. 2.1.12, p. 2.0-5, Supp. 6	Sec. 2.1.12, p. 2.0-7 and Sec. 2.1.13, p. 2.0-8 Supp. 6

SEISMIC REVIEW TABLE

MECHANICAL & PIPING						
DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA				
		LOAD COMBINATION				ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
		L. C.	Vessel	Piping	Supports	
Vital Piping Systems 0.5*	Analytical and Testing	1. Normal loads	$P_M \leq S_M$ $P_L + P_B \leq 1.5\ S_M$	$P_M \leq S$ $P_L + P_B \leq S$	Working stress or applicable factored load value	For mechanical: ASME , BPVC, Section III For piping: USAS B31.1 (1955) For further details refer to Q. 4.10
* One damping value is given. But not clear whether for O.B.E. or D.B.E.		2. Normal + Design E.Q.	Same as above	$P_M \leq 1.2\ S$ $P_L + P_B \leq 1.2\ S$	1 1/3 working stress	
		3. Normal + SSE	$P_M \leq 1.2\ S_M$ $P_L + P_B \leq 1.2\ (1.5\ S_M)$	$P_M \leq 1.2\ S$ $P_L + P_B \leq 1.2(1.5\ S)$	Maintain equip. within stress limits	
		4. Normal + pipe rupture	Same as above	Same as above	Same as above	
Sec. 5.1.3.8, p. 5.1.3-7	Sec. 5.1.3.8 p.5.1.3-6 and Q.4.5, Q.4.5-1 Supp. 6	Table A.3-1				Sec. 3.2.3, p. 3.2.3-3 Sec. Q. 4.5, p. Q. 4.5-1 Supp. 6

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

Docket Number
50-286

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Indian Point Nuclear Generating Station, Unit No. 3 Reactor type: PWR Containment type: Atmospheric (reinforced concrete) NSSS Manufacturer: Westinghouse Architect Engineer: United Engineer and Contractors	.10	.05	VII	.15	.10	Compared with (1) El Centro 12/30/34 and 5/18/40 (2) Olympia 4/13/49 (3) Taft 7/21/52.	3 components: Each horizontal combined with vertical component by absolute sum.	SRSS; closely spaced (10%) modes combined by absolute sum.	Containment response: Housner spectra	Time history.
8-69/5-76	Sec. 5.1.2.2 p. 5.1.2-4	Sec. 5.1.2.2 p. 5.1.2-4		Sec. 5.1.2.2 p. 5.1.2-4	Sec. 5.1.2.2 p. 5.1.2-4	p. A1-9, Appendix A1 Curves-Fig. A1-1&2	Question 5.22	p. Q5.28-1 p. Q5.37-1	Sec. 5.1.3.5 p. 5.1.3-3	p. Q4.32-1 Vol. VI

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Concrete base mat--9 feet thick. Sec. 5.1.2.1 p. 5.1.2-1	Fine-grained phyllite, a schist, and limestone with bedrock lying close to the surface. Bedrock is jointed and fractured. Sec. 2.7 p. 2.7-1	Not available.	Not available.	Fluctuates between El. 35 to El. 55 (MSL) See Fig. 2.7-3	Three reservoirs are within five mile radius. No information on dams is available. Sec. 2.5 p. 2.5-2	Structure: stick model Soil: cantilever beam assumption indicates fixed base modeling. Appendix 5A Sec. 3.1.5 p. 5A-26→28	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE	(% critical damping)	**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Containment: **Concrete support structure of reactor vessel:** **Concrete structures above ground:** **(a) shear wall** **(b) rigid frame** **Steel assemblies:** **(a) bolted or riveted** **(b) welded**	2.0/5.0 2.0/2.0 5.0/5.0 5.0/5.0 2.5/2.5 1.0/1.0	Containment factored load equations: (a) C=1.0D±0.05D+1.5P±1.0(T+TL) (b) C=1.0D±0.05D+1.25P+1.0(T'+TL')+1.25E (c) C=1.0D±0.05D+1.0P+1.0(T''+TL'')+1.0E' (d) C=1.0D±0.05D+1.0W' (a) = LOCI (b) = Design base accident (DBA)+OBE (c) = DBA+SSE (d) = Design base tornado where C = required load capacity D = dead loads P = accident pressure load T = maximum temperature gradient load associated with 1.5P. TL = liner load due to temperature associated with 1.5P. W' = tornado wind and external pressure drop T' and TL' are T and TL but due to 1.25P. T'' and TL'' are T and TL but due to 1.0P. E = operational base earthquake load E' = design base earthquake load	Containment concrete-- ACI-318-63 Ultimate strength design ACI 318-63 Part IV-B
Sec. 2.1.8, p. 5A-10, Appendix 5A **Table A.1-1, p. A1-10, Appendix A1**		p. 5A-13 Appendix 5-A Table 3.2, 4.1	p. 5.1.1-2 p. 5A-13, Appendix 5-A

SEISMIC REVIEW TABLE

MECHANICAL & PIPING						
DAMPING OBE/SSE	(% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA: LOAD COMBINATION			DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
				Piping	Vessels	
Piping:	0.5/0.5	Analytical.	(1) Normal=D+T+P	$P \leq \sigma$	$P_m \leq S_m$ & $P_L \leq 1.5S_m$ P_m(or P_L)$+P_B \leq 1.5S_m$	Piping: ANSI B31.1-1955 ASME BPVC Sec. III-1965
			(2) Upset=D+T+P+E	$P \leq 1.2\sigma$	P_m(or P_L)$+P_B+Q \leq 3.0S_m$	
			(3) Faulted=D+T+P+E'	Design limit curves	$P_m \leq (1.25S_m)$ or S_y or $P_L \leq (1.25S_m)$ or $1.5S_y$ whichever is larger	
			(4) Faulted=D+T+P+PR	Design limit curves	P_m(or P_L)$+P_B \leq 1.5(1.2S_m)$ or $1.5S_y$ whichever is larger	
			(5) Faulted=D+T+P+E'+PR	Design limit curves	For stress limit refer to Table A.1-3	
			D = dead load, T = thermal load, P = pressure load, E = OBE, E' = SSE			
Table A.1-1, p. A.1-10 p. 4.2-8; p. 4.3-29		Sec. 2 p. A.3-3 p. A.3-10-12 For testing p. Q4.17 Vol. VI	Sec. 4.0, p. A1-18, Appendix A1			Table 4.10-6 & 10 p. 4.9-2

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	**Analytical and testing.** **Sec. 3** **Appendix A3** **p. Q5.16-2** **Vol. VI**	**Not available.**	**Westinghouse Report** **WCAP-7817** **"Seismic Testing of Electrical and Control Equipment"** Sec. 3 p. A.3-6, 7, 8 Appendix A3 Supplement 4

SEISMIC REVIEW TABLE

Docket Number
50-333

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
James A. Fitzpatrick Nuclear Power Plant Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Stone and Webster Engineering Corp. 5-70/10-74	0.08 p. 2.6-1	.053 p. 2.6-1	VIII	0.15 p. 2.6-1	0.10 p.2.6-1	Articifical time-history used Sec. 2.6 , p. 2.6-1	3 components. Results for earthquake in X and Y(vertical) directions simultaneously, and Z and Y directions simultaneously were computed separately. App. C 3.3 p. C.3-4	SRSS Sec. 12.5.1 p. 12.5-1	Housner Sec. 2.6, p. 2.6-2 See Fig. 2.6-1 and Fig. 2.6-2	Time-history method. Sec. 12.5.4, p. 12.5-13

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete mat. 5'-9" thick embedded 45 ft. below top of bedrock in the surrounding area Sec. 12.3.1, p. 12.3-1	10-12ft. of glacial till which lies directly on top of the Oswego sandstone with laminations and lenticular beds of dark gray shale At 130 ft. below surface it makes contact with Lorraine Group Sec. 2.5 p. 2.5-1	150 ft. of Oswego sandstone	Not available.	Water table at the site slopes toward Lake Ontario at an average gradient of 37 ft. per mile and the direction of ground water is toward the lake. Sec. 2.4.1 p. 2.4-1	Not available.	Stick model with springs to model the rock. Sec. 12.5.1.1 p. 12.5-1	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

STRUCTURES					
		DESIGN CRITERIA			
DAMPING OBE/SSE	(% critical damping)	LOAD COMBINATION			ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
		L. C.	Structural steel	Concrete	
Concrete structures	2.0/5.0	1. Normal dead + live load	AISC Code	ACI 318 working stress	Building code requirements ACI-318 (working stress design)
Steel frame structures,		2. "1" + wind	1/3 increase of AISC	1/3 increase per ACI Code	Specific for structural concrete ACI-301
Bolted and riveted assemblies	2.0/3.0	3. "1" + OBE	Same as above	Same as above	
Welded assemblies	1.0/1.0	4. "1" + DBE	90% of yield	75% of ultimate	Concrete chimneys ACI-307
Fluid containers	0.5/0.5				AISC
		5. Normal dead + tornado load	Same as above	Same as above	NY State Building Construction Code
		6. Normal dead + max. possible flood	Same as above	Same as above	
Sec. 12, Table 12.4-2			Table 12.4.3		Sec. 12.4.8 to 12.4-5

SEISMIC REVIEW TABLE

<table>
<tr><th colspan="5">MECHANICAL & PIPING</th></tr>
<tr><th></th><th>DAMPING OBE/SSE (% critical damping)</th><th>METHOD OF QUALIFICATION</th><th colspan="2">DESIGN CRITERIA</th></tr>
<tr><th></th><th></th><th></th><th>LOAD COMBINATION</th><th>ACCEPTANCE CRITERIA & ALLOWABLE STRESSES</th></tr>
<tr><td>Vital piping systems</td><td>0.5/1.0</td><td>Analytical</td><td>Piping:
1. General membrane primary stress:
$S_{LP} + S_{DL} \le S_m$
2. Operating basis earthquake:
$S_{LP} + S_{DL} + S_{OBEQ} = S_{LP} + \frac{M_R}{SM} i \le 1.8\ S_m$
where $M_R = \sqrt{(M_{x1} \pm M_{x2})^2 \pm (M_{y1} \pm M_{y2})^2 + (M_{z1} \pm M_{z2})^2}$
3. Design basis earthquake
$S_{LP} + (S_{DL} + S_{TH} + S_{DBEQ}) = S_{LP} + \frac{M_R}{SM} i \le 3\ S_m$
where
$M_R = \sqrt{(M_{x1} + M_{x2} \pm M_{x3})^2 + (M_{y1} + M_{y2} \pm M_{y3})^2 + (M_{z1} + M_{z2} \pm M_{z3})^2}$
———
S_{LP} = Longitudinal Pressure Stress
S_{DL} = Dead Load Stress
S_{TH} = Thermal Stress
S_{OBEQ} = Operating Earthquake Stress
S_{DBEQ} = Design Earthquake Stress
S_m = Allowable Stress at operating temperature
i = Appropriate stress intensification factor
SM = Section modulus</td><td>For piping:
ANSI B31.1.0
App. C.3.3, p. c.3-3

Mechanical:
ASME BPVC Section III Subsection B, 1968 Edition and Addenda published to June 30, 1968.</td></tr>
<tr><td>Sec. 12, Table 12.4-2</td><td></td><td>Sec. 12.5.4, p. 12.5-11</td><td></td><td>App. I.3.2.2, p. I.3-2</td></tr>
</table>

Section 12.5.4, p. 12.5-10 to p. 12.5-11

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Not available	Not available

SEISMIC REVIEW TABLE

Docket Number
50-348

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Joseph M. Farley Nuclear Power Plant Units I and II Reactor type: PWR Containment type: 3 buttresses with shallow dome (prestressed concrete) NSSS Manufacturer: Westinghouse Architect Engineer: Bechtel	0.05	0.033	VI	0.10	0.067	Synthesized time history.	3 components: Each horizontal combined with vertical component.	SRSS Closely spaced modes are combined absolutely	Modified Newmark curves.	Time history method.
Unit I: 8-72/6-77 Unit II: 8-72/6-77	Sec. 2.5.2.11	Sec. 2.5.2.11	Sec. 2.5.2.10 p. 2.5-33	Sec. 2.5.2.10 p.2.5-33	Sec. 2.5.2.10 p.2.5-33	Sec. 3.7.1.2 p. 3.7-2	Sec. 3.7.3.7 p. 3.7-14	Sec. 3.7.3.3.4 p. 3.7-13	Sec. 3.7.1.1 p. 3.7-1	Sec. 3.7.2.1 p. 3.7-6

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Rigid mat foundation 9 ft. thick on Lisbon formation. Sec. 2B6.2 p. 2B-15 Sec. 3.8.1.1 p. 3.8-1	Upper residium. Lower residium. Moody's limestone Lisbon formation Sec. 2B.4.3.2 p. 2B-8	40 ft 30 ft 10 ft Sec. 2B.4.3.2 p. 2B-8	Not available.	Approximately 55-65 ft below grade. Sec. 2B.4.3.2 p. 2B-8	There are 13 dams upstream, 14 dams in area: Jim Woodruff, Columbia, Walter F. George, Eagle, City Mills, North Highlands, Oliver, Goat Rock, Bartlett's Ferry, Riverview, Langdale, West Point, Morgan Falls, and Buford Dams. Fig. 2.4-14	Stick model with soil springs. Sec. 3.7.1.6 p. 3.7-3	Soils- 3,000-21,000 psi Lisbon- 50,000-970,000 psi Sec. 2B.7.2.2 p. 2B-20	0.04 critical damping for OBE. 0.07 critical damping for SSE. Table 3.7-1	Not available.

SEISMIC REVIEW TABLE

STRUCTURES			
		DESIGN CRITERIA	
DAMPING OBE/SSE	(% critical damping)	**LOAD COMBINATION**	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Welded steel frame structures: **Reinforced concrete structures plus equipment supports:** **Prestressed concrete structures:** **Table 3.7-1**	2.0/5.0 2.0/5.0 2.0/5.0	Design loading case: 1. D+F+L (construction case) 2. D+F+L+T_o+E (or W) (operating case) 3. D+F+L+P+T_e (design accident case) 4. D+F+L+T_s+E (or W) (prolonged shutdown case) 5. D+F+L+1.15P (test case) Factored loading case: 1. C=1/ϕ(1.0D+1.5P+1.0T_a+1.0F) 2. C=1/ϕ(1.0D+1.25P+1.0T_a+1.25H+1.25E (or 1.25W) +1.0F) 3. C=1/ϕ(1.0D+1.25H+1.0R+1.0F+1.25E (or 1.25W) +1.0T_o) 4. C=1/ϕ(1.0D+1.25H+1.0F+1.25W_t+1.0T_o) 5. C=1/ϕ(1.0D+1.0P+1.0T_a+1.0H+1.0E'+1.0F) 6. C=1/ϕ(1.0D+1.0H+1.0R+1.0E'+1.0F+1.0T_o) Sec. 3.8.1.3 p. 3.8-13	ACI 318-63 AISC 1969 AEC Reg. Guides For further details refer to Section 3.8.1.2. Sec. 3.8.1.2 p. 3.8-3

SEISMIC REVIEW TABLE

MECHANICAL & PIPING						
DAMPING OBE/SSE	(% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA			
			LOAD COMBINATION		ACCEPTANCE CRITERIA & ALLOWABLE STRESSES	
Vital piping:	0.5/1.0	Analytical and Testing	L. C. -Class 1 Components	Stress Limits	ASME, BPVC, Section III, Table 3.9-3	
Welded steel plate assemblies:	1.0/2.0		Normal	$P_M \leq S_M$ $P_L \leq 1.5\ S_M$ P_M (or P_L) + $P_B \leq 1.5\ S_M$ P_M (or P_L) + P_B + Q $\leq 3.0\ S_M$	"Design Criteria for Components not covered by ASME Code."	
Bolted and riveted steel:	3.0/5.0				Ex. Heat exchangers - ARI 410-64	
					Fan	AMCA Test Code 300-67, 211 A-67
			Upset	Same as normal		
			Faulted	Table 5.2-6		
Table 3.7-1		Sec. 3.7.2.1 p. 3.7-5 3.9-1, 3.9-24 3.9-3	p. 3.9-1, Table 3.9-1, Table 5.2-4, -5, -6, -7		Table 3-9-3 Section 3.9.2, 3.9.2	

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Testing and analysis. Sec. 3.10.1 p. 3.10-2	For electrical cable tunnels: (Dead load + live load + E.Q.) 0.75 $\leq$ maximum allowable stress Table 3.8-14	IEEE 344-1971 Sec. 3.10.1,2 p. 3.10-2,3

SEISMIC REVIEW TABLE

Docket Number
50-305

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Kewaunee Nuclear Power Plant Reactor type: PWR Containment type: Dry containment-cylindrical (steel) NSSS Manufacturer: Westinghouse Architect Engineer: Pioneer	0.06	0.04	V normal focus shock within 7 miles of plant site. VII normal focus shock	0.12	0.08	Synthetic time history	Horizontal and vertical components Combination not known	SRSS	Newmark method	Spectral method Blume report #JAB-PS-01, JAB-PS-03
8-68/12-73	App. B Sec. B.4.5 p. B.4-2	App. B Sec. B.6.3 p. B.6-5	App. A p. 31-32	App. B Sec. B.4.5 p. B.4-3	App. B Sec. B.6.3 p.B.6-6		App. B p. B.6-5	App. B p. B.6-5	Plate 8-A and Plate 8-B App. A p. 33	App. B p. B.6-5

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Soil-bearing type (Raft-type formation) Concrete base slab 35 ft. depth of slab	Glacial till Glacial lacus-trine deposits	60-150 ft	Shear wave velocity soil =2500 fps	Varies from 10-30 ft below ground surface	Not avail-able.	Stick model with soil springs.	Glacial till $G=1x10^7$ lbs/sq ft Glacial lucustrine deposits $G=5x10^5$ lbs/sq ft Bedrock $G=7.5x10^8$ lbs/sq ft	5% critical damping OBE,SSE	Not avail-able.
	Bedrock (Niagra dolomite)	350-600 ft	Shear wave velocity rock =11,500 fps						
App. E Sec. E.1-E.3 Fig. E.2-5	App. A p. 16	App. A p. 16	App. A p. 16	App. A p. 11		App. B Sec. B.6.3 p. B.6-5	App. A p. 26 - Table 7	App. B Table B.6-5	

SEISMIC REVIEW TABLE

STRUCTURES				
DAMPING OBE/SSE	(% critical damping)	DESIGN CRITERIA		
		LOAD COMBINATION		ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Reactor Containment vessel	1.0/1.0			ACI 318-63
Shield building	2.0/2.0	Normal operating	Dead+live+wind+snow	
Reactor containment vessel internal concrete	5.0/5.0	OBE	Dead+live+DBA+snow+greater of the OBE or wind	
Steel frame structures	2.0/2.0	DBE	Dead+live+snow+DBA+DBE	
Reinforced concrete construction	2.0/2.0	Tornado	Dead+live+300 mph design tornado+tornado missile, if any	
App. B Table B.6-5		Table B.6-1		App. B Table B.6-2

SEISMIC REVIEW TABLE

MECHANICAL & PIPING					
DAMPING OBE/SSE	(% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA		
			LOAD COMBINATION		ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
				Pressure Vessels / Piping	
Piping systems	0.5/0.5	Analytical or Tests.	Normal condition:	(a) $P_m \leq S_m$ (b) P_m (or P_L)+$P_b \leq 1.5S_m$ — Piping: $P \leq S$ (c) P_m (or P_L)+P_b+$Q \leq 3.0S_m$	ASME, BPVC, Sec. III, 1968
Mechanical Equipment	2.0/2.0		Upset condition:	(a) $P_m \leq S_m$ (b) P_m (or P_L)+$P_b \leq 1.5S_m$ — Piping: $P \leq 1.2S$ (c) P_m (or P_L)+P_b+$Q \leq 3.0S_m$	ANSI B31.1 code for power piping 1967.
			Emergency condition:	(a) $P \leq 1.2S_m$ or S_y (b) P_m (or P_L)+$P_b \leq 1.8S_m$ or $1.5S_y$ — Piping: $P \leq 1.5(1.2S)$	
			Faulted condition:	(a) Stainless steel: design limit curve — Piping: (a) Stainless steel design limit curve (b) Carbon steel: (i) $P_m = 1.5S_m$ or $1.2S_y$ (ii) P_m (or P_L)+$P_b \leq 2.25S_m$ or $1.875S_y$ — Piping: (b) Carbon steel $P \leq S_y$ or $1.8S$	
App. B Table B.6-5		App. B p. B.7-10d,e	Table B.7-2 Table B.7-3	For further details refer to App. B	App. B p. B.7-6

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Analysis	"Electrical equipment and its supports were designed to be sufficiently rigid so that its natural frequency will be out of the range of resonance with the building structure".	Not available

B.7-10C

SEISMIC REVIEW TABLE*

Docket Number
50-409

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
La Crosse (Genoa) Nuclear Generating Station Reactor type: BWR Containment type: Pre-Mark (steel) NSSS Manufacturer: Allis Chalmers, Manufacturing Co. Architect Engineer: Sargent and Lundy Engineers 3-63/7-67	.06 Sec. 2.4	.04 (Vertical acceleration used for re-analysis of M.S., Feedwater HPCI piping systems 1975-77). Sec. 2.4	VI Sec. 2.4	.12 Sec. 2.4	.08 Sec. 2.4	Taft 1952 record chosen as initial accelerogram. A ground time-history which envelops the 2% damping curve of R.G. 1.60 was generated for analysis of major structures such as the containment.	Horizontal only for RCB Maximum horizontal spectra (x or z direction) are added simultaneously with the vertical for major piping and equipment.	SRSS for equipment and piping (R.S.) Algebraic sum for reactor bldg. (time history method.)	R.G. 1.60 used as basis to develop response spectra from Taft earthquake. (not specifically stated as such but curves are those of R.G. 1.60)	No vertical response spectra generated, instead use 2/3 of horizontal ground response spectra. Horizontal response spectra derived from time history analysis. Reanalysis of Mechanical and Piping, 1975-77, No amplification of vertical response.

*Information was obtained from BNL Docket search and SEPB Report "Seismic Review of La Crosse BWR Phase I Report."

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Pile foundation 232 piles will support 50 tons each	15 ft. of hydraulic fill overlies about 100-130 ft. of glacial outwash and fluvial deposits at the site. Bedrock of flat-lying sandstone and shale of the	Dresbach group extends below these deposits about 650 ft. where it makes contact with the crystalline basement.	Not available	Not available	Not available	Lumped-mass for structure soil-spring and dashpot deconvolution process used; soil layers modeled as shear beam (2% damping used)	Not available	Not available	Not available

SEISMIC REVIEW TABLE

STRUCTURES	DAMPING OBE/SSE (% Critical damping) 1/2 SSE	SSE	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Reactor Containment	3.0 up	7.0 up	<u>Structural Steel - Elastic:</u> Construction: $1.0\ D + 1.0\ L + 1.0\ T_o + W < 1.33$ AISC (1969) Test: $1.0\ D + 1.0\ L + 1.0\ T_o + 1.0\ R_o < 1.33$ AISC (1969) Normal: $1.0\ D + 1.0\ L + 1.0\ T_o + 1.0\ R_o <$ AISC Severe Environmental: $1.0\ D + 1.0\ L + 1.0\ T_o + 1.0\ R_o + E <$ AISC Extreme Environmental: $1.0\ D + 1.0\ L + 1.0\ T_o + 1.0\ R_o + E' < 1.6$ AISC <u>R/C - strength design:</u> Construction: $1.1\ D + 1.3\ L + 1.3\ T_o + 1.3\ W$ Test: $1.1\ D + 1.3\ L + 1.3\ T_o + 1.3\ R_o$ Normal: $1.4\ D + 1.7\ L + 1.3\ T_o + 1.3\ R_o$ Severe Environmental: $1.4\ D + 1.7\ L + 1.3\ T_o + 1.3\ R_o + 1.3\ W$ $0.9\ D + 1.3\ T_o + 1.3\ R_o + 1.3\ W$ $1.4\ D + 1.7\ L + 1.3\ T_o + 1.3\ R_o + 1.4\ E$ $0.9\ D + 1.3\ T_o + 1.3\ R_o + 1.4\ E$ Extreme Environmental: $1.0D + 1.0\ L + 1.0\ T_o + 1.0\ R_o + 1.0\ E'$ Section 3.7.1; Table 4.5-1 and 4.5-2	Allowable structural Capacities for RCB, Two stacks, turbine building waste disposal building: <u>Concrete</u>: (1/2 SSE / SSE) Moment: M_u / $0.63\ M_u$ Shear: V_u / $0.60\ V_u$ <u>Steel</u> (1/2 SSE / SSE) Moment: $0.66\ M_y$ / M_y Shear: $0.40\ V$ / $0.53\ V$
Turbine building		7.0		
Stacks		7.0 up		
New diesel generator building	4.0	7.0		

SEISMIC REVIEW TABLE

MECHANICAL & PIPING						
	DAMPING OBE/SSE	(% Critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA: LOAD COMBINATION		DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Piping	1/2 SSE 1.0	SSE 2.0	Not available	M.S. Piping:	Load conditions from NB-3110, 3620	Piping: AEC Reg. Position 1 and Subsection NB-3600 of Section III of ASME B&PV Code
				Design:	(Primary) $P_o + DL + E < 1.5\ S_M$	
				Normal:	(Primary and secondary) $T + P + SA + TA + E < 3\ S_M$	
				Upset:	Same as for normal condition	
				Emergency:	(Primary stress) $< 2.25\ S_M$	
				Faulted:	$P_o + DL + E < 3.0\ S_M$ (Main steam piping and feedwater piping designed as Class 2 since fatigue loads not considered). Follows R.G. 1.48, EQ 8,9,10,11 of ASME Code	

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Not available	Not available

SEISMIC REVIEW TABLE

Docket Number
50-309

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Maine Yankee Atomic Power Company Reactor type: PWR Containment type: Sub-atmospheric (Reinforced concrete) NSSS Manufacturer: Combustion Engineering Architect Engineer: Stone & Webster Engineering Corp.	0.05	0.033	VI	0.10	.067	No earthquake time-history used.	Each horizontal combined with the vertical resulting in two load cases. The method of combination is unclear.	No combination used flexual mode used only.	Housner spectra	Empirical procedure used for piping to provide amplified response spectra. For equipment and anchors used equivalent static load method or Housner response spectra. Amendment 22 (4-71) Q. 4.4 Q. 4.5 Method used described in Section 5.1.1.2.2 p. 5-6
10-68/9-72	Sec. 1.3.2 p. 1-6	Sec. 1.3.2 p. 1-6		Sec. 1.3.2 p. 1-6	p. 1-6	Amendment 20 (3-71) Q. 4.5	p.5-3	p. 5-6	Sec. 2.5.4 p. 2-27 Figs. 2.5.6 and 2.5.7	

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Flat reinforced concrete slab bearing on bedrock with a central reactor vessel pit. 10 ft. thick	Major structure Hard crystalline bedrock Minor structure on rock or compacted granular fill above the rock.	Joints in bedrock are medium spaced, ranging from 1 to 5 ft intervals or and less.	7,000 fps	Dug wells: less than 25 ft deep. Drilled wells: depth of 100 ft or more.	Not available.	Translational & Rocking modes were not incorporated in the dynamic model.	$1.80 \times 10^6 - 2.06 \times 10^6$ psi	Not available.	Not available.
Sec. 5.1 p. 5-1	Sec. 2.4 p. 2-23	Sec. 2.4 p. 2-23	Sec. 2.4 p. 2-23	Sec. 2.3.3 p. 2-22		Sec. 5.1.1.2.2 p. 5-6	Sec. 2.4 p. 2-23		

SEISMIC REVIEW TABLE

STRUCTURES			
		DESIGN CRITERIA	
DAMPING OBE/SSE	(% critical damping)	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
1. Reactor containment. 2. Reinforced concrete structure, other than containment (on rock or soil). 3. Reinforced concrete structure (not on soil or rock). 4. Steel framed structure Bolted or riveted Welded 5. Reactor vessel Welded assemblies Bolted assemblies	5.0/7.0 5.0/7.0 2.0/5.0 3.0/5.0 1.0/2.0 1.0/1.0 3.0/3.0	1. (1.0 ± 0.05) D + 1.5 P + 1.0 (T+TL) 2. (1.0 ± 0.05) D + 1.25 P + 1.0 (T+TL) + 1.25 E 3. (1.0 ± 0.05) D + 1.0 T + 1.0 C 4. (1.0 ± 0.05) D + 1.0 P + 1.0 (T+TL) + 1.0 E' D = dead load P = design pressure load TL = load by exposed liner T = temperature gradient load E = OBE E' = SSE	Containment: Ultimate strength methods ACI 318-63, Sec. 1504, Part IV B or the Ultimate Strength Design Handbook ACI Special Publication No. 17.
Table 2.5-1		Section 5.1.1.2, p. 5-2	Section 5.1.1.2, p. 5-2

SEISMIC REVIEW TABLE

MECHANICAL & PIPING					
DAMPING OBE/SSE	(% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA		
			LOAD COMBINATION *		ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
1. Mechanical equipment.	2.0/2.0	Analytical	Reactor vessel internal structure 1. Design loading + OBE 2. Normal Operating + SSE 3. Normal Operating + SSE + pipe rupture Where: $S_L = S_y + (1/3)(S_u - S_y)$ $S_D = 1.2\ S_m$	$P_m \leq S_m$ $P_B + P_L \leq 1.5\ S_m$ $P_m \leq S_D$ $P_B \leq 1.5\ [1-(\frac{P_m}{S_D})^2] S_D$ $P_m \leq S_L$ $P_m \leq 1.5\ [1-(\frac{P_m}{S_L})^2] S_L$	ASME BPVC, Section III
2. Piping.	1.0/2.0		1. Design load + OBE 2. N.O. + SSE 3. N.O. + SSE + pipe rupture	Piping Applicable code allowables $P_m \leq S_D$ $P_B \leq \frac{4}{\pi} S_D \cos (\frac{\pi}{2} \cdot \frac{P_m}{S_D})$ $P_m \leq S_L$ $P_B \leq \frac{4}{\pi} S_L \cos (\frac{\pi}{2} \cdot \frac{P_m}{S_L})$	
Amendment 20 (3-71) Q. 4.9, Table 2.5-1		Amendment 22 (4-71) Q. 4.8			p. 3-4, 4.2-4

*For reactor internals: Table 3.2-1, p. 3-4
Vessels and piping: Table 4.2-3, p. 4.2-4

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE *

Docket Number
50-245

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Millstone Point Nuclear Power Station Unit 1 Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Ebasco	0.07	0.05	VII	0.17	0.113	Taft 69° west earthquake record (Blume response spectrum is more conservative than Taft response spectrum)	Horizontal and vertical (X+Y,Z+Y) The resulting seismic stress for the two motions were combined linearly.	No modal combination needed for time history. Unclear information for response spectrum method.	Housner	Equivalent Static Method - for intake structure, turbine bldg., main steam lines, Class I piping in reactor and turbine bldg., batteries and battery racks. Time History Method: Reactor bldg., ventilation stack, radwaste/control room, condensate storage tank Response Spectrum Gas turbine bldg., recirculation loop piping, torus, RPV, isolation condensor, fuel racks
5-66/10-70	Sec. XII p. XII-1.7	Sec. XII p. XII-1.7		Sec. XII p. XII-1.7	p. XII-1.7	Q VII - A.9 and Q VII - A.10 Amend. 17	Sec. XII p. XII-1.7		Fig. XII-1.2 Fig. XII-1.3 Sec. XII p. XII-1.7	p. XII-1.12

Information obtained from BNL Docket Search and SEPB Report, "Seismic Review of Millstone Nuclear Power Station, Unit 1"

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete square mat (42'-6") and six feet of thickness at elevation of 32'-0". The foundation is supported directly on the bedrock. Gas turbine building founded on piles. Turbine build mat foundation on piles.	not applicable	not applicable	14,000 fps Sec. XII-p. XII-1.13	Not available	None	Lumped mass with soil springs (for reactor bldg. only). Rocking mode was considered for reactor bldg. Fixed base without rocking for other major structures. Sec. XII p. XII-1.2.1	Not available	Not available	Not available

SEISMIC REVIEW TABLE

<table>
<tr><th colspan="3">STRUCTURES</th></tr>
<tr><th rowspan="2">DAMPING OBE/SSE (% critical damping)</th><th colspan="2">DESIGN CRITERIA</th></tr>
<tr><th>LOAD COMBINATION</th><th>ACCEPTANCE CRITERIA & ALLOWABLE STRESSES</th></tr>
<tr><td>1. Reinforced concrete structures 5.0
2. Steel frame structures 2.0
3. Welded assemblies 1.0
4. Bolded and riveted assemblies 2.0
5. Ventilation stack 5.0
6. Radwaste Bldg., Control room 5.0
7. Condensate storage tank 0.5(fluid) 2.0(tank)
8. Gas Turbine Bldg. 5.0

Sec. XII p. XII-1.7 and Table VII - A.14-1, Q.A.14, Amend. 17</td><td>1. D + R + E - Normal allowable code stresses are used in AISC and ACI increase in design stress for earthquake loads is not permitted.
2. D + R + E´ - Stresses are limited to the minimum yield point. In few cases, stresses may exceed yield pt. then in this case the limit-design method as discussed in AEC publication TID -7024 "Nuclear Reactor and Earthquakes", Section 5.7, to determine that the energy absorption capacity exceeds the energy input.

D = Dead load R = Jet force or pressure due to rupture of any one pipe
E = Design earthquake load E´ = maximum earthquake load
Sec. XII - 1.12
1. DL + LL + OL + E (.07g)
2. DL + LL + OL + W
3. DL + LL + OL + E´(.17g)

Table XII -1 p. XIII - 1.3</td><td>1. AISC
2. ACI Code

Table XII-1</td></tr>
</table>

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
1. Vital Piping System 0.5 Sec. XII p. XII-1.7 2. Containment heat exchange 2.0 3. RPV 2.0 4. Recirculation loop piping 0.5 5. Suppression chamber 2.0	Analytical	Reactor Vessel Internals 1. D + E — Stress criteria of ASME Section III, Class A vessel 2. D + E´ — The secondary and primary plus secondary stresses are examined on a rational basis taking into account elastic and plastic strains. Emergency Core Cooling Systems 1. D + T + H + E — Stresses remain within code allowable. USAB-B 31.1 plus code cases (piping) 2. D + T + H + E´ — Primary stresses are within the stress criteria of ASME Section III, Class A. The secondary and primary plus secondary stresses and examined on a rational basis taking into account elastic and plastic strains. These strains are limited to preclude failure by deformation. Primary Containment 1. D + P + H + T + E 2. D + P + R + H + T + E 3. D + P + R + H + T + E	ASME Section III, Class B USAS - B31.1-1967 Sec. XII Question A.14, Amend 17 Table XII-1

D = Dead load
P = Pressure due to LOCA
R = Jet-force or pressure on structure due to rupture of any one pipe
H = Force on structure due to thermal expansions of pipes
T = Thermal loads on containment due to LOCA
E = Design E.Q. load; E´= maximum E.Q. load

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Battery racks and batteries were designed to withstand lateral and vertical seismic loads of 0.12g horizontal and 0.046g vertical	Not available

SEISMIC REVIEW TABLE

Docket Number
50-336

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Millstone Nuclear Power Plant Unit 2 Reactor type: PWR Containment type: 3 buttresses with shallow dome (prestressed concrete) NSSS Manufacturer: Combustion Engineering Architect Engineer: Bechtel	0.09	0.06	VII	0.17	0.11	Synthetic time-history	3 components: Each horizontal combined with vertical component simultaneously.	Absolute sum method.	Separate sets of design spectra were developed for rock foundation and backfill. Housner for rock foundation. Modified Newmark for backfill	Time history method.
12-70/9-75	Sec. 5.8.1.1 p. 5.8-1	Sec. 5.8.3.2.2 p. 5.8-8	Amend. 39 Sec. 2.6	Sec. 5.8.1.1 p. 5.8-1	Sec. 5.8.3.2 p.5.8-8	Sec. 5.8.1.1 p. 5.8-1 Fig. 5.8-6	Sec. 5.8.4 p. 5.8-11	Sec. 5.8.3.2.11 p. 5.8-7	Sec. 5.8.1 p. 5.8-1 Fig. 5.8-1,2 Fig. 5.8-3,4	Sec. 5.8.4 p. 5.8-11

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reactor building mat rests on unweathered rock. Depth: 8½ feet Sec. 2.7.5 p. 2.7-3 Sec. 5.2.1 p. 5.2-1	Glacial deposits: Ablation till and a dense basal till which lies above the bedrock. Bedrock consist of Monson gneiss intruded by westerly granite. Sec. 2.4 p. 2.4-4 p. 2.4-5	Glacial deposits 0 to 30 ft Bedrock: 11 to 54 ft below ground. Sec. 2.4 p. 2.4-4. p. 2.4-5	5500-7500 fps in bedrock. Sec. 2.4.4 p. 2.4-9	Little or no ground water is present in bedrock. So virtually all ground water is restricted to the soil overburden. Water level is subjected to considerable seasonal fluctuations. Sec. 2.5.2 p. 2.5-2 Fig. 2.4-2c, 2d	Not available.	Backfill: Stick model with soil springs. Bedrock: Stick model with fixed base. Sec. 5.8.2 p. 5.8-3,4	Not available.	2%/5% Table 5.8-1 p. 5.8-9	2% Sec. 5.8.3.3 p. 5.8-10

SEISMIC REVIEW TABLE

STRUCTURES				
		DESIGN CRITERIA		
DAMPING OBE/SSE	(% critical damping)	LOAD COMBINATION		ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Welded steel plate assemblies:	1.0/1.0	a. D+F+L	Construction case	ACI-318-63
Welded steel framed structures:	2.0/2.0	b. $D+F+L+T_o+E$	Operating case	ACI-301-66
Bolted or riveted steel framed structures:	2.5/2.5	c. $D+F+L+P+T_i$	Design incident case	ASME, BPVC (1968)
Reinforced concrete equipment supports:	2.0/3.0	d. $D+F+L+T_s+E$	Prolonged shutdown case	AISC, 1963
Reinforced concrete frames and buildings:	3.0/5.0	e. D+F+L+1.15P	Test case	
Prestressed concrete structures:	2.0/5.0	D = dead loads L = live loads F = prestressing loads P = design pressure T_i = thermal loads due to the loss of coolant incident T_o = thermal loads due to operating temperature T_s = thermal loads due to transient wall temperature over a prolonged shutdown (20 F at exterior face, 70 F at center, 50 F at interior face) E = operating basis earthquake loads (0.09 g) For further details refer to Section 5.2.3.2.5.		
Table 5.8-1, p. 5.8-9		Sec. 5.2.3.2.4 p. 5.2.8		Sec. 5.1.2 p. 5.1-2

SEISMIC REVIEW TABLE

MECHANICAL & PIPING

DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Steel piping: 0.5/0.5	Analytical and testing.	Reactor coolant system (vessels): 1. Design loading + OBE: $P_m \leq S_m$; $P_b + P_L \leq 1.5 S_m$ 2. Normal operation + SSE: $P_m \leq S_m$; $P_b \leq 1.5 \left[1 - \left(\frac{P_m}{S_D}\right)^2\right] S_D$ 3. Normal operation + SSE + pipe rupture: $P_m \leq S_m$; $P_b \leq 1.5 \left[1 - \left(\frac{P_m}{S_L}\right)^2\right] S_L$ $S_L = S_y + (1/3)\ (S_u - S_y)$ R.C.S. (Piping) 1. Design loading + OBE: $P_m \leq S_m$; $P_b + P_L \leq 1.5 S_m$ 2. Normal operation + SSE: $P_m \leq S_m$; $P_b \leq 4/\pi S_D \ \text{Cos}\left(\frac{\pi}{2} \cdot \frac{P_m}{S_D}\right)$ 3. Normal operation + SSE + pipe rupture: $P_m \leq S_L$; $P_b \leq 4/\pi S_L \ \text{Cos}\left(\frac{\pi}{2} \cdot \frac{P_m}{S_D}\right)$	Piping-- ANSI B 31.7 ANSI B 31.1.0 Sec. 1.2.14, p. 1.2-21 and Sec. 4.5.2.1, p. 4.5-5 Pressure vessels-- ASME, BPVC, p. 1.2-19 and Sec. 4.5.2.2, p. 4.5-5
Sec. 5.8.3.3 p. 5.8-9	Sec. 5.8.5 p. 5.8-12	See Table 4.2-2, p. 4.2-3. For mechanical see Sec. 3.2.1, p. 3.2-1 to 3.2-5.	

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Analytical and testing. Sec. 5.8.6 p. 5.8-13	Not available.	Instrumentation designed as per Reg. guide 1.12. Sec. 5.8.6 p. 5.8-13

SEISMIC REVIEW TABLE

Docket Number
50-263

NAME AND NSSS TYPE OF THE PLANT	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
CP/OL ISSUE DATE	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Monticello Nuclear Generating Plant, Unit 1 Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Bechtel	Class I 0.06 Class II 0.05	0.004 0.0033	VIII	0.12	0.08	Taft Earthquake of July 21, 1952, North 69 West component	Horizontal and vertical component combined linearly.	SRSS	Response spectra from Taft earthquake	Time-history analysis for Class 1 structures, UBC for Class 2
6-67/9-70	Sec. 2.1.9 p. 12-28	Sec. 6.0 p. 2.6-1	Sec. 6.0 p. 2.6-1	Sec. 2.1.9 p. 12-28		Sec. 6.0, p. 2-6.1	Sec. 2.1.9, p. 12-2.8	Sec. 2.1.9 p. 12-2.9c and Vol.VI Append. A Reactor Building Seismic Analysis p-6	Fig. 2-6-5 p. 2-6.1 Sec. 2.1.9, p. 12-2.8a and p. 12-2.9	Sec. 2.1.9 p. 12-2.9

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE *	THICKNESS	V_s PROFILE						
Reinforced concrete mat founded on medium sand with some gravel.	Decomposed granitic and basic rocks of precambrian age comprise Wethered precambrian crystalline rocks are directly below Above the sandstone is a series of alluvial strata consists predominately of clean	the formation. 75 to 122 ft. the above strata. 10 to 15 ft. sands with gravel, as well as a few layers of clay and gracial till. 50 ft.	Not available.	The water table beneath the low terraces which border the Mississippi River usually lies at about river elevation and slopes very slightly toward the river during periods of normal stream flow. Groundwater at shallow depths moves toward the Mississippi River or its tributaries at variable gradients depending on local conditions.	Not available.	Stick model with soil springs.	Not available.	Not available	10.0% of critical damping.
Sec. 2.2.1.1 p. 12-2.13				Sec. 5.4, p. 2-5.3 and Fig. 2-5-3		Append. A. at Seismic Analysis Part p. 2		App. A Sec. 2.1.9 p. 12-2.8	Append. A Table 1 p.8

Sec. 5.3, p. 1-5.2, p. 2-5.3

*Because of space Type and Thickness columns are combined together.

SEISMIC REVIEW TABLE

STRUCTURES		
	DESIGN CRITERIA	
DAMPING OBE/SSE (% critical damping)	**LOAD COMBINATION**	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Recommended damping: Rector-boilding (massive construction with many cross walls and equipment and providing only secondary containment) 5.0 Thin-shell and prestressed concrete 2.0 Steel structures 2.0 Ref. Append. A., Table 1, p.8	1. Primary containment a. D + P + H + T + OBE b. D + P + R + H + T + OBE c. D + P + R + H + T + SSE 2. Reactor building and all other Class 1 structure a. D + R + OBE b. D + R + SSE c. D + W d. D + W' Sec. 2.1.4, p. 12-2.3 and 12-3.6	AISC - Sixth Edition ACI - 318-63 ASME CODE Sec. III and IX ACI 505-54 for R. C. Chimney Sec. 2.1.4, NSP-1, p. 12-2.6 Table 12-2-1 Sec. 2-1.4, p. 12-2.4 and p. 12-2.5

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Piping: Vital Damping System 0.5	Analytical	3. Reactor vessel supports a. D + H + R + OBE b. D + H + R + SSE 4. Reactor vessel internals a. D + O.B.E. b. D + S.S.E. c. D + P 5. Emergency core cooling system (ECCS) a. D + O.B.E. b. D + S.S.E. ————————— For piping: Suction header pipe: Dead loads + seismic loads + OBE = 820 psi } Dead loads + seismic loads + SSE = 1640 psi } allowable stress is 17, 500 psi	ASME Sec. III and USAS B 31.1-1967
Append. A, Table 1, p. 8	Sec. 2.1.9, p. 12-28	Sec. 2.1.4, p. 12-2.3-12.2.6 p. 12-2.11	Sec. 2.1.4., p. 12-2.5 and p. 12-2.6

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Inspection and testing for: 1. Auxiliary Power System 2. Plant standby generator systems. 3. D-L Power supply systems. 4. Reactor protection system power supplies. Sec. 8 p. 8.3-5 p. 8.4-4 p. 8.5-6 p. 8.6-2	Not available.	For diesel-generator set: Equipment shall conform to applicable standards of the NEMA, ASA, DEMA, ASME, NBFW, NIPA, ASTM, IEE, USASI and state and local regulations. Sec. 4.1 p. 8-4.1

SEISMIC REVIEW TABLE

Docket Number
50-220

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Nine Mile Point Nuclear Station Unit No. 1 Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Stone & Webster Engineering Corp.	Not used	Not used	IX	0.11	0.055	Not used	Not available.	SRSS	Hounser	Analysis by Reserve Energy-Technique, by John Blume
4-65/8-69			PHSR III-1	PHSR III-1	Amendment 6, Supp. 2, Question I-11			Amend. 6, Supp.2, Question I-2.	PHSR XI-22 App. C	PHSR III-1

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
All major structures founded on Oswego sandstone. Reactor bldg. is founded in rock to a depth of 60 ft.	10-12 ft. of glacial till was removed. Bedrock is Oswego sandstone. It makes contact with Lorraine Shale at a depth of 185 ft.	185 ft.	14,000 fps	195 ft. below ground surface	Not available.	Stick model with soil springs.	Not available.	2 to 3% critical damping.	Not available.
PHSR III-3	Amend. 2, Vol. 2, FSAR 6/1/67		Amend. 6, Supp. 2, FSAR, Oct. 1968, Question IV 12, p IV-24	App. C "Earth Science"		Amend. 6, Supp.2, Question I-2		Amend. 6, Supp. 2, FSAR Oct. 1968, Question IV 12, p IV-25	

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE (% critical damping)	DESIGN CRITERIA	
	LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
critical damping for integral reinforced-concrete structures.................... 5.0 **critical damping for ventilation stack**... 7.5 **Details:** First supplement to PHSR in answer to question III-1(d)	Reactor bldg. Waste disposal bldg. screen and pump house drywell radial steel framing: DL + LL + OL + Design Earthquake Reactor vessel concrete pedestal DL + Equipment Load + Temp. (operating) DL + Equipment Load + Jet Load + Temp. + Design Earthquake See Table I-4 for 10 load combinations for the drywell	1. ACI-318-63 2. For proportioning of concrete members: Part IV-A "Working stress design" of Code 318-63. 3. Reinforced-concrete ventilation stack: ACI 505-54 4. AISC specifications for the design, fabrication and erection of structural steel for building. 5. New York State Building Code 6. UBC
Amendment 6, Supp. 2, Question I-5	Supplement 2, question I-4, question I-9	Amend. 6, Supp. 2, Question I-2

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Core spray piping and sparger ring located in the reactor vessel: Equations given in ASME Section III. Drywell - ASME Sect. VIII plus Code Case 1270N-5, 1271N, 1272N-5 Amend. 5-Supp 1 (5/20/68) Question II-12.	1. "Method of Differences" 2. Reactor internals: ASME Code Class A 1. Amend. 6, Supp. 2, Question I-10 2. Amend. 5, Supp. 1 FSAR Question I-5

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

Docket Number
50-338

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
North Anna Power Station Unit 1 Reactor type: PWR Containment type: Sub-atmospheric (reinforced concrete) NSSS Manufacturer: Westinghouse Architect Engineer: Stone and Webster	0.06g for structures on rock 0.09g for structures on soil	0.04g for structures on rock 0.06g for structures on soil	VII	0.12g for structures on rock 0.18g for structures on soil	0.08g for structures on rock 0.12g for structures on soil	E-W and N-S components of Helena, Montana 1935 earthquake, and the S-E component of the San Francisco 1957 earthquake.	2 components: Horizontal plus vertical added simultaneously	SRSS	Developed from Helena 1935 and San Francisco 1957 by enveloping the response spectra shown in Fig. 2.5-9 thru Fig. 2.5-12.	Time history method.
2-71/11-77	p. 1.2-2 1.2-3	p. 1.2-2 p. 1.2-3		p. 1.2-2 1.2-3	p.1.2-2 1.2-3	p. 2.5-9	p. 3.7-10	Sec. 3.7	p. 2.5-9	Sec. 3.7

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Flat reinforced concrete mat 10 ft. thick. Founded on concrete backfill.	Saprolite soil weathered rock	Not available.	Not available.	Not available.	North Anna Reservoir	Stick model with soil springs.	Fresh and slightly weathered rock $G=1.0x10^6$ psi Soils @ 10 ft. depth 14,000 psi @ 20 ft. depth 19,800 psi	Not available.	Not available.
p. 1.2-2 p. 2.5-17	p. 2.5-12				Sec. 2.4.1.1	Sec. 3.7 p. 2.5-9	p. 2.5-24		

SEISMIC REVIEW TABLE

STRUCTURES

DAMPING OBE/SSE			DESIGN CRITERIA	
			LOAD COMBINATION Containment Structural Loading Criteria:	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Stress Level	Type & Condition of Struct, Syst. or Component	Percentage Critical Damping	(1.0 ± 0.05) D ± 1.0 P ± 1.0 (T + TL) + 1.5 E (1.0 ± 0.05) D ± 1.0 P ± 1.0 (T + TL) + 1.0 (DBE) (1.0 ± 0.05) D + 1.25 P + (T' +TL') + 1.25 E	AISC Manual ACI 301-66 ACI 318-63
1. Low Stress, well below proportional limit. Stresses below 0.25 yield point.	a. Steel, reinforced concrete; no cracking and no slipping at joints.	0.5 to 1.0		
2. Working stress limited to 0.5 yield point stress	a. Welded steel, well reinforced concrete (with only slight cracking)	2.0		
	b. Bolted steel	5.0		
3. At or just below yield point	a. Welded steel	5.0		
	b. Reinforced concrete	5.0		
	c. Bolted steel	7.0		
Table 3.7.2-1			p. 3.8-87, Table 3.8.2.2-1	p. 3.7-49 3.8-17

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Piping 0.5/1.0	Analysis and Testing	ASME Class 1 Piping: based on Subarticle NB-3650 Class A Components 1) Normal a) $P_m \leq S_m$, b) $P \leq 1.5\ S_m$, c) $P_m (\text{or } P_L) + P_B \leq 1.5\ S_m$ d) $P_m (\text{or } P_L) + P_B + Q \leq 3.0\ S_m$ 2) Upset a) $P_m < S_m$, b) P_L S $1.5\ S_m$(SIC) c) $P_m (\text{or } P_L) + P_B + P_B \leq 1.5\ S_m$ d) $P_m (\text{or } P_L) + P_B + Q \leq 3.0\ S_m$ 3) Faulted i) $P_m \leq 1.2\ S_m$ or S_y whichever is larger, AND $P_m (\text{or } P_L) + P_B \leq 1.5\ (1.2)\ S_m$ or $1.5\ S_y$ whichever is larger ii) Table 5.2-15	ANSI B31.7-1969 ASME BPVC Sec. III
p. 3.7-23	p. 3.7-46,47 p. 3.7-22	p. 3.7-30, p. 5.2-46, T 5.2-15	p. 3.1-101 p. 3.7-49

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
NOT AVAILABLE	Analysis and testing p. 3.10-1	NOT AVAILABLE	IEEE Standard 344-1971 p. 3.10-1

SEISMIC REVIEW TABLE

Docket Number
50-269, 270, 287

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Oconee Nuclear Station Unit Nos. 1,2,3 Reactor type: PWR Containment type: 6 buttresses with shallow dome (pre-stressed concrete) NSSS Manufacturer: Babcock & Wilcox Architect Engineer: Utility & Bechtel Unit #1: 11-67/2-73 Unit #2: 11-67/10-73 Unit #3: 11-67/7-74	0.05 for rock foundation Sec. 2.6 p. 2-9	0.03	VI	0.10 for rock foundation. 0.15 for over-burden foundation. Sec. 2.6 p. 2-9	0.07	Time history record of the N-S, May 1940 El Centro Earthquake was used (vertical and N-S horizontal components) at 0.01 sec intervals for the first 30 sec of duration. Sec. 1C.3.4.2.1 p. 1C-4d	3 components: Each horizontal combined with the vertical simultaneously. Sec. 5A. 2.2 p. 5A-3	Absolute sum p.5-19	R-S smooth curve with max. acceleration of .15g @ 2% damping. Housner. Plate II-4 App. 2B	Time-history method. Sec. 1C.3.4.2.1 p. 1C-4d Sec. 1C.3.4.2.2(b) p. 1C-4e-4f

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete foundation slab. Depth = 8½ feet thick. Founded on bedrock.	Banded biotite hornblande geniss and granite geniss. The surface has weathered unevenly and the residual soils grade down irregularly.	Sound Rock is found at depths of 5-40 feet	Not available in FSAR	Not available in FSAR.	"Design of Keowee and Jocassee Dam" Refer to PSAR p. 2.4.3 and Question 8.6-PSAR Supp. 1, Question 12.1-PSAR Supp. 4, Question 12.2-PSAR Supp. 4, Item 11-PSAR Supp. 5, Item 1-PSAR Supp. 6.	Stick model with soil springs.	Not available	in FSAR.	2% OBE 5% SSE
Sec. 5.1.2.1 p. 5-2			Refer to Sec. 2.5 and Sec. 2.6 p. 2-8 in PSAR	Refer to PSAR 2.4.4 Sec. 2.4.5 p. 2-8	Sec. 2.4.4 p. 2-8	Sec. 5.1.3.2 p. 5-18	Refer to Sec. 2.5, p. 2-8, in PSAR	and Sec. 2.6 2-9	p. 5-12 Fig. 5-10

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE	(% critical damping)	**DESIGN CRITERIA** **LOAD COMBINATION**	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Welded carbon and stainless steel assemblies:	1.0	$\underline{Y}=1/\phi(1.0D+1.0P+1.0T+E')$	ACI 318-63
Steel framed structures:	2.0	$\underline{Y}=1/\phi(1.05D+1.25P+1.0T+1.25E \text{ or } W)$	ACI 301
Reinforced concrete equipment supports:	2.0	$\underline{Y}=1/\phi(1.05D+1.5P+1.0T)$	ASME, PVBC, Sec. III, VIII, IX
Reinforced concrete frames and buildings:	5.0	$\underline{Y}=1/\phi(1.0D+1.0W_t+1.0P_i)$ for tornado forces	
Prestressed concrete structures (i) under design earthquake forces	2.0	$\underline{Y}$=required yield strength of structure $\underline{D}$=dead loads P=design accident pressure T=thermal load E=seismic load based on design earthquake E'=seismic load based on maximum hypothetical earthquake W=wind load P_i=stress due to differential pressure Φ=capacity reduction factor	
(ii) under maximum hypothetical earthquake	5.0		
Sec. 5A.2.2 p. 5A-3		For further details refer to Sec. 5A.2.2, p. 5A-2	Sec. 5.1.2.1 p. 5-4

MECHANICAL & PIPING

DAMPING OBE/SSE	(% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Vital piping:	0.5	Analytical	(A) piping: I. Design loads + design earthquake loads $P_m \leq 1.0S_m$ $P_L+P_b \leq 1.5S_m$ II. Design loads + maximum hypothetical earthquake loads $P_m \leq 1.2S_m$ $P_L+P_b \leq 1.2(1.5S_m)$ III. Design loads + pipe rupture loads $P_m \leq 1.2S_m$ $P_L+P_b \leq 1.2(1.5S_m)$ IV. Design loads + maximum hypothetical earthquake loads + pipe rupture loads $P_m \leq 2/3S_u$ $P_L+P_b \leq 2/3S_u$ P_L=Primary local membrane stress intensity P_b=Primary bending stress intensity P_m=Primary general membrane stress intensity S_m=Allowable membrane stress intensity S_u=Ultimate stress p. 4-4	For piping: Nuclear power piping code USAS B31.7, Sec. 1C.3, p. 1C-3 Mechanical components: -ASME, Sec. III for nuclear vessels. $-S_m$ values Table N-421 of ASME code. Sec. 4.1.2.5.1 Sec. 4.1.2.5.2 p. 4-3
Sec. 5A.2.2 p. 5A-3		Sec. 1C.3.4.1 p. 1C-4ai		

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Analytical and tests. Table 8.8 p. 8-36	Not available.	No detailed information available. Refer to Table 8.8 for some seismic considerations. p. 8-36

SEISMIC REVIEW TABLE *

Docket Number
50-219

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Oyster Creek Nuclear Power Station Unit 1 Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Burns & Roe, Inc. 12-64/4-69	0.11 Sec. V.3 p. V-3-1	0.073 Sec. V.3 p. V-3-5	VII	0.22 Sec. V.3 p. V-3-5	0.147 Sec. V.3 p. V-3 -5	Not used	2 components: Horizontal and vertical added directly and linearly for: Reactor building, Control room/turbine building, rad. waste building. Horizontal only for intake structure. Sect. 3.6 Amend. 11 Q IV-3-1	SRSS Amend.11 Quest. IV-2-1	Housner spectra used for analysis of reactor building, ventilation stack, control room, rad-waste bldg. Equivalent static method for intake structure, suction header, spent fuel pool Question IV. 2 Amend. 11, Sec. V-3-1.2, FDSAR, Sec. 3.5.1	No floor response spectra: Seismic Design curves for FWCI piping and equipment. p. 5-11, 12 Amend. 38

*Information from BNL Docket search and SEPB Report "Seismic Review of Oyster Creek Nuclear Power Plant for SEP", Phase I Report.

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Mat foundation Grade: + 23 ft MSL Foundation: -11 ft MSL	Fine to medium texture sand of med. density	17 ft.	Not available	Wells are 60 to 70 ft. or more in depth.	Not available	Rocking mode analyzed separately in seismic analysis of reactor and control room/ turbine building. Using a torsional spring to represent the foundation flexibility.	Not available	Not available	Not available
	alternating layers of clay, silt and fine sand	17 ft							
	dense sand, med. to coarse texture	65 ft.							
	layers of clay, silt and fine sand	8 ft.							
	dense fine to coarse sand	below							
Sec. II.5.2	Sec. II.5.2	Sec. II.5.2		Sec. II.4, p. II-4-1					

SEISMIC REVIEW TABLE

STRUCTURES				
DAMPING OBE/SSE (% critical damping)		DESIGN CRITERIA: LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES: Reinforcing Steel Max. Tension	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES: Concrete Max. Allowable Compression
Reinforced concrete structures (reactor building)	10.0	Reactor building., Control Room., Battery Room., Intake Structure.*		
steel frame structures	2.0	1. DL + LL + OL + E (0.11g)	1. $0.5\ F_y$	$0.45\ f'_c$
welded assemblies	1.0	2. DL + LL + OL + W	2. $0.667\ F_y$	$0.60\ f'_c$
bolted and riveted assemblies	2.0	3. DL + LL + OL + E´(0.22g)	3. $0.90\ F_y$	$0.90\ f'_c$
reinforced concrete stack	5.0	Reactor Concrete Pedestel**		
		1. DL + equipment + jet load + temperature + OBE	1. $0.25\ F_y$	$0.133\ f'_c$ (bending)
		2. DL + equipment + jet load + temperature + SSE	2. $0.25\ F_y$	$0.267\ f'_c$ (bending)
		Drywell Concrete Shield***		
		1. DL + LL + over pressure + max. temp. + OBE	1. $0.50\ F_y$	$0.45\ f'_c$
		2. DL + LL + over pressure + max. temp. + SSE	2. $0.50\ F_y$	$0.45\ f'_c$
		3. DL + LL + max. temp. + OBE + jet force	3. $0.667\ F_y$	$0.60\ f'_c$
Sec. V.3, p. Table V-3-1				

*Table V-3-3, Table 1-A-4, Amend. 22
**Table 1-A-2, Amend. 22
***Table 1-A-1, Amend. 22

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
1. Bolted and riveted assemblies 2.0 2. Welded assemblies 1.0 3. Vital piping 0.5 Table V-3-1 Sec. V.3 p. V-3-2	Not available	Class I piping* — Allowable stress Thermal — S_A MOL + SL — S_H MOL + 2(SL) — Safe shutdown can be achieved MOL = Max. operating loads SL = Seismic loads due to OBE $S_A = f(1.25\ S_c + 0.25\ S_H)$ f = stress range reduction factor S_c, S_H = a-lowable stress, ASA B31.1 Reactor vessel supports* Seismic - Normal AISC allowables Seismic + jet - 150% of normal AISC allowables 2(seismic) - 150% of normal AISC allowables Primary containment ** DL + operating + LOCA + E — ASME Sec. VIII DL + operating + LOCA + E′ — Code case 1272N-5 * Ques. IV. 1, Amend. 11 ** Table V-3-2, Sec. 3.8.1	See load combinations and Supplement 6, Amend. 68, Appendix 6.

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE (% Critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Quoted from answer to Question IV.1, Amend 11 "The control room panels and auxiliary racks are usually shipped assembled and therefore these units must be designed for normal shipping shock which is in the order of several g's acceleration. Certain components are removed and padded to reduce vibration effect and excessive acceleration. In all cases, however, the design analysis is made of the panels and instruments. All relays in safety circuits are energized; and since they are capable of closing against 1.0g, they can certainly maintain contact during an acceleration of 0.22g." Question IV.1, Amend. 11	

SEISMIC REVIEW TABLE*

Docket Number
50-255

NAME AND NSSS TYPE OF THE PLANT	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
CP/OL ISSUE DATE	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Palisades Nuclear Generating Plant Unit 1 Reactor type: PWR Containment type: 6 buttresses with shallow dome (prestressed concrete) NSSS Manufacturer: Combustion Engineering Architect Engineer: Bechtel	0.10	0.067	VII	0.20	0.13	Containment design Housner spectra. For floor response spectra generation and for equipment and piping the 1952 TAFT earthquake was used, whose R-S envelops the Housner spectra.	Maximum horizontal component with vertical component simultaneously.	SRSS - response spectra method for structural modes and piping.	Housner design spectrum	Not clear - it appears that TAFT 1952 earthquake was used to generate floor response spectra. Then from lumped-mass model, the accelerations at each floor level were obtained and the TAFT response spectra were scaled to those valves. Static method used for piping with frequency > 20 Hz. For vertical R-S, 2/3 of horizontal ground spectrum Ref. 3.Q.5.8 and Q.5.6.
3-67/3-71	p. 2-16	Sec. A.2 p. A-7		p. 2-16	Sec. A.2 p. A-7		Sec. A.2 p. A-7		Question 5.13 p. 5.13-1	

*Information obtained from BNL Docket search and SEPB Report, "Seismic Review of Palisades NPP Unit No. 1".

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete slab 8 1/2 to 13 ft. thick Sec. 5.1.2 p. 5-2	Loose dune sand overlies about 30 ft. of well-compacted, gray silty sand. Below this is about 90 ft. of compact till. Bedrock, Mississippian Coldwater Shale, is reached at a depth of about 150 ft. below	lake level. It is composed of blue, gray or red shale. **	5400 fps for lake deposits 6700 fps for glacial till 10,000 fps for bedrock	10 ft. from ground surface Sec. 2.4.1, p. 2-14, p. 5.10-21	Not available	Containment: Lumped mass, spring model. Determine horizontal spring constant and 2 vertical springs which provide rotational restraint. "Building FNDT. interaction effects". 10-66, ASCE Engr. Mech.	Not available	Not available	Not available

Sec. 2.3.1
p. 2-10 to p. 2-11

** Type and thickness of bearing information are presented together.

SEISMIC REVIEW TABLE

STRUCTURES

	DAMPING OBE/SSE (% critical damping)
1. Welded steel framed structures	2.0/2.0
2. Bolted steel framed structures	2.0/2.0
3. Reinforced concrete: structures on soil including structural damping	5.0/7.5
4. Prestressed concrete: containment structure on soil including structural damping	4.0/7.5

Sec. A.2, p. A-8, Appendix A

DESIGN CRITERIA

LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Final design (SSE) for Class I structures except the containment shell 1. $Y = 1/\phi\ (1.25D + 1.0R + 1.25E)$ 2. $Y = 1/\phi\ (1.25D + 1.25H + 1.25E)$ 3. $Y = 1/\phi\ (1.25D + 1.25H + 1.25E)$ (0.9 D is used where dead load subtracts from critical stress in the above two equations) 4. $Y = 1/\phi\ (1.0D + 1.0R + 1.0E')$ 5. $Y = 1/\phi\ (1.0D + 1.0H + 1.0E')$	ACI 318-63 Code Utlimate strength design Sec. A.2, p. A-3, Appendix A
Final design (SSE) of the containment structure ($.7 < \phi < .9$) a) $Y = 1/\phi\ (1.05D + 1.5P + 1.0T_A + 1.0F)$ b) $Y = 1/\phi\ (1.05D + 1.25P + 1.0T_A + 1.25H + 1.25E + 1.0F)$ c) $Y = 1/\phi\ (1.05D + 1.25H + 1.0R + 1.0F + 1.25E + 1.0T_o)$ d) $Y = 1/\phi\ (1.05D + 1.0F + 1.25H + 1.25W + 1.0T_o)$ e) $Y = 1/\phi\ (1.0D + 1.0P + 1.0T_A + 1.0H + 1.0E' + 1.0T_o)$ f) $Y = 1/\phi\ (1.0D + 1.0H + 1.0R + 1.0E' + 1.0F + 1.0T_o)$	Sec. B.1.6 p. B-5, Appendix B
Y = Required yield strength of the structures D = Dead load of structure and equipment + any other permanent loads contributing stress, such as soil or hydrostatic loads R = Force or pressure on structure due to rupture of any one pipe H = Force on structure due to thermal expansion of pipes under operating conditions. E = Design seismic load for Class I structures E' = Maximum seismic load for Class I structures W = Wind load for Class I structures, tornado load for containment ϕ = Capacity reduction factor (Defined in B.1.7) P = Design accident pressure loads	Containment Working Stress: a. $D + L + F + T_o$ b. $D + L + F + T_A + E$ (or W) c. $P' = 1.15P$ FSAR App. B.1

F = Effective prestress loads
T_o = Thermal loads due to temperature gradient through wall during operating conditions
T_A = Thermal loads due to temperature gradient through the wall and expansion

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA** — **LOAD COMBINATION**	**DESIGN CRITERIA** — **ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
1) **Welded steel plate assemblies** 1.0/1.0 2) **Concrete equipment supports on another structures** 2.0/2.0 3) **Steel piping** 0.5/0.5	Analytical method DC control centers 250V-test	Critical reactor vessel internal structural 1. Design loading + design earthquake forces $P_m \le S_m$ $P_B + P_L \le 1.5 S_m$	P_L, P_m, S_m, S_y are defined in the ASME Boiler and Pressure Vessel Codes, Section III, Article 4.
		2. Normal operating loadings + hypothetical earthquake forces $P_m \le S_D$ $P_B \le 1.5 [1-(\frac{P_m}{S_D})^2] S_D$	ASA B31.1 "USA Standard Code for pressure piping power piping."
		3. Normal operating loadings + hypothetical earthquake forces + pipe rupture loadings $P_m \le S_L$ $P_B \le 1.5 [1-(\frac{P_m}{S_L})^2] S_L$	Piping: FSAR App. A Q.5.12, Q.5.7
		S_u = Minimum tensil strength of material at temperature $S_L = S_y + (1/3)(S_u - S_y)$ S_D = Design stress = $1.2 S_m$	Sec. 3.2 p. 3.6
Sec. A.2 Appendix A	Question 5.8 p. 5.8-3	Class 1 systems and equipment design (including piping) 1. MOL + PTT + SL — 1. Applicable code allowable stress 2. MOL + MTT + SL — 2. Minimum yield stress at temperature 3. MOL + MTT + 2SL — 3. Minimum yield stress at temperature may be exceed but limited to no more than + 10% MOL = Maximum normal operating load including design pressure, design temperature + piping and support reactions PTT = Normal planned thermal transients associated with expected plant normal operating transients such as start-up, shutdown and load swings	

MTT = Maximum thermal transients in the systems functioning during plant energency conditions such as full power reactor trip turbine generator trip, loss of auxiliary power and the DBA

SL = Design seismic load resulting from a seismic ground surface acceleration of 0.1g

2SL = Hypothetical seismic load resulting from a seismic ground surface acceleration of 0.2g

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Not available	Not available

SEISMIC REVIEW TABLE

Docket Number
50-277, 278

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Peach Bottom Atomic Power Station, Unit 2 and 3 Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Bechtel Unit 2: 1-68/8-73 Unit 3: 1-68/7-74	0.05 p.C.2-1	0.033 p.C.2-2	VII Sec. 2.5. 3.1.1, p.2.5-12	0.12 p.C.2-2	0.08 p.C.2-2	Synthetic time-history.	2 components H+V simultaneous p. C.4-1 Sec. C.2.2 Sec. C.3.3	Absolute sum (Response spectrum analysis) Sec. C.3.3 p. C.3-3	Housner OBE: Fig. C.3.1 SSE: Fig. C.3.2 Max. acceleration = 0.15g @ 2% damping p. C.3-2,	Time-history method using an earthquake time-history whose raw spectrum response curve is greater than or equal to the site design response spectrum curve. Sec. C.3.3 p. C.3-3

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Class I structures: Spread or mat foundation on fresh rock Peters Creek Schist. Depth: Not available Auxiliary building: Steel H bearing pile foundation.	Residual soils. Weathered Peters Creek Schist. Fresh Peters Creek Schist.	0 to 40 ft. below surface. 25 to 65 ft. in thickness. 15 to 80 ft. below surface.	Not available	Varies from 12 to 15 ft. near and upstream. Reaches 100 ft. one mile downstream.	Site is 9 miles above Conowingo Dam; 6 miles below Holtwood Dam	Fig. C.3.3 indicates fixed base stick model.	Not available	Not available	Not available
p. 2.7-3, p. 2.7.4	p. 2.5-14	p.2.5-14		p. 2.5-10	p. 2.5-10	p. C.3.3			

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE (% critical damping)		**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Reinforced concrete strutures	2.0/5.0	1. D + E 2. D + E´ 3. D + W 4. D + W´ 5. D + E + T 6. D + E´ + T 7. D + F where D = Dead load, W = Wind load, W´ = Tornado load, E = OBE, E´ = DBE, T = Thermal, F = Flood	AISC for structural steel ACI 318-63 for reinforced concrete <u>Maximum allowable stresses</u> Steel - .9 yield strength Concrete - .85 compressive strength Reinforcement- .9 yield strength See Codes on p. C.2-8.
Steel framed structures	2.0/5.0		
Weld steel assemblies	1.0/2.0		
Bolted and riveted assemblies	2.0/5.0		
p. C.2-2		p. C.2-6 p. C.2-7 For further reference, refer Appendix C	p. C.2-6

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE (% critical damping)		**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**	
			LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Welded steel assemblies	1.0/2.0	Analysis and tests	Normal and upset: 1. D. W. + pressure 2. D. W. + pressure + OBE 3. D. W. + pressure + thermal 4. D. W. + pressure + OBE + thermal Emergency: 1. D. W. + DBE Faulted: 1. D. W. + DBE + Jet reaction forces	<u>Reactor Vessel</u> ASME BPVC III <u>Piping</u> USAS B 31.1.0
Bolted and riveted assemblies	2.0/5.0			
Seismic Class I Piping System	0.5/0.5			
p. C.2-2		p. C.5-1	For further details refer to TAble C.5.6, Table C.5.7	Table C.5.6 Table C.5.7

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Test and empirical experience. p. C.5-1	Not available	Not available

SEISMIC REVIEW TABLE

Docket Number
50-293

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Pilgrim Nuclear Power Station Unit No. 1 Reactor type: BWR Containment type: Reinforced Concrete NSSS Manufacturer: General Electric Architect Engineer: Bechtel	0.08	0.053	VII	0.15	0.10	Taft Earthquake, July 21, 1952 normalized to 0.08g and 0.15g ground accelerate was used for computer analysis and results compared against those from smothed response spectra method.	Horizontal component and vertical component were acting simultaneously.	For piping system: SRSS For struct: not available.	Housner	Time-history method using Taft record. Then each curve was compared to the ground response spectrum and corrected to fall below the ground spectrum curve.
8-68/6-72	Sec. 2.5.3.2 p. 2.5-6	App. C, Sec. C.2.2 p. C.0-1	Sec. 2.5.3.2 p. 2.5-6	Sec. 2.5.3.2 p. 2.5-6	App. C, Sec. C.2.2 p. C.0-1	Sec. 12.2.3.5.2 p. 12.2-5	Comment 12.2.4 p. 2-26	App. C, Sec. C.3.3 p. C.0-7	Fig. 2.5-5 Fig. 2.5-6	Sec. 12.2.3.5.2, p. 12.2-6 Comment: 12.2.2 p. 2-22

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Heavily rein- forced concrete mat 8 ft. depth Sec. 12.2.2.1, p. 12.2-2	Layers of glacial and recent deposits. Upper layer sandy silts (about 20 ft.) lower layer (glacial zone) poorly graded to well graded sands with varying a- mount of gravel. Boulders are scattered thru-out the	soils. Bedrock is Dedham Granodiorite Group with a depth of six feet.	Not available.	Ground water table generally follows the site topo- graphy. i.e., moderately steep ground water gra- dients are present with flow toward Cape Cod Bay. Water level is a- bout 2 1/2 to 5 ft. from surface (gathered from boring logs). Sec. 2.4.1.3.2, p. 2.4-1	Not avail- able.	Stick model with soil springs. Sec. 12.2.3.5.2 p. 12.2-5	Not available.	Not available.	Not avail- able.

Sec. 2.5.2.4.2
and Sec. 2.5.2.4.3
p. 2.5-4

SEISMIC REVIEW TABLE

STRUCTURES			
	DAMPING OBE/SSE (% critical damping)	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Reinforced concrete building	5.0/7.5	1. Dead load + OBE.	1. Stresses according AISC. and ACI Codes.
Internal concrete structures and equipment supports	2.0/3.0	2. Dead load + wind loading.	2. Maximum allowable stress increased 1/3 above normal code-allowable stress.
Steel frame structures	2.0/5.0		
Bolted steel assemblies	2.0/5.0	3. Dead load + jet forces and pressure and temperature transient with rupture of single pipe + OBE.	3. Normal code-allowable stress.
Welded assemblies	1.0/2.0		
		4. Dead load + R + SSE	4. Steel - 15% of AISC Code allowable stress concrete -0.75 f´c where "working stress design" method is used. Reinforcement = 0.9 f_y when "ultimate strength design" method is used. Load factor of 9.0 is used with appropiate reduction factor as in ACI-318-63.
		R= Jet forces and pressure and temperature transient with rupture of single pipe.	
Table 12.2.3, p. 12.2-6		Details: See C.2.3, App. C, p. C.0-2	Details: See C.2.3, App. C, p. C.0-2

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Class I Piping System 0.5/1.0	Both analytical and empirical (testing).	Load combinations are presented as tables. Per ASME Code. <u>Drywell membrane stresses</u>: D + R + E; D + R + flood — stress intensities are defined per code paragraph N-413 and their limits as per code N-413.	ASME BPVC Section III
Table 12.2.3, p. 12.2-6 Table 12.2.3-2	App. C, C.3.1, p. C.0-5	Table C-9 Table C-20	Sec. C.3.4, App. C, p. C.0-7

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Not available	Not available

SEISMIC REVIEW TABLE

Docket Number
50-266, 301

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY mm	HOR. g	VERT. g					
Point Beach Nuclear Plant Unit No. 1 & 2 Reactor type: PWR Containment type: 6 buttresses with shallow dome (prestressed concrete) NSSS Manufacturer: Westinghouse Architect Engineer: Bechtel	0.06	0.04	NOT AVAILABLE	0.18	0.08	NOT AVAILABLE	Horizontal & Vertical Components Combined Simultaneously	SRSS	Housner Spectra	Olympia, Washington N80E on April 13, 1949 Earthquake normalized to .06g was used for this analysis.
Unit 1: 7-67/10-70 Unit 2: 7-68/11-71	Sec. 5.1 p. 5.1-41			Sec. 5.1 p. 5.1-41			Append. A p. A-3	Sec. 5.1.2.4 p. 5.1-52	Q. 5.2 p. 5.2-2 Fig. A-1 & A-2	Append. A. p. A-18

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION: TYPE	BEARING INFORMATION: THICKNESS	BEARING INFORMATION: V_s PROFILE	GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
For containment building: Reinforced concrete foundation slab which is supported by steel H-piles Depth is not available Sec. 1.2 p. 1.2-2 Sec. 2.11.4 p. 2.11-3	Overburden soils: silty clay, silty sand, sand, gravel, cobbles and boulders Bedrock: Niagara dolomite the bedrock as a whole consists of dolomites limestones and sandstones. Sec. 2.9.3 p. 2.9-2	70 ft. to 100 ft. NOT AVAILABLE	NOT AVAILABLE	"The potable water for use at the Point Beach Plant is drawn from a 257 ft. deep well." Sec. 2.6 p. 2.6-10	NOT AVAILABLE	Structure: Stick Model Soil: Cantilever Beam assumption indicates fixed base modelling Q.5.15 p.Q5.15-6	NOT AVAILABLE	OBE/SSE: 5.0/5.0 % of damping factors. Append. A p. A-5	NOT AVAILABLE

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE (% critical damping)	DESIGN CRITERIA	
	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Welded Steel Framed Structures 2.0/2.0 Bolted Steel Framed Structures 2.5/5.0 Reinforced Concrete Structures on Soils 5.0/7.5 Prestressed Concrete Containment Structures on Piles 2.0/5.0	For Containment Structures: a) Y = 1/ϕ (1.05D + 1.5p + 1.0TA + 1.0F) b) Y = 1/ϕ (1.05D + 1.25p + 1.0TA + 1.25H = 1.25E + 1.0F) c) Y = 1/ϕ (1.05D + 1.25H + 1.0R + 1.0F + 1.25E + 1.0To) d) Y = 1/ϕ (1.05D + 1.0F + 1.25H + 1.0W + 1.0To) e) Y = 1/ϕ (1.0D + 1.0p + 1.0TA + 1.0H + 1.0E' + 1.0F) f) Y = 1/ϕ (1.0D + 1.0H + 1.0R + 1.0E' + 1.0F + 1.0To) Note: 0.95D is used instead of 1.05D where dead load subtracts critical stress.	For Concrete Structures of the Reactor Containment: ACI-318-63. For further details refer to Sec. 5.1 p. 5.1-8
Append. A p. A-5 Table A.1-1	Sec. 5.1 p. 5.1-26	Sec. 5.1 p. 5.1-2

SEISMIC REVIEW TABLE

MECHANICAL & PIPING						
DAMPING OBE/SSE (% critical damping)		**METHOD OF QUALIFICATION**	**DESIGN CRITERIA** — **LOAD COMBINATION**	Pressure Vessel	Piping	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Interior Concrete Equip. Supports	2.0/2.0	Analytical & Testing	Normal Conditions	(a) $P_m \le S_m$ (b) P_m(or P_L)$+P_B \le 1.5S_m$ (c) P_m(or P_L)$+P_B+Q \le 3.0S_m$	$P \le S$	For pressure piping: ASME BPVC, USAS B31.3 For reactor vessel: ASME Sec. III, Class A
Vital Piping Systems	0.5/0.5		Upset Conditions (Normal + OBE)	(a) $P_m \le S_m$ (b) P_m(or P_L)$+P_B \le 1.5S_m$ (c) P_m(or P_L)$+P_B+Q \le 3.0S_m$	$P \le 1.2S$	
Welded Steel Plate Assemblies	1.0/2.0		Emergency Conditions	(a) $P_m \le 1.2S_m$ or $P_m \le S_y$ whichever is larger (b) P_m(or P_L)$+P_B \le 1.5\ (1.2S_m)$ or P_m(or P_L)$+P_B \le 1.5\ (S_y)$ whichever is larger	$P \le 1.2S$	
			Faulted Conditions (Normal + DBE, Normal + DBA, Normal + DBE + DBA')	Design Limit Curves of WCAP-5890, Rev. 1 as Modified by Note 1 of This Appendix	Same as Pressure Vessel	
Append. A p. A-5 Table A.1-1		Append. A p. A-3 & Vol. 2 Sec. 5.1 p. 5.1-41				Append. A p. A-3 Sec. 4 Table 4.1-9

P_m = Primary general membrane stress intensity
P_L = Primary local membrane stress intensity
P_B = Primary bending stress intensity
Q = Secondary stress intensity
S_m = Stress intensity from ASME BPVC III Code
S_y = Minimum specified material yield

DBA' = Steady-state Portion of Design Basis Accident

Append. A, Table A.3-1

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
NOT AVAILABLE	Testing as per WCAP 7397-L. Q.5.2 p. 5.2-2	NOT AVAILABLE	NOT AVAILABLE

SEISMIC REVIEW TABLE

Docket Number
50-282,306

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Prairie Island Nuclear Generating Plant Unit 1 and 2 Reactor Type: PWR Containment Type: Dry Containment-Cylindrical (Steel) NSSS Manufacturer: Westinghouse Architect Engineer: Pioneer	0.06	0.04	VI	0.12	0.08	Synthetic time-history	2 components combined linearly JAB-PS-02 App. B, John Blume	SRSS	Housner	Time history method. For details refer to John A. Blume report, JAB-PS-04.
Unit #1: 6-68/8-73 Unit #2: 6-68/10-74	Sec. 2.10.2 p. 2.10-2	Sec. 5.2.1 p. 5.2-6		Sec. 2.10.2 p. 2.10-2	Sec. 5.2.1 p. 5.2-6	B. 6-7 App. A-1 p. 4.11	B.6-9 B.6-6	App. B Sec. B.6.3(i) p. B.6-10	App. A. Plate 4.5,4.6	App. B Sec. B6.3 p. B.6-6 to B.6-7

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Plant grade is at Elv. 693.5 1. Mat foundation at Elv. 674 App. A-1, p. 5.12 Because of problem with liquefaction of soils above Elv. 645 due to ground acceleration, the soil above Elv. 645 is densified to a minimum relative density of 85%. For further details refer to App. Al, Sec. 5	Overburden materials are permeable sandy Alluvial soils from glacial outwash and recent river deposits. The bedrock is sandstone of Franconia formation of < 180 feet in thickness. Sec. 2.9.4 p. 2.9-4&2.9-5	Structures are founded on densified sandy Alluvial soils of 158 to 185 feet.	Elv. 0-20 loose sand 470 ft/sec Elv. 20-50 med dense 2150 ft/sec Elv. 50-180 very dense 2860 ft/sec Elv. 180-4100 Sandstone 5020 ft/sec App. A Sec. 4 Plate 4.1	Ground water table is 5 ft to 20 ft of the ground surface of the site and slope southwest from the Missippi River toward Vermillion River. Sec. 2.7.1 p. 2.7-1	Lock and dam number 2 is 17 miles upstream of plant site. It is 3250 ft long dike, 2 single-lift locks with chambers 110'x600' and 110'x 500'; and a spillway section of 20-30 ft. Amend. 22 Sec. 2.7.3 p. 2.7-8C	Stick model with soil springs. App. B Sec. B6.3 p. 3.6-6	Not available.	5% of critical damping. Amend. 12 App. B Table B.6-5	Not available.

SEISMIC REVIEW TABLE

STRUCTURES				
DAMPING OBE/SSE	(% critical damping)	**DESIGN CRITERIA** — **LOAD COMBINATION**		**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
		L. C.	Class 1	R/C: ACI 318-63 — Steel: AISC
Reactor building containment vessel:	1.0/1.0	Normal operating	D + L + (W or S)	" — "
Reactor building shield structure:	2.0/2.0	OBE	D + L + DBA + greater of the OBE + (W or S)	
Reactor building internal concrete construction:	5.0/5.0	DBE	D + L + S + DBA + DBE	1 1/2 times ACI 318-63 1 1/2 AISC
Steel framed structures:	2.0/2.0	Tornado	D + L + tornado + tornado missiles	$f_c = 0.85 f_c'$ — $f_s = 0.9 F_y$ $f_s = 0.9 F_y$
Reinforced concrete construction:	2.0/2.0	Other	Jet forces, rupture loads, flood whereever applicable	
Amend. 12 (11-15-71) App. B Table B.6-5		For details refer to App. B, Sec. B.6.1, p. B.6-1 and Table B.6-1.		App. B Sec. B.3 p. B.3-1

SEISMIC REVIEW TABLE

MECHANICAL & PIPING					
DAMPING OBE/SSE	(% critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**		
			LOAD COMBINATION		**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Piping systems:	0.5/0.5	Analytical and testing.		Vessel / Piping	ASME, BPVC, Section III
Mechanical equipment:	2.0/2.0		1. Normal condition (D.L. thermal and pressure)	Vessel: (a) $P_m \leq S_m$ (b) P_m (or P_L)+$P_B \leq 1.5S_m$ (c) P_m (or P_L)+P_B+$Q \leq 3.0S_m$ Piping: $P \leq S$	ANSI B31.1, 1967 (App. B., Table B.7-3) p. 5.2-11 App. B Table B.7-3
			2. Upset condition (normal and OBE)	Vessel: (a) $P_m \leq S_m$ (b) P_m (or P_L)+$P_B \leq 1.5S_m$ (c) P_m (or P_L)+P_B+$Q \leq 3.0S_m$ Piping: $P \leq 1.2S$	
			3. Emergency condition	Vessel: (a) $P_m \leq 1.2S_m$ or S_y whichever is larger (b) P_m (or P_L)+$P_B \leq 1.5(1.2S_m)$ or $1.5S_y$ whichever is larger Piping: $P \leq 1.5(1.2S)$	LOAD COMBINATION (cont.) P_m=Primary general membrane stress intensity P_L=Primary local membrane stress intensity P_B=Primary bending stress intensity Q =Secondary stress intensity S_m=Allowable stress intensity value from ASME, BPVC S_y=Maximum specified material yield strength Amend. 24 (10-6-72) Table 5.2-1 P =Stress S =Allowable stress from ANSI B31.1 code for power piping 1967
			4. Faulted condition (Normal+DBE+pipe rupture)	Vessel: (a) $P_m \leq 1.5S_m$ or $1.2S_y$ whichever is larger (b) P_m (or P_L)+$P_B \leq 2.25S_m$ or $1.875S_y$ whichever is larger Piping: $P \leq S_y$ or 1.8S	
Amend. 12 (11-15-71) App. B Table B.6-5		App. B Sec. B.7(i) p. B.7-9 p. B.7-14	S_y=Minimum specified yield strength (ASME, BPVC Code, Sec. III) Amend. 11, App. B., Table B.7-2 and Table B.7-3		

App. B, Table B.7-3.
p. 5.2-11

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

Docket Number
50-254, 265

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Quad - Cities Station Unit 1 and 2 Reactor type: BWR Containment type: Mark I(Steel) NSSS Manufacturer: General Electric Architect Engineer: Sargent & Lundy, Engineers	0.12	0.08	VII	0.24	0.16	South-East component of San Francisco Golden Gate 1952 earthquake normalized to a maximum ground acceleration.	Horizontal and vertical components combined simultaneously.	SRSS	Ground response spectra for the Golden Gate Park earthquake as well as the Housner spectra.	Normalized Golden Gate 1952 earthquake was used for the Time History Method.
Unit 1: 2-67/9-71 Unit 2: 2-67/3-72	Sec. 2.6 p. 2.6-1	Sec. 12.1.1.3 p. 12.1-6	Sec. 12.1.1.3 p. 2.6-1	Sec. 2.6 p. 2.6-1	Sec. 12.1.1.3 p.12.1-6	Append. C p. E-1	Sec. 12.1.2 p.12.1-9	Sec. 12.1.2 p.12.1-9	Amend. 13, Sec. 12, p. 12.1-1, Fig. 12.1-1	Sec. 12, Amend.13 p. 12.3-8

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reactor building: Reinforced concrete foundation. 297 ft.-0 by 150 ft. -0	Zone 1: (above El 530) contains both good & poor zones much of bad rock has been excavated Zone 2: (El 530-500) primarily good rock Zone 3: (El 500-475) both good & poor zones. Zone 4: (Below El 475) primarily good rock	0 to 20 ft. 30 ft. 25 ft. 50 ft.	Turbine Room No. 1. Middle Grout Zone 8,000 to 9,000 fps. above Upper Soft Zone 5,500 to 7,500 fps. Upper Soft Zone 3,900 to 5,100 fps. Good Rock Zone 8,000 fps. Lower Soft Zone 4,700 to 6,200 fps. below Deep Soft Zone 6,000 fps.	Not available.	This site is about midway between Lock and Dam No. 14 and 13 on Mississippi River.	Structure: Stick Model Soil: Fig. 12.1.6 shows fixed base assumption.	300,000 psi to 1,500,000 psi	Not available.	Not available.
Sec. 12.1.2.1 p. 12.1-7	Amend. 15 p. 13 Table 4		Amend. 15, p.6		Sec. 2.4, p. 2.4-1	Sec. 12.1.2, p. 12.1-8 and p. 12.1-9	Amend. 15, 1 of 2		

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE (% critical damping)	DESIGN CRITERIA	
	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Reinforced concrete structure 5.0* Steel frame structure 2.0 Welded assemblies 1.0 Bolted and riveted assemblies 2.0 *(For both O.B.E and D.B.E.) Sec. 12.1.1.3, Table 12.1.1, p. 12.1-6 and p. 12.2-4	Primary containment (including penetrations) = a) D + P + H + T + E b) D + P + H + T + E c) D + P + H + T + E´ Class I structure = D + R + E D + R + E´ D + L D = Dead load; L = Wind live load P = Pressure due to loss-of-coolant accident R = Jet force or pressure on structure due to rupture of any one pipe H = Force on structure due to thermal expansion of pipes under operating conditions T = Thermal loads on containment, reactor vessel, and internals due to loss-of-coolant accident. E = Design earthquake load, ground horizontal g = 0.12, vertical g = 0.68 E´ = Maximum earthquake load, ground horizontal g = 0.24, vertical g = 0.16 Amend. Sec. 12, p. 12.1-3 ∿ p. 12.1-6	AISC - For structure steel ACI - 318 - 63 Amend. 13, Sec. 12, p. 12.13-1

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Vital Piping Systems 0.5 (For both O.B.E. and D.B.E. except for the standby gas treatment system, where 1% of critical damping was used).	Analytical	Reactor primary vessel supports = a) D + H + E b) D + H + R + E c) D + H + E´ Reactor primary vessel internals = a) D + E b) D + E´ c) P + D + T Other major Class I equipment = a) D + T + M + E b) D + T + M + E´ For designations refer to previous page.	For reactor pressure vessel: ASME Boil and Pressure Code, Sec. III, 1963 and Summer 1964, Append. A. Class I piping: USAS B31.1
Sec. 12.1.1.3, Table 12.1.1 p. 12.1-6	Amend. Sec. 12 p. 12.2-14	Amend. 13, Sec. 12, p. 12.3-10	Append. C p. ii, Amend. Sec. 12, p. 12.1-4

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

Docket Number
50-312

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA: OBE HOR. g	OBE VERT. g	SSE INTENSITY MM	SSE HOR. g	SSE VERT. g	EARTHQUAKE TIME HISTORY	METHOD OF COMBINATION: NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	DESIGN SPECTRA: TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
Rancho Seco Nuclear Generating Station Unit No. 1 Reactor type: PWR Containment type: 3 buttresses with shallow dome (pre-stressed concrete) NSSS Manufacturer: Babcock and Wilcox Architect Engineer: Bechtel	0.13	0.09	VI	0.25	0.17	1952 Taft Earthquake	Three earthquake components: two horizontal and one vertical. Results for each horizontal earthquake were added separately on absolute basis to those from vertical earthquake; yielding two distinct seismic loading cases.	SRSS both for structures and piping.	Accelerogram of Taft Earthquake 1952. The response spectra are broadened in their range of peak responses.	Time-history acceleration method
10-68/8-74	p. 5.1-2	p. 5.1-2		p. 5.1-2	p. 5.1-2	Appendix 5B p. 5B-4	Question AEC 5.51 p. 5A-51	Question AEC 5-51 p. 5A-51	Appendix 5B p. 5B-4, Figs. SK6292-S-59 and SK6292-S-62	Appendix B p. 5B-4

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Circular reinforced concrete mat 8 ft thickness Foundation is found about 35 ft below grade surface. Sec. 5.2.1 p. 5.2-1 Appendix 2E p. 2E-1	The granite & metamorphic basement is overlain in the site by 1500 to 2000 ft tertiary or older sediments. The surface unit is pliocene laguna formation of firm siltstone, sand, gravel Appendix 2C, p 2C-7, Table 2C-1.2 Sec. 2.5	The surface unit of pliocene laguna formation is about 126 ft.	Not available.	150 ft below original ground surface. p. 2.4-1	1. Data on reservoirs and lakes within 50-mile radius are given in Table 2.4-1. 2. Plot of on-site dam, Question AEC No. 2.14. Appendix 2A p. 2A-132	Stick model with soil springs. Sec. 5.2.1.3.6 p. 5.2-18	Not available	10% for design basis earthquake. Appendix 5B p. 5B-6	Not available

SEISMIC REVIEW TABLE

STRUCTURES

DAMPING OBE/SSE	(% critical damping)
Stress level:*	
1. a) Welded structural steel, reinforced or prestressed concrete, no cracking, no joint slip.	0.5/1.0
2. a) Welded structural steel, reinforced and prestressed concrete (only slight cracking).	2.0
b) Reinforced concrete with considerable cracking.	3.0/5.0
c) Bolted and/or riveted steel.	5.0/7.0
3. a) Welded structural steel, prestressed concrete (without complete loss in prestress).	5.0
b) Prestressed concrete with no prestress left.	7.0
c) Reinforced concrete.	7.0/10.0
d) Bolted and/or riveted steel.	10.0/15.0
4. Rocking of entire structure	5.0/9.0
Translation of entire structure	30 (OBE, SSE)

*NOTE. Stress level 1 = low, well below proportional limit. Stress below 1/4 yield point.
Stress level 2 = Working stress
Stress level 3 = At or just below yield point
Stress level 4 = Varies

Appendix 5B
p. 5B-7

DESIGN CRITERIA	
LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
A) $\phi C = (1 \pm 0.05)\ D + 1.5\ P + 1.0\ T_A + 1.0\ F$ B) $\phi C = (1 \pm 0.05)\ D + 1.25\ P + 1.0\ T_A + 1.25\ H + 1.25\ E + 1.0\ F$ C) $\phi C = (1 \pm 0.05)\ D + 1.25\ H + 1.0\ R + 1.0\ F + 1.25\ E + 1.0\ T_c$ D) $\phi C = 1.0\ D + 1.0\ P + 1.0\ T_A + 1.0\ E' + 1.0\ F + 1.0\ H$ E) $\phi C = 1.0\ D + 1.0\ H + 1.0\ R + 1.0\ E' + 1.0\ F + 1.0\ T_o$	1. ACI-318-63 Ultimate strength method Question AEC 5.23, p. 5A-25 2. AISC (Sixth Edition) Sec. 5.1.3, p. 5.1-4
ϕ = Capacity reduction factor. D = Dead loads of structures and equipment plus any other permanent loading contribution stress, such as hydrostatic or soil. P = Design accident pressure load. F = Effective prestress loads. R = Force or pressure on structure due to rupture of any one pipe. H = Force on structure due to thermal expansion or contraction of pipes due to design conditions. T_o = Thermal loads due to the temperature gradient during operating conditions. T_A = Thermal loads due to the temperature gradient. E = OBE C = Required capacity to resist factored loads. E' = DBE	NOTE: 1. Normal working stress. Design methods are used for design load case. 2. Factored load case--to check the capacity to withstand accident conditions.
p. 5.1-6 and p. 5.2-7	Sec. 5.1.4, p. 5.1-4a For details see: Sec. 5.2.1.3 p. 5.2-11

MECHANICAL & PIPING				
DAMPING OBE/SSE (% critical damping)		METHOD OF QUALIFICATION	DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Vital piping systems or equipment.		Dynamic analysis	I. Design loads + OBE loads: $P_m \leq 1.0\ S_m$; $P_L + P_B \leq 1.5\ S_m$	Nuclear vessels: ASME BPVC 1967, Section III
Low, well below proportional limit, stress below 1/4 yield point.	0.5	Testing	II. Design loads + DBE loads: $P_m \leq 1.2\ S_m$; $P_L + P_B \leq 1.2\ (1.5\ S_m)$	Piping: USAS I, B31.7
			III. Design loads plus pipe rupture load: $S_m \leq 2/3\ S_U$; $P_L + P_B \leq 2/3\ S_U$	
Working stress, no more than point.	0.5/1.0		IV. Design loads + DBE + pipe + rupture loads: $P_m \leq 2/3\ S_U$; $P_L + P_B \leq 2/3\ S_U$	
At or just below point.	0.5/2.0		P_L = Primary local membrane stress intensity. P_m = Primary general membrane stress intensity. P_B = Primary bending stress intensity. S_m = Allowable membrane stress intensity. S_U = Ultimate stress for unirradiated material at operating temperature.	
p. 5B-7		Question AEC 5.49 p. 5A-49	p. 4.1-4	p. 4.1-5

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Test data/or calculations of equipment to with-stand OBE and DBE are provided by vendors. Question AEC 5.67 p. 5A-62	Not available.	Not available.

SEISMIC REVIEW TABLE*

Docket Number 50-244

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Robert Emmett Ginna Nuclear Power Plant, Unit No. 1 Reactor type: PWR Containment type: cylindrical without buttresses (prestressed concrete) NSSS Manufacturer: Westinghouse Architect Engineer: Gilbert	0.08	0.08	V	0.20	0.20	None used	Two comp., larger horizontal plus vertical, combined via "direct addition" vertical component is assumed unamplified due to high axial stiffness of the containment.	None (Containment analyzed as single degree of freedom).	Housner	Equivalent static approach based on Housner ground spectra. Multimode response spectrum analysis used to check containment vessel and RHRS pipeline from RCS loop to containment.
4-66/9-69	Sec. 5.1.2.4 p. 5.1.2-15	Sec. 5.1.2.4 p. 5.1.2-15	Sec. 2.9 p. 2.9-1	Sec. 5.1.2.4 p. 5.1.2-15	Sec. 5.1.2.4 p. 5.1.2-15					

*Information was obtained from BNL Docket Search and SEPB Report "Seismic Review of Ginna Nuclear Power Station Unit No. 1 for SEP, Phase 1 Report".

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Foundations for major structures will be installed at depths of 25 or more feet below original ground level. Foundations are spread or mat foundations on natural compact granular soil, compacted granular backfill or sound bedrock. The containment cyclinder is founded on rock (sandstone) by means of post-tensioned rock anchors. The base slab is 2' thick.	Major structures are founded on Queenston formation atop a thin layer of natural or compacted granular soils immediately above the bed rock. The Queenston is roughly 1000 ft. thick and overlies 80 ft. of	Oswego sandstone, approximately 600 ft. of Lorrain shales. About 30 ft. of overburden was removed prior construction of foundation.	Not available	Not available	Not available	SDOF stick model with fixed base (checked with MDOF model and rock foundation modeled as elastic media with rotation and translation.	Not used	Not used	Not used

App. 2B, p. 2B-4
Sec. 5.1.2.1
p. 5.1.2-1

Sec. 2.8.2
2.8.3
p. 2.8-1
p. 2.8-2

SEISMIC REVIEW TABLE

STRUCTURES			
	DAMPING OBE/SSE (% critical damping)	**DESIGN CRITERIA** — **LOAD COMBINATION**	**DESIGN CRITERIA** — **ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
1. Containment structure (prestressed cylindrical wall)	2.0	<u>Containment Structure Loading Combinations:</u> <u>Normal</u>- 12 load combinations, example $1.0\ DL + 1.17\ VP + 1.0\ OT_S + 2.0\ E$ <u>Test</u>- 4 load combinations, example $1.0\ DL + 1.17\ VP + 1.0\ OT_W + 1.15\ IP$ <u>Accident Pressure</u>- Cond. "d" - 12 load combinations, example $1.0\ DL + 1.17\ VP + 1.0\ OT_W + 1.0\ IP + 1.0\ AT_{60} + 0.8\ E$ (a=0.1g) Cond. "a" - 4 load combinations, example $1.0\ DL + 1.17\ VP + 1.0\ OT_W + 1.5\ IP + 1.0\ AT_{90}$ Cond. "b" -8 load combinations, example $1.0\ DL + 1.17\ VP + 1.0\ OT_W + 1.25\ IP + 1.0\ AT_{90} + E$ Cond. "c" - 8 load combinations, example $1.0\ DL + 1.17\ VP + 1.0\ OT_S + 1.0\ IP + 1.0\ AT_{60} + 2.0\ E$ DL = Dead load VP = Vertical prestress $OT_{W,S}$ = Operating temp. winter, summer App. 5D, Table 5.1.2-41 FSAR IP = Internal pressure (p=60 psig) AT_{60} = Accident pressure + temperature (p = 60 psig, T = 286°F) E = Design earthquake (a=0.1g)	ACI-318 AISC - 63 State of New York Building Construction Code, 1961 (Class III structures) 5.1.2.3 FSAR 5.1.2.4, 7.2
2. Concrete support structure for reactor vessel and steam generator	2.0		
3. Steel assemblies a) Bolted or riveted b) Welded	 2.5 1.0		
4. Other concrete above ground	5.0		
Table 5.1.2-1			

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA		
		LOAD COMBINATION		ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
1. Vital Piping System 0.5	Analytical and Testing	Loading Combination / Vessels and Reactor Internals / Piping 1. Normal + OBE: $P_m \leq S_m$, $P_L + P_B \leq 1.5\ S_m$ / $P_m \leq 1.2\ S$, $P_L + P_B \leq 1.2\ S$ 2. Normal + SSE: $P_m \leq 1.2\ S_m$, $P_L + P_B \leq 1.2(1.5\ S_m)$ / $P_m \leq 1.2\ S$, $P_L + P_B \leq 1.2(1.5\ S)$ 3. Normal + Pipe rupture loads: $P_m \leq 1.2\ S_m$, $P_L + P_B \leq 1.2\ (1.5\ S_m)$ / $P_m \leq 1.2\ S$, $P_L + P_B \leq 1.2(1.5\ S)$ P_m = Primary general membrane stress; or stress intensity P_L = Primary local membrane stress; or stress intensity P_B = Primary bending stress; or stress intensity S_m = Stress intensity value from ASME B and PV Code Sec. III S = Allowable stress from USAS B31.1 Code for pressure piping		ASME BPVC Sec. III, USAS B31.1 Supports -- Working stress (1) -- within yield after load redistribution (2) -- within yield after load redistribution (3) Fuel Pool Racks: Reg. guides 1.13, 26, 28, 38, 60, 61 ANSI N 18.2 - 1973 ANSI N 45.2.2 - 1972 ANSI N 45.2.13 - 1974 Structural Welding Code AWS Spec. D1.1 Rev. 2-74 ASME BPV Code, Sec. III, Sec. VIII, and IX, 1974 AISC - 1974 FSAR 9.5, App. 14A
Table 5.1.2-1	Amend. 2, Question 5	FSAR 5.1.2, FSAR App. 4-A, Table 1		

Equipment: FSAR Table 3.2.3-2 through 3.2.3-7

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Testing Amend. 2 Question 5	Class I instrumentation: Control Room: Racks have been assembled and the mounting and wiring of all components has been designed such that the functions of the circuits or equipment will perform in accordance with prescribed limits when subjected to seismic accelerations of 0.21g in the horizontal and vertical direction simultaneously. Control room, containment, and auxiliary bldg: Mounting and wiring of all components has been done such that simultaneous accelerations of 0.52g in the horizontal and vertical planes will not dislodge, cause relative movement or result in any loss or change of function of circuits or equipment. Section 5.1.2.4, 7.2	Not available

SEISMIC REVIEW TABLE

Docket Number
50-272, 311

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Salem Nuclear Generating Station Units 1 and 2 New Jersey Reactor type: PWR Containment type: Atmospheric (reinforced concrete) NSSS Manufacturer: Westinghouse Architect Engineer: United Engineers and Constructors Unit #1: 12-66/8-71 Unit #2: 10-67/8-71	0.10 Sec. 2.9 p. 2.9-1	0.067 Sec. 2.9 p. 2.9-1	VII Sec. 2.9 p. 2.9-1	0.20 Sec. 2.9 p. 2.9-1	.133 Sec. 2.9 p. 2.9-1	El Centro (N-S) May 18, 1940 normalized to 0.10g to 0.20g for OBE and DBE respectively was used for containment structure analysis by step by step integration method. Sec. 5.2.4.2 p. 5.2-17	The vertical component was considered to be acting simultaneously with the horizontal motion. Sec. 5.2.4.2 p. 5.2-17	1. Response spectra analysis: Sq root of sum of squares but if < 3 modes→ absolute sum of maximum values. 2. Time history analysis (finite element method): summing of significant modes. App. C Sec. C.3.3 p. C.3-2	1. For freq > 0.33 cps: Aug spectra developed by Housner. 2. For freq < 0.33 cps: Utilized data suggested by Newmark. Fig. IIC-3a Fig. IIC-3b App. B p. IIC-10	Time history method. App. C Sec. C.3.3 p. C.3-2

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Circular concrete mat Depth 16 ft Sec. 5.6.2 See Table 5.6-1	1800 feet of sediments. Upper 35 feet includes hydraulic fill and Quaternary alluvium of clay silt and some sand and gravel. Vincentown formation is encountered at about 70 feet. App. B p. IIC-9	Foundations are established directly in Paleocene silty sands of Vincentown formation or upon compacted fill extended to Vincentown. Depth of Vincentown is 90 feet. App. B p. IIC-9	3500 ft./sec App. B. p. IIC-9	Water level is about 20' from surface, but ground water movement thru acquifiers is quite low due to low permeability. The direction is going into Delaware River. App. B p. IIB-14 Table IIB-2	Not available.	Two methods were used: 1. Lumped mass model analysis using aug resp. spectra 2. Finite element modal analysis, for structure and soil. The most conservative results are used. Sec. 5.2.4.2 p. 5.2-17	Not available.	2%--OBE 5%--DBE Sec. 5.2.4.2 p. 5.2-17	Not available.

See Plate IIC-1, App. B

SEISMIC REVIEW TABLE

STRUCTURES		
	DESIGN CRITERIA	
DAMPING OBE/SSE (% critical damping)	**LOAD COMBINATION**	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Concrete structures: 2.0/5.0 Structural steel: Bolted or riveted 2.5 Welded 1.0	1. Operating + DBA + OBE $C=1.0D\pm 0.05D+1.25P+1.0(T'+TL')+1.25E+1.0B$ 2. Operating + DBA + DBE $C=1.0D\pm 0.05D+1.0P+1.0(T''+TL'')+1.0E'+1.0B$ 3. Operating + DBE $C=1.0D\pm 0.05D+1.0T'''+1.0E'+1.0B$ C = Required load capacity of section D = Dead load P = Accident pressure load T' = Load due to maximum temperature gradient based upon temperature associated with 1.25 times accident pressure T'' = Load due to maximum temperature gradient based upon temperature associated with accident pressure T'''= Load due to operating temperature gradient thru the steel liner, concrete shell and mat E = Load from OBE E' = Load from DBE TL' = Load exerted by liner based upon temperature with 1.25 times accident pressure TL''= Load exerted by liner based upon temperature associated with accident pressure.	ACI 318-63 AISC Manual, 6th edition Note: (a) For normal operating + OBE" "Working Stress Design" ACI 318-63 and the allowable stresses are 1/3 above the normal applicable code working stresses. (b) For normal load + DBE: "Ultimate Strength Design" ACI 318-63
App. C Sec. C.3.2 p. C.3-1	Sec. 5.2.3 p. 5.2-7 to 5.2-8	Sec. 5.6.3 p. 5.6-2

MECHANICAL & PIPING				
DAMPING OBE/SSE	(% critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA** **LOAD COMBINATION**	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Vital piping system:	0.5	Not available.	Vessel / Piping 1. Normal condition: Vessel (a) $P_m \le S_m$ (b) P_m or $(P_L)+P_b \le 1.5S_m$ (c) $P_m(P_L)+P_b+Q \le 3.0S_m$; Piping (a) $P_m \le S$ (b) P_m or $(P_L)+P_b \le S$ 2. Upset condition: Vessel (a) $P_m \le S_m$ (b) $P_m(P_L)+P_b \le 1.5S_m$ (c) $P_m(P_L)+P_b+Q \le 3.0S_m$; Piping (a) $P_m \le 1.2S$ (b) P_m or $(P_L)+P_b \le 1.5(1.2S)$ 3. Emergency condition: Vessel (a) $P_m \le 1.2S_m$ or S_y whichever is larger (b) $P_m(P_L)+P_b \le 1.5(1.2S_m)$ or $1.5S_y$ whichever is larger; Piping (a) $P_m \le 1.2S$ (b) P_m or $(P_L)+P_b \le 1.5(1.2S)$ 4. Faulted condition: Vessel: Design limit curves*; Piping: Design limit curves* NOTE: P_m = primary general membrane stress, P_L = primary local membrane stress, P_b = primary bending stress, S_m = stress value for ASME, BPVC code, Section III, nuclear vessels, S_y = minimum specified material yield, S = allowable stress from USASI, B31.1 code for press piping. App. C, Table C.4-2	ASME Nuclear Vessel Code Section III ANSI B31.1 for piping Sec. 5.2.8.3 p. 5.2-53
App. C Sec. C.3.2 p. C.3-1				

*Design limit curves developed using 50% of ultimate strain as maximum allowable membrane strain.

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE *

Docket Number
50-206

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
San Onofre Nuclear Generating Station Unit 1 Reactor type: PWR Containment type: Dry containment-spherical (steel) NSSS Manufacturer: Westinghouse Architect Engineer: Bechtel 3-64/3-67	0.25 0.25g for Cat. A, 0.20g for Cat. B, UBC for Cat. C.	0.167	Not available	0.50 0.50g for initial design, 0.67g for reevaluation of reactor bldg, NSSS, containment sphere, concrete sphere enclosure, foundation and cradle and diesel gen. bldg.	0.33 (0.44g for re-evaluation)	A synthetic time history was generated so that it's response spectra envelop the Housner spectra at 2% damping. 3.7.1-1	See below	See below	Housner spectra used in original design and 1972-75 re-evaluation except that a site specific spectra was used for the concrete sphere enclosure and the deisel generator bldg. 3.7.1.1	Floor response spectra by time history method for re-evaluation of RCL piping, equipment, and NSSS supports. All other Category "A" piping and equipment (ECCS, ACS, SIS, feedwater lines, CVC) - 1.0g and 0.67g for horizontal and vertical, 0.5g, Housner spectra for equipment.

System	Analysis	E.Q.Comp.&Comb.	Modal Comb.
Reactor bldg.	Res. Spec.	3comp. R.G. 1.92	R.G. 1.92
D.G. Bldg.	Res. Spec.	3comp. R.G. 1.92	R.G. 1.92
Steel Containment sphere	Res. Spec.	3comp. SRSS	SRSS
RCL piping and equipment	Time history	3comp. algebraic	Direct integration
RCL supports	Time history	3comp. algebraic	Direct integration
Concrete sphere enclosure	Res. Spec.	3comp. SRSS	SRSS
Diesel Gen. Bldg.	Res. Spec.	3comp. R.G. 1.92	R.G.1.92
Main bldg.	Res. Spec.	3comp. Absolute	Absolute
Intake struct., Aux. bldg., battery rm.	Res. Spec.	2comp. Absolute	N/A

*Information from BNL Docket search and SEPB Report No. EDAC-175-166.01, August '79, "Seismic Design Bases and Criteria for San Onofre Nuclear Generating Station, Unit 1".

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
The foundation of the containment-reactor building is in the shape of a spherical segment extending from the ground surface to a depth of 40 ft. The supporting medium is San Mateo sand. Bedrock is at a depth of 1000 ft. p. 3.7.1-6	1. Quarternary terrance deposits: Consist of clayey or silty, fine to coarse sand with some cobbles. Average thickness is 40 ft. 2. San Mateo formation: Massive, well-graded, fine	to coarse sand with gravel and occasional lenses of thin beded gray shale or siltstone. Approx. 1000 ft. thick.	Surface terrace deposit 400 and 1250 fps San Mateo sand 765 fps Capistrano siltstones 2000 fps Monterey shale 2160 fps San Onofre Breccia 5000 fps undifferentiated sediments 3,900 fps	Average level of ground water is 15 ft. below original grade (Eℓ + 5ft. MLLW Datum), and the gradient is 17 ft. per mile toward the ocean. Sec. 1.1.4 p. 1-10	Not available	Soil-structure interaction is represented by a set of six frequency-independent interaction springs attached to the reactor building structure at the center of gravity of the base mat. "SHAKE" program used.	Not available	Soil horizontal translation - 12% Soil vertical translation - 18% Soil rocking - 10% These values include radiation and material damping.	Not available

Sec. 1.3.2
p. 1-56

p. 3.7.2-4

Table 3.7.1-3

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE (% critical damping)		**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
1. Reactor vessel internals (stainless steel core support structure) (a) welded assemblies (b) bolted assemblies 2. Reinforced concrete reactor support 3. Steel containment vessel and foundation 4. Framed steel structures 5. Concrete structures above ground (a) shear wall type (b) rigid frame type Sec. 9.2.2 Table 9.1 p. 9-10	 1.0 2.0 4.0 4.0 2.5 7.0 5.0	<u>Concrete structures</u> (concrete sphere enclosure) $u = 1.4\ D + 1.7\ L$ $u = 1.4\ D + 1.7\ L + 1.9\ E$ $u = D + L + T_o + R_o + E'$ $u = D + L + T_A + R_A + 1.0\ P_A + (Y_R + Y_j + Y_M) + E'$ (9 additional L.C.) <u>Steel structures</u> $S = D + L$ $1.6S = D + L + T_o + R_o + E'$ $1.6S = D + L + T_A^o + R_A^o + P_A + 1.0\ (Y_R + Y_j + Y_M) + E$ (8 additional L.C.) <u>Reactor building and foundation and cradle support</u> $u = 1.0\ D + 1.0\ L + 1.0$ (DBE) $0.9Y = 1.0\ D + 1.0\ L + 1.0$ (DBE) Y = ultimate strength of section	Concrete sphere enclosure, Reactor bldg. (concrete internals), foundation and cradle, diesel generation bldg. - ACI 318 - 71, AISC 1971 Main building, intake structures, auxiliary bldg., battery rm., turbine pedestal - ACI 318 - 63 - AISC 1963 - UBC 1964 Refueling Water Stg. Tank-API publication for storage tank.

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
		DESIGN CRITERIA	
DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
1. Vital Piping Systems 0.5 Sec. 9.2.2 Table 9.1 p. 9-10	Not Available	Containment sphere Primary membrane and bending stresses are evaluated at: A). Basic shell thickness under combined dead weight, design pressure and seismic loads B). Shell to base mat juncture under combined deadweight, design pressure and seismic loads. C). Shell in vicinity of equipment hatch and personnel lock D). Main feedwater penetration under combined dead weight, internal pressure, seismic, and piping.	Containment sphere: ASME Sect. III, 1971 and 1972 Summer Addenda Allowable Stress / Ref. Primary Membrane — S_M — NE-3221.1 Primary Membrane plus primary bending — $1.5S_M$ — NE-3221.3 Primary plus secondary — $3.0S_M$ — NE-3131.0, NB-3222.2 Equipment&Piping,RCL&NSSS Supports Category A, ASME, Section III, 1971, NB-3600;All other Category A piping and equipment (feedwater, CVC, ECCS, ACS): ASME Section III - 1962, USAS B 31.1 (1964) DIESEL Gen-IEEE-STD-344

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Not available	Tested or evaluated to determine that the instruments would withstand 1.0g without misoperation. Amend. 10, Suppl. 1, Quest. 14	Not available	Not available

SEISMIC REVIEW TABLE

Docket Number

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Shippingport Project 129 Reactor type: PWR Containment type: Dry containment-spherical (steel) NSSS Manufacturer: Westinghouse Architect Engineer: Burns and Roe, Inc. also Stone and Webster Engineering Corp.	← Not available →									

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
← Not Available →									

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE	DESIGN CRITERIA	
	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	ASME Code Sec. VIII 1952 Ed. P.A. Regulations for pressure vessels 1954 ed.

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
←	Not Available		→

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
←		Not Available	→

SEISMIC REVIEW TABLE

Docket Number
50-335

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
St. Lucie Plant, Unit No. 1. Reactor type: PWR Containment type: Dry containment-cylindrical (steel) NSSS Manufacturer: Combustion Engineering Architect Engineer: Ebasco	0.05	0.033 for shield building	VI	0.10	0.067 for shield building	Synthetic time-history	Each horizontal combined with the vertical on an absolute sum basis. Resulting two load cases.	SRSS	Housner spectra	Time-history method using synthetic time history
7-70/ 3-76	Sec. 2.5 p. 2.5-25a	Sec. 3.8.2.2, p. 3.8-67, Amend. 32	Sec. 2.5 p. 2.5-27		Sec. 3.8.2.2, p. 3.8-67, Amend. 32	Sec. 2.5.3 p. 2.5-28	Sec. 3.7.3.2.4, p. 3.7-43a	Sec. 3.7.2, p. 3.7-19	Fig. 2.5-23 and 24 Fig. 3.7-1 and 2	Sec. 3.7 p. 3.7-36 Sec. 3.7 p. 3.7-3 Rev. 16

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION: TYPE	BEARING INFORMATION: THICKNESS	BEARING INFORMATION: V_s PROFILE	GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
For reactor building: Rigid foundation mat.	Loose sand with small a- mounts of silt and clay, containing isolated poc- kets of shell fragments	and limestone nodules. 50' to 60'	Not available	Shallow non- artesian aquifer extends to a depth of about 150 ft. below land surface	"No dams are located within the hydrological influence of Hutchinson Island."	Stick model with soil springs.	Generally utilize shear shear moduli ranging from ranging from 16,700 psi to 14,000 psi.	Not available	Not a- vailable
p. 2.5-1	More dense contains a greater percentage of fines (material finer than the no. 200 sieve) and has very few pockets of	limestone nodules and * 60' to 150'	Sec. 2.5-36 p. 2.5-38	Vol. 1, Sec. 2.4 p. 2.4-20	Sec. 2.4, p. 2.4-7a	Sec. 3.7.2.1.1 p. 3.7-6	Sec. 2.5, p. 2.5-38	p. 2.5-19	

(Note: Due to space the columns for Type and Depth had to be continued here....)

* shell fragments

more clayey than the material above, does not contain pockets of shells and limestone, and is dense in consistency. Vol. 1, Sec. 2.5, p. 2.5-8 — 150' to at least 400'

SEISMIC REVIEW TABLE

STRUCTURES			
DAMPING OBE/SSE (% critical damping)		**DESIGN CRITERIA**	
		LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Welded steel framed structure	2.0/2.0	Shield Building (1.0 ± 0.05)(D + T) + 1.25 LOCA + 1.25 OBE (1.0 ± 0.05)(D + T) + 1.25 OBE (1.0 ± 0.05)(D + T) + 1.0 LOCA + 1.0 DBE (1.0 ± 0.05)(D + T) + 1.0 DBE For further details refer to Sec. 3.8.2.2 p. 3.8-68 of Amend. 32-9/6/74.	AIC 318-63 Φ Yield capacity reduction factors are used. Sec. 3.8.2.2.8 p. 3.8-71 AISC -1969 Sec. 3.8 p. 3.8-2,3
Bolted or riveted steel framed structure	2.5/2.5		
Reinforced concrete frames and buildings	2.0/5.0		
Steel containment vessel	2.0/2.0		
Sec. 3.7 p. 3.7-3a			

SEISMIC REVIEW TABLE

MECHANICAL & PIPING					
DAMPING OBE/SSE (% critical damping)		**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**		
			LOAD COMBINATION		**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Welded steel plate assemblies Reinforced concrete equipment supports Steel piping Sec. 3.7 p. 3.7-3a	1.0/1.0 2.0/5.0 0.5/0.5	Analytical and Testing Sec. 3.7, p. 3.7-36,43a Sec. 3.9 p. 3.9-1	<u>Containment Vessel</u> LOCA + OBE: $P_M \leq 1.0\ S_m$ $P_L + P_B \leq 1.5\ S_m$ $P_L + P_B + Q \leq 3.0\ S_m$ LOCA + DBE: $P_M \leq 0.9\ S_y$ $P_L + P_B \leq 0.9\ S_u$ OBE + Pipe rupture: $P_M \leq 1.0\ S_m$ $P_L + P_B \leq 1.5\ S_m$ $P_L + P_B + Q \leq 3.0\ S_m$ DBE + Pipe rupture: $P_M \leq 0.9\ S_y$ $P_L + P_B \leq 0.9\ S_u$ OBE + Thermal + Seismic loads on piping: $P_M \leq 1.0\ S_m$ $P_L + P_B \leq 1.5\ S_m$ $P_L + P_B + Q \leq 3.0\ S_m$ LOCA + DBE with pressure & thermal + seismic loads on piping: $P_M \leq 0.9\ S_y$ $P_L + P_B \leq 0.9\ S_u$ Table 3.8-7 p. 3.8-30 Amend. 32	<u>Piping</u> Design: $P_m \leq S_m$ $P_L + P_b \leq 1.5\ S_m$ $P_L + P_b + P_e + Q \leq 3.0\ S_m$ Normal: $P_L + P_b + P_e + Q + F = S_p$ (use fatigue curve) Upset: (Press + Wt. + OBE + VT) $P_L + P_b + P_e + Q \leq 3.0 S_m$ $P_L + P_b + P_e + Q + F = S_p$ (use fatigue curve) Emergency: (Press + Wt. + DBE) Max press ≤ 1.5 design press $P_L + P_b \leq 2.25\ S_m$ Faulted: (Press + Wt. + DBE + rupture) Max press ≤ 2.0 design press. $P_L + P_b \leq 3.0\ S_m$ Table 3.9-3 p. 3.9-18 Amend. 38	ASME BPVC Sec. III Sec. 3.8 p. 3.8-14 Rev. 13, 7-15-73 ANSIB31.7 Sec. 3.9 Table 3.9-3 p. 3.9-18

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Testing and Inspection Sec. 8.3 p. 8.3-23	Type II - 600 v penetration assembly. A steel plate barrier has been erected inside the containment in the electrical system penetrations: $D + P_R \leq$ 90 percent of material yield strength $D + OBE \leq$ normal AISC working stress $D + DBE \leq$ 90 percent of material yield strength Vol. 2 Sec. 3.8 p. 3.8-33, Rev. 15 (10-11-73)	IEEE - 317, April 1971 Standard for electrical assemblies in containment structure for nuclear fueled power generating stations. Sec. 3.8, p. 3.8-33, Rev. 15, 10-11-73. IEEE -279 (Aug. 1968) IEEE -308 (Nov. 1970) Sec. 8.1, p. 8.1-2

SEISMIC REVIEW TABLE

Docket Number

50-280, 281

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY mm	HOR. g	VERT. g					
Surry Power Station Unit 1 & 2 Reactor type: PWR Containment type: sub-atmospheric (reinforced concrete) NSSS Manufacturer: Westinghouse Architect Engineer: Stone and Webster Unit 1: 6-68/5-72 Unit 2: 6-68/1-73	0.07 Sec. 2.5.4 p. 2.5.4-1 2-13-70	0.046	VII Sec. 2.5 p. 2.5.5-5 2-13-70	0.15 Sec. 2.5.5 p. 2.5.5-1 & p. 2.5.5-7 12-1-69	0.10	Synthetic time-history Q4.23, Supp. 1	For Class 1 Structures Hor. & Vert. Combined simultaneously p. 15.2-16 B.1-1	SRSS Sup. Vol. 1 2.4.10 p.S4.10-2 10-15-70 & Sup. Vol.1 Q.4.12 p. S4.12 p. S4.12-2 10-15-70	1) For frequencies higher than 2 cycles/sec. Housner Spectra 2) Frequency range between 0.3 cycles/sec. Housner Average Spectra have been normalized to a max. ground velocity of about 4"/sec for O.B.E. and 9"/sec for P.B.E. 3) For frequencies lower than about 0.3 cycles/sec. using data suggested by Dr. Newmark & Hall. Sec. 2.5.5 p. 2.5.5-9 Fig. 2.5-4, 2.5-5	The floor response spectra are encompassed by the umbrella spectrum used in the dynamic analyses if Westinghouse supplied equipment. RCL analysis done with floor response spectra App. B, p. B.3-I Supp. Vol. 1 Q.4.10, Q 5.10, 4.12

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
For Major Class I Struct. (except for the fuel building and main steam valve enclosure struct.): MAT Foundation. 10 ft. thick Pile foundation: turbine foundation spent fuel pit, mainsteam shielding, RWST	Surface Deposits-Consist of sand, silty sand thin layers of iron oxide-cemented sands and clays of Norfolk Estuarine Formation	50' 80'	Not available Sec. 2.5 p. 2.5.5-2 TYPE - THICKNESS (cont.) *Below this lie formations of — Thickness Eocene — 45' Paleocene — 55' Cretaceous — 800'	18 wells within a five mile radius of the site. Depth from 280'∿799' 4 operating water wells on the site obtain water from the Eocene sediments at depth about 400'	NOT AVAILABLE	STICK MODEL with soil springs	NOT AVAILABLE	O.B.E/S.S.E. 0.05/0.10 This is an overall value which includes the damping in both the reinforced concrete structure and the damping.	O.B.E/S.S.E 0.02/0.05
	Below this lies clays, compact sand and silt members, and shell fragments of the Chesapeake Formation	240' thickness varying from -16 msl to -47 msl *	Crystalline Bedrock. — Estimated at a depth of about 1300'						
Sec. 15.4 p. 15.4-8 Sec. 15.5 p. 15.5.1-1 p. 2.4.6-1			Sec. 2.4 p. 2.4.2-2	Part B Vol. 1 Sec. 2.3		p. 15.5.1.4-2 Append. B Sec. B.2 p. B.3-1		Sec. 15.5 p. 15.5.1.4-2 & p. 15.5.1.4-3	Supp. Vol.1 Q. 5.22 p. S5.22-1

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE (% of Crit. Damping)	DESIGN CRITERIA	
	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
1) Containment Struct. & Foundation 5.0/10.0 2) Steel Framed Struct. Including Supporting Struct. and Foundations a) Bolted 2.5 b) Welded 1.0 3) Concrete Struct. Aboveground a) Shear-wall type 5.0 b) Rigid-frame type 5.0	1. Operating + DBA = (1.0±0.05) D+1.5P+1.0 (T+TL) 2. Operating + DBA + OBE = (1.0±0.05) D+1.0P+1.0(T+TL) +1.5E 3. Operating + DBA + DBE = (1.0±0.05) D+1.0P+1.0(T+TL) +1.0HE 4. Operating + 1.25DBA + 1.25OBE = (1.0±0.05) D + (1.25p)+(T'+TL') +1.25E 5. Operating + Tornado Loading = (1.0±0.05) D + 1.0T' + 1.0C	For Containment Struct. ACI 318-63 Part IV-B
Sec. 15.3 & Supp. Vol. 1 p. 15.5.1.4-3 Q. 5.12 Sec. 15.2 P. S5.12-1 Table 15.2.4-1 p. 15.2-19	Sec. 15.5 Table 15.5.1.2-1 p. 15.5.1.2-4 4-15-70	Sec. 15.5 p. 15.5.1.2-2

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE (% Critical Damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA** — **LOAD COMBINATION** PRESSURE VESSELS	**DESIGN CRITERIA** — **LOAD COMBINATION** PIPINGS	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Reactor Vessel Internals of Control Rod Assembly Drives: a) Welded assemblies 1.0 b) Bolted assemblies 2.0 Vital Piping Systems: a) Carbon steel 0.5/1.0 b) Stainless steel 0.5/1.0 Reinforced concrete reactor support structure including the reactor vessel 5.0 Mechanical equipment, including pumps, fans, and similar items 2.0	Analytical & Testing	Normal Conditions: $P_m \leq$ Sm P_m(or P_L)+$P_B \leq 1.5S_m$ P_m(or P_L)+PB+Q $\leq 3.0S_m$	$P_m \leq S$	ASME BPVC SEC. III USAS B31.1
		Upset Conditions: $P_m \leq S_m$ P_m(or P_L)+$P_B \leq 1.5S_m$ P_m(or P_L)+P_B+Q $\leq 3.0S_m$	$P_m \leq 1.2S$	
		Emergency Conditions: $P_m \leq 1.2S_m$ or $P_m \leq S_y$ whichever is larger P_m(or P_L)+$P_B \leq 1.5(1.2S_m)$ or P_m(or P_L)+$P_B \leq 1.5(S_y)$ whichever is larger	$P_m \leq 1.2S$	
		Faulted Conditions: Design Limit Curves of WCAP-5890	Design Limit Curves of WCAP-5890	
Sec. 15.2 Table 15.2.4-1 p. 15.2-19 Supp. Vol. 1 Q5.12 p. S5.12-1	Sec. B.5 p. b.5-1 Table B.5-1 Supp. Vol. 1 Q 4.10 p. S4.10-1	P_m= Primary general membrane stress intensity P_L= Primary local membrane stress intensity P_B= Primary bending stress intensity Q = Secondary stress intensity		App. B p. B.2-8 p. B.2-10 p. B.2-13

S_m= Stress intensity value from ASME BPVC III
S_y= Minimum specified material yield
For further details refer to App. B, Talbe B.2-1, p. B.2-6

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
NOT AVAILABLE	Tests Method. (This tests data is contained in WCAP-7397-L Seismic Testing of Electrical and Control Systems Equipment) Supp. Vol. 1 Q.4.11 p. S4.11-1 3-15-71	NOT AVAILABLE	NOT AVAILABLE

SEISMIC REVIEW TABLE

Docket Number
50-289

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Three Mile Island Unit 1 Reactor type: PWR Containment type: 6 buttresses with shallow dome (pre-stressed concrete) NSSS Manufacturer: Babcock and Wilcox Architect Engineer: Gilbert	0.06	0.04	VI	0.12	0.08	1957 Golden Gate Park - Average smooth revised with 1940 El Centro - normalized to ground acceleration of 0.06g. Synthetic time-history for floor response spectra	Horizontal and vertical combined by absolute sum.	Piping: SRSS and modes 10% within each other are added absolutely.	Actual spectra envelops Golden Gate and El Centro earthquake time histories.	Time-history method. Gilbert Topical Report # 1729 "Dynamic Analysis of Vital Piping Systems Subjected to Seismic Motion."
5-68/4-74	Sec. 5.1.2.1.1 p. 5-10	Sec. 5.1.2.1.1 p. 5-10	Sec. 2.8.1 p. 2-41	Sec. 5.1.2.1.1 p. 5-10	Sec. 5.1.2.1.1 p. 5-10	Sec. 2.7.1, p. 2-31 Sec. 2.8.2, p. 2-42	Sec. 5.2.4.1.2 p. 5-52	Sec. 5.4.5.1 p. 5-76a p. 5-52	Sec. 2-7, p. 2-31 Fig. 2-24 Fig 5-48	Sec. 5.4.5.1 p. 5-76a Fig. 5-49 through 5.54

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete mat foundation bearing on rock. 9 ft. thick with a 2 ft. thick concrete slab. Above the bottom liner plate.	sand and gravel ——— bedrock	14-19 ft. ———	Bedrock 8,500 to 11,500 fps.	Depth: between 14 and 19 ft.	Not available.	Stick model with fixed base	Not available.	Not available.	Not available.
Sec. 5.2, p. 5-11a	Sec. 2.7.1 p. 2-30 Sec. 2.7.4.3 p. 2-37	Sec. 2.7.1 p. 2-30 Sec. 2.7.4.3 p- 2-37	Sec. 2.7.3.4 p. 2-34	Sec. 2.7.4.3 p. 2-37		Fig. 5-47			

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE (% critical damping)	**DESIGN CRITERIA**	
	LOAD COMBINATION	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Reactor Building: 2.0/2.0 Concrete Equipment Supports: 2.0/3.0 Steel Framed Structure: a) Bolted or riveted 2.5/2.5 b) Welded 1.0/1.0 Prestressed concrete structures 2.0/5.0	a) $C = (1.0 \pm 0.05)\ D + 1.5P + 1.0T$ b) $C = (1.0 \pm 0.05)\ D + 1.25P + 1.0T' + 1.25E$ c) $C = (1.0 \pm 0.05)\ D + 1.0P + 1.0T + 1.0E'$ d) $C = (1.0 \pm 0.05)\ D + 1.0W_t + 1.0\ P_t$	Reactor Building: ACI 318-63 ACI 301-66 (modified) AISC Manual of Steel Construction ASME BPVC Sect. III, VIII and IX ASA N 6.2-1965
Sec. 5.2.1.2.11 p. 5-18a	Sec. 5.2.3.2 p. 5-40	Sec. 5.2.3.1, p. 5-39 Sec. 5.2.2.4.1, p. 5-31

SEISMIC REVIEW TABLE

MECHANICAL & PIPING				
DAMPING OBE/SSE (% critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**		
		LOAD COMBINATION		**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Vital Piping 0.5/0.5 Welded Steel Plate Assemblies 1.0/1.0	Analytical and Testing	Design loads + DBE loads Design loads + SSE loads Design loads + SSE loads + Pipe rupture	$P_m \leq S_m$ $P_L + P_b \leq 1.5\ S_m$ $P_m + P_b \leq 1.2(1.5\ S_m)$ $P_m \leq 2/3\ S_\mu$ $P_L + P_b \leq 2/3\ S_\mu$	ASME BPVC Sec. III USAS B31.1.0 USAS B31.7
Sec. 5.2.1.2.11, p. 5-18a	p. 5-10 p. 5-76b	Sec. 4.1.2.5, p. 4-3		Table 4-2 , p. 4-38; and Sec. 4.1.3, p.4-5

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Not available.	Not available.	Not available.

SEISMIC REVIEW TABLE

Docket Number

50-320

NAME AND NSSS TYPE OF THE PLANT	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
CP/OL ISSUE DATE	HOR. g	VERT. g	INTENSITY mm	HOR. g	VERT. g					
Three Mile Island Nuclear Station Unit 2 Reactor type: PWR Containment type: 6 buttresses with shallow dome (prestressed concrete) NSSS manufacturer: Babcock and Wilcox Architect Engineer: Burns and Roe	0.06	0.04	VII	0.12	0.08	Golden Gate, 1957 El Centro, 1940 Synthetic time-history for floor response spectra	Vertical & Horizontal Components were considered to act simultaneously	SRSS. Closely spaced modes combined directly	Acceleration response Spectra for ½SSE were partially developed from "Golden Gate Park S.F. March 1957" Earthqk. Then it is modified in the low frequency region by the 1940 El Centro Earthquake - normalized to basic ground motion of 0.06g (OBE) p. 2.5-11 Fig. 2.5-8	Time-History Method Using simulated ground motion.
Unit 2: 11-69/5-78	Sec 3.7.1.1 p. 3.7-1	Sec 3.7.2.8 p. 3.7-5		Sec 3.7.1.1 p. 3.7-1	Sec 3.7.2.9 p. 3.7-5	Sec 3.7.1.2 p. 3.7-1	Sec 3.7.2.9 p. 3.7-5	Sec 3.7.3.4 p. 3.7-8	Sec. 3.7.1.2 p. 3.7-1	Sec. 3.7.2.6 p. 3.7-5

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
The foundation slab is mild-steel reinforced circular mat Depth: 11 feet	The station is founded on unweathered shales and sandstones of Gettysburg Formation.	NOT AVAILABLE	NOT AVAILABLE	Water levels occurred generally at a depth in excess of 15 ft & ranged from 14 to ft. The ground water level occurred at a max. 6.2 ft above the top of rock with less than one ft of head above the soil-rock interface at one pt. of observation.	No large dams exist immediately upstream of the site.	Stick model with rock springs	NOT AVAILABLE	NOT AVAILABLE	NOT AVAILABLE
Sec. 1.2.3.1.1 p. 1.2-3	Sec 2.5.1 p. 2.5-7	2.9		Sec 2.4.13.2 p. 2.4-26	Sec 2.4.4 p. 2.4-12	Sec 3.7.1.6 p. 3.7-3,4			

SEISMIC REVIEW TABLE

STRUCTURES

DAMPING OBE/SSE (% of critical damping)		DESIGN CRITERIA: LOAD COMBINATION	DESIGN CRITERIA: ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Welded steel plate assemblies	1.0/1.0	see load combination table below	1. ACI 318-63 ACI 318-71
Welded steel framed structures	2.0/2.0		
Bolted steel framed structures(riveted)	2.5/2.5		2. AISC-1965
Reinforced concrete equipment supports	2.0/3.0		
Reinforced concrete frames & buildings	3.0/5.0		
Prestressed concrete structures	2.0/5.0		
Cable Tray Hangers (lateral direction)	5.0/10.0		
Table 3.7-1 p. 3.7-13		Table 3.8.-1,-2	Sec. 3.8.1.2 p. 3.8-2

Unit Load	A	B	C	D	E	F	G
Dead load	0.95	0.90	0.95	0.87	0.95	0.95	0.90
Int. pres.	1.50	1.25	1.25	1.00	-	1.00	1.00
Prestress	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Wind load	-	-	1.25	-	-	-	-
Tornado load	-	-	-	-	1.25	-	-
Earthquake	-	0.81	-	1.0	-	-	0.81
Thermal norm	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Accident	1.00	1.00	1.00	1.00	-	1.00	1.00
Thermal incr.							

SEISMIC REVIEW TABLE

MECHANICAL & PIPING						
DAMPING OBE/SSE (% of critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA** — **LOAD COMBINATION**		Components	Piping	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Steel Piping 0.5/0.5	Analytical procedure 1. Equivalent Static Load Method 2. Dynamic Analysis Method	I.	Max Operating Loads + ½SSE (upset)	$P_m \leq 1.0S_m$ $P_L+P_b \leq 1.5S_m$	$P_m \leq S_m$ $P_L+P_b \leq 1.5S_m$	1. ASME, B&PV Code Section III 2. ANSI B31.7
		II.	Max Operating Loads + SSE (emergency)	$P_m \leq 1.2S_m$ $P_L+P_b \leq 1.2(1.5S_m)$	$P_m \leq 1.2S_m$ or S_y $P_L \leq 1.8S_m$ or $1.5S_y$ $P_L+P_b \leq 1.8S_m$ or $1.5S_m$	
		III.	Max Operating + SEE + Pipe Rupture Loads Faulted	$P_m \leq 2/3S_u$ $P_L+P_b \leq 2/3S_u$	$P_m \leq$ $P_L \leq$ $2/3S_u$ $P_L+P_b \leq$	
			P_b = Primary bending stress P_L = Primary local membrane stress P_m = Primary general membrane stress S_m = Allowable stress S_y = Minimum yield strength at temp. S_u = Ultimate strength of material at temp. For components: Table 3.6-1, p. 3.6-5; Table 5.2-4, p. 5.2-34 For piping: Table 5.2-3, p. 5.2-33			
Table 3.7-1 p. 3.7-13	Sec 3.9.1.2.1 p. 3.9-1,-2					Table 3.6-1 p. 3.6-5

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
NOT AVAILABLE	TESTING Sec 3.10.1.3 p. 3.10-2	NOT AVAILABLE	NOT AVAILABLE

SEISMIC REVIEW TABLE

Docket Number
50-344

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Trojan Nuclear Plant, Unit No. 1 Reactor type: PWR Containment type: 3 buttresses with hemispherical dome (prestressed concrete) NSSS Manufacturer: Westinghouse Architect Engineer: Bechtel	0.15	0.10	VIII	0.25	0.17	Synthetic time history	Horizontal combined with vertical component combined absolutely	SRSS	Developed by Dr. I. M. Idriss for 2% critical damping. For other damping values Newmark's amplification factors were used.	For Westinghouse equipment: horizontal and vertical seismic were used. They were compared with the horizontal and vertical floor response spectra developed by Bechtel Corporation. Time-history used to generate response spectra BC-TOP-4
2-71/ 11-75	Sec. 2.5 p. 2.5-19 Sec. 3.7 p. 3.7-1	Sec. 3.7 p. 3.7-1	Sec. 2.5 p. 2.5-19	Sec. 3.7 p. 3.7-1	Sec. 3.7 p. 3.7-1	Sec. 3.7 p. 3.7-3	Sec. 3.7 p. 3.7-8 p. 3.7-12	Sec. 3.7 p. 3.7-22	Sec. 3.7 p. 3.7-2 Fig. 3.7-1 & 3.7-2	Sec. 3.7 p. 3.7-31

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
For containment: Rigid base mat foundation. Depth is not available. Administration building supported by steel H-piles which go to rock 15 ft to 53 ft below grade. Sec. 3.7,p. 3.7-9 Sec. 3.7,p. 3.7-4 TYPE (cont.) * soft clayed silt to silty clay with varying amounts of inter-mixed fine sand and layers of silty fine sand. Sec. 2.5, p. 2.5-9	The site is under-laid by bedrock and re-cent al-luvium. The bed-rock is volcanic in ori-gin and consists princi-pally of tuffs, tuff breccias, agglomer-ates, and basalt flow. Al-luvium consists of soft to very*	The thick-ness of the alluv-ium is consider-ed to be close to 280ft.The upper ap-prox. 80 to 100 ft of the al-luvium: soft to very soft clayed silt. At 50 ft depth range: decom-posed wood fragments and vege-tation**	4500 fps to 5000 fps. Sec. 2.5 p. 2.5-15 DEPTH(cont.) ** upper 25 ft to 35 ft. Predom-inately silty fine sand. All holes in the al-luvium encoun-tered principal-ly soft clayed silt between 30 ft to 90 ft. Sec. 2.5, p. 2.5-9	Wells vary in depth from 50 feet to over 200 feet. Sec. 2.4 p. 2.4-54	Grand Coulee Dam at Columbia River mile 597. Sec. 2.4 p. 2.4-33	The dynamic analysis was performed using stick model with fixed-base assumption. Results were compared with respect to flexible-base model and found to be conserva-tive. Sec. 3.7 p. 3.7-6	0.7×10^6 psi Sec. 2.5 p. 2.5-12	Not available.	Not avail-able.

SEISMIC REVIEW TABLE

STRUCTURES						
DAMPING OBE/SSE				DESIGN CRITERIA		
				LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES	
	Stress Level			$C=1/\phi\{(1.0\pm0.05)D+1.5P+1.0T_A+1.0F\}$	ACI 315-65	
	Low	Working	At yield point	$C=1/\phi\{(1.0\pm0.05)D+1.25P+1.0T_A+1.0H_A+1.25E+1.0F\}$	ACI 318-63	
Steel Structure				$C=1/\phi\{(1.0\pm0.05)D+1.25P+1.0T_o+1.25H_o+1.25E+1.0F\}$	AISC 6th edition (1967)	
Prestressed concrete	1.0	2.0	5.0	$C=1/\phi\{(1.0\pm0.05)D+1.0H_A+1.0R+1.0F+1.25E+1.0T_A\}$	ASCE paper no. 3269	
Reinforced concrete				$C=1/\phi\{(1.0\pm0.05)D\pm1.25H_o+1.0R+1.0F+1.25E+1.0T_o\}$		
				$C=1/\phi\{(1.0\pm0.05)D+1.0P+1.0T_A+1.0H_A+1.0E'+1.0F\}$		
				$C=1/\phi\{(1.0\pm0.05)D+1.0P+1.0T_o+1.25H_o+1.0E'+1.0F\}$		
				$C=1/\phi\{(1.0\pm0.05)D+1.0H_A+1.0R+1.0E'+1.0F+1.0T_A\}$		
				$C=1/\phi\{(1.0\pm0.05)D+1.25H_o+1.0R+1.0E'+1.0F+1.0T_o\}$		
				$C=1/\phi\{(1.0\pm0.05)D+1.0A+1.0F+1.0T_o\}$		
				For the combinations of category I structures other than containment refer to p. 3.8-13.		
Sec. 3.7 Table 3.7-1 p. 3.7-3				Sec. 3.8 p. 3.8-38	Sec. 3.8 p. 3.8-12, 33	

SEISMIC REVIEW TABLE

MECHANICAL & PIPING						
DAMPING OBE/SSE (% critical damping)				METHOD OF QUALIFICATION	DESIGN CRITERIA	
					LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
	Stress Level			Analytical and testing.	For reactor vessel internals: Normal+OBE $<$ ASME, BPVC Code, Sec. III for upset condition. For ANSI B31.7 Class II and III and ANSI B31.1.0 seismic category I piping systems: --For O.B.E.: $S_T = S_{OBE} + S_{1p} + S_{wT} \le 1.2S_h$ where: S_T = maximum total longitudinal stress S_{OBE} = maximum bending stress due to O.B.E. S_{1p} = longitudinal pressure stress S_{wT} = bending stress due to weight effect S_h = basic material allowable stress at maximum (hot) temperature --For S.S.E.: $S_{T(S.S.E.)} = S_{SSE} + S_{1p} + S_{wT} \le 1.8S_h$ where: $S_{T(S.S.E.)}$ = maximum longitudinal stress S_{SSE} = maximum bending stress due to SSE	For reactor vessel internals: ASME, BPVC Code, Section III For piping: ANSI B31.7 and ANSI B31.1.0
	Low	Working	At yield point			
Vital piping:	0.5	0.5	0.5			
Sec. 3.7 Table 3.7-1					Sec. 3.7; p. 3.7-12; p. 3.7-26.	Sec. 3.7; p. 3.7-12 Sec. 3.7; p. 3.7-26

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Analytical and Testing Sec. 3.10 p. 3.10-1	Not available. Sec. 3.10 p. 3.10-2	IEEE 344-1971 Sec. 3.10 p. 3.10-1

SEISMIC REVIEW TABLE

Docket Number
50-250,251

NAME AND NSSS TYPE OF THE PLANT CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY mm	HOR. g	VERT. g					
Turkey Point Plant Unit No. 3 & 4 Reactor type: PWR Containment type: 6 buttresses with shallow dome (pre-stressed concrete) NSSS Manufacturer: Westinghouse Architect Engineer: Bechtel	0.05	0.033	VII	0.15	0.10	Synthetic time history	Vertical & Horizontal Components Applied Simultaneously	SRSS (Response Spectrum Analysis) Sec. 5.1 p 5.1.3-13 For reactor internals Summing the Absolute values obtained for all modes.	The Response Spectra used are those based on TID-7074 scaled to the appropriate ground accel. (Fig. 5A-1 & 2) Ref. Report to the AEC Regulatory Staff. Dockets No. 50-250 & 50-251 by N. M. Newmark & W. J. Hall, p. 5) Housner	TIME HISTORY METHOD
Unit 3: 4-67/7-72 Unit 4: 4-67/4-73	Sec. 2.11 p. 2.11-2	Sec. 2.11 p. 2.11-2		Sec. 2.11 p. 2.11-2	Sec. 2.11 p. 2.11-2	p. 5.1.3-11	Appen. 5A p. 5A-12	Appen. 5A p. 5A-9b	Sec. 5.1 p. 5.1.3-13	Sec. 5.1 p. 5.1.3-11 REV. 5 - 8-28-70 6 - 10-2-70

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL % Critical Damping	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
For containment: reinforced concrete slab. Thickness: 10 ½ feet Sec. 5.1 p. 5.1.2-1	Organic, Mangrove swamp soils overlies the Miami oolite bedrock formation which extends to about 20' below sea level (site elev less than 10') Small voids and solutions channels are present. - - - - - Below this are the Fort Thompson*	4ft to 8ft of swamp soils - overlies the Miami oolite bedrock formation. * - - - - - Extends to 70ft below sea level	NOT AVAILABLE TYPE THICKNESS (cont.) Formation (Limestone and calcareous sandstone - - - - - The Tamiami Formation (clayey and calcareous marl indurated locally to limestone with beds of silty and shell sands) and the Hawthorne and Tampa Formations Vol. 1, Sec. 2.9 p. 2.9-4	UNCLEAR INFORMATION Sec. 2.10 p. 2.10-1	NOT AVAILABLE	FIG. 5.1-13 indicates stick model with soil springs p. 5.1.3-13	NOT AVAILABLE	O.B.E./S.S.E. Soil: 5.0/10.0 Vol. 1 Append. 5A p. 5A-13	Composite with Soil: 5.0/7.5

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE (% critical damping)	**DESIGN CRITERIA** **LOAD COMBINATION**	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Welded steel framed structure: 2.0/2.0 Bolted steel framed structure: 2.0/2.0 Concrete equipment supports on another structure: 2.0/2.0 Prestressed concrete containment structure: 2.0/5.0 Prestressed containment including interior concrete and soil composite: 3.5/7.5 R.C. frames and buildings: 3.0/5.0 Append. 5A p. 5A-13	For class I structure outside the containment structure: $Y=1/\phi(1.25D+1.25E)$ $Y=1/\phi(1.25D+1.0R)$ $Y=1/\phi(1.25D+1.25H+1.25E)$ $Y=1/\phi(1.0D+1.0E')$ where: Y = regular D yield strength of the structure. D = dead load of structure and equipment plus any other permanent loads contributing stress. In addition, a portion of "live load" is added when such load is expected to be present when the unit is operating. R = force or pressure on structure due to rupture of any one pipe. H = force on structure due to restrained thermal expansion of pipes under operating conditions. E = design earthquake load. E' = maximum earthquake load. W = wind load. (to replace E in the above load equation whenever it produces higher stresses than E does) ϕ = 0.9 for R.C. in flexure. ϕ = 0.85 for tension, shear, bond, and anchorage in R.C. ϕ = 0.75 for spirally R.C. comp. members (cont.)	ACI 318-63 AISC Manual of Steel Construction (6th edition) Append. 5A, p. 5A-5 Sec. 5.1, p. 5.1.8-1 LOAD COMBINATION (cont.) ϕ = 0.70 for tied comp. members. ϕ = 0.9 for fabricated structure of steel. Vol. 1, Append. 5A p. 5A-5

SEISMIC REVIEW TABLE

MECHANICAL & PIPING						
DAMPING OBE/SSE (% of Critical Damping)		METHOD OF QUALIFICATION	DESIGN CRITERIA			
			LOAD COMBINATION			ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
			LOADING COMBINATIONS	VESSELS	PIPING	
Welded Steel Plate Assemblies	1.0/1.0	For Class I = Analysis and testing	Normal Loads	$P_m \leq S_m$ $P_L + P_B \leq 1.5\ S_m$	$P_m \leq S_m$ $P_L + P_B \leq S$	ASME BPVC Sec. III USAS B 31.1 Code for piping.
Steel Piping	0.5/0.5		Normal + Design Earthquake Loads	$P_m \leq S_m$ $P_L + P_B \leq 1.5\ S_m$	$P_m \leq 1.2\ S$ $P_L + P_B \leq 1.2\ S$	
			Normal + Maximum Potential Earthquake Loads	$P_m \leq 1.2\ S_m$ $P_L + P_B \leq 1.2\ (1.5\ S_m)$	$P_m \leq 1.2\ S$ $P_L + P_B \leq 1.2\ S$	
			Normal + Pipe Rupture Loads	$P_m \leq 1.2\ S_m$ $P_L + P_B \leq 1.2\ (1.5\ S_m)$	$P_m \leq 1.2\ S$ $P_L + P_B \leq 1.2\ S$	
Append. 5A p. 5A-13		Vol. 1 Append. 5A p. 5A-12 p. 5A-17	Append. 5A p. 5A-6, Table 5A-1			Append. 5A, Table 5A-1 p. 5A-8

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available.	Tests and inspections. Vol. 2 Sec. 8.5 p. 8.5-1 & p. 8.5-2	"Electrical cable trays and DC battery racks are being checked for 'g' loadings obtained from the spectrum curves of the supporting floors. Motor control center and load centers have been shaker table tested to demonstrate no-loss-of-function capability under the maximum hypothetic earthquake. Mechanical and electrical equipment has been purchased under specifications that include a description of the seismic design criteria for the plant." p. 5A-16, B-37	

SEISMIC REVIEW TABLE

Docket Number
50-271

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Vermont Yankee Nuclear Power Station Reactor type: BWR Containment type: Mark I (steel) NSSS Manufacturer: General Electric Architect Engineer: Ebasco	0.07	0.046	V to low VII	0.14	0.093	1952 Taft earthquake N69°W	Each horizontal combined with the vertical simultaneously, resulting two distinct seismic cases.	SRSS	Housner spectra	Time-history method using earthquake N69°W component of Taft earthquake normalized to 0.07g (0.14g). See also "additional information concerning seismic analysis of piping" in App. I.
12-67/3-72	p. 2.5-9	p. 12.2-6		p.2.5-9	p.12.2-6	App. A	App. C, Sec. C.2.6 p.C.2-22	App. A p. A.5-6	See App. A., Sect. 5, Fig. 10	Question C-1, App. I, p. I.2-144

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Concrete mat. depth is not availalbe. All Class I structures except main stack are founded on bedrock. The main stack rests on end bearing steel piles which transfer the loads to the bedrock. Questions 12.18 12.19 12.22 App. I, p. I2-69	Glacial deposits from pleistocene age which consists of hard biotite gneiss. Rock type = Oliverian Plutonic Series Sec. 2.5.1,p. 2.5-1	30 ft. of glacial over burden above local bedrock. Sec. 2.5.1, p. 2.5-1	6,500 fps Sec. 2.5.2.5.2 p. 2.5-6	Unclear information (About @ El 230 and existing ground surface is @ 250 from boring logs presented in sec. 2.5)	1.Vernon Dam is about 3,500 ft. downstream. 2. Other dams are 32, 75 and 132 miles up-stream. But have relatively low heads from 29 to 62 ft. Sec. 2.4 p. 2.4-1	Lumped mass with soil springs Fig. 3, App. A.1	1.53×10^6 lb/in^2 Sec. 2.5.2.5.2, p. 2.5-6	Not available	Not available

SEISMIC REVIEW TABLE

<table>
<tr><th colspan="3">STRUCTURES</th></tr>
<tr><td rowspan="2">DAMPING OBE/SSE (% critical damping)</td><th colspan="2">DESIGN CRITERIA</th></tr>
<tr><td>LOAD COMBINATION (Allowable Stress)</td><td>ACCEPTANCE CRITERIA & ALLOWABLE STRESSES</td></tr>
<tr><td>1. Reinforced concrete structures 5.0
2. Steel frame structure 2.0
3. Bolted or riveted assembly 2.0

Sec. 12.2.1.2.1, p. 12.2-6</td><td>1. D + L + E — 1. Normal allowable code stresses are used. No increase in design stresses for the load combinations considered is premitted.
2. D + L + R + E´
D + L + W´ — 2. Yield stresses for ductile materials 0.85 times of ultimate strength concrete.
<hr>D = Deal load, L = Live load, E = OBE, E´ = DBE
R = Jet force or pressure due to rupture of one pipe
Sec. 12.2.1, p. 12.2-2<hr>Note that no load factors were applied to the equations above because no plastic strength design for steel structures or ultimate strength design for concrete was used. "Allowable stress design."

Question 12.15, App. I, p. I.2-66</td><td>1. ACI 318-63
2. AISC (1963)
"Allowable Stress Design."

Sec. 12.2.1, p. 12.2-1</td></tr>
</table>

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE (% critical damping)	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
-Welded assembly (Equipment and supports) 1.0 -Vital Piping System 0.5 Sec. 12.2.1.2.1, p. 12.2-6	1. Analytical 2. Testing App. C	<u>Primary containment</u> <u>L.C.</u> Normal & Upset 1. DL 2. Design pressure 3. Design temperature 4. Piping and mechanical loads 5. Design basis earthquake Emergency condition loads 1. Dead load 2. Design pressure 3. Design temperature 4. Piping and mechanical loads 5. Maximum hypothetical earthquake For flooded containment condition 1. Dead weight 2. Design basis earthquake 3. Flooding water load App. C. pg. C.2-30	<u>Stress Limit</u> ASME B&PV Code, Sect. III, Subsection B. Membrane stress intensity $S_A = 1.0\ S_M = 17{,}500$ psi Primary local membrane and bending : $S_{limit} = 1.5\ S_M = 26{,}250$ psi Membrane plus secondary bending $S_{limit} = 3.0\ S_M = 52{,}500$ psi Primary local stress = 90% of yield strength @ design temperature $S_a = 0.90 \times 33{,}700 = 30{,}330$ psi Primary local stress = 90% of yield strength @ 100°F $S_a = 0.90 \times 38{,}000 = 34{,}200$ psi

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Not available	Not available

SEISMIC REVIEW TABLE*

Docket Number
50-29

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA**						METHOD OF COMBINATION		DESIGN SPECTRA	
	OBE		SSE			EARTHQUAKE TIME HISTORY	NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
	HOR. g	VERT. g	INTENSITY MM	HOR. g	VERT. g					
Yankee Rowe Nuclear Power Station. Reactor type: PWR Containment type: Spherical (steel) NSSS Manufacturer: Westinghouse Architect Engineer: Stone and Webster Engineer Corp. 11-57/7-60	← No Seismic Analysis Performed →		VI							

* Remarks: Information obtained from BNL Docket Search and SEPB Report by LLL "Seismic Design Bases and Criteria for Yankee Rowe Generating Station", EDAC 175-130.02, January 1979.

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
"All structures and equipment should be founded on spread footings. Where there is possibility of heaving due to frost action, footings should be carried to a minimum depth of 5'-0" below ground surface"- summary of Stone and Webster's structural design requirements 10-17-57. General design of turbine generator foundation conform to "GET-1749A"- "turbine generator foundations" and Stone and Webster Reinforcing Standard for Turbine Supports ' 4-20-48	"The plant is situated on medium to fine sands with some clay and silt, cobbles and boulders".	Not available	Not available	Not available	Sherman Dam	← No soil-structure Interaction analysis →			

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE	DESIGN CRITERIA	
	LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
None used	"Neither structures nor equipment were classified into seismic categories, e.g., seismic category I or equivalent, but instead were classified as safety related or non-safety related. These systems were designed and analyzed in accordance with the design codes in effect in 1955. For structures, the design of lateral load restraint systems was dictated by wind requirements. No lateral force provisions were made for internal structures or equipment."	AISC American Standard Building Code requirements A58.1-1955 ACI 318-56 ASTM - specifications for structural steel for bridges. ASA A56.1 - 1952 Stone and Webster "Summary of Structural Design Requirements, Yankee Atomic Electric Co." J. O. No. 9699, October 1957.

SEISMIC REVIEW TABLE

MECHANICAL & PIPING			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
None used	None used	Not available	ASME B and PV Code, Section VIII "Unfired Pressure Vessels" 1955 and code case 1226 ASTM specification for A300 (Class A201, Grade B, Firebox Quality)

SEISMIC REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
None used	None	"Electrical penetrations, control room systems, etc, were designed based on nuclear, mechanical and functional criteria. No provisions for lateral loads."	Not available

SEISMIC REVIEW TABLE

Docket Number
50 - 295, 304

NAME AND NSSS TYPE OF THE PLANT / CP/OL ISSUE DATE	EARTHQUAKE DATA: OBE HOR. g	OBE VERT. g	SSE INTENSITY MM	SSE HOR. g	SSE VERT. g	EARTHQUAKE TIME HISTORY	METHOD OF COMBINATION: NO. OF EARTH. COMP. USED AND ITS COMB.	MODAL COMB.	DESIGN SPECTRA: TYPE OF GROUND DESIGN SPECTRA	METHOD OF GENERATION OF FLOOR RESPONSE SPECTRA
Zion Nuclear Plant Unit 1 and 2 Reactor type: PWR Containment type: 6 buttresses with shallow dome (prestressed concrete) NSSS Manufacturer: Westinghouse Architect Engineer: Sargent and Lundy Engineers Unit 1: 12-68/4-73 Unit 2: 12-68/11-73	0.08 p.2.11-2	0.05 p.2.11-2	VII Q.2.26-1	0.17 p.2.11-3	0.11 p.2.11-3	Compared with the 1940 El Centro (N-S) earthquake record with maximum acceleration of 0.08g. Amend. 18 Q.5.79	Each horizontal was combined with the vertical components simultaneously. Amend. 14 Q.4.23	SRSS with closely spaced modes combined by absolute sum method (response spectrum) Amend. 14 Q.4.23	Design response spectra using 1940 El Centro (N-S) earthquake record with maximum acceleration of 0.08g at the rock level. Amend. 19 Q.5.83	Time-history method using 1940 El Centro (N-S) earthquake record. Amend. 14, Q. 4.25 Amend. 19, Q. 5.83

SEISMIC REVIEW TABLE

FOUNDATION AND LIQUEFACTION ASSESSMENT						SOIL - STRUCTURE INTERACTION			
TYPE OF FOUNDATION AND ITS DEPTH	BEARING INFORMATION			GROUND WATER TABLE	DAM	METHOD OF MODELLING	G_s PROFILE	MATERIAL DAMPING OF SOIL	LIMITATION ON MODAL DAMPING
	TYPE	THICKNESS	V_s PROFILE						
Reinforced concrete slab 9ft thick p. 5.1-5	The plant will be founded on relatively firm partly preconsolidated. Pleistocene glacial deposits. Formations below the site consist of: 1) 24-33 ft. of lake deposits-sand, gravel and pockets of peat and organic material. 2) Glacial deposits extending to a depth of 102-116 ft. below the surface - silt, clay, sand and gravel.		Not available 3) Niagare dolomite is 250' thick 4) Lower bedrick formations consists of sandstone and dolomite, some shale and siltstone layers. Several thousands of ft. thick. 5) Precambrain basement.*	Ground water is near the surface over much of the site area p. 2.9-5	Not available	Aux. building was modelled as fixed base assumptions with lumped mass building model. Reactor building model has a rocking soil spring only. A comparison study was made with a soil model by finite element mesh. Amend. 18 Q. 5.79 Amend. 14 Q.5.3,Q.4.23	Not available	Soil % critical damping: OBE 2 DBE 5 Q. 5.80	Not available

p. 2.9-4

* Type and thickness of bearing information are presented together.

SEISMIC REVIEW TABLE

STRUCTURES		
DAMPING OBE/SSE (% critical damping)	**DESIGN CRITERIA** — **LOAD COMBINATION**	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Reactor containment: 0.5/2.0 Q. 4.23	1) C = (1/ϕ) (1.05 D + 1.25 P + 1.0 T + 1.25 E) 2) C = (1/ϕ) (1.05 D + 1.5 P + 1.0 T) 3) C = (1/ϕ) (1.05 D + 1.0 P + 1.0 T + E′) C = Required yield strenght of the structure as defined below D = Dead loads P = Design accident pressure T = Thermal loads due to the temperature gradient through the wall and expansion of the liner and based on a temperature corresponding to the factored design accident pressure E = Operating basis earthquake (OBE) load E′ = Design basis earthquake (DBE) load W = Wind load ϕ = Capacity reduction factor p. 5.1-38	ACI Code 318-63 refer to page 5.1-41 for ϕ values. AISC Manual of Steel Construction (6th Edition) p. 5.1-41

SEISMIC REVIEW TABLE

MECHANICAL & PIPING					
DAMPING OBE/SSE (% critical damping)	**METHOD OF QUALIFICATION**	**DESIGN CRITERIA**			
		LOAD COMBINATION	Pressure Vessels	Pressure Piping	**ACCEPTANCE CRITERIA & ALLOWABLE STRESSES**
Piping OBE = 0.5	Analytical and Testing	1) Normal condition	a) $P_m \leq S_m$ b) P_m(or P_L) + $P_B \leq 1.5\ S_m$ c) P_m(or P_L) + P_B + Q ≤ 3.0 S_m	a) $P_m \leq S$ b) P_m(or P_L) + $P_B \leq S$	ASME B&PV Code Section III, Nuclear Vessels for limit curves: WCAP 5890, Rev. 1
		2) Upset condition	a) $P_m \leq S_m$ b) P_m(or P_L) + $P_B \leq 1.5\ S_m$ c) P_m(or P_L) + P_B + Q ≤ 3.0 S_m	a) $P_m \leq 1.2\ S$ b) P_m(or P_L) + $P_B \leq 1.2\ S$	
		3) Emergency condition	a) $P_m \leq 1.2\ S_m$ or S_y whichever is larger b) P_m(or P_L) + $P_B \leq 1.5$ (1.2 S_m) or 1.5 S_y whichever is larger	a) $P_m \leq 1.2\ S$ b) P_m(or P_L) + $P_B \leq 1.5$ (1.2 S)	
		4) Faulted condition	Design limit curves as discussed in the text	Design limit curves as discussed in the text	
P. Q. 5.32-1	Appendix D Amend. 14 Q. 4.23 p. Q4.23-3	P_m = Primary general membrane stress intensity P_L = Primary local membrane stress intensity P_B = Primary bending stress intensity			Appendix D

Q = Secondary stress intensity
S_m = Stress intensity from ASME B&PV Code, Section III, nuclear vessels
S_y = Minimum specified material yield (ASME B&PV Code, Section III, Table N-421 or equivalent)
S = Allowable stress from USASI B31.1 Code for pressure piping. Table B1-2, Appendix D

SEISMIC-REVIEW TABLE

ELECTRICAL EQUIPMENT			
DAMPING OBE/SSE	METHOD OF QUALIFICATION	DESIGN CRITERIA	
		LOAD COMBINATION	ACCEPTANCE CRITERIA & ALLOWABLE STRESSES
Not available	Not available	Not available	Not available

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16. ABSTRACT *(200 words or less)*

The Seismic Review Table is a summary of Engineering Design parameters that were employed in the seismic analysis and design of nuclear power plants. The table covers 71 reactors licensed to operate by the U.S.N.R.C. The information contained is listed plant by plant and consists of OBE and SSE "g" level and Modified Mercalli Intesity; Earthquake Time History used to develop the ground response spectra or as input in the dynamic analysis; Number of Earthquake Components used and Method of Combining Them; Method of Modal Combination; Type of Ground Design Spectra; Method of Generation of Floor Response Spectra; Type of Foundation and Depth; Type, Thickness, Shear Wave Velocity and Shear Modulus Profile of the Surrounding Subgrade Soil and Bedrock; Ground Water Table Depth; nearby Dams; Modelling Method used for soil-structure interaction; Material Damping of Soil; Limitation on Modal Damping. Damping Values; and Loading Combinations, and Acceptance Criteria for Category I Structures, Mechanical Equipment, Piping, and Electrical systems. The goal of the Seismic Review Table is to provide a reference of the available information relevant to the seismic design of currently licensed nuclear power plants.

17. KEY WORDS AND DOCUMENT ANALYSIS

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