SMUD

SACRAMENTO MUNICIPAL UTILITY DISTRICT

RANCHO SECO NUCLEAR GENERATING STATION

UNIT NO. 1

PRELIMINARY SAFETY ANALYSIS REPORT

Volume V

NOVEMBER 1967

Docket No. 50-312
April 15, 1968

AMENDMENT NO. 2

SACRAMENTO MUNICIPAL UTILITY DISTRICT

RANCHO SECO NUCLEAR GENERATING STATION

UNIT NO. 1

Amendment No. 2 to the Sacramento Municipal Utility District's Preliminary Safety Analysis Report includes both replacement pages and new pages and tabs. All pages to be inserted are identified as Amendment 2, except the reprinted appendices. Any technical text material changed by this amendment is coded in the outside margin by a black bar and the numeral two.

Before inserting the Amendment 2 material in the different volumes, it is suggested that Appendices 2A, 2C, 2D and 2E be removed from Volume IV, discarded and replaced with the new reprinted appendices 2A, 2C, 2D, and 2E. Additionally, remove Appendices 3 and 4 (including tabs) from Volume V and place at the back of Volume IV. The list of Effective Pages should be checked to verify the completeness of Volumes I thru V.

It should be noted that three new additional pages, 10, 11 and 12 are to be added to the License Application.

The response to letter from Peter A. Morris, Director, Division of Reactor Licensing to E. K. Davis, General Counsel, Sacramento Municipal Utility District, dated March 21, 1968, is arranged in the question order of the above letter. For convenience a cross reference of the AEC DRL question number and SMUD response number is presented below. Response to questions are to be inserted into the volumes according to the assigned SMUD number.

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APPENDIX 5A

DESIGN BASES FOR
STRUCTURES, SYSTEMS AND EQUIPMENT

1.0 GENERAL

The design bases for structures for normal operating conditions are governed by the applicable building design codes. The design bases for specific systems and equipment are stated in the appropriate PSAR Section. The basic design criterion for the maximum hypothetical accident and seismic conditions is that there be no loss of function if that function is related to public safety.

2.0 CLASSES OF STRUCTURES, SYSTEMS AND EQUIPMENT

2.1 CLASS 1

Class 1 structures, systems and equipment are those whose failure could cause uncontrolled release of radioactivity or those essential for immediate and long-term operation following a loss-of-coolant accident. They are designed to withstand the appropriate seismic loads and other applicable loads without loss of function. When a system as a whole is referred to as Class 1, portions of the system not associated with the loss of function criteria, may be designated as Class 2. Class 1 structures will be sufficiently isolated or protected from Class 2 structures to ensure that their integrity is maintained at all times. 2

The following are Class 1 structures. 2

- Containment structure shell
- Nuclear service spray ponds and pipe lines 2
- The auxiliary building that houses engineered safeguards systems, control room, and radioactive materials
- Fuel storage facilities 2
- Supports for Class 1 system components
- Storage Reservoir 3

Class 1 equipment and systems are as follows 2

- Reactor vessel and internals including control rods and control rod drives
- Primary coolant system components (steam generators, pressurizer, pumps, etc.) and piping, including vent and drain piping inside the containment

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- Containment penetrations up to and including the first isolation valve outside containment

3 - Main steam and main feedwater piping up to the code limit of ASME Boiler and Pressure Vessel Code Section I. (Stop Valves)

- Atmospheric dump and main steam safety valves and associated piping from main steam headers

- New and spent fuel storage racks and fuel handling equipment

- Motor-driven and steam-driven auxiliary feedwater pump, condensate storage tank and associated piping

2 - Emergency diesel generators including fuel supply

- Containment building crane (unloaded condition)

2 - Control boards, switchgear, load centers, batteries, transformers and cable runs serving Class 1 equipment

3 - Nuclear service raw water system

- Nuclear service cooling water system

- Containment spray system

- Containment air recirculation

2 - Low pressure injection and decay heat removal

- Core flooding injection tanks and piping

2 - High pressure injection, make-up and purification

3 - Borated water storage tank

2 - Radioactive waste treatment

- Spent fuel cooling and clean-up

1 - Plant Vent

2.2 CLASS 2

Class 2 structures, systems, and equipment are those whose failure would not result in the release of radioactivity and would not prevent reactor shutdown.

3.0 DESIGN BASES

3.1 CLASS 1 STRUCTURES DESIGN

3.1.1 Containment Structure

The design of the containment structure for all credible conditions of loading including normal loads, accident loads, thermal loads and environmental loads (including seismic) is found in Section 5, Containment System.

3.1.2 Storage Reservoir

The design of the storage reservoir is found in Appendix 2G, Storage Reservoir Criteria. 1

3.1.3 Structures Other Than Containment and Reservoir

a. Normal Operations

Loads encountered during normal plant operation including design earthquake loads are resisted by the structure using design methods of appropriate standards and codes insofar as they are applicable. Normal allowable stresses are used for this load condition.

b. Accident, Wind and/or Seismic Conditions

Class 1 structures are, in general, proportioned to maintain elastic behavior when subjected to various combinations of dead loads, accident loads, thermal loads, wind loads and/or earthquake loads. Concrete structures are designed for ductile behavior wherever possible; that is, with steel stress controlling the design.

The final design of Class 1 structures other than the containment structure satisfies the following load combinations and factors.

A = 1.0D + 1.0L + 1.0H
A = 1.0D + 1.0H + 1.0E/W
Y = 1/Ø (1.0D + 1.0H + 1.0E')
Y = 1/Ø (1.0D + 1.0R)
Y = 1.0D + 1.0R + 1.0E' 3

In areas where dead load subtracts from critical stress 0.90 D will be used.

A = capacity of the structure based upon allowable code stresses with no stress increase.
Y = required yield capacity of the structures.
D = dead load of structure and equipment plus any other permanent loads contributing stress, such as soil or hydrostatic loads. In addition, a portion of "live load" is added when such load is expected to be present when the plant is operating. An allowance is also made for future permanent loads.
L = appropriate live load
R = load on structure from reaction or pressure due to rupture of any one pipe. 2
H = load on structure due to thermal expansion of pipes under operating conditions.
E = "design earthquake" load resulting from (Figure 5A-1) ground surface acceleration of 0.13g. 3
E' = "maximum hypothetical earthquake" load resulting from (Figure 5A-2) seismic ground surface acceleration of 0.25g. 3
W = wind load

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- Ø = 0.90 for reinforced concrete in flexure.
- Ø = 0.85 for tension, shear, bond, and anchorage in reinforced concrete.
- Ø = 0.75 for spirally-reinforced concrete compression members.
- Ø = 0.70 for tied compression members.
- Ø = 0.90 for fabricated structural steel.
- Ø = 0.90 for mild reinforcing steel (not prestressed) in direct tension.
- Ø = 0.95 for prestressed tendons in direct tension.

The containment structure and engineered safeguards systems components are protected by barriers from all credible missiles which might be generated from the primary system. Local yielding or erosion of barriers is permissible due to jet or missile impact,
1 provided there is no general failure. Missile barriers are designed on the basis of absorbing energy by plastic yielding.

The final design of the missile barrier and equipment support structures inside the containment will be reviewed to assure that they can withstand applicable pressure loads, jet forces, pipe reactions and earthquake loads without loss of function. The deflections or deformations of structures and supports will be checked to assure that the functions of the containment and engineered safeguards equipment are not impaired.

2 The maximum displacement of structures, systems and equipment will be considered so the design and major components will have structural separation (with the exception of the fuel transfer
1 tube) which will allow for differential movement. The foundation material is uniform and of such a nature that no permanent settlement or tilting will result from seismic loads.

3.2 CLASS 1 SYSTEMS AND EQUIPMENT DESIGN

Components and systems classified as Class 1 will be designed in accordance with the following criteria

a. For Case I stress intensities shall be maintained within the allowable working stress limits accepted as good practice, and where applicable, as set forth in the appropriate design standards, e.g., ASME Boiler and Pressure Vessel Code and USASI B31.1 Code for Pressure Piping.

3 b. For Cases II, III, and IV stress intensities and the corresponding strains shall be limited so that the function of the component or system shall not be impaired as to prevent a safe and orderly shutdown of the plant.

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Case	Loading Combination	Stress Limits
I	Design loads + design earthquake loads	$P_m \le 1.0\ S_m$
		$P_\ell + P_b \le 1.5\ S_m$
II	Design loads + maximum hypothetical earthquake loads	$P_m \le 1.2\ S_m$
		$P_\ell + P_b \le 1.2\ (1.5\ S_m)$
III	Design loads + pipe rupture loads	$P_m \le 1.2\ S_m$
		$P_\ell + P_b \le 1.2\ (1.5\ S_m)$
IV	Design loads + maximum hypothetical earthquake loads + pipe rupture loads	$P_m \le 2/3\ S_u$ 3
		$P_\ell + P_b \le 2/3\ S_u$

* where P_m = Primary general membrane stress intensity

S_m = Allowable membrane stress intensity

P_ℓ = Primary local membrane stress intensity

P_b = Primary bending stress intensity

S_u = Ultimate stress for unirradiated material at operating temperature

* (1) All symbols have the same definition or connotation as those in ASME B&PV Code Section III, Nuclear Vessels.

* (2) Portions of systems or components not covered by ASME B&PV Code Section III will be designed in accordance with applicable codes using the stress limits stated above. 2

* (3) The limits given above are for primary stresses; general membrane, local membrane, and bending. Based on available stress-strain curves, the corresponding strains will be about 20% of the uniform strain or less. This applies to all pertinent material, in the unirradiated condition. 4

* (4) Maximum local strains, due to $P_\ell + P_b$ will be in the order of 3% for carbon steel and 10% for type 18-8 stainless steel for cases I and II in unirradiated material. For Cases III and IV the piping will be restrained to prevent secondary damage.

All components will be designed to insure against structural instabilities regardless of stress levels. 3

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Adequate flexibility will be provided in piping and other interconnecting elements to allow for differential movement during an earthquake.

3.3 CLASS 2 STRUCTURES, SYSTEMS AND EQUIPMENT DESIGN

All Class 2 structures, systems and equipment are designed in accordance with the applicant's standard practice. However, in no case will the design criteria in this classification be less restrictive than that required by standard applicable codes and standards or the requirements of the Uniform Building Code.

4.0 EARTHQUAKE LOADS FOR CLASS 1 STRUCTURES, SYSTEMS AND EQUIPMENT

Seismic Forces (E and E') -- AEC publication TID 7024, "Nuclear Reactors and Earthquakes," is used as the basic design guide for seismic analysis.

3 The "design earthquake" to be used for this plant has a ground acceleration of 0.13 g horizontally and 0.07g vertically, acting simultaneously. The "maximum hypothetical earthquake" has a ground acceleration of 0.25g horizontally and 0.13g vertically, acting simultaneously.

Seismic loads on structures, systems and equipment are determined by realistic evaluation of dynamic properties and the accelerations from the attached acceleration spectrum curves (Figures 5A-1, 5A-2).

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5.0 DAMPING*

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Stress Level	% Critical Damping	
	Type and Condition of Structure	Percentage of Critical Damping
1. Low, well below proportional limit, stresses below 1/4 yield point	a. Vital piping	0.5
	b. Steel, reinforced or prestressed concrete, no cracking, no joint slip	0.5 to 1.0
2. Working stress, no more than about 1/2 yield point	a. Vital piping	0.5 to 1.0
	b. Welded steel, prestressed concrete, well reinforced concrete (only slight cracking)	2
	c. Reinforced concrete with considerable cracking	3 to 5
	d. Bolted and/or riveted steel	5 to 7
3. At or just below yield point	a. Vital piping	2
	b. Welded steel, prestressed concrete (without complete loss in prestress)	5
	c. Prestressed concrete with no prestress left	7
	d. Reinforced concrete	7 to 10
	e. Bolted and/or riveted steel	10 to 15
4. All ranges	Rocking of Entire Structure	5 to 9 **
	Translation of Entire Structure	30% **

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* Reference 8
** Reference 5, 6, 7

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6.0 LOADINGS COMMON TO ALL STRUCTURES

Ice or Snow Loading - A uniform distributed live load of 20 pounds per square foot on all roofs provides for any anticipated snow and/or ice loading.

7.0 REFERENCES

1. "Nuclear Reactors and Earthquakes" AEC Publication TID-7024.

2. Housner, G.W., Design of Nuclear Power Reactors Against Earthquakes, Proceedings of the Second World Conference on Earthquake Engineering, Page 133, Japan (1960).

3. Housner, G.W., Behavior of Structures During Earthquakes, Journal of the Engineering Mechanics Division, Proceedings of the American Society of Civil Engineers, Page 109, October 1959.

4. Task Committee on Wind Forces, "Wind Forces on Structures," ASCE Paper No. 3269.

5. Arnold, R. N., Bycroft, G. N., Warburton, G. B., Forced Vibrations of a Body on an Infinite Elastic Solid, Journal of Applied Mechanics, American Society of Mechanical Engineers, Vol. 22, No. 3 (1955).

6. Whitman, R. V., Richart, F. E., Design Procedures for Dynamically Loaded Foundations, Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineers, SM6 (Nov. 1967).

3

7. Parmelee, R. A., Building-Foundation Interaction Effects, Journal of the Engineering Mechanics Division, American Society of Civil Engineers, EM2 (April 1967).

8. Newmark, N. M., Design Criteria for Nuclear Reactors Subjected to Earthquake Motions, Presented at the International Atomic Energy Agency Meeting in Tokyo, (June 1967).

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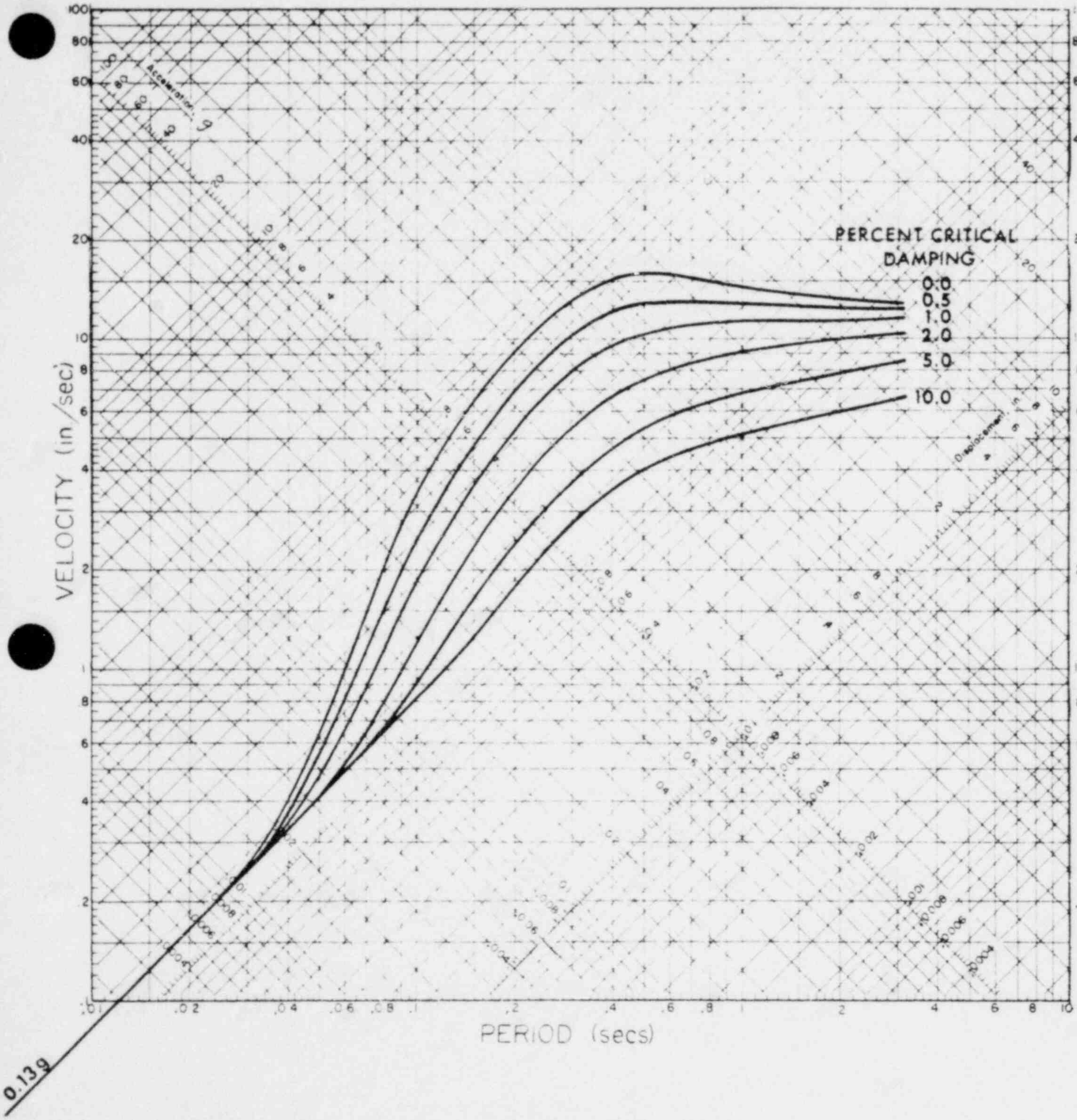

FIGURE 5A-1
DESIGN EARTHQUAKE RESPONSE SPECTRUM
GROUND ACCELERATION 0.13g

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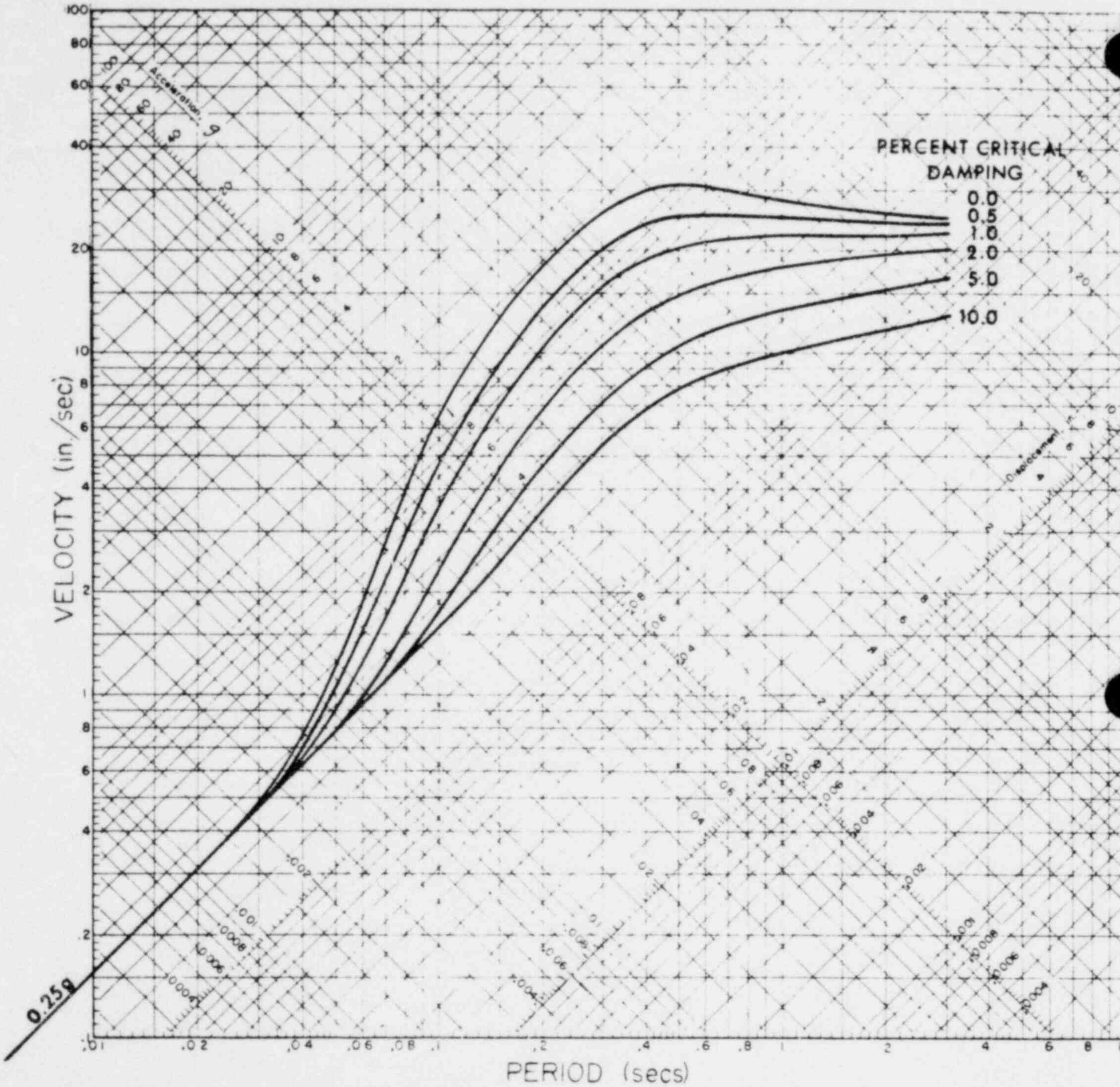

FIGURE 5A-2
MAXIMUM HYPOTHETICAL EARTHQUAKE
RESPONSE SPECTRUM GROUND
ACCELERATION 0.25g

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