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October 12, 1973

SECY-R 74-50

# POLICY SESSION ITEM

For: The Commissioners

Thru: Director of Regulation

Subject: Amendments to 10 CFR Part 100, Reactor Site Criteria - Seismic and Geologic Siting Criteria and 10 CFR Part 50 Licensing of Production and Utilization Facilities - Technical Specifications.

Purpose: To consider publication in effective form of amendments to 10 CFR Part 100 which would add an Appendix A, Seismic and Geologic Siting Criteria for Nuclear Power Plants and an amendment to 10 CFR Part 50 which would add a footnote to § 50.36(c)(2). The purpose of the criteria is to set forth the principal seismic and geologic considerations used in evaluating the suitability of proposed sites for nuclear power plants and the suitability of the plant design bases established in consideration of the seismic and geologic characteristics of the proposed sites. These amendments include substantive changes, based on adverse public comments, to the rule as approved by the Commission for public comment.

Discussion: On November 25, 1971, following Commission approval of a staff paper SECY-R-311, a notice of proposed rule making was published in the Federal Register proposing amendments to 10 CFR Part 100. Sixty days were allowed for public comment.

Comments from thirty-four organizations and individuals were received in response to the proposed amendments. A list of these individuals and organizations is attached as Enclosure "B". The significant comments are summarized and discussed in Enclosure "C".

The comments received indicated aspects of the proposed amendments which required amplification and clarification to make the intent clearer and to provide flexibility in

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implementation of the criteria. The Advisory Committee on Reactor Safeguards has reviewed the proposed Seismic and Geologic Siting Criteria and believes them acceptable to publish in effective form.

The changes made to the proposed rule as a result of the comments received and other considerations are shown in comparative text form in Enclosure "A".

The criteria were prepared by the Regulatory staff in cooperation with the United States Geological Survey and the National Oceanic and Atmospheric Administration. These organizations have concurred in the changes made to the proposed criteria.

A footnote has been added to § 50.36(c)(2) of 10 CFR Part 50 to assure that each power reactor licensee is aware of the limiting condition of operation which is imposed under paragraph V(a)(2) of Appendix A to 10 CFR Part 100. This limitation requires that if vibratory ground motion exceeding that of the Operating Basis Earthquake occurs, shut down of the nuclear power plant will be required. Prior to resuming operations, the licensee will be required to demonstrate to the Commission that no functional damage has occurred to those features necessary for continued operation without undue risk to the health and safety of the public.

Recommendation: The Commission approve publication of amendments to 10 CFR Part 100, Reactor Site Criteria, modifying §100.10 and adding an Appendix A entitled "Seismic and Geologic Siting Criteria for Nuclear Power Plants" and an amendment to 10 CFR Part 50, Licensing of Production and Utilization Facilities by adding a footnote at the end of §50.36(c)(2).

Note that no Environmental Impact Statement is required because the amendments do not constitute a major federal action significantly affecting the quality of the human environment. A memorandum to file which discusses the considerations which were made in arriving at this determination is on file at the Public Document Room. A copy is attached as Enclosure "E".

Note that the amendments, as set out in Enclosure "A", will be published in the Federal Register to be effective 30 days after publication.

Note that the Joint Committee on Atomic Energy will be informed by letter.

Note that a public announcement such as Enclosure "D" will be issued when the notice of rule making is filed with the Office of the Federal Register.

Coordination: The Directorate of Licensing and the Office of the General Counsel concur in this recommendation. The Advisory Committee on Reactor Safeguards believes it is acceptable to publish the proposed criteria. The draft public announcement was prepared by the Office of Information Services.

Scheduling: For consideration at an early policy session.

Lester Rogers
Director of Regulatory Standards

Contact:
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This paper will be considered at a special Regulatory Policy Session set for Tuesday, October 16 at 2:00 p.m. in Commissioners' Dining Room, Germantown.

Commissioner Doub has requested the 5 day Rule be waived because it relates to the Commission's response to Myron Cherry's letter of September 26. The Commission's response is 2 weeks overdue.

Paul C. Bender
Secretary of the Commission

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ENCLOSURE "A"

TITLE 10 - ATOMIC ENERGY

CHAPTER I - ATOMIC ENERGY COMMISSION

PART 50 - LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

PART 100 - REACTOR SITE CRITERIA

Seismic and Geologic Siting Criteria

On November 25, 1971, the Atomic Energy Commission published in the FEDERAL REGISTER (36 FR 22601) for public comment proposed amendments to 10 CFR Part 100, "Reactor Site Criteria," which would add an Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants". The purpose of the criteria is to set forth the principal seismic and geologic considerations which guide the Commission in its evaluation of the suitability of proposed sites for nuclear power plants and the suitability of the plant design bases established in consideration of the seismic and geologic characteristics of the proposed sites in order to provide reasonable assurance that the nuclear power plant can be constructed and operated at a proposed site without undue risk to the health and safety of the public.

All interested persons were invited to submit comments or suggestions in connection with the proposed amendments within 60 days after publication of the notice of proposed rule making in the FEDERAL REGISTER. After consideration of the comments received in response to the notice of

proposed rule making the Commission has decided to adopt the amendments in the form set out below. The amendments as adopted reflect the suggestions in a number of the comments. Major differences in Appendix A from the amendments published for comment are:

1. The Safe Shutdown Earthquake and the Operating Basis Earthquake have been defined in terms of geology and seismology.

   The proposed rule defined the Safe Shutdown Earthquake and the Operating Basis Earthquake in terms of the effect of these earthquakes on structures, systems and components of the plant. This concept has been retained in these amendments, so that effects on plant structure as well as geologic and seismic considerations are required to adequately define each earthquake.

2. Advances in the state of the art of geologic investigations have been taken into account by giving more credit to three-dimensional investigations, such as those obtained from offshore geologic surveys, in determining the extent of the zone requiring detailed faulting investigations.

3. The selection of an Operating Basis Earthquake has been made mandatory and has been applied to those features of the plant that are safety related.

The proposed rule required that the Operating Basis Earthquake selected be related to the operability of those structures, systems and components necessary for power generation. Many of the comments questioned the legality of imposing safety requirements on portions of the plant which were not safety related. As a result of these comments, the definition of the Operating Basis Earthquake was made more restrictive.

Other significant changes which relate to specific sections of Appendix A are as follows:

1. Section I of Appendix A, entitled "Purpose," has been revised to reference General Design Criterion 2 of Appendix A to 10 CFR Part 50 which requires that nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of natural phenomena without loss of capability to perform their safety function.

2. Section II of Appendix A, entitled "Scope," has been revised to:
   a. Clarify the Commission's intent that the investigations described in Appendix A of 10 CFR Part 100 are considered to fall within the scope of §50.10(c)(1) of 10 CFR Part 50.
   b. Define in more precise terms when additional investigations or more conservative determinations or both are required.

c. State that the criteria do not address investigations of possible volcanism required for sites located in areas of volcanic activity and that investigations of the volcanic aspects of such sites will be determined on a case-by-case basis.

3. A number of definitions included in Section III of Appendix A have been revised to define more precisely the terms used in this appendix with respect to geology and seismicity, and their relationship to safety related structures, systems and components of a nuclear power plant.

The specific changes made to the definitions of Section III are as follows:

a. Paragraph (c) of Section III has been revised so that the Safe Shutdown Earthquake is that earthquake which is based upon an evaluation of the maximum earthquake potential considering the regional and local geology and seismology and the specific characteristics of local subsurface material.

b. In paragraph (d) of Section III the definition of the Operating Basis Earthquake has been revised by substituting for the definition of the earthquake which produces the vibratory ground motion for which those structures, systems and components necessary for power generation are designed to remain operable, the earthquake which produces vibrating ground motion for which those features

of the nuclear power plant necessary for continued operation without undue risk to the health and safety of the public are designed to remain functional, and considering the regional and local geology and seismology and specific characteristics of local subsurface material, which could reasonably be expected to affect earthquake vibratory motion at the plant site during the operating life of the plant.

c. The term "active" fault has been replaced by the term "capable" fault throughout the appendix to eliminate the confusion which has existed between the Appendix A definition of an "active" fault and the other definitions of an active fault widely used by geologists. As used in the Appendix, a capable fault is a fault whose geologic history is taken into account in evaluating the fault's potential for causing vibratory ground motion and which is capable of causing surface faulting. An additional change has been made to paragraph III(g) in that the regional restriction concerning instrumentally determined macro-seismicity has been deleted from paragraph (g)(2) of Section III. The definition now includes only the characteristics of macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault.

d. The definition of "zone requiring detailed faulting investigation" in paragraph (j) of Section III has been revised to state more

clearly the scope and types of investigations in the zone needed to demonstrate that the need to design for surface faulting does not exist, or that the design basis for surface has been properly determined.

4. Section IV, entitled "Required Investigations," has been revised as follows:

   a. A statement has been added in paragraph (a) of Section IV that the investigations for vibratory ground motion produced by the Safe Shutdown Earthquake are considered to provide an adequate basis for selection of an Operating Basis Earthquake.

   b. Paragraph (a)(2) of Section IV has been modified to require that investigations for vibratory ground motion and surface faulting include consideration of the possible effects of man's activities on the tectonic structures underlying the site and the region surrounding the site.

   c. A new paragraph (b)(2) has been added to Section IV to clarify that an evaluation of tectonic structures underlying the site with regard to their potential for causing surface displacement at or near the site is required and that such evaluation shall include consideration of the effects of man's activities on the tectonic structures underlying the site and the region surrounding the site.

   d. A footnote has been added to paragraphs (a)(7) and (b)(7) of Section IV to clearly state that in the absence of absolute dating,

evidence of recency of movement of a fault may be obtained by applying relative dating techniques to rupture, offset warped or otherwise structurally disturbed surface or near surface material or geomorphic features.

e. A footnote has been added to paragraph (a)(7) and (b)(7) of Section IV to clarify that the applicant is to evaluate whether a fault is a capable fault with respect to the defined characteristics stated in paragraph IIIg by conducting a reasonable investigation using suitable geologic and geophysical techniques.

5. The following changes have been made to Section V, entitled "Seismic and Geologic Design Bases:"

a. Paragraph V(a) has been expanded to provide for determination of the design basis for the expected vibratory ground motion as well as the design basis for maximum vibratory ground motion.

b. A requirement has been added to paragraph (a)(1)(iv) of Section V that, in the case where a causative fault is near the site, the effect of proximity of an earthquake on the spectral characteristics of the Safe Shutdown Earthquake shall be taken into account.

c. Paragraph (a)(2) of Section V has been changed to require the applicant to specify the Operating Basis Earthquake. A requirement which reflects the seismic design bases for plants recently evaluated for construction permits that the maximum vibratory ground acceleration of the Operating Basis Earthquake shall be

at least one-half the maximum vibratory ground acceleration of the Safe Shutdown Earthquake has been added.

d. Paragraph (b)(1) of Section V has been revised to specify that more detailed three dimensional information such as that obtained from precise investigative techniques may justify the use of a narrower zone requiring detailed faulting investigations. This change has been made to give greater recognition to advances in the state of the art of geologic investigations. Examples of certain types of faults which may require an increase in the width of the zone also are given.

e. Paragraph (d)(1) of Section V has been modified to include consideration of the loading effects of dams or reservoirs in the determination of soil stability.

f. Paragraph (d)(4) of Section V requires that those structures which are not located in the immediate vicinity of the site, but which are safety related, be designed to withstand the effects of the Safe Shutdown Earthquake and the design basis for surface faulting, determined on a basis comparable to that of the nuclear power plant.

6. The following significant changes were made to Section VI, entitled "Application to Engineering Design:"

a. Paragraphs (a)(1) and (a)(2) of Section VI have been revised to permit the use of a suitable qualification test to demonstrate

tha: structures, systems and components can withstand the seismic and other concurrent loads.

b. Paragraph VI(a)(1) has been changed to eliminate the requirement that safety related structures, systems, and components also be designed to withstand the effects of vibratory motion of at least fifty percent of the Safe Shutdown Earthquake in combination with other appropriate loads well within elastic limits. This requirement is now included as part of the determination of the Operating Basis Earthquake in paragraph (a)(2) of Section V.

c. Paragraph (a)(2) of Section VI has been modified to reflect the change made to the Operating Basis Earthquake definiti: and to define more precisely the stress and deformation limits within which all structures, systems, and components of the nuclear power plant necessary for continued operation without undue risk to the health and safety of the public shall be designed to remain functional.

d. A footnote has been added to the end of paragraph (a)(3) of Section VI that the criteria do not address the need for instrumentation that would automatically shut down a nuclear power plant when an earthquake occurs which exceeds a predetermined intensity.

e. A footnote has been added to §50.36(c)(2) of 10 CFR Part 50 to assure that each power reactor licensee is aware of the limiting

condition of operation which is imposed under these criteria. This limitation requires that if vibratory ground motion exceeding that of the Operating Basis Earthquake occurs, shut down of the nuclear power plant will be required. Prior to resuming operations, the licensee will be required to demonstrate to the Commission that no functional damage has occurred to those features necessary for continued operation without undue risk to the health and safety of the public.

The criteria describe the seismic and geologic investigations required to obtain information needed to determine the design basis for earthquake-produced vibratory ground motion and for seismically induced floods and water waves. They also describe investigations required to obtain information to determine whether and to what extent the nuclear power plant need be designed to withstand the effects of surface faulting.

The design basis for the maximum vibratory ground motion is determined, as described in the criteria, through evaluation of the seismology and geology and the geologic and seismic history of the site and the surrounding region. The most severe earthquakes associated with tectonic structures or tectonic provinces in the region surrounding the site are identified by considering those historically reported earthquakes that can be associated with these structures or provinces. If faults in the region surrounding the site are capable faults, the most severe expected earthquakes associated with these faults are determined by also considering their geologic history. Because of the limited historical data, the most severe earthquakes

associated with these tectonic structures or tectonic provinces are determined in a conservative manner and are usually larger than the maximum earthquake historically recorded. The design basis for vibratory ground motion at the site is then determined by assuming that the epicenters or locations of highest intensity of the earthquakes are situated at the point on the tectonic structures or tectonic provinces nearest the site.

The criteria require the evaluation of other design considerations which are affected by the design basis for vibratory ground motion, including soil stability, slope stability, and cooling water supply.

In order to determine whether and to what extent a nuclear power plant need be designed to withstand the effects of surface faulting, the criteria require that the location of the site with respect to capable faults be considered. Procedures are provided for determining whether the site is within a zone requiring detailed faulting investigation based on its location with respect to capable faults. Where a site is within a zone requiring detailed faulting investigation, the criteria require that the regional and local geologic and seismic characteristics of the site be investigated in considerable detail. The adequacy of the detailed investigation will be determined by the Commission on an individual case basis, taking into account the specific site characteristics. Where the detailed investigation indicates that surface faulting need not be taken into account in the design of the nuclear power plant, the criteria require that sufficient data to clearly justify the proposed design basis be presented in the license application.

The criteria also provide general guidance for the design of a nuclear power plant to withstand earthquake-caused effects, pending the development of more detailed criteria.

The amendments were prepared in cooperation with the U.S. Geological Survey and the National Oceanic and Atmospheric Administration. The amendments reflected the experience accumulated by these agencies and the Atomic Energy Commission in evaluating seismic and geologic characteristics of sites for the location of nuclear power plants.

Discussions have been held with various interested groups to assure clarity of the criteria.

A determination has been made that an Environmental Impact Statement is not required. The considerations factored into this determination are included in a memorandum on file at the Commission's Public Document Room at 1717 H Street, N.W., Washington, D.C.

The seismic and geologic siting criteria in this appendix supplement 10 CFR Part 100 by specifying the seismic and geologic investigations and analyses necessary to determine the acceptability of a proposed site as required by § 100.10(a). The existing provisions in § 100.10(c)(1) stating that the design of a facility should conform to accepted building codes or standards and that no facility should be located closer than one-fourth mile from the surface location of a known capable earthquake fault will be superseded by these criteria.

The criteria also provide general guidance for the design of a nuclear power plant to withstand earthquake-caused effects, pending the development of more detailed criteria.

The amendments were prepared in cooperation with the U.S. Geological Survey and the National Oceanic and Atmospheric Administration. The amendments reflected the experience accumulated by these agencies and the Atomic Energy Commission in evaluating seismic and geologic characteristics of sites for the location of nuclear power plants.

Discussions have been held with various interested groups to assure clarity of the criteria.

A determination has been made that an Environmental Impact Statement is not required. The considerations factored into this determination are included in a memorandum on file at the Commission's Public Document Room at 1717 H Street, N.W., Washington, D.C.

The seismic and geologic siting criteria in this appendix supplement 10 CFR Part 100 by specifying the seismic and geologic investigations and analyses necessary to determine the acceptability of a proposed site as required by § 100.10(a). The existing provisions in § 100.10(c)(1) stating that the design of a facility should conform to accepted building codes or standards and that no facility should be located closer than one-fourth mile from the surface location of a known capable earthquake fault will be superseded by these criteria.

The criteria will also assist license applicants in complying with § 50.34(a)(1) of 10 CFR Part 50 which requires that the preliminary safety analysis report include a description and safety assessment of the site on which a production or utilization facility is to be located, with appropriate attention to features affecting facility design.

Pursuant to the Atomic Energy Act of 1954, as amended, and sections 552 and 553 of title 5 of the United States Code, the following amendments to Title 10, Chapter I, Code of Federal Regulations, Parts 50 and 100 are published as a document subject to codification.

1. A footnote is added at the end of §50.36(c)(2) to read as follows::

   */ See paragraph V(a)(2) of Appendix A of Part 100 of this chapter.

2. In § 100.10, paragraph (c)(1) is revised to read as follows:*

   § 100.10 Factors to be considered when evaluating sites.

   Factors considered in the evaluation of sites include those relating both to the proposed reactor design and the characteristics peculiar to the site. It is expected that reactors will reflect through their design, construction and operation an extremely low probability for accidents that could result in release of significant quantities of radioactive fission products. In addition, the site location

* Deletions from the text of the proposed rule are lined through and bracketed, and additions are underscored.

and the engineered features included as safeguards against the hazardous consequences of an accident, should one occur, should insure a low risk of public exposure. In particular, the Commission will take the following factors into consideration in determining the acceptability of a site for a power or testing reactor:

* * * * *

(c) Physical characteristics of the site, including seismology, meteorology, geology, and hydrology.

(1) Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," [~~sets forth the principal seismic and geologic considerations which guide the Commission in its evaluation of the suitability of proposed sites for nuclear power plants.~~] describe the nature of investigations required to obtain the geologic and seismic data necessary to determine site suitability and provide reasonable assurance that a nuclear power plant can be constructed and operated at a proposed site without undue risk to the health and safety of the public. They describe procedures for determining the quantitative vibratory ground motion design basis at a site due to earthquakes and describe information needed to determine whether and to what extent

a nuclear power plant need be designed to withstand the effects of surface faulting

* * * * *

3. A new Appendix A is added to 10 CFR Part 100 to read as follows:

APPENDIX A

SEISMIC AND GEOLOGIC SITING CRITERIA FOR NUCLEAR POWER PLANTS

I. PURPOSE

General Design Criterion 2 of Appendix A to Part 50 of this chapter requires that nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. It is the purpose of these criteria to set forth the principal seismic and geologic considerations which guide the Commission in its evaluation of the suitability of proposed sites for nuclear power plants and the suitability of the plant design bases established in consideration of the seismic and geologic characteristics of the proposed sites.

These criteria are based on the limited geophysical and geological information available to date concerning faults and earthquake occurrence and effect. They will be revised as necessary when more complete information becomes available.

II. SCOPE

These criteria, which apply to nuclear power plants, describe the nature of the investigations required to obtain the geologic and seismic

data necessary to determine site suitability and provide reasonable assurance that a nuclear power plant can be constructed and operated at a proposed site without undue risk to the health and safety of the public. They describe procedures for determining the quantitative vibratory ground motion design basis at a site due to earthquakes and describe information needed to determine whether and to what extent a nuclear power plant need be designed to withstand the effects of surface faulting. Other geologic and seismic factors required to be taken into account in the siting and design of nuclear power plants are identified.

The investigations described in this appendix are within the scope of investigations permitted by § 50.10(c)(1) of this chapter.

Each applicant for a construction permit shall investigate all seismic and geologic factors that may affect the design and operation of the proposed nuclear power plant irrespective of whether such factors are explicitly included in these criteria. Additional investigations and/or more conservative determinations than those included in these criteria may be required for sites located in [~~unusual geologic or seismic areas~~] areas having complex geology or in areas of high seismicity. If an applicant believes that the particular seismology and geology of a site indicate that some of these criteria, or portions thereof, need not be satisfied, the specific sections of these criteria should be identified

in the license application, and supporting data to justify clearly such departures should be presented.

These criteria do not address investigations of volcanic phenomena required for sites located in areas of volcanic activity. Investigations of the volcanic aspects of such sites will be determined on a case-by-case basis.

## III. DEFINITIONS

As used in these criteria:

(a) The "magnitude" of an earthquake is a measure of the size of an earthquake and is related to the energy released in the form of seismic waves. "Magnitude" means the numerical value on a Richter scale.

(b) The "intensity" of an earthquake is a measure of its effects on man, on man-built structures, and on the earth's surface at a particular location. "Intensity" means the numerical value on the Modified Mercalli scale.

(c) The "Safe Shutdown Earthquake"[1/] is that earthquake which is based upon an evaluation of the maximum earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material. It is that earthquake which produces the maximum vibratory ground motion for which certain structures, systems,

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[1/] The "Safe Shutdown Earthquake" defines that earthquake which has commonly been referred to as the "Design Basis Earthquake."

and components [~~important to safety~~] are designed to remain functional. These structures, systems, and components are those necessary to assure:

(1) The integrity of the reactor coolant pressure boundary,

(2) The capability to shut down the reactor and maintain it in a safe shutdown condition, or

(3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the guideline exposures of this part.

(d) The "Operating Basis Earthquake" is that earthquake which, [~~produces the vibratory ground motion for which these structures, systems and components necessary for power generation are designed to remain operable.~~] considering the regional and local geology and seismology and specific characteristics of local subsurface material, could reasonably be expected to affect the plant site during the operating life of the plant; it is that earthquake which produces the vibratory ground motion for which those features of the nuclear power plant necessary for continued operation without undue risk to the health and safety of the public are designed to remain functional.

(e) A "fault" is a tectonic structure along which differential [~~displacement~~] slippage of the adjacent earth materials has occurred parallel to the fracture plane. It is distinct from [~~nontectonic~~] other types of ground disruptions such as landslid[~~ing~~]es, fissur[~~ing~~]es, and crater[~~ing~~]s. A fault may have gouge or breccia between its two walls and includes any

associated monoclinal flexure [~~(a-acceplike-bend-in-otherwise-horizontal-or gently-dipping-bed, which passes into a fault)~~] or other similar geologic structural feature.

(f) "Surface faulting" is differential ground displacement at or near the surface caused directly by fault movement and is distinct from nontectonic types of ground disruptions, such as landslid[~~ing~~]es, fissur[~~ing~~]es, and crater[~~ing~~]s.

(g) [~~An "active~~] A "capable fault" [~~*~~] is a fault which has exhibited one or more of the following characteristics:

(1) Movement at or near the ground surface at least once [~~in~~] within the past 35,000 years or [~~more than once in~~] movement of a recurring nature within the past 500,000 years. [~~In the absence of data permitting absolute dating, faults with sufficiently recent movement to leave perceptible evidence of surface rupture, surface warping, or offset of geomorphic features are considered active faults.~~]

(2) Macro-seismicity [~~:~~] instrumentally [~~well~~] determined [~~macro-seismicity for a fault located in the continental United States west of the Rocky Mountain Front, or in Alaska, Hawaii or Puerto Rico.~~] with records of sufficient precision to demonstrate a direct relationship with the fault.

[~~*The definition and use of "active fault" in these criteria is not the same as other definitions generally used by geologists. An "active fault" is a fault whose geologic history shall be taken into account in evaluating the fault's potential for causing vibratory ground motion or surface faulting. The historic seismicity of a fault shall be taken into account in determining the design basis for vibratory ground motion even though the fault is not considered to be an active fault by these criteria.~~]

(3) A structural relationship to [~~an active~~] a capable fault according to characteristics (1) or (2) of this paragraph such that movement on one could be reasonably expected to be accompanied by movement on the other.

In some cases, the geologic evidence of past activity at or near the ground surface along a particular fault may be obscured at a particular site. This might occur, for example, at a site having a deep [~~alluvial~~] overburden. For these cases, evidence may exist elsewhere along the fault from which an evaluation of its characteristics in the vicinity of the site can be reasonably based. Such evidence shall be used in determining whether the fault is [~~an active~~] a capable fault within this definition.

[~~Valid geologic reasons may exist to demonstrate that a fault which has one of the characteristics stated in (1) through (3) is not an active fault within this definition. For example, some faults may lack deep seated, long term causes and be due to shallow short term causes.~~] Notwithstanding the foregoing paragraphs III g(1), (2) and (3), structural association of a fault with geologic structural features which are geologically old (at least pre-Quaternary) such as many of those found in the Eastern region of the United States [~~may~~] shall, in the absence of conflicting evidence, demonstrate that the fault is not [~~an active~~] a capable fault within this definition.

(h) A "tectonic province" is a region of the North American continent characterized by a relative [~~uniformity~~] consistency of the geologic structural features contained therein.

(i) A "tectonic structure" is a large scale dislocation or distortion within the earth's crust. Its extent is measured in miles.

(j) A "zone requiring detailed faulting investigation" is [the] a zone within which a nuclear power reactor may not be located [only if] unless a detailed investigation of the regional and local geologic and seismic characteristics of the site [is made in order to consider the need to design for surface faulting.] demonstrates that the need to design for surface faulting has been properly determined.

(k) The "control width" of a fault is the maximum width of the zone containing mapped fault traces, including all [Quaternary] faults [traces] which can be reasonably inferred to have experienced differential movement during Quaternary times and which join or can reasonably be inferred to join the main fault trace, measured within 10 miles along the fault's trend in both directions from the point of nearest approach to the site. (See Figure 1[)] of this appendix.)

(l) A "response spectrum" is a plot of the maximum [peak] responses (acceleration, velocity or displacement) of a family of idealized single-degree-of-freedom damped oscillators against natural frequencies (or periods) of the oscillators to a specified vibratory motion input at their supports.

## IV. REQUIRED INVESTIGATIONS

The geologic, seismic and engineering characteristics of a site and its environs shall be investigated in sufficient scope and detail to [fit]

provide reasonable assurance that they are sufficiently well understood to permit an adequate evaluation of the proposed site, and [(2)] to provide sufficient information to support the determinations required by these criteria and to permit adequate engineering solutions to actual or potential geologic and seismic effects at the proposed site. The size of the region to be investigated and the type of data pertinent to the investigations shall be determined by the nature of the region surrounding the proposed site. The investigations shall be carried out by a review of the pertinent literature and[/or] field investigations and shall include the steps outlined in [(a) through (c)] paragraphs (a) through (c) of this section.

(a) Required Investigation for Vibratory Ground Motion. The purpose of the investigations required by this paragraph is to obtain information needed to describe the vibratory ground motion produced by the Safe Shutdown Earthquake. All of the steps in paragraphs (a)(5) through (a)(6) of this section need not be carried out if the Safe Shutdown Earthquake can be clearly established by investigations and determinations of a lesser scope. The investigations required by this paragraph provide an adequate basis for selection of an Operating Basis Earthquake. The investigations shall include the following:

(1) Determination of the lithologic, stratigraphic, hydrologic, and structural geologic conditions of the site and the region surrounding the site, including its geologic history;

(2) Identification and evaluation of tectonic structures underlying the site and the region surrounding the site, whether buried or expressed at the

surface[.]. The evaluation should consider the possible effects caused by man's activities such as withdrawal of fluid from or addition of fluid to the subsurface, extraction of minerals, or the loading effects of dams or reservoirs;

(3) [~~Determination~~] Evaluation of physical evidence concerning the behavior during prior earthquakes of the surficial geologic materials and the substrata underlying the site from the lithologic, stratigraphic, and structural geologic studies;

(4) Determination of the static and dynamic engineering properties of the materials underlying the site. Included should be properties needed to determine the behavior of the underlying material during earthquakes and the characteristics of the underlying material in transmitting earthquake-induced motions to the foundations of the plant, such as seismic wave velocities, density, water content, porosity, and strength;

(5) Listing of all historically reported earthquakes which have affected or which could [~~be~~] reasonably be expected to have affected the site, including the date of occurrence and the following measured or estimated data: magnitude or highest intensity, and a plot of the epicenter or [~~region~~] location of highest intensity. Where historically reported earthquakes could have caused a maximum ground acceleration of at least one-tenth the acceleration of gravity (0.1g) at the foundations of the proposed nuclear power plant structures, the acceleration or intensity and duration of ground shaking at these foundations shall also be estimated.

Since earthquakes have been reported in terms of various parameters[~~,~~] such as magnitude, intensity at a given location, and effect on ground, structures, and people at a specific location, some of these data may have to be estimated by use of appropriate empirical relationships. [~~Where appropriate,~~] The comparative characteristics of the material underlying the epicentral location or region of highest intensity and of the material underlying the site in transmitting earthquake vibratory motion shall be considered;

(6) Correlation of epicenters or [~~regions~~] locations of highest intensity of historically reported earthquakes, where possible, with tectonic structures any part of which is located within 200 miles of the site. Epicenters or [~~regions~~] locations of highest intensity which cannot be reasonably correlated with tectonic structures shall be identified with tectonic provinces any part of which is located within 200 miles of the site;

(7) For faults, any part of which is within 200 miles[2/] of the site and which may be of significance in establishing the Safe Shutdown Earthquake, determination of whether these faults are to be considered as

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[2/] If the Safe Shutdown Earthquake can be associated with a fault closer than 200 miles to the site, the procedures of paragraphs (a)(7) and (a)(8) of this section need not be carried out for successively more remote faults.

[~~active~~] capable faults.[3/, 4/] This determination is required in order to permit appropriate consideration of the geologic history of such faults in establishing the Safe Shutdown Earthquake. For guidance in determining which faults may be of significance in determining the Safe Shutdown Earthquake, Table 1 of this appendix presents the minimum length of fault to be considered versus distance from site. [~~Active~~] Capable faults of lesser length than those indicated in Table 1 and faults which are not [~~active~~] capable faults [~~generally~~] need not be considered in determining the Safe Shutdown Earthquake, except where unusual circumstances indicate such consideration is appropriate;

Table 1

| Distance from the site (miles) | Minimum length of fault (miles) [~~to~~] which shall be considered in establishing Safe Shutdown Earthquake |
|---|---|
| 0 to 20 | 1 |
| greater than 20 to 50 | 5 |
| greater than 50 to 100 | 10 |
| greater than 100 to 150 | 20 |
| greater than 150 to 200 | 40 |

3/ In the absence of absolute dating, evidence of recency of movement may be obtained by applying relative dating technique to ruptured, offset, warped or otherwise structurally disturbed surface or near surface materials or geomorphic features.

4/ The applicant shall evaluate whether or not a fault is a capable fault with respect to the characteristics outlined in paragraphs III(g)(1), (2), and (3) by conducting a reasonable investigation using suitable geologic and geophysical techniqus.

(8) For capable faults, any part of which is within 200 miles[2/] of the site and which may be of significance in establishing the Safe Shutdown Earthquake [~~and which are considered as active faults~~], determination of:

(i) The length of the fault;

(ii) The relationship of the fault to regional tectonic structures; and

(iii) The nature, amount, and geologic history of displacements along the fault, including particularly the estimated amount of the maximum Quaternary displacement related to any one earthquake along the fault.

(b) Required Investigation for Surface Faulting. The purpose of the investigations required by this paragraph is to obtain information to determine whether and to what extent the nuclear power plant need be designed for surface faulting. If the design basis for surface faulting can be clearly established by investigations of a lesser scope, not all of the steps in paragraphs (b)[~~(3)~~] (4) through (b)[~~(6)~~] (7) of this section need [~~not~~] be carried out. The investigations shall include the following:

(1) Determination of the lithologic, stratigraphic, hydrologic, and structural geologic conditions of the site and the area surrounding the site, including its geologic history;

(2) Evaluation of tectonic structures underlying the site, whether buried or expressed at the surface, with regard to their potential for causing surface displacement at or near the site. The evaluation shall

consider the possible effects caused by man's activities such as withdrawal of fluid from or addition of fluid to the subsurface, extraction of minerals, or the loading effects of dams or reservoirs;

[~~(2)~~](3) Determination of geologic evidence of fault offset at or near the ground surface at or near the site;

[~~(3)~~](4) For faults greater than 1000 feet long, any part of which is within 5 miles[5/] of the site, determination of whether these faults are to be considered as [~~active~~] capable faults;

[~~(4)~~](5) Listing of all historically reported earthquakes which can reasonably be associated with [~~active~~] capable faults greater than 1000 feet long, any part of which is within 5 miles[5/] of the site, including the date of occurrence and the following measured or estimated data: magnitude or highest intensity, and a plot of the epicenter or region of highest intensity;

[~~(5)~~](6) Correlation of epicenters or [regions] locations of highest intensity of historically reported earthquakes with [~~active~~] capable faults greater than 1000 feet long, any part of which is located within 5 miles[5/] of the site;

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[5/] If the design basis for surface faulting can be determined from a fault closer than 5 miles to the site, the procedures of paragraphs (b)[~~(3)~~](4) through (b)[~~(6)~~](7) of this section need not be carried out for successively more remote faults.

[~~(6)~~](7) For [~~active~~] capable faults greater than 1000 feet long, any part of which is within 5 miles[5/] of the site, determination of:[6/], [7/]

(i) The length of the fault;

(ii) The relationship of the fault to regional tectonic structures;

(iii) The nature, amount, and geologic history of displacements along the fault, including particularly the estimated amount of the maximum Quaternary displacement related to any one earthquake along the fault; and

(iv) The outer limits of the fault established by mapping Quaternary fault traces for 10 miles along its trend in both directions from the point of its nearest approach to the site.

(c) Required Investigation for Seismically Induced Floods and Water Waves.

(1) For coastal sites, the investigations shall include the determination of:

(i) Information regarding distantly and locally generated waves or tsunami which have affected or could have affected the site. Available evidence regarding the runup and drawdown associated with historic tsunami in the same coastal region as the site shall also be included;

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6/ In the absence of absolute dating, evidence of recency of movement may be obtained by applying relative dating techniques to ruptured, offset, warped or otherwise structurally disturbed surface of near-surface materials or geomorphic features.

7/ The applicant shall evaluate whether or not a fault is a capable fault with respect to the characteristics outlined in paragraphs I.(6)(1), (2), and (3) by conducting a reasonable investigation using suitable geologic and geophysical techniques.

(ii) Local features of coastal topography which might tend to modify tsunami runup or drawdown. Appropriate available evidence regarding historic local modifications in tsunami runup or drawdown at coastal locations having [~~similar~~] topography similar to that of the site shall also be obtained; and

(iii) Appropriate geologic and seismic evidence to provide information for establishing the design basis for seismically induced floods or water waves from a local offshore earthquake, from local offshore effects of an onshore earthquake, or from coastal subsidence. This evidence shall be determined, to the extent practical, by a procedure similar to that required in paragraphs (a) and (b) of this section. The probable slip characteristics of offshore faults shall also be considered as well as the potential for offshore slides in submarine material.

(2) For sites located near lakes and rivers, investigations similar to those required in [~~sub~~]paragraph (c)(1) of this section shall be carried out, as appropriate, to determine the potential for the nuclear power plant to be exposed to seismically induced floods and water waves as, for example, from the failure during an earthquake of an upstream dam or from slides of earth or debris into a nearby lake.

## V. SEISMIC AND GEOLOGIC DESIGN BASES

(a) Determination of Design Basis for Vibratory Ground Motion. The design of each nuclear power plant shall take into account the potential

effects of vibratory ground motion caused by earthquakes. The design basis for the maximum vibratory ground motion and the expected vibratory ground motion [~~is~~] should be determined through evaluation of the seismology, geology, and the [~~geologic and~~] seismic and geologic history of the site and the surrounding region. The most severe earthquakes associated with tectonic structures or tectonic provinces in the region surrounding the site [~~are~~] should be identified, [~~by~~] considering those historically reported earthquakes that can be associated with these structures or provinces and other relevant factors. If faults in the region surrounding the site are [~~active~~] capable faults, the most severe [~~expected~~] earthquakes associated with these faults [~~are~~] should be determined by also considering their geologic history. The vibratory ground motion at the site [~~is~~] should be then determined by assuming that the epicenters or [~~regions~~] locations of highest intensity of the earthquakes are situated at the point on the tectonic structures or tectonic provinces nearest to the site. The earthquake which could cause the maximum vibratory ground motion at the site [~~is~~] should be designated the Safe Shutdown Earthquake. The specific procedures for determining the design basis for vibratory ground motion are given in the following [~~sections~~] paragraphs.

(1) Determination of Safe Shutdown Earthquake. The Safe Shutdown Earthquake shall be identified through evaluation of seismic and geologic information developed pursuant to the requirements of paragraph (V(a), as follows:

(i) The historic earthquakes of greatest magnitude or intensity which have been correlated with tectonic structures pursuant to the requirements of paragraph (a)(6) of Section IV shall be determined. In addition, for [active] capable faults, the information required by paragraph (a)(8) of Section IV shall also be taken into account in determining the earthquakes of greatest magnitude related to the faults. The magnitude or intensity of [these] earthquakes based on geologic evidence may be larger than that of the maximum earthquakes historically recorded. The accelerations at the site shall be determined assuming that the epicenters of the earthquakes of greatest magnitude or the [~~regions~~] locations of highest intensity related to the tectonic structures are situated at the point on the structures closest to the site;

(ii) Where epicenters or [~~regions~~] locations of highest intensity of historically reported earthquakes cannot be reasonably related to tectonic structures but are identified pursuant to the requirements of paragraph (a)(6) of Section IV with tectonic provinces in which the site is located, the accelerations at the site shall be determined assuming that these earthquakes occur [~~adjacent to~~] at the site.

(iii) Where epicenters or [~~regions~~] locations of the highest intensity of historically reported earthquakes cannot be reasonably related to tectonic structures but are identified pursuant to the requirements of paragraph (a)(6) of Section IV with tectonic provinces in which the site is not located, the accelerations at the site shall be determined assuming

that the epicenters or [~~regions~~] locations of highest intensity of these earthquakes are [~~located~~] at the closest point to the site on the boundary of the tectonic province;

(iv) The earthquake producing the maximum vibratory acceleration at the site, as determined from [~~subdivisions (i) through (iii)~~] paragraphs (a)(1)(i) through (iii) of this section shall be designated the Safe Shutdown Earthquake for vibratory ground motion, except as noted in [~~subdivision (v)~~] paragraph (a)(1)(v) of this section. The characteristics of the Safe Shutdown Earthquake shall be derived from more than one earthquake determined from [~~subdivisions (i) through (iii)~~] paragraphs (a)(1)(i) through (iii) of this section, where necessary to assure that the maximum vibratory acceleration at the site throughout the frequency range of interest is included. In the case where a causative fault is near the site, the effect of proximity of an earthquake on the spectral characteristics of the Safe Shutdown Earthquake shall be taken into account. In order to compensate for the limited data, the procedures in [~~subdivisions (i) through (iii)~~] paragraphs (a)(1)(i) through (iii) of this section [~~should~~] shall be applied in a conservative manner. The maximum vibratory accelerations of the Safe Shutdown Earthquake at [~~the~~] each of the various foundation[~~s~~] locations of the nuclear power plant structures at a given site shall be determined taking into account the characteristics of the underlying soil material in transmitting the earthquake-induced motions, obtained pursuant to paragraphs (a)(1), (3), and (4) of Section IV. The Safe Shutdown

Earthquake shall be defined by response spectra corresponding to the maximum vibratory accelerations as outlined in paragraph (a) of Section VI; and

(v) Where the maximum vibratory accelerations of the Safe Shutdown Earthquake at the foundations of the nuclear power plant structures are determined to be less than one-tenth the acceleration of gravity (0.1g) as a result of the steps required in [~~subdivisions (i) through (iv)~~] paragraphs (a)(1)(i) through (iv) of this section, it shall be assumed that the maximum vibratory accelerations of the Safe Shutdown Earthquake at these foundations are at least 0.1g.

(2) Determination of Operating Basis Earthquake. The Operating Basis Earthquake [~~may~~] shall be specified by the applicant after considering the seismology and geology of the region surrounding the site. If vibratory ground motion [~~occurs which produces a maximum acceleration above .05g at any foundation of the nuclear power plant structures or which exceeds~~] exceeding that of the Operating Basis Earthquake occurs, [~~whichever is greater,~~] shutdown of the nuclear power plant will be required. Prior to resuming operations, the licensee [~~shall~~] will be required to demonstrate to the Commission that no functional damage has occurred to those features necessary for continued operation without undue risk to the health and safety of the public. The maximum vibratory ground acceleration of the Operating Basis Earthquake shall be at least one-half the maximum vibratory ground acceleration of the Safe Shutdown Earthquake.

(b) Determination of Need to Design for Surface Faulting. In order to determine whether a nuclear power plant is required to be designed to

withstand the effects of surface faulting, the location of the [~~site~~] nuclear power plant with respect to [~~active~~] capable faults shall be considered. The area over which each of these faults has caused surface faulting in the past is identified by mapping its fault traces in the vicinity of the site. The fault traces are mapped along the trend of the fault for 10 miles in both directions from the point of its nearest approach to the [~~site~~] nuclear power plant because, for example, traces may be obscured along portions of the fault. The maximum width of the mapped fault traces, called the control width, is then determined from this map. Because surface faulting has sometimes occurred beyond the limit of mapped fault traces or where fault traces have not been previously recognized, the control width of the fault is increased by a factor which is dependent upon the largest potential earthquake related to the fault. This larger width delineates a zone, called the zone requiring detailed faulting investigation, in which the possibility of surface faulting must be [~~considered~~] determined. The following [~~section~~] paragraphs outline[~~s~~] the specific procedures for determining the zone requiring detailed faulting investigation for [~~an active~~] a capable fault.

(1) Determination of Zone Requiring Detailed Faulting Investigation. The zone requiring detailed faulting investigation for [~~an active~~] a capable fault which was investigated pursuant to the requirement of paragraph (b) [~~(6)~~](7) of Section IV shall be determined through use of the following table:

Table 2

Determination of Zone Requiring Detailed Faulting Investigation

| Magnitude of Earthquake | Width of Zone Requiring Detailed Faulting Investigation (See Figure 1) |
|---|---|
| Less than 5.5 | 1 x control width |
| 5.5 - 6.4 | 2 x control width |
| 6.5 - 7.5 | 3 x control width |
| Greater than 7.5 | 4 x control width |

The largest magnitude earthquake related to the fault shall be used in Table 2. This earthquake shall be determined from the information developed pursuant to the requirements of paragraph (b) of Section IV for the fault, taking into account the information required by paragraph (b)[~~(6)~~](7) of Section IV. The control width used in Table 2 is determined by mapping the outer limits of the fault traces from information developed pursuant to [~~subdivision IV~~] paragraph (b) [~~(6)~~](7)(iv) of Section IV. The control width shall be used in Table 2 unless the characteristics of the fault are obscured for a significant portion of the 10 miles on either side of the point of nearest approach to the [~~site~~] nuclear power plant. In this event, the use in Table 2 of the width of mapped fault traces more than 10 miles from the point of nearest approach to the [~~site~~] nuclear power plant may be appropriate.

The zone requiring detailed faulting investigation, as determined from Table 2, shall be used for the fault except where:

(i) The zone requiring detailed faulting investigation from Table 2 is less than one-half mile in width. In this case the zone shall be at least one-half mile in width; or

(ii) Definitive evidence concerning the regional and local characteristics of the fault justifies use of a different value. For example, thrust or bedding-plane faults may require an increase in width of the zone to account for the projected dip of the fault plane; or

(iii) More detailed three-dimensional information, such as that obtained from precise investigative techniques, may justify the use of a narrower zone. Possible examples of such techniques are the use of accurate records from closely spaced drill holes or from closely spaced, high-resolution offshore geophysical surveys.

In delineating the zone requiring detailed faulting investigation for a fault, the center of the zone shall coincide with the center of the fault at [~~its~~] the point of nearest approach of the fault to the [~~site~~] nuclear power plant as illustrated in Figure 1.

(c) Determination of Design Bases for Seismically Induced Floods and Water Waves. The size of seismically induced floods and water waves which could affect a site from either locally or distantly generated seismic activity shall be determined, taking into consideration the results of the investigation required by paragraph (c) of Section IV. Local topographic characteristics which might tend to modify the possible runup and drawdown at the site shall be considered. Adverse tide conditions shall also be taken into account in determining the effect of the floods and waves on

the site. The characteristics of the earthquake to be used in evaluating the offshore effects of local earthquakes shall be determined by a procedure similar to that used to determine the characteristics of the Safe Shutdown Earthquake in paragraph V(a).

(d) Determination of Other Design Conditions.

(1) Soil Stability. Vibratory ground motion associated with the Safe Shutdown Earthquake can cause soil instability due to ground disruption such as fissuring, differential consolidation, liquefaction, and cratering which is not directly related to surface faulting. The following geologic features which could affect the foundations of the proposed nuclear power plant structures shall be evaluated, taking into account the information concerning the physical properties of materials underlying the site developed pursuant to paragraphs (a)(1), (3), and (4) of Section IV and the effects of the Safe Shutdown Earthquake:

(i) Areas of actual or potential surface or subsurface subsidence, uplift, or collapse resulting from:

(a) Natural features such as tectonic depressions and cavernous or karst terrains, particularly those underlain by calcareous or other soluble deposits;

(b) Man's activities such as withdrawal of fluid from or addition [of] fluid to the subsurface [~~fluids~~], [~~or mineral~~] extraction[s] of minerals, or the loading effects of dams or reservoirs; and

(c) Regional [~~warping~~s] deformation.

(ii) Deformational zones such as shears, joints, fractures, [and] folds, or combinations of these features.

(iii) Zones of alteration or irregular weathering profiles and zones of structural weakness composed of crushed or disturbed materials.

(iv) Unrelieved residual stresses in bedrock.

(v) Rocks or soils that might be unstable because of their mineralogy, lack of consolidation, water content, or potentially undesirable response to seismic or other events. Seismic response characteristics to be considered shall include liquefaction, thixotropy, differential consolidation, cratering, and fissuring.

(2) Slope stability. Stability of all slopes, both natural and artificial, the failure of which could adversely affect the nuclear power plant, shall be considered. An assessment shall be made of the potential effects of erosion or deposition and of combinations of erosion or deposition with seismic activity, taking into account information concerning the physical properties of the materials underlying the site developed pursuant to paragraphs (a)(1), (3), and (4) of Section IV and the effects of the Safe Shutdown Earthquake.

(3) Cooling Water Supply. Assurance of adequate cooling water supply for emergency and long-term shutdown decay heat removal shall be considered in the design of the nuclear power plant, taking into account information concerning the physical properties of the materials underlying the site developed pursuant to paragraphs (a)(1), (3), and (4) of Section IV and the effects of the Safe Shutdown Earthquake and the design basis for surface

faulting. Consideration of river blockage or diversion or other failures which may block the flow of cooling water, coastal uplift or subsidence, or tsunami runup and drawdown, and [~~of the~~] failure of dams and intake structures shall be included in the evaluation, where appropriate.

(4) Distant Structures. Those structures which are not located in the immediate vicinity of the site but which are safety related shall be designed to withstand the effects of the Safe Shutdown Earthquake and the design basis for surface faulting determined on a comparable basis to that of the nuclear power plant, taking into account the material underlying the structures and the different location with respect to that of the site.

## VI. APPLICATION TO ENGINEERING DESIGN [~~CRITERIA~~]

[~~The engineering design criteria included in this section are intended only for general guidance; more detailed criteria for seismic design of nuclear power plants are being developed.~~]

(a) Vibratory Ground Motion.

(1) Safe Shutdown Earthquake. The vibratory ground motion produced by the Safe Shutdown Earthquake shall be defined by response spectra corresponding to the maximum vibratory accelerations at the elevations of the foundations of the nuclear power plant structures determined pursuant to paragraph (a)(1) of Section V. The response spectra shall relate the response of the foundations of the nuclear power plant structures

to the vibratory ground motion, considering such foundations to be single-degree-of-freedom damped oscillators and neglecting soil-structure interaction effects. In view of the limited data available on vibratory ground motions of strong earthquakes, it usually will be appropriate that the response spectra be smoothed design spectra developed from [~~an envelope of~~] a series of response spectra related to the [~~measured~~] vibratory motions caused by more than one earthquake.

The nuclear power plant shall be designed so that, if the Safe Shutdown Earthquake occurs, [~~all~~] certain structures, systems, and components [~~important to safety~~] will remain functional. These structures, systems, and components are those necessary to assure [~~(1)~~] (i) the integrity of the reactor coolant pressure boundary, [~~(2)~~] (ii) the capability to shut down the reactor and maintain it in a safe condition, or [~~(3)~~] (iii) the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the guideline exposures of this part. In addition to seismic loads, including aftershocks, applicable concurrent functional and accident-induced loads shall be taken into account in the design of these safety-related structures, systems, and components. The design of the nuclear power plant shall also take into account the possible effects of the Safe Shutdown Earthquake on the facility foundations by ground disruption, such as fissuring, differential consolidation, cratering, liquefaction, and landsliding, as required in paragraph (d) of Section V.

The engineering method used to ensure that the required safety functions are maintained during and after the vibratory ground motion

associated with the Safe Shutdown Earthquake shall involve the use of either a suitable dynamic analysis, [~~such as a time history method,~~] or a suitable qualification test to demonstrate that structures, systems and components can withstand the seismic and other concurrent loads, except where it can be demonstrated that the use of an equivalent static load method provides adequate conservatism.

The analysis or test shall take into account soil-structure interaction effects and the expected duration of vibratory motion. It is permissible to [~~allow~~] design for strain limits in excess of yield strain in some of these safety-related structures, systems, and components during the Safe Shutdown Earthquake and under the postulated concurrent conditions, provided that the necessary safety functions are maintained.

[~~These safety related structures, systems, and components shall also be designed to withstand the effects of vibratory motion of at least fifty percent of the Safe Shutdown Earthquake in combination with other appropriate loads well within elastic limits.~~]

(2) Operating Basis Earthquake. [~~Where the applicant chooses to design the nuclear power plant to withstand the effects of an Operating Basis Earthquake,~~] The Operating Basis Earthquake shall be defined by response spectra. All structures, systems, and components of the nuclear power plant necessary for [~~power generation shall be designed to withstand~~] continued operation without undue risk to the health and safety of the public shall be designed to remain functional and within applicable stress

and deformation limits when subjected to the effects of the vibratory motion of the Operating Basis Earthquake in combination with normal operating [~~other appropriate~~] loads. [~~well within elastic limits~~] The engineering method used to ensure that [~~all~~] these structures, systems, and components [~~necessary for power generation~~] are capable of withstanding the effects of the Operating Basis Earthquake shall involve the use of either a suitable dynamic analysis [~~such as a time history method~~,] or a suitable qualification test to demonstrate that the structures, systems and components can withstand the seismic and other concurrent loads, except where it can be demonstrated that the use of an equivalent static load method provides adequate conservatism. The analysis or test shall take into account soil-structure interaction effects and the expected duration of vibratory motion.

(3) Required Seismic Instrumentation. Suitable instrumentation shall be provided so that the seismic response of nuclear power plant features important to safety can be determined promptly to permit comparison of such response with that used as the design basis. Such a comparison is needed to decide whether the plant can continue to be operated safely and to permit such timely action as may be appropriate.

These criteria do not address the need for instrumentation that would automatically shut down a nuclear power plant when an earthquake occurs which exceeds a predetermined intensity. The need for such instrumentation is under consideration.

(b) Surface Faulting.

(1) If the [~~reactor~~] [~~facility~~] nuclear power plant is to be located within the zone requiring detailed faulting investigation, a detailed investigation of the regional and local geologic and seismic characteristics of the site shall be carried out to determine the need to take into account surface faulting in the design of the nuclear power plant. Where it is determined that surface faulting need not be taken into account, sufficient data to clearly justify the determination shall be presented in the license application.

(2) Where it is determined that surface faulting must be taken into account, [~~guidance~~] the applicant shall, in establishing the design basis for surface faulting on a site [~~shall be obtained~~] [~~from the data in Technical Information Document 24124, "Historic Surface Faulting in Continental United States and Adjacent Parts of Mexico," by M. G. Bonilla, U.S. Geological Survey, 1967,~~] take into account [~~from the~~] evidence concerning the regional and local geologic and seismic characteristics of the site and from any other relevant data.

(3) The design basis for surface faulting shall be taken into account in the design of the nuclear power plant by providing reasonable assurance that in the event [~~of occurrence~~] of such displacement during faulting [~~all~~] certain structures, systems, and components [~~important to safety~~] will remain functional. These structures, systems, and components are those necessary to assure [~~(1)~~] (i) the integrity of the reactor coolant pressure boundary, [~~(2)~~] (ii) the capability to shut down

the reactor and maintain it in a safe shutdown condition, or [~~(3)~~] (iii) the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the guideline exposures of this part. In addition to seismic loads, including aftershocks, applicable concurrent functional and accident-induced loads shall be taken into account in the design of such safety features. The design provisions shall be based on an assumption that the design basis for surface faulting can occur in any direction and azimuth and under any part of the nuclear power plant, unless evidence indicates this assumption is not appropriate, and shall take into account the estimated rate at which the surface faulting may occur.

(c) Seismically Induced Floods and Water Waves and Other Design Conditions. The design basis for seismically induced floods and water waves from either locally or distantly generated seismic activity and other design conditions determined pursuant to paragraphs (c) and (d) of Section V, shall be taken into account in the design of the nuclear power plant so as to prevent undue risk to the health and safety of the public.

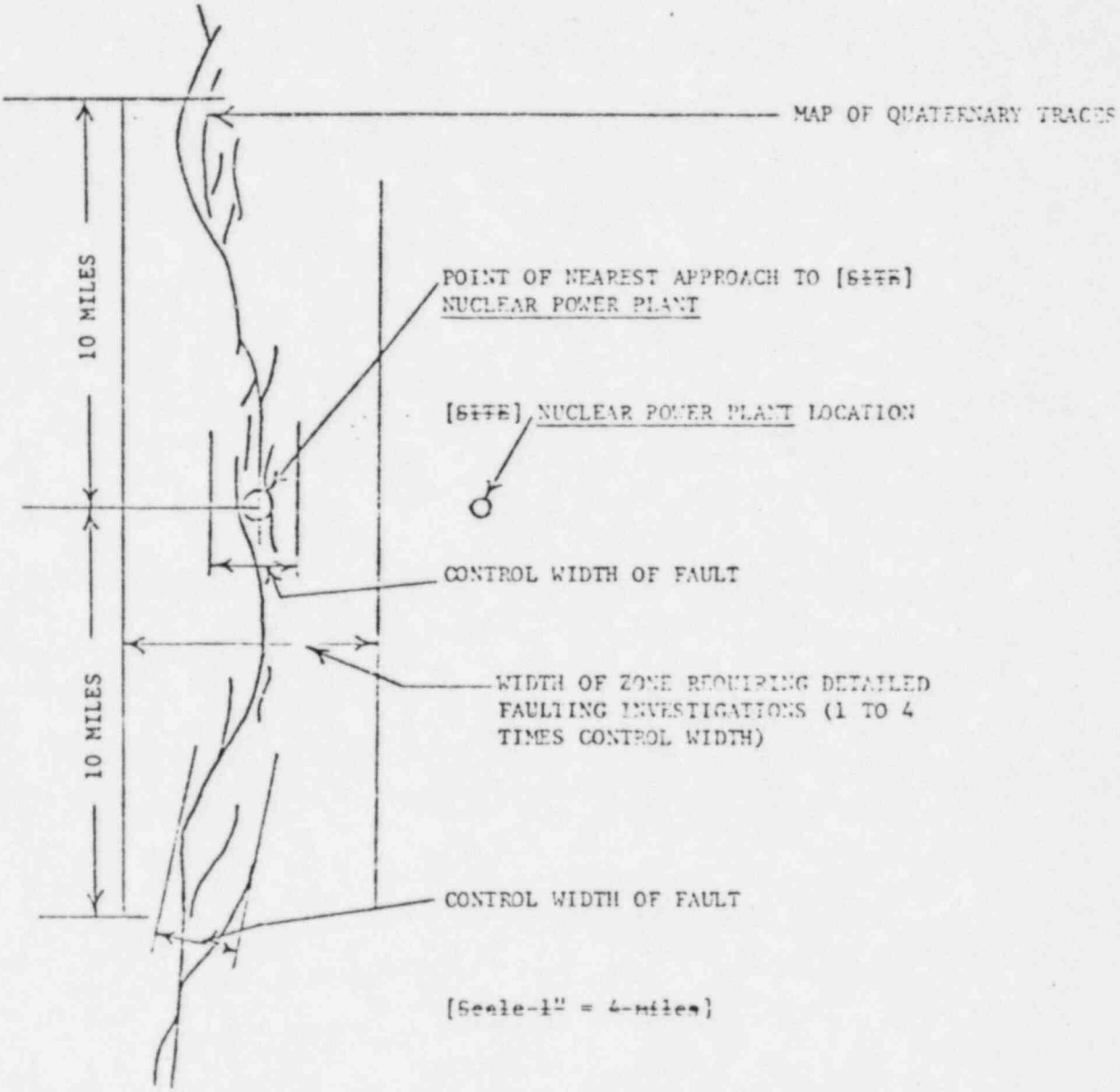


Figure 1 - Diagrammatic illustration of delineation of width of zone requiring detailed faulting investigations for a specific [site-area] nuclear power plant location.

Effective date. This amendment becomes effective on _____.*

(Sec. 161, Pub. Law 83-703, 68 Stat. 948 (42 USC 2201)

Dated _____, this _____ day

of _____ 1973.

For the Atomic Energy Commission

_____

Paul C. Bender
Secretary of the Commission

*A date certain will be inserted calculated 30 days after publication in the Federal Register.



Enclosure "A"

ENCLOSURE "B"

List of Individuals and Organizations Submitting Comments on Notice of Proposed Rule Making (36 FR 22601) Published in the Federal Register, November 25, 1971[1/]

| | | |
|---|---|---|
| 1. | Daniel N. Miller, Jr., The Geological Survey of Wyoming, University of Wyoming | 12/10/71 |
| 2. | Larry Williams, Oregon Environmental Council | 12/13/71 |
| 3. | J. W. Gore, Jr., Baltimore Gas and Electric Company | 12/16/71 |
| 4. | Harold Oslick, Ebasco Services Incorporated | 1/6/72 |
| 5. | Floyd L. Goss, Department of Water and Power, The City of Los Angeles | 1/14/72 |
| 6. | Richard J. Holt, Weston Geophysical Research, Inc. | 1/17/72 |
| 7. | Rev. Daniel Linehan, S. J., Boston College | 1/17/72 |
| 8. | L. C. Dail, Duke Power Company | 1/18/72 |
| 9. | J. D. Stevenson, University of Pittsburgh | 1/18/72 |
| 10. | R. F. Walker, Public Service of Colorado | 1/19/72 |
| 11. | W. F. Swiger, Stone & Webster Engineering Corporation | 1/20/72 |
| 12. | R. S. Hunter, American Electric Power Service Corp. | 1/20/72 |
| 13. | Douglas H. Hamilton, Earth Science Associates | 1/20/72 |
| 14. | Charles F. Kocher, Southern California Edison Co. | 1/21/72 |
| 15. | Modesto Iriarte, Jr., Puerto Rico Water Resources Authority | 1/21/72 |

[1/] Copies of comments received are available in the Office of the Secretary of the Commission.

| | | |
|---|---|---|
| 16. | W. H. Arnold, Jr., Westinghouse | 1/21/72 |
| 17. | Philip A. Crane, Jr., Pacific Gas and Electric Co. | 1/21/72 |
| 18. | R. D. Allen, Bechtel Corporation | 1/21/72 |
| 19. | Richard H. Jahns, Stanford University | 1/21/72 |
| 20. | Vicent J. Murphy, Weston Geophysical Research, Inc. | 1/21/72 |
| 21. | John M. Waage, Gulf General Atomic Company | 1/21/72 |
| 22. | Robert H. Bryan, Oak Ridge National Laboratory | 1/24/72 |
| 23. | Joseph G. Fischer, Dames & Moore | 1/24/72 |
| 24. | A. P. Bray, General Electric Company | 1/24/72 |
| 25. | J. J. Mottimoe, Sacramento Municipal Utility District | 1/24/72 |
| 26. | James E. Watson, Tennessee Valley Authority | 1/24/72 |
| 27. | Neal L. Moylan, New York State Stomic Energy Council | 1/26/72 |
| 28. | D. C. Switzer, Northeast Utilities Service Company | 1/27/72 |
| 29. | Martin R. Engler, Jr., San Diego Gas & Electric Co. | 1/27/72 |
| 30. | J. L. Ward, Sargent & Lundy | 1/31/72 |
| 31. | James F. Malloy, Babcock & Wilcox | 2/1/72 |
| 32. | John D. HOffman, Sierra Club Legal Defense Fund, Inc. | 2/22/72 |
| 33. | George A. Kiersch, Cornell University | 3/29/72 |
| 34. | Gary B. Griggs, University of California, Santa Cruz | 5/26/72 |

ENCLOSURE "C"

Summary of Significant Comments
Received and Their Resolution

a. Comment - The procedures set forth in these criteria are too rigid, and may with time discourage the use of new techniques as may become available.

Resolution - Changes have been made to give greater recognition to advances in the state of the art. For example, paragraph (b)(1) of Section V has been revised to permit the use of narrower zones requiring detailed faulting investigation than those specified in Table 2 of paragraph (b)(1) of Section V when justified by more detailed three dimensional information, such as that obtained from offshore geophysical surveys.

b. Comment - More definitive criteria should be set forth for evaluating the adequacy of a particular location and for the proper design of a nuclear power plant at a particular site.

Resolution - The Seismic and Geologic Siting Criteria are intended to provide requirements for site investigations and evaluations. These criteria will form the basis for development of Regulatory Guides, which will include numerous areas such as slope stability,

liquefaction, transmission of vibratory ground motion to the foundations of nuclear power plants, damping factors, and acceptable soil and rock investigative techniques. This task will require a number of years to complete and will provide detailed guidance for evaluating the adequacy of particular site locations and for developing the proper design inputs for these sites.

Seismic design criteria and analysis requirements are also being developed. For example, a special task force under the sponsorship of the A.S.M.E. is developing seismic design criteria and analysis requirements for code system components. It is intended that these criteria and requirements will be included in the A.S.M.E. Boiler and Pressure Vessel Code, Section III which has been adopted as a part of AEC regulations.

c. Comment - The criteria should better define the Commission's role with regard to review of applicants' data, investigations, and design prior to issuance of a construction permit or an operating license.

Resolution - Section 1 entitled "Purpose" has been revised to reference General Design Criterion 2 of Appendix A of 10 CFR 50 which defines the Commission's role with regard to the ability of safety related items to withstand the effects of natural phenomena.

d. Comment - It should be made clear that all necessary site investigation will be permitted prior to the issuance of a construction permit.

Resolution - The section entitled "Scope" has been revised to state specifically that the investigations described in Appendix A of Part 100 fall within the scope of investigations permitted by §50.10(c) of 10 CFR Part 50 which permits site exploration prior to issuance of a construction permit.

e. Comment - The section entitled "Scope" should be revised to better define the term "unusual geologic or seismic areas."

Resolution - A change to the third paragraph of this section has been made to reflect this comment.

f. Comment - The criteria should make it clear that they are not intended to address the subject of "volcanism."

Resolution - A change has been made to the section entitled "Scope" to reflect this comment.

g. Comment - The criteria should specify pertinent modifications to Mercalli Scale and Richter Scale.

Resolution - The Regulatory staff considers it desirable to provide flexibility for the use of all of the available data in evaluating

the magnitude and intensity of the maximum earthquake potential. This data may be available in many forms, and therefore, a requirement that a particular scale be used is unnecessarily restrictive.

h. Comment - The criteria should define the Safe Shutdown Earthquake in geologic terms rather than in terms of how it will be applied to the plant design.

Resolution - A change to the definition of the Safe Shutdown Earthquake in paragraph (c) of Section III has been made to include consideration of regional and local geology and seismology and specific characteristics of local subsurface material in evaluating the maximum earthquake potential.

i. Comment - The Operating Basis Earthquake definition of paragraph (d) of Section III should relate:

(1) Only to safety related features of the plant and not to features necessary for power generation.

(2) To the level of expectation of occurrence that could be expected to occur at the plant site during the life of the plant.

Resolution - A change reflecting this comment has been made to paragraph (d) of Section III. The Operating Basis Earthquake has

also been redefined to include a consideration of the regional and local geology and seismology and specific characteristics of local subsurface material.

j. Comment - The term "active" fault is ambiguous. There has never been general agreement among geologists as to the definition of an "active" fault, and it is too much to expect that adding another definition will clarify matters. Suggest use of the relatively clear term "capable" fault in place of "active" fault.

Resolution - The term "active" fault has been replaced by the term "capable" fault throughout the criteria.

k. Comment - In paragraph (g)(1) of Section III delete the phrase "or more than once in the past 500,000 years" since there is no way in which it can be used without requiring extraordinarily unusual geologic data.

Resolution - Paragraph (g)(1) of Section III has been revised to clarify the original intent that movement of a recurring nature within the past 500,000 years should be used as a characteristic in the determination of a "capable" fault. Further, a footnote has been added to paragraph (a)(7) and (b)(7) of Section IV to emphasize the use of relative dating techniques and other geomorphic evidence

in the determination of recency of movement when absolute dating evidence does not exist.

l. Comment - In paragraph (g)(2) of Section III Puerto Rico is included as an area having well-defined macro-seismicity-fault relationship although there are no known active faults on the island of Puerto Rico. It is recommended that Puerto Rico be excluded from the category. Further comments received from the ACRS Seismic Subcommittee indicated dissatisfaction with the regional approach of paragraph (g)(2) of Section III which lists instrumentally well determined macro-seismicity for only those faults located in the continental United States west of the Rocky Mountain Front or in Alaska, Hawaii, or Puerto Rico as one characteristic of an "active" fault.

Resolution - Paragraph (g)(2) of Section III has been revised to eliminate a regional consideration of characteristics of an "active" ("capable") fault and to define one characteristic of a "capable" fault as "macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault."

m. Comment - A number of comments received expressed concern that the criteria place the burden of proof upon an applicant to demonstrate

that a fault is not an "active" fault instead of requiring an applicant to make a reasonable investigation to determine whether a particular fault exhibits any of the characteristics listed in paragraph (g) of Section III.

Resolution - A footnote has been added to paragraphs (a)(7) and (b)(7) of Section IV which requires the applicant to evaluate whether or not a fault is a capable fault with respect to the characteristics outlined in paragraphs (g)(1), (2) and (3) of Section II conducting a reasonable investigation using suitable geologic and geophysical techniques.

n. Comment - Revise the definition of a "zone requiring detailed faulting investigation" to prohibit building a nuclear power plant anywhere within the control width of an active (capable) fault or on top of an active (capable) fault.

Resolution - Paragraph (j) of Section III has been revised to clarify the original intent that a "zone requiring detailed faulting investigation" is a zone within which a nuclear power reactor may not be located unless a detailed investigation of the regional and local geologic and seismic characteristics of the site demonstrates that the need to design for surface faulting does not exist or that the design basis for surface faulting has been properly determined.

o. Comment - In paragraph (1) of Section III redefine "response spectrum" by relating oscillator acceleration, velocity and displacement to natural period and damping.

Resolution - A change reflecting this comment has been made to paragraph (1) of Section III.

p. Comment - Investigations for vibratory ground motion should include consideration of hydrological conditions.

Resolution - A change reflecting this comment has been made to paragraph (a)(1) of Section IV.

q. Comment - In paragraph (a) of Section IV entitled "Required Investigation for Vibratory Ground Motion" the full investigation of paragraphs (a)(1) through (a)(8) of Section IV should be required in all cases except where there are no historically reported earthquakes of potential significance to the site, and no faults within 200 miles of the site.

Resolution - In paragraph (a)(5) of Section IV the criteria require consideration of all historically reported earthquakes which have affected or which could reasonably be expected to have affected the site. Paragraph (a)(7) of Section IV requires that for faults, any part of which is within 200 miles of the site and which may be of significance in establishing the Safe Shutdown Earthquake, a determination be made whether the faults are considered to be capable

faults. Further, guidance is provided in Table I to establish the significance of capable faults. This is considered to be sufficient to establish the scope of investigations required under paragraph (a) of Section IV.

r. Comment - The criteria should clearly state that the most severe possible earthquake and surface fault must be the design bases in all cases.

Resolution - The definition of the Safe Shutdown Earthquake has been revised to require an evaluation of the maximum earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material.

s. Comment - In the case where a causative fault is near the site, the effect of an earthquake on the spectral characteristics of the Safe Shutdown Earthquake should be taken into account.

Resolution - A change reflecting this comment has been made to paragraph (a)(1)(iv) of Section V.

t. Comment - A number of comments were made which reflect concern over the need to shut down the plant following an earthquake greater than the Operating Basis Earthquake. Many of these concerns stem from words in the proposed rule which require that the licensee demonstrate to the Commission that no functional damage has occurred to those features necessary for continued operation.

Resolution - Paragraph (a)(2) of Section V has been revised to require the licensee to demonstrate to the Commission that no functional damage has occurred to those features necessary for continued operation without undue risk to the health and safety of the public.

u. Comment - In paragraph (b) of Section V, the reference point for tracing a fault should be the reactor and not the site boundary.

Resolution - A change reflecting this comment has been made to paragraph (b) of Section V and to Figure 1.

v. Comment - For thrust or bedding plane faults the criteria should require a zone of investigation which extends along the projected dip of the fault plane.

Resolution - An example has been included in paragraph (b)(1)(ii) of Section ' to emphasize that regional and local geologic characteristics of a fault may require a different control width for the zone requiring detailed faulting investigation.

w. Comment - Paragraph (d)(1)(i)(b) of Section V should be expanded to include the loading effects of dams and reservoirs.

Resolution - A change has been made to paragraph (d)(1)(i) of Section V to reflect this comment. Further, revisions have been

made to Section IV to require consideration of the possible effects of fluid withdrawal or addition and the loading effects of dams or reservoirs during required investigations for vibratory ground motion and surface faulting.

x. Comment - The criteria should define more clearly the Safe Shutdown Earthquake requirements for auxiliary structures located a considerable distance from the site.

Resolution - A change reflecting this comment has been made to paragraph (d)(4) of Section V.

y. Comment - In paragraphs (a)(1) and (a)(2) of Section VI, qualification by testing should be considered a suitable substitute for dynamic analysis to prove the seismic capability of systems, structures and components.

Resolution - The use of suitable qualification tests to demonstrate that structure, systems, and components can withstand the seismic and other concurrent loads is now permitted by paragraphs (a)(1) and (a)(2) of Section VI.

z. Comment - Eliminate the requirement of paragraph (a)(1) of Section VI that, for the Safe Shutdown Earthquake, safety related structures, systems, and components also be designed to withstand the effects of

vibratory motion of at least fifty percent of the Safe Shutdown Earthquake in combination with other appropriate loads well within elastic limits.

Resolution - The 50 percent requirement of the Safe Shutdown Earthquake has been eliminated from paragraph (a)(1) of Section VI. This requirement is now included as a factor in the determination of the Operating Basis Earthquake by the statement in paragraph (a)(2) of Section V that the maximum vibratory ground acceleration of the Operating Basis Earthquake shall be at least one-half the maximum vibratory ground acceleration of the Safe Shutdown Earthquake. This requirement reflects the seismic design bases for plants recently evaluated for construction permits.

ENCLOSURE "D"

DRAFT PUBLIC ANNOUNCEMENT

AEC PUBLISHES SEISMIC AND GEOLOGIC
SITING CRITERIA FOR NUCLEAR POWER PLANTS

The Atomic Energy Commission is adding an Appendix "Seismic and Geologic Criteria for Nuclear Power Plants" to Part 100 of its Regulations. The amendment, first proposed in November 1971, will become effective 30 days after publication in the Federal Register on _____.

The purpose of the new Appendix is to set forth the principal seismic and geologic considerations used by the Commission in evaluating the suitability of proposed sites for nuclear power plants and the suitability of the plant design taking into consideration the seismic and geologic characteristics of the proposed sites.

The criteria were proposed and have been finalized in cooperation with the United States Geological Survey and the National Oceanic and Atmospheric Administration. They reflect advances in the state-of-the-art geologic investigations achieved since late 1971 by giving more credit to three dimensional investigations such as those obtained from offshore geologic surveys in the determination of the extent of the zone requiring detailed faulting investigations.

The criteria describe the investigations required to obtain the geologic and seismic data necessary to determine site suitability and to provide reasonable assurance that the proposed nuclear power plant can be constructed and operated at a proposed site without undue risk to the health and safety of the public.

Information obtained from the investigations will be used to determine the design basis for earthquake-produced ground motion and for seismically-induced floods and water waves. Information also will be used to determine whether and to what extent the nuclear power plant needs to be designed for surface faulting.

ENCLOSURE "E"

DETERMINATION WITH RESPECT TO THE NEED FOR AN ENVIRONMENTAL IMPACT STATEMENT IN THE MATTER OF EFFECTIVE AMENDMENTS TO 10 CFR PART 100, SEISMIC AND GEOLOGIC SITING CRITERIA

## I. INTRODUCTION

On November 25, 1971, the Atomic Energy Commission published in the FEDERAL REGISTER (36 FR 22601) for public comment proposed amendments to 10 CFR Part 100, "Reactor Site Criteria," which would add an Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants". The purpose of the criteria is to set forth the principal seismic and geologic considerations which guide the Commission in its evaluation of the suitability of proposed sites for nuclear power plants and the suitability of the plant design bases established in consideration of the seismic and geologic characteristics of the proposed sites in order to provide reasonable assurance that the nuclear power plant can be constructed and operated at a proposed site without undue risk to the health and safety of the public.

All interested persons were invited to submit comments or suggestions in connection with the proposed amendments within 60 days after publication of the notice of proposed rule making in the FEDERAL REGISTER. After consideration of the comments received in response to the notice of proposed rule making the Commission is considering adopting amendments which are the subject of this determination. The amendments as adopted would reflect the suggestions in a number of the comments.

This report summarizes the results of the evaluation by the Regulatory Staff to determine whether there is a need for publication of an environmental statement in connection with this amendment to the Commission's regulations.

## II. DISCUSSION

The criteria describe the seismic and geologic investigations required to obtain information needed to determine the design basis for earthquake-produced vibratory ground motion and for seismically induced floods and water waves. They also describe investigations required to obtain information to determine whether and to what extent the nuclear power plant need be designed to withstand the effects of surface faulting.

The design basis for the maximum vibratory ground motion is determined, as described in the criteria, through evaluation of the seismology and geology and the geologic and seismic history of the site and the surrounding region. The most severe earthquakes associated with tectonic structures or tectonic provinces in the region surrounding the site are identified by considering those historically reported earthquakes that can be associated with these structures or provinces. If faults in the region surrounding the site are capable faults, the most severe expected earthquakes associated with these faults are determined by also considering their geologic history. Because of the limited historical data, the most severe earthquakes associated with these tectonic structures or tectonic provinces are

determined in a conservative manner and are usually larger than the maximum earthquake historically recorded. The design basis for vibratory ground motion at the site is then determined by assuming that the epicenters or locations of highest intensity of the earthquakes are situated at the point on the tectonic structures or tectonic provinces nearest the site.

The criteria require the evaluation of other design considerations which are affected by the design basis for vibratory ground motion, including soil stability, slope stability, and cooling water supply.

In order to determine whether and to what extent a nuclear power plant need be designed to withstand the effects of surface faulting, the criteria require that the location of the site with respect to capable faults be considered. Procedures are provided for determining whether the site is within a zone requiring detailed faulting investigation based on its location with respect to capable faults. Where a site is within a zone requiring detailed faulting investigation, the criteria require that the regional and local geologic and seismic characteristics of the site be investigated in considerable detail. The adequacy of the detailed investigation will be determined by the Commission on an individual case basis, taking into account the specific site characteristics. Where the detailed investigation indicates that surface faulting need not be taken into account in the design of the nuclear power plant, the criteria require that sufficient data to clearly justify the proposed design basis be presented in the license application.

The criteria also provide general guidance for the design of a nuclear power plant to withstand earthquake-caused effects, pending the development of more detailed criteria.

The proposed amendments were prepared in cooperation with the U.S. Geological Survey and the National Oceanic and Atmospheric Administration. The proposed amendments reflected the experience accumulated by these agencies and the Atomic Energy Commission in evaluating seismic and geologic characteristics of sites for the location of nuclear power plants.

Prior to and after issuing the proposed amendments for public comment, discussions were held with a representative group of utilities and their specialist consultants in order to assure clarity of the criteria and their applicability to sites being considered by the nuclear industry. After the public comment period on the proposed amendment and as a result of comments received from the Sierra Club Legal Defense Fund, meetings were held with representatives of the Sierra Club to assure that their comments could be properly taken into account in preparing the final amendments.

The seismic and geologic siting criteria in this appendix will supplement 10 CFR Part 100.

The criteria would also assist applicants in complying with § 50.34(a)(1) of 10 CFR Part 50 which requires that the preliminary safety analysis report include a description and safety assessment of the site on which

a production or utilization facility is to be located, with appropriate attention to features affecting facility design.

## III. EVALUATION

The following considerations are pertinent to the evaluation of the need for a detailed environmental statement.

A. Environmental Impact

The expected result of this rule making action is to codify criteria currently being used in the evaluation of license applications on a case-by-case basis to determine if the applicant provides reasonable assurance that the proposed nuclear power plant can be built and operated without undue risk to the health and safety of the public.

The establishment of Seismic and Geologic Siting Criteria for Nuclear Power Plants will not have any direct effect on the public. Any public impact of earthquakes on a nuclear power plant is evaluated by review of the seismic and geologic history of the area surrounding the site and the material underlying the foundations of the plant. During the licensing process all aspects of the design of a nuclear power plant are reviewed to assure that in the event of a maximum potential earthquake that certain structures, systems, and components will remain functional. These structures, systems and components are those necessary to assure:

(1) The integrity of the reactor coolant pressure boundary of accidents which could result in potential offsite exposure comparable to the guideline exposures of 10 CFR Part 100.

(2) The capability to shut down the reactor and maintain it in a safe shutdown condition, or

(3) The capability to prevent or mitigate the consequences.

In addition, detailed environmental impact statements are prepared for issuance of construction permits and operating licenses for fuel reprocessing plants.

The Seismic and Geologic Siting Criteria are written on a general basis to assure that the licensee developed site investigations and evaluations result in plant designs which can withstand a maximum potential earthquake without undue risk to the health and safety of the public. The establishment of these Seismic and Geologic Siting Criteria are based on Regulatory Staff experience in the review of the seismic design bases of nuclear power plants and the investigations and evaluations necessary to assure the adequacy of these design bases.

A detailed investigation of the regional and local geologic and seismic characteristics of a site can have a direct impact on the environment. It may be necessary to have limited terrain alterations for a testing

program that is conducted in and around the site location. Investigations that can require alterations of the site include:

(1) Bore holes (usually 4 to 6 inches in diameter),

(2) Trenches,

(3) Test pits,

(4) Geophysical surveys,

(5) Installation of piezometers, and

(6) Installation of seismographs.

The amount of additional land, other than the plant site that would have to be cleared would be a small fraction of the total site area. In most cases, other than for bore holes, this would not extend beyond the site boundaries, and as such, native or wildlife habitat would remain undisturbed.

Any aesthetic impacts on the land resulting from implementation of uncultivated land for the testing can be reduced by the filling of trenches, regrading, landscaping, and planting of grasses to prevent erosion. Bore holes can be sealed to prevent possible ground water contamination.

Site investigation will contribute a noise impact which is localized and temporary and therefore considered to be insignificant. In addition, the noise level is reduced by the surrounding terrain and foliage.

F. Cost-Beneft Analysis

The Seismic and Geologic Siting Criteria do not establish a basis for developing a cost-benefit analysis in the strict sense. It is not possible to quantify either costs or benefits with these criteria and any qualitative assessments associated with the rule would be necessarily vague. Specific site and plant characteristics would establish a basis for a meaningful cost-benefit analysis. A typical site investigation may range from $300,000 to $1,000,000.

A possible cost savings may be realized by applicants in that this action will identify for use in siting and designing the nuclear power plant the same criteria that will be used by the AEC in evaluating the suitability of a proposed site criteria. An application that speaks to these criteria could be expected to require less supplemental information and a shorter time for evaluation. This could also result in a savings to the AEC in the commitment of manpower for the evaluation of the license application.

## IV. SUMMARY

These criteria by themselves, do not have a significant effect on the general public or the environment. The Seismic and Geologic Siting Criteria, which cover all nuclear power plants, are by their nature broad to permit site investigations and evaluations required of specific proposed sites and

and safety of the public. The issuance of formal guidance does not change the environmental impact of nuclear power plants, nor does it affect the licensee's requirement to protect the health and safety of the public. The Commission's review assures that the health and safety of the public is not jeopardized. Case-by-case license evaluation has provided assurance that nuclear power plants can be designed, built and operated without undue risk to the health and safety of the public.

Although the issuance of the Seismic and Geologic Siting criteria does not affect the health and safety of the public, it does present to the public the criteria against which proposed sites and designs of nuclear power plants are reviewed.

Modification of the Criteria

The Seismic and Geologic Siting Criteria describe the seismic and geologic investigation that are currently being reviewed during the licensing process. A possible alternative to the criteria would be to prohibit reactors from regions of the country that have a high seismic history. However, the detailed investigation of the regional and local geologic and seismic characteristics of the site called for by the Criteria should enable adequate safety judgments to be made on a site by site basis and obviate any need for such a broad prohibition.

The detailed investigations described by the Seismic and Geologic Siting Criteria are currently being used by licensees and are within the scope of investigations permitted by § 50.10(c)(1).

B. Adverse Environmental Effects

The Seismic and Geologic Siting Criteria do not significantly change the environmental effects currently resulting from operation of nuclear power plants.

C. Relationship between Short-term and Long-term Productivity

The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity would not be affected as a result of these criteria.

D. Irreversible and Irretrievable Commitment of Resources

There is no irreversible or irretrievable commitment of resources as a result of the Seismic and Geologic Siting Criteria.

E. Alternatives

No Seismic and Geologic Siting

The evaluation of the licensee's seismic designs and associated site investigations and evaluations could continue on a case-by-case basis, although this would not provide formal guidance to applicants and the public concerning the minimum requirements for protecting the health

plant designs which form the bases for the licensing review of a particular proposed site and plant. These specific plant design and site considerations establish the impact that operation of that specific plant will have on the general public and on the environment. The licensee-generated site investigations and evaluations and specific plant design features form part of the bases for the environmental impact statement that is published in support of action to license a nuclear power plant for operation.

## V. CONCLUSIONS

Based on the above evaluation of the need for an environmental impact statement in the matter of the amendments to 10 CFR Part 100, by adoption of Appendix A entitled "Seismic and Geologic Siting Criteria," we have concluded that an impact statement is not required for the following reasons:

1. The Seismic and Geologic Siting Criteria codify existing licensing practice. The rule making action will not increase or decrease environmental impact resulting from the licensing of nuclear power plants under existing interim criteria.

2. These criteria are written on a broad basis and they do not specifically identify methods for conformance. Site variations for meeting these criteria will depend on each individual licensee's proposed site characteristics. Therefore, the levels of environmental impact from nuclear power plants will not be dictated by these criteria.