



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 3, 1996

The Honorable Newt Gingrich
Speaker of the United States
House of Representatives
Washington, DC 20515

Dear Mr. Speaker:

Pursuant to Subtitle E of the Small Business Regulatory Enforcement Fairness Act of 1996, 5 U.S.C. 801, the Nuclear Regulatory Commission (NRC) is submitting a final rule that will update the criteria used in decisions regarding power reactor siting, including geologic, seismic, and earthquake engineering considerations for future nuclear power plants. This rule would allow the NRC to benefit from experience gained in application of the procedures and methods contained in the current regulation and to incorporate the rapid advancements in the earth sciences and earthquake engineering. In addition, this rule benefits from public comments received.

This rule primarily consists of two separate changes, namely, the source term and dose considerations, and the seismic and earthquake engineering considerations of reactor siting. Basic reactor site criteria that have been shown to be important to protecting public health and safety would be incorporated into the regulations, while source term and dose calculations that apply primarily to plant design would be relocated. In the seismic area, the rule would require thorough regional and site-specific geoscience investigations. The Safe Shutdown Earthquake (SSE) would be employed in plant design, whereas the Operating Basis Earthquake (OBE) would require a plant shutdown and inspection, were it to occur.

We have determined that this rule is not a "major rule" as defined in 5 U.S.C. 804(2). We have confirmed this determination with the Office of Management and Budget.

Enclosed is a copy of the final rule, which is being transmitted to the Federal Register for publication. The Regulatory Flexibility Certification is included in the final rule. Also enclosed is a copy of the Regulatory Analysis for this final rule that contains the NRC's cost-benefit determinations. This final rule is scheduled to become effective 30 days after publication in the Federal Register.

Sincerely,

Dennis K. Rathbun, Director
Office of Congressional Affairs

Enclosures: Final Rule
Regulatory Analysis

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December 3, 1996

The Honorable Al Gore
President of the United
States Senate
Washington, DC 20510

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A handwritten signature in dark ink, appearing to read "Dennis K. Rathbun", is written over a horizontal line.

Dennis K. Rathbun, Director
Office of Congressional Affairs

Enclosures: Final Rule
Regulatory Analysis



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December 3, 1996

Mr. Robert P. Murphy
General Counsel
General Accounting Office
Room 7175
441 G Street, NW
Washington, DC 20548

Dear Mr. Murphy:

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Dennis K. Rathbun, Director
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PUBLIC ANNOUNCEMENT

The Nuclear Regulatory Commission (NRC) announced that it is issuing regulations to amend and to update the criteria used in decisions regarding power reactor siting, including geologic, seismic, and earthquake engineering considerations for future nuclear power plants. Existing reactor licensees would be unaffected by these changes. The revisions would allow the NRC to benefit from experience gained in the application of the procedures and methods used in the current regulation and to incorporate advancements in the earth sciences and earthquake engineering since the regulation was issued in 1973. In addition, the regulations benefit from public comments received.

This rule primarily consists of two separate changes, namely, the source term and dose considerations, and the seismic and earthquake engineering considerations of reactor siting. Basic reactor site criteria that have been shown to be important to protecting public health and safety would be incorporated into the regulations, while source term and dose calculations that apply primarily to plant design would be relocated.

In the seismic area, the rule would require thorough regional and site-specific geoscience investigations. The Safe Shutdown Earthquake (SSE) would be employed in plant design, whereas the Operating Basis Earthquake (OBE) would require a plant shutdown and inspection, were it to occur.

REGULATORY ANALYSIS
REVISION OF 10 CFR PART 100
AND 10 CFR PART 50

STATEMENT OF THE PROBLEM

This Regulatory Analysis covers two topics. First is the final rule revising 10 CFR Part 100, "Reactor Site Criteria," for future plants. The second topic is a final rule codifying geologic and seismic siting factors for new plants. Both topics address the relocation to 10 CFR Part 50 plant design criteria from Part 100 and Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100. The first proposed revision to these regulations was published for public comment on October 20, 1992 (57 FR 47802). Due to the substantive nature of the changes, the Commission requested that all parts (10 CFR Parts 50 and 100), be reissued for public comment (Ref. 1). The second proposed revision to these regulations was published for public comment on October 17, 1994 (59 FR 52555).

This regulatory analysis is presented in two parts, corresponding to the two considerations stated above.

Reactor Siting Criteria (Nonseismic)

The NRC's regulations in 10 CFR Part 100, "Reactor Site Criteria," present a framework that guides the Commission in its evaluation of the suitability of proposed sites for stationary power and testing reactors. The present criteria regarding reactor siting were issued in April 1962. There were only a few small power reactors operating at that time. The present regulation requires that every reactor have an exclusion area that has no residents, although transient use is permitted. A low population zone immediately beyond the exclusion area is also required. The regulation recognizes the importance of accident considerations in reactor siting; hence, a key element in it is the determination of the size of the exclusion area via the postulation of a large accidental fission product release within containment and the evaluation of the radiological consequences in terms of doses. Doses are calculated for two hypothetical individuals, located at any point (generally, the closest point) on the exclusion area boundary and at the outer radius of the low population zone, and are required to be within specified limits (25 rem to the whole body and 300 rem to the thyroid gland). In addition, the nearest population center, containing about 25,000 or more residents, must be no closer than one and one-third times the outer radius of the low population zone. The effect of these requirements is to set both individual and, to some extent, societal limits on dose (and implicitly on risk) without setting numerical criteria on the size of the exclusion area and low population zone. In practice the source term and dose calculations contained in 10 CFR 100 have influenced aspects of reactor design, such as containment leak rate and performance of fission product cleanup systems such as sprays or filters, more than siting.

Since the issuance of Part 100 in 1962, there have been significant changes and developments in power reactor technology. The nuclear power industry has developed and matured significantly. From the existence of a few small power plants, the industry has grown until there are presently about 110 power reactors in operation on 69 sites in the United States. Light-water commercial power reactors have accumulated about 2000 reactor-years of operating experience in the United States. Reactor power levels have also significantly increased. Early

plants typically had reactor power levels of about 150 megawatts thermal, whereas recently licensed plants have power levels about 20 to 25 times greater.

There has been increased development of and reliance upon fission product cleanup systems in modern plants to mitigate the consequences of postulated accidents. As a result, present nuclear power plants could be located at sites with a very small exclusion area and still meet the dose criteria of Part 100.

There has also been an increased awareness and concern over potential nuclear accidents. In addition, there has been significant research on nuclear accidents including the factors leading to their initiation as well as accident phenomenology and progression. Although accident considerations have been of key importance in reactor siting from the very beginning, major developments in risk assessment such as the issuance of the Reactor Safety Study (WASH-1400, Ref. 2), and NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants" (Ref. 3), as well as the occurrence of the Three Mile Island accident in 1979, and the accident at Unit 4 of the Chernobyl reactor in the Soviet Union in 1986, have greatly increased awareness, knowledge, and concerns in this area.

Since initial promulgation of Part 100 in 1962, the Commission has approved more than 90 sites for nuclear power plants and has had an opportunity to review a number of others. As a result of these reviews, much experience has been gained regarding how siting factors influence and affect risk.

The substantial base of knowledge accumulated over the last 30 years on reactor siting, design, construction and operation reflect the fact that the major factors that determine public health and safety are the reactor design, construction and operation.

Siting factors and criteria, however, are important in assuring that the radiological doses from normal operation and postulated accidents will be acceptably low, that natural phenomena and potential man-made hazards will be appropriately factored into the design of the plant, and that site characteristics are amenable to the development of adequate emergency plans to protect the public and adequate security measures to protect the plant.

The Commission believes that the criteria for siting power reactors should provide basic site criteria that reflect the significant experience gained since the regulation was first issued in 1962.

Seismic Siting and Earthquake Engineering Criteria

Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100, "Reactor Site Criteria," sets forth a framework that guides the staff in its evaluation of the adequacy of applicants' investigations of geologic and earthquake phenomena and proposed plant design parameters. The issuance of Appendix A was an important step in establishing a definitive regulatory framework for dealing with earth science issues in the licensing of nuclear power plants. Appendix A contains the following statement:

"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."

The bases for Appendix A were established in the late 1960s and became effective December 13, 1973. Since then, with advances in the sciences of seismology and geology, along with the occurrence of some licensing issues not foreseen in the development of Appendix A, a number of significant difficulties have arisen in the application of this regulation. Specific problematic areas include the following:

1. In making geoscience assessments, there is a need for considerable latitude in judgment. This latitude in judgment is needed because of limitations in data and geologic and seismic analyses, and because of the rapid evolution taking place in the geosciences in terms of accumulating knowledge and in modifying concepts. This need was recognized when Appendix A was developed. However, having detailed geoscience assessments in Appendix A, a regulation, has created difficulty for applicants and the staff in terms of inhibiting the use of needed judgment. Also, it has inhibited flexibility in applying basic principles to new situations and the use of evolving methods of analyses (for instance, probabilistic) in the licensing process.
2. Various sections of Appendix A lack clarity and are subject to different interpretations and dispute. Also, some sections in the Appendix do not provide sufficient information for implementation. As a result of being both overly detailed in some areas and not detailed enough in others, the Appendix has been the source of licensing delays and debate and has inhibited the use of some types of analyses such as probabilistic seismic hazard analysis.
3. In other siting areas, such as hydrology, regulatory guidance has been handled effectively through use of regulatory guides. Many problems encountered in implementing Appendix A could best be alleviated through the use of regulatory guides and a program for continuous updating.
4. The Operating Basis Earthquake (OBE) is associated with (i) the functionality of those features necessary for continued operation without undue risk to the health and safety of the public, (ii) an earthquake that could reasonably be expected to affect the plant site during the operating life of the plant, (iii) a minimum fraction of the Safe Shutdown Earthquake (SSE), and (iv) plant shutdown if vibratory ground motion is exceeded. These multi-aspects have resulted in seismic criteria that have led to overly stiff piping systems and excessive use of snubbers and supports which, in fact, could result in less reliable piping systems. Also, regulatory guidance defining an exceedance of the OBE, and plant shutdown or restart procedures have not been developed. Post earthquake evaluations are handled on an ad-hoc basis.
5. The stipulation in Appendix A that the SSE response spectra be defined at the foundation of the nuclear power plant structures has often led to confrontations with many in the engineering community who regard this stipulation as inconsistent with sound practice.

OBJECTIVES

Reactor Siting Criteria (Nonseismic)

The objective of this regulatory action is to provide a stable regulatory basis for siting nuclear power plants by stating basic site criteria in Part 100 that reflects past experience, operational results, and research insights.

This is accomplished by:

- a. providing basic site criteria reflecting past experience and importance to risk and
- b. relocating those requirements that apply to reactor design from Part 100 to Part 50.

The major changes associated with the revision of the regulation are:

1. The regulatory action applies to applicants who apply for a construction or early site permit on or after the effective date of the final regulations. The current regulation will remain in place and be applicable to all licensees and applicants prior to the effective date of the final regulations.
2. Part 100 states basic site criteria.
3. Source term and dose calculations are relocated to Part 50 consistent with the location of other design requirements in the regulation.

Since the revision to the regulation will not be a backfit, the licensing bases for existing nuclear power plants must remain in the regulation. Therefore, the revised regulation is designated as a new subpart to Part 100 for future plants while the current Part 100 is maintained for existing plants.

Finally, in support of the above changes, Regulatory Guide 4.7 has been revised.

Seismic Siting and Earthquake Engineering Criteria

The objectives of the regulatory action are to:

1. Provide a stable regulatory basis for seismic and geologic siting and applicable earthquake engineering design of future nuclear power plants that will avoid licensing delays due to unclear regulatory requirements;
2. Provide a flexible structure to permit consideration of new technical understandings; and
3. Have the revision to the regulation completed prior to the receipt of an early site application.

The major points associated with the revision of the regulation are:

1. The regulatory action applies to applicants who apply for an early site permit, design certification, or combined license (construction permit and operating license) pursuant to 10 CFR Part 52, or a construction permit or operating license pursuant to 10 CFR Part 50 on or after the effective date of the final regulation. However, for those operating license applicants and holders whose construction permit was issued prior to the effective date of the final regulation, the seismic and geologic siting and earthquake engineering criteria in Appendix A to 10 CFR Part 100 continues to apply.
2. Criteria not associated with the selection of the site or establishment of the safe shutdown earthquake ground motion have been placed in Part 50. This action is consistent with the location of other design requirements in Part 50.

Because the criteria presented in the final regulation does not apply to existing plants, the licensing bases for existing nuclear power plants must remain part of the regulations. Therefore, the revised criteria on seismic and geologic siting is designated as a new § 100.23, "Geologic and Seismic Siting Factors," to 10 CFR Part 100 and is added to the existing body of regulations.

Earthquake engineering criteria is located in 10 CFR Part 50 in a new Appendix S. Since Appendix S is not self executing, applicable sections of Part 50 (i.e., §50.34, §50.54) are revised to reference Appendix S.

The rule makes conforming amendments to 10 CFR Parts 52 and 100.

Finally, in support of the above changes, several regulatory guides and standard review plan sections are revised or developed as appropriate.

ALTERNATIVES

Reactor Siting Criteria (Nonseismic)

The alternatives considered included:

- No action (e.g., continue to use existing Part 100)
- Delete the existing Part 100 and replace it with an entirely new Part 100 that eliminates the dose calculation and specifies site criteria.
- Retain the existing Part 100 for current plants and add a new section to Part 100 for future plants that eliminates the dose calculation and specifies site criteria.

The first alternative considered by the Commission was to continue using current regulations for site suitability determinations. This is not considered an acceptable alternative. Accident source terms and dose calculations currently influence plant design requirements as well as siting. It is considered desirable to state basic siting criteria which, through importance to risk, have been shown to be key to assuring public health and safety. Further, significant advances in the earth sciences and in earthquake engineering, that deserve to be reflected in the regulations, have taken place since the promulgation of the present regulation.

Deletion of the existing regulation also is not considered an acceptable alternative since it is the licensing bases for virtually all the operating nuclear power plants and those in various stages of obtaining their operating license.

Therefore, the last option is the preferable course of action and is the option evaluated further in this analyses.

Seismic Siting and Earthquake Engineering Criteria

The first alternative considered by the Commission was to avoid initiating a rulemaking proceeding. This is not an acceptable alternative. Although the siting related issues associated with the current generation of nuclear power plants are completed or nearing completion, there is a need to initiate the regulatory action in light of the current and future staff review of advanced reactor seismic design criteria. The current regulation has created difficulties for applicants and the staff in terms of inhibiting flexibility in applying basic principles to new situations and using evolved methods of analysis in the licensing process.

A second alternative considered was the deletion of the existing regulation (Appendix A to Part 100). This is not an acceptable alternative because these provisions form part of the licensing bases for many of the operating nuclear power plants and others that are in various stages of obtaining their operating license. Also, geologic and seismic siting criteria are needed for future plants.

Since there are problems with implementing the existing regulation (Appendix A to Part 100), the only satisfactory alternative is to revise the regulation. The approach of establishing the revised requirements in a new Section 100.23 to Part 100 or Appendix S to Part 50 while retaining the existing regulation was chosen as the best alternative. This approach is consistent with the current body of regulations; that is, requirements associated with seismology and geology, like meteorology and hydrology, are contained within Part 100 not an appendix to Part 100. Similarly, detailed requirements associated with Part 50 are contained in appendices to Part 50 not within the sections of Part 50.

Finally, the following memoranda or reports provide further support for a revision to Appendix A to Part 100:

1. Staff Requirements Memorandum from Chilk to Taylor dated January 25, 1991, Subject: SECY-90-341 - Staff Study on Source Term Update and Decoupling Siting from Design (Ref. 4).

"The staff should further ensure that the revisions to Appendix A of Part 100 are available to support the time schedule shown in the paper [Commission Briefing on Source Term Update and Decoupling Siting from Design (SECY-90-341), dated December 13, 1990] for option 2, and are technically supportable with the information that will be available at the time the draft comes forward for Commission action."

2. Memorandum from Taylor to Beckjord dated September 6, 1990, Subject: Revision of Appendix A, 10 CFR Part 100, "Seismic and Geologic Siting Criteria for Nuclear Power Plants" (Ref. 5).

"I approve of your plan to begin work on the development of a revised regulation and this activity should be assigned a high priority status."

3. NUREG-0625, Siting Policy Task Force (Ref. 6).

"Revise Appendix A to 10 CFR Part 100 to better reflect the evolving technology in assessing seismic hazards."

4. NUREG-1061, "Report of the U.S. Nuclear Regulatory Commission Piping Review Committee," Vol 5, April 1985 (Ref. 7).

"The Committee recommends that

- o Rulemaking amending Appendix A to 10 CFR Part 100 be undertaken to permit decoupling of the OBE and SSE... ."

CONSEQUENCES

a. Costs and Benefits

Benefits

Reactor Siting Criteria (Nonseismic)

The revision to Part 100 is beneficial to all. The industry and the public will benefit from a clearer, more uniform and consistent licensing process.

Benefits to the industry, the public, and the NRC staff will result from the following changes:

1. Clear Statement of Basic Site Criteria. The revision to Part 100 provides basic site criteria with regard to acceptably low radiological consequences under normal operation and postulated accident conditions, assurance that natural phenomena as well as man-made hazards are factored into the plant design, and that the site is amenable to the development of adequate emergency plans and security measures. In addition, the criteria have been selected to be consistent with past experience and with the quantitative health objectives in the NRC Safety Goal Policy.
2. Current Practices Will Be Reflected. The final regulations reflect industry design practices and the associated staff review procedures that have evolved since Part 100 was issued in 1962. An example of this is the requirement that man-made hazards from nearby industrial and transportation facilities will be appropriately considered in the plant design. Review of this area has been a part of the staff review for many years. Hence, the rule involves no substantive changes in this area.

3. Source Term and Dose Calculations. The final rule relocates the use of a postulated source term and the calculation of radiological consequences to Part 50 to reflect that these largely affect aspects of reactor design. The radiological consequences are expressed in total effective dose equivalent (TEDE), which is consistent with usage in Part 20 and amenable with the use of a revised and updated source term consisting of nuclides in addition to the noble gases and iodine.
4. Risk to the Public. The NRC Staff has generated a reduced set of source terms based on the NUREG-1150 (Ref. 3) analyses and the Independent Risk Assessment Plant. These source terms were used in the MELCOR Accident Consequences Code System (MACCS) for six reactor-containment designs. The results of these analyses indicate that the risk to the public is acceptably low and the quantitative health objectives (QHO) of the Commission's Safety Goal Policy are met for all plants up to 3800 MWt, the largest capacity plant considered in the analyses.

Seismic Siting and Earthquake Engineering Criteria

The revision of Appendix A to Part 100 is beneficial to all. The public will benefit from a clearer, more uniform and consistent licensing process subject to fewer interpretations. The NRC staff will benefit from improved regulatory implementation (both technical and legal), fewer interpretive debates, and increased regulatory flexibility. Applicants will derive the same benefits in addition to avoiding licensing delays because of unclear regulatory requirements.

The regulatory action reflects changes intended to (1) benefit from the public comments associated with the first and second proposed revision of the current regulation, (2) benefit from the experience gained in applying the existing regulation; (3) resolve interpretative questions; (4) provide needed regulatory flexibility to incorporate state-of-the-art improvements in the geosciences and earthquake engineering; (5) simplify the language to a more "plain English" text; and (6) acknowledge various internal staff and industry comments.

Benefits to applicants or NRC staff will result from the following changes:

1. Uncertainties and probabilistic methods. The new regulation (Section 100.23) explicitly recognizes that there are inherent uncertainties in establishing the seismic and geologic design parameters and allows for the option of using a probabilistic seismic hazard methodology capable of propagating uncertainties as a means to address these uncertainties. The rule further recognizes that the nature of uncertainty and the appropriate approach to account for it depend greatly on the tectonic regime and parameters, such as, the knowledge of seismic sources, the existence of historical and recorded data, and the understanding of tectonics. Therefore, methods other than the probabilistic methods, such as sensitivity analyses, may be adequate for some sites to account for uncertainties.

The key elements of this approach are:

- Conduct site-specific and regional geoscience investigations,
- Target exceedance probability is set by examining the design bases of more recently licensed nuclear power plants,

- Determine if information from geoscience investigations change probabilistic results,
- Conduct probabilistic seismic hazard analysis and determine ground motion level corresponding to the target exceedance probability
- Determine site-specific spectral shape and scale this shape to the ground motion level determined above,
- NRC staff review of ground motion
- Update the data base and reassess probabilistic methods at least every ten years.

Thus, the rule is anchored by the Commission Severe Accident Policy and requires thorough regional and site-specific geoscience investigations. In general, the approach reflects the comments of the U.S. utility industry.

Results of the regional and site-specific investigations must be considered in application of the probabilistic method. The current probabilistic methods, the NRC sponsored study conducted by Lawrence Livermore National Laboratory (LLNL) or the Electric Power Research Institute (EPRI) seismic hazard study, are essentially regional studies without detailed information on any specific location. The regional and site-specific investigations provide detailed information to update the database of the hazard methodology to make the probabilistic analysis site-specific.

It is also necessary to incorporate local site geological factors such as stratigraphy and topography and to account for site-specific geotechnical properties in establishing the design basis ground motion. In order to incorporate local site factors and advances in ground motion attenuation models, ground motion estimates are determined using the procedures outlined in Standard Review Plan Section 2.5.2, Revision 3, "Vibratory Ground Motion."

The NRC staff's review approach to evaluate an application is described in SRP Section 2.5.2. This review takes into account the information base developed in licensing more than 100 plants. Although the basic premise in establishing the target exceedance probability is that the current design levels are adequate, the staff review further assures that there is consistency with previous licensing decisions and that the scientific bases for decisions are clearly understood. This review approach will also assist in assessing the fairly complex regional probabilistic modeling which incorporates multiple hypotheses and a multitude of parameters. Furthermore, this process should provide a clear basis for the staff's decisions and facilitate communication with nonexperts.

2. Reflect current design practices. The final regulations reflect industry design practices and the associated staff review procedures (for instance, the location of the control point for the seismic input) that have evolved since the initial regulation (Appendix A to Part 100) was issued in 1973. Many of these practices and

procedures were incorporated into the revision of Standard Review Plan Sections 2.5.2, 3.7.1, 3.7.2, and 3.7.3 that are associated with the resolution of Unresolved Safety Issue (USI) A-40, "Seismic Design Criteria."

3. Clarify the multi-facets associated with the Operating Basis Earthquake (OBE). In the existing regulation, the OBE is associated with (1) the functionality of those features necessary for continued operation without undue risk to the health and safety of the public, (2) an earthquake that could reasonably be expected to affect the plant site during the operating life of the plant, (3) a minimum fraction of the Safe Shutdown Earthquake (SSE), and (4) plant shutdown if the vibratory ground motion is exceeded. In some cases, for instance, piping, the multi-facets of the OBE made it possible for the OBE to have more design significance than the SSE. The seismological basis, that is, the association of the OBE with a likelihood of occurrence has been removed from the regulation. Other facets of the OBE, for instance, its value (percent of the SSE) and relationship with plant shutdown are discussed below. The functionality aspect of the OBE remains unchanged.
4. Value of the Operating Basis Earthquake Ground Motion (OBE) and required OBE analysis. The final regulation allows the value of the OBE to be set at (i) one-third or less of the SSE, where OBE requirements are satisfied without an explicit response or design analyses being performed, or (ii) a value greater than one-third of the SSE, where analysis and design are required. There are two issues the applicant should consider in selecting the value of the OBE: first, plant shutdown is required if vibratory ground motion exceeding that of the OBE occurs (discussed below in Item 5, Required Plant Shutdown), and second, the amount of analyses associated with the OBE. An applicant may determine that at one-third of the SSE level, the probability of exceeding the OBE vibratory ground motion is too high, and the cost associated with plant shutdown for inspections and testing of equipment and structures prior to restarting the plant is unacceptable. Therefore, the applicant may voluntarily select an OBE value at some higher fraction of the SSE to avoid plant shutdowns. However, if an applicant selects an OBE value at a fraction of the SSE higher than one-third, a suitable analysis shall be performed to demonstrate that the requirements associated with the OBE are satisfied. The design shall take into account soil-structure interaction effects and the expected duration of the vibratory ground motion. The requirement associated with the OBE is that 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 remain functional and within applicable stress, strain and deformation limits when subjected to the effects of the OBE in combination with normal operating loads.

As stated above, it is determined that if an OBE of one-third of the SSE is used, the requirements of the OBE can be satisfied without the applicant performing any explicit response analyses. In this case, the OBE serves the function of an inspection and shutdown earthquake. Some minimal design checks and the applicability of

this position to seismic base isolation of buildings are discussed below. There is high confidence that, at this ground-motion level with other postulated concurrent loads, most critical structures, systems, and components will not exceed currently used design limits. This is ensured, in part, because, for future designs PRA insights will be used to support a margins-type assessment of seismic events. A PRA-based seismic margins analysis will consider sequence-level High Confidence, Low Probability of Failures (HCLPFs) and fragilities for all sequences leading to core damage or containment failures up to approximately one and two-thirds the ground motion acceleration of the design basis SSE (Reference: Item II.N, Site-Specific Probabilistic Risk Assessment and Analysis of External Events, memorandum from Samuel J. Chilk to James M. Taylor, Subject: SECY-93-087 - Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advance Light-Water Reactor (ALWR) Designs, dated July 21, 1993.

There are situations associated with current analyses where only OBE is associated with the design requirements, for example, the ultimate heat sink (see Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants"). In these situations, a value expressed as a fraction of the SSE response would be used in the analyses. Section VII of the final rule identifies existing guides that would be revised technically to maintain the existing design philosophy.

In SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advance Light-Water Reactor (ALWR) Designs," the NRC staff requested Commission approval on 42 technical and policy issues pertaining to either evolutionary LWRs, passive LWRs, or both. The issue pertaining to the elimination of the OBE is designated I.M. The NRC staff identified actions necessary for the design of structures, systems, and components when the OBE design requirement is eliminated. The staff clarified that guidelines should be maintained to ensure the functionality of components, equipment, and their supports. In addition, the staff clarified how certain design requirements are to be considered for buildings and structures that are currently designed for the OBE, but not the SSE. Also, the NRC staff has evaluated the effect on safety of eliminating the OBE from the design load combinations for selected structures, systems, and components and has developed proposed criteria for an analysis using only the SSE. Commission approval is documented in the Chilk to Taylor memorandum dated July 21, 1993, cited above.

More than one earthquake response analysis for a seismic base isolated nuclear power plant design may be necessary to ensure adequate performance at all earthquake levels. Decisions pertaining to the response analyses associated with base isolated facilities will be handled on a case by case basis.

5. Guidance for required plant shutdown. The regulation treats plant shutdown associated with vibratory ground motion exceeding the OBE or significant plant damage as a condition in every operating license. The shutdown requirement is a condition of the license (10 CFR 50.54) rather than a limiting condition of operation (10 CFR

50.36), because the necessary judgements associated with exceedance of the vibratory ground motion or significant plant damage can not be adequately characterized in a technical specification. A new paragraph, §50.54(ff) is added to the regulations to require plant shut down for licensees of nuclear power plants that comply with the earthquake engineering criteria in Paragraph IV(a)(3) of Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," to 10 CFR Part 50. Regulatory Guide 1.166, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post-Earthquake Actions," (Draft was DG-1034) has been developed to provide guidance acceptable to the NRC staff for determining whether or not vibratory ground motion exceeding the OBE or significant plant damage had occurred and nuclear power plant shut down is required. The guidance is based on criteria developed by the Electric Power Research Institute (EPRI). Regulatory Guide 1.167, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event," (Draft was DG-1035) has been developed to provide guidelines that are acceptable to the NRC staff for performing inspections and tests of a nuclear power plant equipment and structures prior to plant restart. This guidance is also based on EPRI reports.

6. Reduced level of detail. The level of detail presented in the final regulations has been limited to general guidance. The final regulations identify and establish basic requirements. Detailed guidance, that is, the procedures acceptable to the NRC for meeting the requirements, has been removed and placed in Regulatory Guide, 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motions," (Draft was DG-1032).
7. Provide greater flexibility. The regulations provide a flexible structure that will permit the consideration of new technical understandings and state-of-the-art advancements since the detailed guidance has been removed from the regulation and placed into regulatory guides.
8. Clarify interpretations. Changes have been made to the seismic and geologic siting criteria to resolve past questions of interpretation. As an example, the definitions and required investigations sections of the final regulation has been significantly changed to eliminate or modify phrases that were more applicable to only the western United States.
9. Clarify text. The regulations use more explicit terminology. For instance, the Safe Shutdown Earthquake (SSE) and Operating Basis Earthquake are now referenced as the Safe Shutdown Earthquake Ground Motion (SSE) and the Operating Basis Earthquake Ground Motion (OBE). In addition, appropriate changes within the text highlight that the SSE used as the design basis is not associated with a single earthquake but characterized by free-field ground motion response spectra.

Costs

Reactor Siting Criteria (Nonseismic)

The costs associated with the revised regulations are subdivided into two categories; the first is associated with siting criteria modifications (Part 100), the second is associated with (Part 50) modifications.

Part 100

The overall cost impact associated with revising the siting criteria aspects of the regulation are neutral. Important factors in this regard are:

1. Nearby Industrial and Transportation Facilities. This area of review is incorporated into the regulations as one of the basic site criteria. It has been a part of the staff review for many years. The rule involves no substantive changes in this area and would merely codify what has been staff practice for a number of years.
2. Feasibility of Carrying out Protective Actions. The rule requires that the site characteristics be amenable to the development of adequate emergency plans. Emergency plans are currently required in 10 CFR 50.47. Hence, this rule imposes no new requirements but requires early assurance of emergency planning feasibility as part of the site review process, possibly reducing time and costs at the OL or COL stage by avoiding licensing delays.

The cost impact associated with this revision is neutral. The revision is expected to increase time and costs for site approval but should significantly reduce time and costs at the OL or COL stage by avoiding licensing delays.

3. Feasibility of Developing Adequate Security Measures. The rule requires that the site characteristics be such that adequate security measures to protect the plant can be developed. Security measures are currently required in 10 CFR Part 73. Hence, this rule imposes no new requirements but requires early assurance of the feasibility of developing security measures as part of the site review process, possibly reducing time and costs at the OL or COL stage by avoiding licensing delays.

The cost impact associated with this revision is neutral. The revision is expected to increase time and costs for site approval but should significantly reduce time and costs at the OL or COL stage by avoiding licensing delays.

Part 50

The overall cost impact associated with revising the reactor licensing aspects of the regulation are neutral because the source term and dose calculations have always been required under Part 100 for site suitability but are now required under Part 50 and used in evaluating plant features.

Seismic Siting and Earthquake Engineering Criteria

The costs associated with the regulations are subdivided into two categories; the first is associated with the geosciences and site investigations (Section 100.23), the second is associated with earthquake engineering (Appendix S to Part 50).

10 CFR 100.23

The overall cost impact associated with the geosciences and site investigation aspects of the regulation as compared to Appendix A of Part 100 are slightly increased in some areas but reduced overall because of anticipated improvement in the licensing process. Specific examples include:

1. **Reduced Licensing Delays.** The licensing process is enhanced because information needed for the staff review can be incorporated in the safety analysis reports at the time of docketing instead of later through staff questions and applicant responses.
2. **Probabilistic Evaluations.** Probabilistic evaluations to determine vibratory ground motion, surface tectonic deformation, and seismically induced floods and water waves reflect to some extent what is already current staff practice. In particular, probabilistic hazard analyses have been used to determine the probability of exceeding the Safe Shutdown Earthquake Ground Motion at the plant site. However, the overall use of probabilistic evaluations as suggested in Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of the Safe Shutdown Earthquake Ground Motions," is new but should not have a significant cost impact. Computer codes to perform the probabilistic analyses are available. An applicant would input the site coordinates and local site effects (current requirement) to obtain the probabilistic hazard data. It is estimated that these analyses can be performed within a few days.

Appendix S to Part 50

The overall cost impact associated with the earthquake engineering aspects of the regulation are neutral or reduced. Specific examples include:

1. **Reduced OBE Analysis.** The response analyses associated with the Operating Basis Earthquake Ground Motion (OBE) is eliminated if the applicant sets the OBE at one-third of the Safe Shutdown Earthquake Ground Motion (SSE). Selecting an OBE value greater than one-third of the SSE does not increase the analytical effort above current requirements.
2. **Control Point Location.** Changing the location of the control point (the point at which the vibratory ground motion is applied) from the foundation level to the free-field does not affect costs. The following discussion from Section 2.1.1.4 of NUREG-1233 (pages 13 and 14) is applicable:

"A number of recent plants were designed to the 1975 Standard Review Plan requirements

which specified the free-field motion at the free-surface for soil-structure interaction analysis. During the operating license (OL) review, the implementation of the current position of input motion at the foundation level in the free field resulted in a modification of some structural floor beams of seismic Category I structures at one plant. No hardware changes resulted at other plants. (Note that the staff's investigation was limited to the Safe shutdown systems and structures that housed them, and allowance was made for tested strength values in some cases.)"

3. Seismic Instrumentation. Although the seismic instrumentation requirements are different (only time-history accelerographs instead of frequency-history accelerographs, response spectrum recorders and peak accelerographs), the cost is essentially the same as that associated with operating plants; there are fewer instruments required. The maintenance and calibration costs with the new solid-state seismic instrumentation are less than that associated with the current instrumentation. The processing of instrumentation data will be done at the site, thereby reducing the potential for prolonged plant shutdown while data are being evaluated. In general, the ability to expeditiously assess the effects of the earthquake on the plant will save both staff and licensee resources.
4. Post-Earthquake Activities. In preparation of post-earthquake activities, it is recommended that the licensee inspect and base-line certain structures, equipment and piping. Base line inspections would aid in differentiating between pre-existing conditions at the nuclear power plant and earthquake related damage. The structures, equipment and piping selected for these inspections are comprised of those routinely examined by plant operators during normal plant walkdowns and inspections. After an earthquake, plant operators familiar with the plant would walkdown and visually inspect accessible areas of the plant. Unnecessary plant shutdowns would be avoided since the pre-earthquake condition of equipment and structures (for example, physical appearance, leak rates, vibration levels) would be known. This approach has been submitted to the NRC staff for approval by the Nuclear Management and Resources Council (NUMARC) (now the Nuclear Energy Institute (NEI)) and is documented in an Electric Power Research Report, EPRI NP-6695, "Guidelines for Nuclear Power Plant Response to an Earthquake." The associated cost impact is minimal and recommended by industry.

IMPACTS

a. Other NRC Programs

None for the Nonseismic siting criteria.

Although Appendix A to 10 CFR Part 100 is titled "Seismic and Geologic Siting Criteria for Nuclear Power Plants," it is also referenced in two

other parts of the regulation. They are (1) Part 40, "Domestic Licensing of Source Material," Appendix A, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Waste Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content," Section I, Criterion 4(e), and (2) Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste," Paragraphs (a)(2)(b) and (a)(2)(f)(1) of §72.102.

In conjunction with the second proposed revision to the regulations the Department of Energy (Office of Civilian Radioactive Waste Management), requested that an explicit statement be added to the Statement of Consideration as to whether or not § 100.23 applies to the Mined Geologic Disposal System (MGDS) and a Monitored Retrievable Storage (MRS) facility. DOE provided the following documentation: (1) NRC has noted in NUREG-1451, "Staff Technical Position on Investigations to Identify Fault Displacement Hazards and Seismic Hazards at a Geologic Repository," that Appendix A to 10 CFR Part 100 does not apply to a geologic repository; (2) NUREG-1451 also notes that the contemplated revisions to Part 100 would also not be applicable to a geologic repository; and (3) Section 72.102(b) requires that, for an MRS located west of the Rocky Mountain front or in areas of known potential seismic activity in the east, the seismicity be evaluated by the techniques of Appendix A to 10 CFR Part 100.

In response, the staff stated that the referenced applicability of § 100.23 to other than power reactors, if considered appropriate by the NRC, would be a separate rulemaking. That rulemaking would clearly state the applicability of § 100.23 to an MRS or other facility. In addition, NUREG-1451 will remain the NRC staff technical position on seismic siting issues pertaining to an MGDS until it is superseded through a rulemaking, revision of NUREG-1451, or other appropriate mechanism.

b. Other Government Agencies

Since the siting and licensing of nuclear power plants is carried out solely by NRC staff, no impact is projected for other government agencies.

c. Constraints

None.

DECISION RATIONALE

Reactor Siting Criteria (Nonseismic)

The major considerations that have guided the Commission in this revision to the reactor site criteria are as follows:

1. The criteria will assure a low risk for individuals as well as for society in general, even in the event of severe but unlikely reactor accidents. The criteria are consistent with the Commission Safety Goal Policy with respect to the risk of both prompt and latent cancer fatalities. In addition, the Commission has examined severe accident risks associated with possible land contamination or property damage in the event of significant releases of long-lived

radioactive species, such as cesium. Siting away from densely populated centers is expected to result in a low likelihood of significant offsite contamination of densely populated areas.

2. The criteria will assure that man-made activities as well as natural events associated with the site location are identified and used in matching a design with the site.
3. The criteria will assure that site characteristics are such that adequate emergency plans can be developed to protect the public.
4. The criteria will assure that site characteristics are such that adequate security measures to protect the plant can be developed.
5. The criteria will explicitly state the Commission's policy that reactors should be sited away from densely populated centers.

The revisions reflect current staff practice. The revised regulations will not reduce risk, but would improve the description in the regulations of current staff practice in licensing.

Seismic Siting and Earthquake Engineering Criteria

The recommendations to revise the existing regulation (Appendix A to 10 CFR Part 100) by adding sections for future applications pertaining to the geosciences and site investigations (§ 100.23) and earthquake engineering (Appendix S to Part 50) are based primarily on qualitative rather than quantitative or probabilistic (i.e., core damage frequency reduction) arguments. The staff's evaluation augments the regulatory analysis associated with the implementation of Unresolved Safety Issue (USI) A-40, "Seismic Design Criteria" (NUREG-1233, Ref. 8). USI A-40 was implemented in August 1989 through the revision of Standard Review Plan Sections 3.7.1, "Seismic Design Parameters," 3.7.2, "Seismic System Analysis," 3.7.3, "Seismic Subsystem Analysis," and 2.5.2, "Vibratory Ground Motion."

The staff's conclusion is that for operating reactor and operating license applicants, the final regulations have little effect on risk. Operating plants generally have been, and will be, seismically upgraded by plant-specific actions such as implementation of the Systematic Evaluation Program (SEP), the implementation of Generic Letter 88-20, Supplement 4, "Individual Plant Examinations of External Events (IPEEE) for Severe Accident Vulnerabilities," the implementation of USI A-46, "Verification of Seismic Adequacy of Equipment in Operating Plants," and NRC Bulletin programs. Therefore, this regulatory action is applicable only to applicants who apply for an early site permit, design certification, combined license, construction permit or operating license on or after the effective date of the final regulations.

No overall increases in costs are expected in implementing the regulations for applicants for early site permits, design certifications, combined licenses, construction permits or operating license. In addition, the regulations will reduce delays in the licensing process because information needed for the staff review can be incorporated in the safety analysis reports at the time of docketing instead of later through staff questions and applicant responses.

Therefore, the staff proposes that all new applicants be required to comply with the revised regulations.

Current Regulatory Action

The current regulatory action consists of the following:

1. Revisions to §21.3, §50.2, §50.8, §50.34, §50.49, §50.54, §50.65, §52.17 and §54.4.
2. Revisions to §100.1, §100.2, §100.3, and §100.8.
3. Add Subpart B, §100.20, §100.21, and §100.23.
4. Add a new Appendix S to Part 50, Earthquake Engineering Criteria for Nuclear Power Plants
5. Issue new Regulatory Guides:
 - a. Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motions," (Draft was DG-1032)
 - b. Regulatory Guide 1.166, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post-Earthquake Actions," (Draft was DG-1034)
 - c. Regulatory Guide 1.167, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event," (Draft was DG-1035)
6. Issue Revised Regulatory Guides:
 - a. Regulatory Guide 4.7, Revision 2, "General Site Suitability Criteria for Nuclear Power Stations," (Draft was DG-4003)
 - b. Regulatory Guide 1.12, Revision 2, "Nuclear Power Plant Instrumentation for Earthquakes," (Draft was DG-1033)
7. Issue Revised Standard Review Plan Sections:
 - 2.5.1, Basic Geologic and Seismic Information.
 - 2.5.2, Vibratory Ground Motion.
 - 2.5.3, Surface Faulting.

Future Regulatory Action

Several existing regulatory guides will be revised to incorporate editorial changes or maintain the existing design or analysis philosophy. These guides will be issued subsequent to the publication of the final regulations that would implement this action.

The following regulatory guides will be revised to incorporate editorial changes. The type of changes contemplated would be to reference new paragraphs in Appendix B to Part 100 or Appendix S to Part 50:

1. 1.57, "Design Limits and Loading Combinations for Metal Primary Reactor Containment System Components"
2. 1.59, "Design Basis Floods for Nuclear Power Plants"
3. 1.60, "Design Response Spectra for Seismic Design of Nuclear Power Plants"
4. 1.83, "Inservice Inspection of Pressurized Water Reactor Steam Generator Tubes"
5. 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis"
6. 1.102, "Flood Protection for Nuclear Power Plants"
7. 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes"
8. 1.122, "Development of Floor Design Response Spectra for Seismic Design of Floor-Supported Equipment or Components"

The following regulatory guides will be revised to maintain existing design or analysis philosophy. For example, the types of changes contemplated would be to change OBE to a fraction of the SSE.

1. 1.27, "Ultimate Heat Sink for Nuclear Power Plants"
2. 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants"
3. 1.124, "Service Limits and Loading Combinations for Class 1 Linear-Type Component Supports"
4. 1.130, "Service Limits and Loading Combinations for Class 1 Plate-and-Shell-Type Component Supports"
5. 1.132, "Site Investigations for Foundations of Nuclear Power Plants"
6. 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants"
7. 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants (Other than Reactor Vessels and Containments)"
8. 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants"

If substantive changes are made during the revisions, the applicable guides will be issued for public comment as draft guides.

IMPLEMENTATION

This regulatory action is applicable only to applicants that apply for an early site permit, design certification, combined license, construction permit, or operating license on or after the effective date of the final regulations. However, for those operating license applicants and holders whose construction permits were issued prior to the effective date of this final regulation, the reactor site criteria in 10 CFR Part 100, and the seismic and geologic siting criteria and the earthquake engineering criteria in Appendix A to 10 CFR Part 100 would continue to apply in all subsequent proceedings, including license amendments and renewal of operating licenses pursuant to 10 CFR Part 54.

REFERENCES

1. Memorandum from Samuel J. Chilk to James M. Taylor, Subject: SECY-94-017 - Options with Regard to Revising 10 CFR Part 100, Reactor Site Criteria, March 28, 1994.
2. U.S. Nuclear Regulatory Commission, "Reactor Safety Study-An Assessment of Risks in U.S. Commercial Nuclear Power plants," NUREG-75/014 (WASH-1400), December 1975.
3. U.S. Nuclear Regulatory Commission, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," NUREG-1150, December 1990.
4. Staff Requirements Memorandum from S.J. Chilk to J.M. Taylor, Subject SECY-90-341, January 25, 1991.
5. Memorandum from J.M. Taylor to E.S. Beckjord, Subject Revision of Appendix A, 10 CFR Part 100, September 6, 1990.
6. U.S. Nuclear Regulatory Commission, "Report of the Siting Policy Task Force," NUREG-0625, August 1979.
7. U.S. Nuclear Regulatory Commission, "Report of the U.S. Nuclear Regulatory Commission Piping Review Committee," NUREG-1061, Volume 5, April 1985.
8. S.K. Shaukat and N.C. Chokshi, "Regulatory Analysis for USI A-40, 'Seismic Design Criteria,'" NUREG-1233, U.S. Nuclear Regulatory Commission, September 1989.
9. Electric Power Research Institute, "Guidelines for Nuclear Plant Response to an Earthquake," NP-6695, December 1989.

NUCLEAR REGULATORY COMMISSION
10 CFR Parts 21, 50, 52, 54 and 100

RIN 3150-AD93

Reactor Site Criteria
Including Seismic and Earthquake Engineering Criteria for
Nuclear Power Plants
and Denial of Petition from Free Environment, Inc. et. al.

AGENCY: Nuclear Regulatory Commission.

ACTION: Final rule and denial of petition from Free Environment, Inc.
et.al.

SUMMARY: The Nuclear Regulatory Commission (NRC) is amending its regulations to update the criteria used in decisions regarding power reactor siting, including geologic, seismic, and earthquake engineering considerations for future nuclear power plants. The rule allows NRC to benefit from experience gained in the application of the procedures and methods set forth in the current regulation and to incorporate the rapid advancements in the earth sciences and earthquake engineering. This rule primarily consists of two separate changes, namely, the source term and dose considerations, and the seismic and earthquake engineering considerations of reactor siting. The Commission also is denying the remaining issue in petition (PRM-50-20) filed by Free Environment, Inc. et. al.

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EFFECTIVE DATE: (30 days after publication in the Federal Register).

FOR FURTHER INFORMATION CONTACT: Dr. Andrew J. Murphy, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone (301) 415-6010, concerning the seismic and earthquake engineering aspects and Mr. Charles E. Ader, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone (301) 415-5622, concerning other siting aspects.

SUPPLEMENTARY INFORMATION:

- I. Background.
- II. Objectives.
- III. Genesis.
- IV. Alternatives.
- V. Major Changes.
 - A. Reactor Siting Criteria (Nonseismic).
 - B. Seismic and Earthquake Engineering Criteria.
- VI. Related Regulatory Guides and Standard Review Plan Sections.
- VII. Future Regulatory Action.
- VIII. Referenced Documents.
- IX. Summary of Comments on the Proposed Regulations.
 - A. Reactor Siting Criteria (Nonseismic).
 - B. Seismic and Earthquake Engineering Criteria.
- X. Small Business Regulatory Enforcement Fairness Act
- XI. Finding of No Significant Environmental Impact: Availability.

- XII. Paperwork Reduction Act Statement.
- XIII. Regulatory Analysis.
- XIV. Regulatory Flexibility Certification.
- XV. Backfit Analysis.

I. Background

The present regulation regarding reactor site criteria (10 CFR Part 100) was promulgated April 12, 1962 (27 FR 3509). NRC staff guidance on exclusion area and low population zone sizes as well as population density was issued in Regulatory Guide 4.7, "General Site Suitability Criteria for Nuclear Power Stations," published for comment in September 1974. Revision 1 to this guide was issued in November 1975. On June 1, 1976, the Public Interest Research Group (PIRG) filed a petition for rulemaking (PRM-100-2) requesting that the NRC incorporate minimum exclusion area and low population zone distances and population density limits into the regulations. On April 28, 1977, Free Environment, Inc. et. al., filed a petition for rulemaking (PRM-50-20). The remaining issue of this petition requests that the central Iowa nuclear project and other reactors be sited at least 40 miles from major population centers. In August 1978, the Commission directed the NRC staff to develop a general policy statement on nuclear power reactor siting. The "Report of the Siting Policy Task Force" (NUREG-0625) was issued in August 1979 and provided recommendations regarding siting of future nuclear power reactors. In the 1980 Authorization Act for the NRC, the Congress directed the NRC to decouple siting from design and to specify demographic criteria for siting. On July 29, 1980 (45 FR 50350), the NRC issued an Advance Notice of Proposed

Rulemaking (ANPRM) regarding revision of the reactor site criteria, which discussed the recommendations of the Siting Policy Task Force and sought public comments. The proposed rulemaking was deferred by the Commission in December 1981 to await development of a Safety Goal and improved research on accident source terms. On August 4, 1986 (51 FR 23044), the NRC issued its Policy Statement on Safety Goals that stated quantitative health objectives with regard to both prompt and latent cancer fatality risks. On December 14, 1988 (53 FR 50232), the NRC denied PRM-100-2 on the basis that it would unnecessarily restrict NRC's regulatory siting policies and would not result in a substantial increase in the overall protection of the public health and safety. The Commission is addressing the remaining issue in PRM-50-20 as part of this rulemaking action.

Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100 was originally issued as a proposed regulation on November 25, 1971 (36 FR 22601), published as a final regulation on November 13, 1973 (38 FR 31279), and became effective on December 13, 1973. There have been two amendments to 10 CFR Part 100, Appendix A. The first amendment, issued November 27, 1973 (38 FR 32575), corrected the final regulation by adding the legend under the diagram. The second amendment resulted from a petition for rulemaking (PRM 100-1) requesting that an opinion be issued that would interpret and clarify Appendix A with respect to the determination of the Safe Shutdown Earthquake. A notice of filing of the petition was published on May 14, 1975 (40 FR 20983). The substance of the petitioner's proposal was accepted and published as an immediately effective final regulation on January 10, 1977 (42 FR 2052).

The first proposed revision to these regulations was published for public comment on October 20, 1992, (57 FR 47802). The availability of the five draft regulatory guides and the standard review plan section that were developed to provide guidance on meeting the proposed regulations was published on November 25, 1992, (57 FR 55601). The comment period for the proposed regulations was extended two times. First, the NRC staff initiated an extension (58 FR 271; January 5, 1993) from February 17, 1993 to March 24, 1993, to be consistent with the comment period on the draft regulatory guides and standard review plan section. Second, in response to a request from the public, the comment period was extended to June 1, 1993 (58 FR 16377; March 26, 1993).

The second proposed revision to these regulations was published for public comment on October 17, 1994 (59 FR 52255). The NRC stated on February 8, 1995, (60 FR 7467) that it intended to extend the comment period to allow interested persons adequate time to provide comments on staff guidance documents. On February 28, 1995, the availability of the five draft regulatory guides and three standard review plan sections that were developed to provide guidance on meeting the proposed regulations was published (60 FR 10880) and the comment period for the proposed rule was extended to May 12, 1995 (60 FR 10810).

II. Objectives

The objectives of this regulatory action are to --

1. State basic site criteria for future sites that, based upon experience and importance to risk, have been shown as key to protecting public health and safety;
2. Provide a stable regulatory basis for seismic and geologic siting and applicable earthquake engineering design of future nuclear power plants that will update and clarify regulatory requirements and provide a flexible structure to permit consideration of new technical understandings; and
3. Relocate source term and dose requirements that apply primarily to plant design into 10 CFR Part 50.

III. Genesis

The regulatory action reflects changes that are intended to (1) benefit from the experience gained in applying the existing regulation and from research; (2) resolve interpretive questions; (3) provide needed regulatory flexibility to incorporate ~~state-of-the-art~~ improvements in the geosciences and earthquake engineering; and (4) simplify the language to a more "plain English" text.

The new requirements in this rulemaking apply to applicants who apply for a construction permit, operating license, preliminary design approval, final design approval, manufacturing license, early site permit, design certification, or combined license on or after the effective date of the final regulations. However, for those operating license applicants and holders whose construction permits were issued prior to the effective date of this

final regulation, the reactor site criteria in 10 CFR Part 100, and the seismic and geologic siting criteria and the earthquake engineering criteria in Appendix A to 10 CFR Part 100 would continue to apply in all subsequent proceedings, including license amendments and renewal of operating licenses pursuant to 10 CFR Part 54.

Criteria not associated with the selection of the site or establishment of the Safe Shutdown Earthquake Ground Motion (SSE) have been placed in 10 CFR Part 50. This action is consistent with the location of other design requirements in 10 CFR Part 50.

Because the revised criteria presented in this final regulation does not apply to existing plants, the licensing bases for existing nuclear power plants must remain a part of the regulations. Therefore, the non-seismic and seismic reactor site criteria for current plants is retained as Subpart A and Appendix A to 10 CFR Part 100, respectively. The revised reactor site criteria is added as Subpart B in 10 CFR Part 100 and applies to site applications received on or after the effective date of the final regulations. Non-seismic site criteria is added as a new §100.21 to Subpart B in 10 CFR Part 100. The criteria on seismic and geologic siting is added as a new §100.23 to Subpart B in 10 CFR Part 100. The dose calculations and the earthquake engineering criteria is located in 10 CFR Part 50 (§50.34(a) and Appendix S, respectively). Because Appendix S is not self executing, applicable sections of Part 50 (§50.34 and §50.54) are revised to reference Appendix S. The regulation also makes conforming amendments to 10 CFR Parts 21, 50, 52, and 54. Sections 21.3, 50.49(b)(1), 50.65(b)(1), 52.17(a)(1), and 54.4(a)(1)(iii) are amended to reflect changes in § 50.34(a)(1) and 10 CFR Part 100.

IV. Alternatives

The first alternative considered by the Commission was to continue using current regulations for site suitability determinations. This is not considered an acceptable alternative. Accident source terms and dose calculations currently primarily influence plant design requirements rather than siting. It is desirable to state basic site criteria which, through importance to risk, have been shown to be key to assuring public health and safety. Further, significant advances in understanding severe accident behavior, including fission product release and transport, as well as in the earth sciences and in earthquake engineering have taken place since the promulgation of the present regulation and deserve to be reflected in the regulations.

The second alternative considered was replacement of the existing regulation with an entirely new regulation. This is not an acceptable alternative because the provisions of the existing regulations form part of the licensing bases for many of the operating nuclear power plants and others that are in various stages of obtaining operating licenses. Therefore, these provisions should remain in force and effect.

The approach of establishing the revised requirements in new sections to 10 CFR Part 100 and relocating plant design requirements to 10 CFR Part 50 while retaining the existing regulation was chosen as the best alternative. The public will benefit from a clearer, more uniform, and more consistent licensing process that incorporates updated information and is subject to

fewer interpretations. The NRC staff will benefit from improved regulatory implementation (both technical and legal), fewer interpretive debates, and increased regulatory flexibility. Applicants will derive the same benefits in addition to avoiding licensing delays caused by unclear regulatory requirements.

V. MAJOR CHANGES

A. *Reactor Siting Criteria (Nonseismic).*

Since promulgation of the reactor site criteria in 1962, the Commission has approved more than 75 sites for nuclear power reactors and has had an opportunity to review a number of others. In addition, light-water commercial power reactors have accumulated about 2000 reactor-years of operating experience in the United States. As a result of these site reviews and operational experience, a great deal of insight has been gained regarding the design and operation of nuclear power plants as well as the site factors that influence risk. In addition, an extensive research effort has been conducted to understand accident phenomena, including fission product release and transport. This extensive operational experience together with the insights gained from recent severe accident research as well as numerous risk studies on radioactive material releases to the environment under severe accident conditions have all confirmed that present commercial power reactor design, construction, operation and siting is expected to effectively limit risk to the public to very low levels. These risk studies include the early "Reactor

Safety Study" (WASH-1400), published in 1975, many Probabilistic Risk Assessment (PRA) studies conducted on individual plants as well as several specialized studies, and the recent "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," (NUREG-1150), issued in 1990. Advanced reactor designs currently under review are expected to result in even lower risk and improved safety compared to existing plants. Hence, the substantial base of knowledge regarding power reactor siting, design, construction and operation reflects that the primary factors that determine public health and safety are the reactor design, construction and operation.

Siting factors and criteria, however, are important in assuring that radiological doses from normal operation and postulated accidents will be acceptably low, that natural phenomena and potential man-made hazards will be appropriately accounted for in the design of the plant, that site characteristics are such that adequate security measures to protect the plant can be developed, and that physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans are identified. The Commission has also had a long standing policy of siting reactors away from densely populated centers, and is continuing this policy in this rule.

The Commission is incorporating basic reactor site criteria in this rule to accomplish the above purposes. The Commission is retaining source term and dose calculations to verify the adequacy of a site for a specific plant, but source term and dose calculations are relocated to Part 50, since experience has shown that these calculations have tended to influence plant design aspects such as containment leak rate or filter performance rather than siting. No specific source term is referenced in Part 50. Rather, the source

term is required to be one that is "... assumed to result in substantial meltdown of the core with subsequent release into the containment of appreciable quantities of fission products." Hence, this guidance can be utilized with the source term currently used for light-water reactors, or used in conjunction with revised accident source terms.

The relocation of source term and dose calculations to Part 50 represent a partial decoupling of siting from accident source term and dose calculations. The siting criteria are envisioned to be utilized together with standardized plant designs whose features will be certified in a separate design certification rulemaking procedure. Each of the standardized designs will specify an atmospheric dilution factor that would be required to be met, in order to meet the dose criteria at the exclusion area boundary. For a given standardized design, a site having relatively poor dispersion characteristics would require a larger exclusion area distance than one having good dispersion characteristics. Additional design features would be discouraged in a standardized design to compensate for otherwise poor site conditions.

Although individual plant tradeoffs will be discouraged for a given standardized design, a different standardized design could require a different atmospheric dilution factor. For custom plants that do not involve a standardized design, the source term and dose criteria will continue to provide assurance that the site is acceptable for the proposed design.

Rationale for Individual Criteria

A. Exclusion Area. An exclusion area surrounding the immediate vicinity of the plant has been a requirement for siting power reactors from the very

beginning. This area provides a high degree of protection to the public from a variety of potential plant accidents and also affords protection to the plant from potential man-related hazards. The Commission considers an exclusion area to be an essential feature of a reactor site and is retaining this requirement, in Part 50, to verify that an applicant's proposed exclusion area distance is adequate to assure that the radiological dose to an individual will be acceptably low in the event of a postulated accident. However, as noted above, if source term and dose calculations are used in conjunction with standardized designs, unlimited plant tradeoffs to compensate for poor site conditions will not be permitted. For plants that do not involve standardized designs, the source term and dose calculations will provide assurance that the site is acceptable for the proposed design.

The present regulation requires that the exclusion area be of such size that an individual located at any point on its boundary for two hours immediately following onset of the postulated fission product release would not receive a total radiation dose in excess of 25 rem to the whole body or 300 rem to the thyroid gland. A footnote in the present regulation notes that a whole body dose of 25 rem has been stated to correspond numerically to the once in a lifetime accidental or emergency dose to radiation workers which could be disregarded in the determination of their radiation exposure status (NBS Handbook 69 dated June 5, 1959). However, the same footnote also clearly states that the Commission's use of this value does not imply that it considers it to be an acceptable limit for an emergency dose to the public under accident conditions, but only that it represents a reference value to be used for evaluating plant features and site characteristics intended to mitigate the radiological consequences of accidents in order to provide

assurance of low risk to the public under postulated accidents. The Commission, based upon extensive experience in applying this criterion, and in recognition of the conservatism of the assumptions in its application (a large fission product release within containment associated with major core damage, maximum allowable containment leak rate, a postulated single failure of any of the fission product cleanup systems, such as the containment sprays, adverse site meteorological dispersion characteristics, an individual presumed to be located at the boundary of the exclusion area at the centerline of the plume for two hours without protective actions), believes that this criterion has clearly resulted in an adequate level of protection. As an illustration of the conservatism of this assessment, the maximum whole body dose received by an actual individual during the Three Mile Island accident in March 1979, which involved major core damage, was estimated to be about 0.1 rem.

The proposed rule considered two changes in this area.

First, the Commission proposed that the use of different doses for the whole body and thyroid gland be replaced by a single value of 25 rem, total effective dose equivalent (TEDE).

The proposed use of the total effective dose equivalent, or TEDE, was noted as being consistent with Part 20 of the Commission's regulations and was also based upon two considerations. First, since it utilizes a risk consistent methodology to assess the radiological impact of all relevant nuclides upon all body organs, use of TEDE promotes a uniformity and consistency in assessing radiation risk that may not exist with the separate whole body and thyroid organ dose values in the present regulation. Second, use of TEDE lends itself readily to the application of updated accident source terms, which can vary not only with plant design, but in which additional

nuclides, besides the noble gases and iodine are predicted to be released into containment.

The Commission considered the current dose criteria of 25 rem whole body and 300 rem thyroid with the intent of selecting a TEDE numerical value equivalent to the risk implied by the current dose criteria. The Commission proposed to use the risk of latent cancer fatality as the appropriate risk measure since quantitative health objectives (QHOs) for it have been established in the Commission's Safety Goal policy. Although the supplementary information in the proposed rule noted that the current dose criteria are equivalent in risk to 27 rem TEDE, the Commission proposed to use 25 rem TEDE as the dose criterion for plant evaluation purposes, since this value is essentially the same level of risk as the current criteria.

However, the Commission specifically requested comments on whether the current dose criteria should be modified to utilize the total effective dose equivalent or TEDE concept, whether a TEDE value of 25 rem (consistent with latent cancer fatality), or 34 rem (consistent with latent cancer incidence), or some other value should be used, and whether the dose criterion should also include a "capping" limitation, that is, an additional requirement that the dose to any individual organ not be in excess of some fraction of the total.

Based on the comments received, there was a general consensus that the use of the TEDE concept was appropriate, and a nearly unanimous opinion that no organ "capping" dose was required, since the TEDE concept provided the appropriate risk weighting for all body organs.

With regard to the value to be used as the dose criterion, a number of comments were received that the proposed value of 25 rem TEDE represented a more restrictive criterion than the current values of 25 rem whole body and

300 rem to the thyroid gland. These commenters noted that the use of organ weighting factors of 1 for the whole body and 0.03 for the thyroid as given in 10 CFR Part 20, would yield a value of 34 rem TEDE for whole body and thyroid doses of 25 and 300 rem, respectively. This is because the organ weighting factors in 10 CFR Part 20 include other effects (e.g., genetic) in addition to latent cancer fatality.

After careful consideration, the Commission has decided to adopt a value of 25 rem TEDE as the dose acceptance criterion for the final rule. The bases for this decision follows. First, the Commission has generally based its regulations on the risk of latent cancer fatality. Although a numerical calculation would lead to a value of 27 rem TEDE, as noted in the discussion that accompanied the proposed rule, the Commission concludes that a value of 25 rem is sufficiently close, and that the use of 27 rather than 25 implies an unwarranted numerical precision. In addition, in terms of occupational dose, Part 20 also permits a once-in-a-lifetime planned special dose of 25 rem TEDE. In addition, EPA guidance sets a limit of 25 rem TEDE for workers performing emergency service such as lifesaving or protection of large populations. While the Commission does not, as noted above, regard this dose value as one that is acceptable for members of the public under accident conditions, it provides a useful perspective with regard to doses that ought not to be exceeded, even for radiation workers under emergency conditions.

The argument that a criterion of 25 rem TEDE in conjunction with the organ weighting factors of 10 CFR Part 20 for its calculation represents a tightening of the dose criterion, while true in theory, is not true in practice. A review of the dose analyses for operating plants has shown that the thyroid dose limit of 300 rem has been the limiting dose criterion in

licensing reviews, and that all operating plants would be able to meet a dose criterion of 25 rem TEDE. Hence, the Commission concludes that, in practice, use of the organ weighting factors of Part 20 together with a dose criterion of 25 rem TEDE, represents a relaxation rather than a tightening of the dose criterion. In adopting this value, the Commission also rejects the view, advanced by some, that the dose calculation is merely a "reference" value that bears no relation to what might be experienced by an actual person in an accident. Although the Commission considers it highly unlikely that an actual person would receive such a dose, because of the conservative and stylized assumptions employed in its calculation, it is conceivable.

The second change proposed in this area was in regard to the time period that a hypothetical individual is assumed to be at the exclusion area boundary. While the duration of the time period remains at a value of two hours, the proposed rule stated that this time period not be fixed in regard to the appearance of fission products within containment, but that various two-hour periods be examined with the objective that the dose to an individual not be in excess of 25 rem TEDE for any two-hour period after the appearance of fission products within containment. The Commission proposed this change to reflect improved understanding of fission product release into the containment under severe accident conditions. For an assumed instantaneous release of fission products, as contemplated by the present rule, the two hour period that commences with the onset of the fission product release clearly results in the highest dose to an individual offsite. Improved understanding of severe accidents shows that fission product releases to the containment do not occur instantaneously, and that the bulk of the releases may not take place for about an hour or more. Hence, the two-hour period commencing with the onset

of fission product release may not represent the highest dose that an individual could be exposed to over any two-hour period. As a result, the Commission proposed that various two-hour periods be examined to assure that the dose to a hypothetical individual at the exclusion area boundary would not be in excess of 25 rem TEDE over any two-hour period after the onset of fission product release.

A number of comments received in regard to this proposed criterion stated that so-called "sliding" two-hour window for dose evaluation at the exclusion area boundary was confusing, illogical, and inappropriate. Several commenters felt it was difficult to ascertain which two hour period represented the maximum. Others expressed the view that the significance of such a calculation was not clearly stated nor understood. For example, one comment expressed the view that a dose evaluated for a "sliding" two-hour period was logically inconsistent since it implied either that an individual was not at the exclusion area boundary prior to the accident, and approached close to the plant after initiation of the accident, contrary to what might be expected, or that the individual was, in fact, located at the exclusion area boundary all along, in which case the dose contribution received prior to the "maximum" two hour value was being ignored.

Although the Commission recognizes that evaluation of the dose to a hypothetical individual over any two-hour period may not be entirely consistent with the actions of an actual individual in an accident, the intent is to assure that the short-term dose to an individual will not be in excess of the acceptable value, even where there is some variability in the time that an individual might be located at the exclusion area boundary. In addition, the dose calculation should not be taken too literally with regard to the

actions of a real individual, but rather is intended primarily as a means to evaluate the effectiveness of the plant design and site characteristics in mitigating postulated accidents.

For these reasons, the Commission is retaining the requirement, in the final rule, that the dose to an individual located at the nearest exclusion area boundary over any two-hour period after the appearance of fission products in containment, should not be in excess of 25 rem total effective dose equivalent (TEDE).

B. Site Dispersion Factors Site dispersion factors have been utilized to provide an assessment of dose to an individual as a result of a postulated accident. Since the Commission is requiring that a verification be made that the exclusion area distance is adequate to assure that the guideline dose to a hypothetical individual will not be exceeded under postulated accident conditions, as well as to assure that radiological limits are met under normal operating conditions, the Commission is requiring that the atmospheric dispersion characteristics of the site be evaluated, and that site dispersion factors based upon this evaluation be determined and used in assessing radiological consequences of normal operations as well as accidents.

C. Low Population Zone. The present regulation requires that a low population zone (LPZ) be defined immediately beyond the exclusion area. Residents are permitted in this area, but the number and density must be such that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident. In addition, the nearest densely populated center containing more than about

25,000 residents must be located no closer than one and one-third times the outer boundary of the LPZ. Finally, the dose to a hypothetical individual located at the outer boundary of the LPZ over the entire course of the accident must not be in excess of the dose values given in the regulation.

While the Commission considers that the siting functions intended for the LPZ, namely, a low density of residents and the feasibility of taking protective actions, have been accomplished by other regulations or can be accomplished by other guidance, the Commission continues to believe that a requirement that limits the radiological consequences over the course of the accident provides a useful evaluation of the plant's long-term capability to mitigate postulated accidents. For this reason, the Commission is retaining the requirement that the dose consequences be evaluated at the outer boundary of the LPZ over the course of the postulated accident and that these not be in excess of 25 rem TEDE.

D. Physical Characteristics of the Site It has been required that physical characteristics of the site, such as the geology, seismology, hydrology, meteorology characteristics be considered in the design and construction of any plant proposed to be located there. The final rule requires that these characteristics be evaluated and that site parameters, such as design basis flood conditions or tornado wind loadings be established for use in evaluating any plant to be located on that site in order to ensure that the occurrence of such physical phenomena would pose no undue hazard.

E. Nearby Transportation Routes, Industrial and Military Facilities As for natural phenomena, it has been a long-standing NRC staff practice to

review man-related activities in the site vicinity to provide assurance that potential hazards associated with such facilities or transportation routes will pose no undue risk to any plant proposed to be located at the site. The final rule codifies this practice.

F. Adequacy of Security Plans The rule requires that the characteristics of the site be such that adequate security plans and measures for the plant could be developed. The Commission envisions that this will entail a small secure area considerably smaller than that envisioned for the exclusion area.

G. Emergency Planning The proposed rule stated that the site characteristics should be such that adequate plans to carry out protective measures for members of the public in the event of emergency could be developed. To avoid any misinterpretation that the Commission is adopting emergency planning standards that implicitly overrule or may be in conflict with previous Commission decisions (e.g., CLI-90-02), the language in the final rule has been modified to be consistent with that of section 52.17 of the Commission's regulations regarding early site permits.

The Commission's decision in Seabrook on emergency planning, made in connection with an operating license review for a site previously approved, is being extended in considering site suitability for future reactor sites. The Commission, in its Seabrook decision, CLI-90-02, reiterated its earlier determination in the Shoreham decision, CLI-86-13, that the adequacy of an emergency plan is to be determined by the sixteen planning standards of 10 CFR 50.47(b), and that these standards do not require that an adequate plan

achieve a preset minimum radiation dose saving or a minimum evacuation time for the plume exposure pathway emergency planning zone in the event of a serious accident. Rather, the Commission noted that emergency planning is required as a matter of prudence and for defense-in-depth, and that the adequacy of an emergency plan was to be judged on the basis of its meeting the 16 planning standards given in 10 CFR 50.47(b). Hence, the characteristics of the site, which determine the evacuation time for the plume exposure pathway emergency planning zone, have not entered into the determination of the adequacy of an emergency plan. Emergency plans developed according to the above planning standards will result in reasonable assurance that adequate protective measures can be taken in the event of emergency.

It is sufficient that an applicant identify any physical site characteristics that could represent a significant impediment to the development of emergency plans, primarily to assure that "A range of protective actions have been developed for the plume exposure pathway emergency planning zone for emergency workers and the public", as stated in the planning standards.

Accordingly, appropriate sections of the rule (e.g., §100.21(g)) have been modified to state that "physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans must be identified." Except for the deletion of the phrase "such as egress limitations from the area surrounding the site", this language is identical to that in §52.17(b)(1). This phrase is being deleted from §100.21(g) (but §52.17(b)(1) remains unchanged), to eliminate any confusion that might arise regarding its scope.

H. Siting Away From Densely Populated Centers

Population density considerations beyond the exclusion area have been required since issuance of Part 100 in 1962. The current rule requires a "low population zone" (LPZ) beyond the immediate exclusion area. The LPZ boundary must be of such a size that an individual located at its outer boundary must not receive a dose in excess of the values given in Part 100 over the course of the accident. While numerical values of population or population density are not specified for this region, the regulation also requires that the nearest boundary of a densely populated center of about 25,000 or more persons be located no closer than one and one-third times the LPZ outer boundary. Part 100 has no population criteria other than the size of the LPZ and the proximity of the nearest population center, but notes that "where very large cities are involved, a greater distance may be necessary."

Whereas the exclusion area size is based upon limitation of individual risk, population density requirements serve to set societal risk limitations and reflect consideration of accidents beyond the design basis, or severe accidents. Such accidents were clearly a consideration in the original issuance of Part 100, since the Statement of Considerations (27 FR 3509; April 12, 1962) noted that:

"Further, since accidents of greater potential hazard than those commonly postulated as representing an upper limit are conceivable, although highly improbable, it was considered desirable to provide for protection against excessive exposure doses to people in large centers,

where effective protective measures might not be feasible... Hence, the population center distance was added as a site requirement."

Limitation of population density beyond the exclusion area has the following benefits:

- (a) It facilitates emergency preparedness and planning; and
- (b) It reduces potential doses to large numbers of people and reduces property damage in the event of severe accidents.

Although the Commission's Safety Goal policy provides guidance on individual risk limitations, in the form of the Quantitative Health Objectives (QHO), it provides no guidance with regard to societal risk limitations and therefore cannot be used to ascertain whether a particular population density would meet the Safety Goal.

However, results of severe accident risk studies, particularly those obtained from NUREG-1150, can provide useful insights for considering potential criteria for population density. Severe accidents having the highest consequences are those where core-melt together with early bypass of or containment failure occurs. Such an event would likely lead to a "large release" (without defining this precisely). Based upon NUREG-1150, the probability of a core-melt accident together with early containment failure or bypass for some current generation LWRs is estimated to be between 10^{-5} and 10^{-6} per reactor year. For future plants, this value is expected to be less than 10^{-6} per reactor year.

If a reactor was located nearer to a large city than current NRC practice permitted, the likelihood of exposing a large number of people to significant releases of radioactive material would be about the same as the probability of a core-melt and early containment failure, that is, less than 10^{-6} per reactor year for future reactor designs. It is worth noting that events having the very low likelihood of about 10^{-6} per reactor year or lower have been regarded in past licensing actions to be "incredible", and as such, have not been required to be incorporated into the design basis of the plant. Hence, based solely upon accident likelihood, it might be argued that siting a reactor nearer to a large city than current NRC practice would pose no undue risk.

If, however, a reactor were sited away from large cities, the likelihood of the city being affected would be reduced because of two factors. First, the likelihood that radioactive material would actually be carried towards the city is reduced because it is likely that the wind will blow in a direction away from the city. Second, the radiological dose consequences would also be reduced with distance because the radioactive material becomes increasingly diluted by the atmosphere and the inventory becomes depleted due to the natural processes of fallout and rainout before reaching the city. Analyses indicate that if a reactor were located at distances ranging from 10 to about 20 miles away from a city, depending upon its size, the likelihood of exposure of large numbers of people within the city would be reduced by factors of ten to one hundred or more compared with locating a reactor very close to a city.

In summary, next-generation reactors are expected to have risk characteristics sufficiently low that the safety of the public is reasonably assured by the reactor and plant design and operation itself, resulting in a

very low likelihood of occurrence of a severe accident. Such a plant can satisfy the QHOs of the Safety Goal with a very small exclusion area distance (as low as 0.1 miles). The consequences of design basis accidents, analyzed using revised source terms and with a realistic evaluation of engineered safety features, are likely to be found acceptable at distances of 0.25 miles or less. With regard to population density beyond the exclusion area, siting a reactor closer to a densely populated city than is current NRC practice would pose a very low risk to the populace.

Nevertheless, the Commission concludes that defense-in-depth considerations and the additional enhancement in safety to be gained by siting reactors away from densely populated centers should be maintained.

The Commission is incorporating a two-tier approach with regard to population density and reactor sites. The rule requires that reactor sites be located away from very densely populated centers, and that areas of low population density are, generally, preferred. The Commission believes that a site not falling within these two categories, although not preferred, can be found acceptable under certain conditions.

The Commission is not establishing specific numerical criteria for evaluation of population density in siting future reactor facilities because the acceptability of a specific site from the standpoint of population density must be considered in the overall context of safety and environmental considerations. The Commission's intent is to assure that a site that has significant safety, environmental or economic advantages is not rejected solely because it has a higher population density than other available sites. Population density is but one factor that must be balanced against the other advantages and disadvantages of a particular site in determining the site's

acceptability. Thus, it must be recognized that sites with higher population density, so long as they are located away from very densely populated centers, can be approved by the Commission if they present advantages in terms of other considerations applicable to the evaluation of proposed sites.

Petition Filed By Free Environment, Inc. et. al.

On April 28, 1977, Free Environment, Inc. et. al., filed a petition for rulemaking (PRM-50-20) requesting, among other things, that "the central Iowa nuclear project and other reactors be sited at least 40 miles from major population centers." The petitioner also stated that "locating reactors in sparsely-populated areas ...has been endorsed in non-binding NRC guidelines for reactor siting." The petitioner did not specify what constituted a major population center. The only NRC guidelines concerning population density in regard to reactor siting are in Regulatory Guide 4.7, issued in 1974, and revised in 1975, prior to the date of the petition. This guide states population density values of 500 persons per square mile out to a distance of 30 miles from the reactor, not 40 miles.

Regulatory Guide 4.7 does provide effective separation from population centers of various sizes. Under this guide, a population center of about 25,000 or more residents should be no closer than 4 miles (6.4 km) from a reactor because a density of 500 persons per square mile within this distance would yield a total population of about 25,000 persons. Similarly, a city of 100,000 or more residents should be no closer than about 10 miles (16 km); a city of 500,000 or more persons should be no closer than about 20 miles (32 km), and a city of 1,000,000 or more persons should be no closer than about 30 miles (50 km) from the reactor.

The Commission has examined these guidelines with regard to the Safety Goal. The Safety Goal quantitative health objective in regard to latent cancer fatality states that, within a distance of ten miles (16 km) from the reactor, the risk to the population of latent cancer fatality from nuclear power plant operation, including accidents, should not exceed one-tenth of one percent of the likelihood of latent cancer fatalities from all other causes. In addition to the risks of latent cancer fatalities, the Commission has also investigated the likelihood and extent of land contamination arising from the release of long-lived radioactive species, such as cesium-137, in the event of a severe reactor accident.

The results of these analyses indicate that the latent cancer fatality quantitative health objective noted is met for current plant designs. From analysis done in support of this proposed change in regulation, the likelihood of permanent relocation of people located more than about 20 miles (32 km) from the reactor as a result of land contamination from a severe accident is very low. A revision of Regulatory Guide 4.7 which incorporated this finding that population density guidance beyond 20 miles was not needed in the evaluation of potential reactor sites was issued for comment at the time of the proposed rule. No comments were received on this aspect of the guide.

Therefore, the Commission concludes that the NRC staff guidance in Regulatory Guide 4.7 provide a means of locating reactors away from population centers, including "major" population centers, depending upon their size, that would limit societal consequences significantly, in the event of a severe accident. The Commission finds that granting of the petitioner's request to specify population criteria out to 40 miles would not substantially reduce the risks to the public. As noted, the Commission also believes that a higher

population density site could be found to be acceptable, compared to a lower population density site, provided there were safety, environmental, or economic advantages to the higher population site. Granting of the petitioner's request would neglect this possibility and would make population density the sole criterion of site acceptability. For these reasons, the Commission has decided not to adopt the proposal by Free Environment, Incorporated.

The Commission also notes that future population growth around a nuclear power plant site, as in other areas of the region, is expected but cannot be predicted with great accuracy, particularly in the long-term. Population growth in the site vicinity will be periodically factored into the emergency plan for the site, but since higher population density sites are not unacceptable, per se, the Commission does not intend to consider license conditions or restrictions upon an operating reactor solely upon the basis that the population density around it may reach or exceed levels that were not expected at the time of site approval. Finally, the Commission wishes to emphasize that population considerations as well as other siting requirements apply only for the initial siting for new plants and will not be used in evaluating applications for the renewal of existing nuclear power plant licenses.

Change to 10 CFR Part 50

The change to 10 CFR Part 50 relocates from 10 CFR Part 100 the dose requirements for each applicant at specified distances. Because these requirements affect reactor design rather than siting, they are more appropriately located in 10 CFR Part 50.

These requirements apply to future applicants for a construction permit, design certification, or an operating license. The Commission will consider after further experience in the review of certified designs whether more specific requirements need to be developed regarding revised accident source terms and severe accident insights.

B. Seismic and Earthquake Engineering Criteria.

The following major changes to Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100, are associated with the seismic and earthquake engineering criteria rulemaking. These changes reflect new information and research results, and incorporate the intentions of this regulatory action as defined in Section III of this rule. Much of the following discussion remains unchanged from that issued for public comment (59 FR 52255) because there were no comments which necessitated a major change to the regulations and supporting documentation.

1. Separate Siting from Design.

Criteria not associated with site suitability or establishment of the Safe Shutdown Earthquake Ground Motion (SSE) have been placed into 10 CFR Part 50. This action is consistent with the location of other design requirements in 10 CFR Part 50. Because the revised criteria presented in the regulation will not be applied to existing plants, the licensing basis for existing nuclear power plants must remain part of the regulations. The criteria on seismic and geologic siting would be designated as a new § 100.23 to Subpart B

in 10 CFR Part 100. Criteria on earthquake engineering would be designated as a new Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," to 10 CFR Part 50.

2. Remove Detailed Guidance from the Regulation.

Appendix A to 10 CFR Part 100 contains both requirements and guidance on how to satisfy the requirements. For example, Section IV, "Required Investigations," of Appendix A, states that investigations are required for vibratory ground motion, surface faulting, and seismically induced floods and water waves. Appendix A then provides detailed guidance on what constitutes an acceptable investigation. A similar situation exists in Section V, "Seismic and Geologic Design Bases," of Appendix A.

Geoscience assessments require considerable latitude in judgment. This latitude in judgment is needed because of limitations in data and the state-of-the-art of geologic and seismic analyses and because of the rapid evolution taking place in the geosciences in terms of accumulating knowledge and in modifying concepts. This need appears to have been recognized when the existing regulation was developed. The existing regulation states that it is based on limited geophysical and geological information and will be revised as necessary when more complete information becomes available.

However, having geoscience assessments detailed and cast in a regulation has created difficulty for applicants and the staff in terms of inhibiting the use of needed latitude in judgment. Also, it has inhibited flexibility in applying basic principles to new situations and the use of evolving methods of analyses (for instance, probabilistic) in the licensing process.

The final regulation is streamlined, becoming a new section in Subpart B to 10 CFR Part 100 rather than a new appendix to Part 100. Also, the level of detail presented in the final regulation is reduced considerably. Thus, the final regulation contains: (a) required definitions, (b) a requirement to determine the geological, seismological, and engineering characteristics of the proposed site, and (c) requirements to determine the Safe Shutdown Earthquake Ground Motion (SSE), to determine the potential for surface deformation, and to determine the design bases for seismically induced floods and water waves. The guidance documents describe how to carry out these required determinations. The key elements of the approach to determine the SSE are presented in the following section. The elements are the guidance that is described in Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motions."

3. Uncertainties and Probabilistic Methods

The existing approach for determining a Safe Shutdown Earthquake Ground Motion (SSE) for a nuclear reactor site, embodied in Appendix A to 10 CFR Part 100, relies on a "deterministic" approach. Using this deterministic approach, an applicant develops a single set of earthquake sources, develops for each source a postulated earthquake to be used as the source of ground motion that can affect the site, locates the postulated earthquake according to prescribed rules, and then calculates ground motions at the site.

Although this approach has worked reasonably well for the past two decades, in the sense that SSEs for plants sited with this approach are judged

to be suitably conservative, the approach has not explicitly recognized uncertainties in geosciences parameters. Because of uncertainties about earthquake phenomena (especially in the eastern United States), there have often been differences of opinion and differing interpretations among experts as to the largest earthquakes to be considered and ground-motion models to be used, thus often making the licensing process relatively unstable.

Over the past decade, analysis methods for incorporating these different interpretations have been developed and used. These "probabilistic" methods have been designed to allow explicit incorporation of different models for zonation, earthquake size, ground motion, and other parameters. The advantage of using these probabilistic methods is their ability not only to incorporate different models and different data sets, but also to weight them using judgments as to the validity of the different models and data sets, and thereby providing an explicit expression for the uncertainty in the ground motion estimates and a means of assessing sensitivity to various input parameters. Another advantage of the probabilistic method is the target exceedance probability is set by examining the design bases of more recently licensed nuclear power plants.

The final regulation explicitly recognizes that there are inherent uncertainties in establishing the seismic and geologic design parameters and allows for the option of using a probabilistic seismic hazard methodology capable of propagating uncertainties as a means to address these uncertainties. The rule further recognizes that the nature of uncertainty and the appropriate approach to account for it depend greatly on the tectonic regime and parameters, such as, the knowledge of seismic sources, the existence of historical and recorded data, and the understanding of tectonics.

Therefore, methods other than the probabilistic methods, such as sensitivity analyses, may be adequate for some sites to account for uncertainties.

Methods acceptable to the NRC staff for implementing the regulation are described in Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion." The key elements of this approach are:

- Conduct site-specific and regional geoscience investigations,
- Target exceedance probability is set by examining the design bases of more recently licensed nuclear power plants,
- Conduct probabilistic seismic hazard analysis and determine ground motion level corresponding to the target exceedance probability
- Determine if information from the regional and site geoscience investigations change probabilistic results,
- Determine site-specific spectral shape and scale this shape to the ground motion level determined above,
- NRC staff review using all available data including insights and information from previous licensing experience, and
- Update the data base and reassess probabilistic methods at least every ten years.

Thus, the approach requires thorough regional and site-specific geoscience investigations. Results of the regional and site-specific investigations must be considered in applications of the probabilistic method. The current probabilistic methods, the NRC sponsored study conducted by Lawrence Livermore National Laboratory (LLNL) or the Electric Power Research Institute (EPRI)

seismic hazard study, are regional studies without detailed information on any specific location. The regional and site-specific investigations provide detailed information to update the database of the hazard methodology as necessary.

It is also necessary to incorporate local site geological factors such as structural geology, stratigraphy, and topography and to account for site-specific geotechnical properties in establishing the design basis ground motion. In order to incorporate local site factors and advances in ground motion attenuation models, ground motion characteristics are determined using the procedures outlined in Standard Review Plan Section 2.5.2, "Vibratory Ground Motion," Revision 3.

The NRC staff's review approach to evaluate ground motion estimates is described in SRP Section 2.5.2, Revision 3. This review takes into account the information base developed in licensing more than 100 plants. Although the basic premise in establishing the target exceedance probability is that the current design levels are adequate, a staff review further assures that there is consistency with previous licensing decisions and that the scientific bases for decisions are clearly understood. This review approach will also assess the fairly complex regional probabilistic modeling, which incorporates multiple hypotheses and a multitude of parameters. Furthermore, the NRC staff's Safety Evaluation Report should provide a clear basis for the staff's decisions and facilitate communication with nonexperts.

4. Safe Shutdown Earthquake.

The existing regulation (10 CFR Part 100, Appendix A, Section V(a)(1)(iv)) states "The maximum vibratory accelerations of the Safe Shutdown Earthquake at each of the various foundation locations of the nuclear power plant structures at a given site shall be determined ..." The location of the seismic input motion control point as stated in the existing regulation has led to confrontations with many applicants that believe this stipulation is inconsistent with good engineering fundamentals.

The final regulation moves the location of the seismic input motion control point from the foundation-level to the free-field at the free ground surface. The 1975 version of the Standard Review Plan placed the control motion in the free-field. The final regulation is also consistent with the resolution of Unresolved Safety Issue (USI) A-40, "Seismic Design Criteria" (August 1989), that resulted in the revision of Standard Review Plan Sections 2.5.2, 3.7.1, 3.7.2, and 3.7.3. The final regulation also requires that the horizontal component of the Safe Shutdown Earthquake Ground Motion in the free-field at the foundation level of the structures must be an appropriate response spectrum considering the site geotechnical properties, with a peak ground acceleration of at least 0.1g.

5. Value of the Operating Basis Earthquake Ground Motion (OBE) and Required OBE Analyses.

The existing regulation (10 CFR Part 100, Appendix A, Section V(a)(2)) states that the maximum vibratory ground motion of the OBE is at least one half the maximum vibratory ground motion of the Safe Shutdown Earthquake ground motion. Also, the existing regulation (10 CFR Part 100, Appendix A,

Section VI(a)(2)) states that the engineering method used to insure that structures, systems, and components are capable of withstanding the effects of the OBE shall involve the use of either a suitable dynamic analysis or a suitable qualification test. In some cases, for instance piping, these multi-facets of the OBE in the existing regulation made it possible for the OBE to have more design significance than the SSE. A decoupling of the OBE and SSE has been suggested in several documents. For instance, the NRC staff, SECY-79-300, suggested that a compromise is required between design for a broad spectrum of unlikely events and optimum design for normal operation. Design for a single limiting event (the SSE) and inspection and evaluation for earthquakes in excess of some specified limit (the OBE), when and if they occur, may be the most sound regulatory approach. NUREG-1061, "Report of the U.S. Nuclear Regulatory Commission Piping Review Committee," Vol.5, April 1985, (Table 10.1) ranked a decoupling of the OBE and SSE as third out of six high priority changes. In SECY-90-016, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," the NRC staff states that it agrees that the OBE should not control the design of safety systems. Furthermore, the final safety evaluation reports related to the certification of the System 80+ and the Advanced Boiling Water Reactor design (NUREG-1462 and NUREG-1503, respectively) have already adopted the single earthquake design philosophy.

Activities equivalent to OBE-SSE decoupling are also being done in foreign countries. For instance, in Germany their new design standard requires only one design basis earthquake (equivalent to the SSE). They require an inspection-level earthquake (for shutdown) of 0.4 SSE. This level

was set so that the vibratory ground motion should not induce stresses exceeding the allowable stress limits originally required for the OBE design.

The final regulation allows the value of the OBE to be set at (i) one-third or less of the SSE, where OBE requirements are satisfied without an explicit response or design analyses being performed, or (ii) a value greater than one-third of the SSE, where analysis and design are required. There are two issues the applicant should consider in selecting the value of the OBE: first, plant shutdown is required if vibratory ground motion exceeding that of the OBE occurs (discussed below in Item 6, Required Plant Shutdown), and second, the amount of analyses associated with the OBE. An applicant may determine that at one-third of the SSE level, the probability of exceeding the OBE vibratory ground motion is too high, and the cost associated with plant shutdown for inspections and testing of equipment and structures prior to restarting the plant is unacceptable. Therefore, the applicant may voluntarily select an OBE value at some higher fraction of the SSE to avoid plant shutdowns. However, if an applicant selects an OBE value at a fraction of the SSE higher than one-third, a suitable analysis shall be performed to demonstrate that the requirements associated with the OBE are satisfied. The design shall take into account soil-structure interaction effects and the expected duration of the vibratory ground motion. The requirement associated with the OBE is that 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 remain functional and within applicable stress, strain and deformation limits when subjected to the effects of the OBE in combination with normal operating loads.

As stated, it is determined that if an OBE of one-third or less of the SSE is used, the requirements of the OBE can be satisfied without the applicant performing any explicit response analyses. In this case, the OBE serves the function of an inspection and shutdown earthquake. Some minimal design checks and the applicability of this position to seismic base isolation of buildings are discussed below. There is high confidence that, at this ground-motion level with other postulated concurrent loads, most critical structures, systems, and components will not exceed currently used design limits. This is ensured, in part, because PRA insights will be used to support a margins-type assessment of seismic events. A PRA-based seismic margins analysis will consider sequence-level High Confidence, Low Probability of Failures (HCLPFs) and fragilities for all sequences leading to core damage or containment failures up to approximately one and two-thirds the ground motion acceleration of the design basis SSE (Reference: Item II.N, Site-Specific Probabilistic Risk Assessment and Analysis of External Events, memorandum from Samuel J. Chilk to James M. Taylor, Subject: SECY-93-087 - Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs, dated July 21, 1993).

There are situations associated with current analyses where only the OBE is associated with the design requirements, for example, the ultimate heat sink (see Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants"). In these situations, a value expressed as a fraction of the SSE response would be used in the analyses. Section VII of this final rule identifies existing guides that would be revised technically to maintain the existing design philosophy.

In SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advance Light-Water Reactor (ALWR) Designs," the NRC staff requested Commission approval on 42 technical and policy issues pertaining to either evolutionary LWRs, passive LWRs, or both. The issue pertaining to the elimination of the OBE is designated I.M. The NRC staff identified actions necessary for the design of structures, systems, and components when the OBE design requirement is eliminated. The NRC staff clarified that guidelines should be maintained to ensure the functionality of components, equipment, and their supports. In addition, the NRC staff clarified how certain design requirements are to be considered for buildings and structures that are currently designed for the OBE, but not the SSE. Also, the NRC staff has evaluated the effect on safety of eliminating the OBE from the design load combinations for selected structures, systems, and components and has developed proposed criteria for an analysis using only the SSE. Commission approval is documented in the Chilk to Taylor memorandum dated July 21, 1993, cited above.

More than one earthquake response analysis for a seismic base isolated nuclear power plant design may be necessary to ensure adequate performance at all earthquake levels. Decisions pertaining to the response analyses associated with base isolated facilities will be handled on a case by case basis.

6. Required Plant Shutdown.

The current regulation (Section V(a)(2)) states that if vibratory ground motion exceeding that of the OBE occurs, shutdown of the nuclear power plant

will be required. The supplementary information to the final regulation (published November 13, 1973; 38 FR 31279, Item 6e) includes the following statement: "A footnote has been added to §50.36(c)(2) of 10 CFR Part 50 to assure that each power plant is aware of the limiting condition of operation which is imposed under Section V(2) of Appendix A to 10 CFR Part 100. This limitation requires that if vibratory ground motion exceeding that of the OBE occurs, shutdown 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." At that time, it was the intention of the Commission to treat the OBE as a limiting condition of operation. From the statement in the Supplementary Information, the Commission directed applicants to specifically review 10 CFR Part 100 to be aware of this intention in complying with the requirements of 10 CFR 50.36. Thus, the requirement to shut down if an OBE occurs was expected to be implemented by being included among the technical specifications submitted by applicants after the adoption of Appendix A. In fact, applicants did not include OBE shutdown requirements in their technical specifications.

The final regulation treats plant shutdown associated with vibratory ground motion exceeding the OBE or significant plant damage as a condition in every operating license. A new §50.54(ff) is added to the regulations to require a process leading to plant shutdown for licensees of nuclear power plants that comply with the earthquake engineering criteria in Paragraph IV(a)(3) of Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," to 10 CFR Part 50. Immediate shutdown could be required until it is

determined that structures, systems, and components needed for safe shutdown are still functional.

Regulatory Guide 1.166, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post-Earthquake Actions," provides guidance acceptable to the NRC staff for determining whether or not vibratory ground motion exceeding the OBE ground motion or significant plant damage had occurred and the timing of nuclear power plant shutdown. The guidance is based on criteria developed by the Electric Power Research Institute (EPRI). The decision to shut down the plant should be made by the licensee within eight hours after the earthquake. The data from the seismic instrumentation, coupled with information obtained from a plant walk down, are used to make the determination of when the plant should be shut down, if it has not already been shut down by operational perturbations resulting from the seismic event. The guidance in Regulatory Guide 1.166 is based on two assumptions, first, that the nuclear power plant has operable seismic instrumentation, including the equipment and software required to process the data within four hours after an earthquake, and second, that the operator walk down inspections can be performed in approximately four to eight hours depending on the number of personnel conducting the inspection. The regulation also includes a provision that requires the licensee to consult with the Commission and to propose a plan for the timely, safe shutdown of the nuclear power plant if systems, structures, or components necessary for a safe shutdown or to maintain a safe shutdown are not available.

Regulatory Guide 1.167, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event," provides guidelines that are acceptable to the NRC staff for performing inspections and tests of nuclear power plant equipment and

structures prior to plant restart. This guidance is also based on EPRI reports. Prior to resuming operations, the licensee must 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 results of post-shutdown inspections, operability checks, and surveillance tests must be documented in written reports and submitted to the Director, Office of Nuclear Reactor Regulation. The licensee shall not resume operation until authorized to do so by the Director, Office of Nuclear Reactor Regulation.

7. Clarify interpretations.

Section 100.23 resolves questions of interpretation. As an example, definitions and required investigations stated in the final regulation do not contain the phrases in Appendix A to Part 100 that were more applicable to only the western part of the United States.

The institutional definition for "safety-related structures, systems, and components" is drawn from Appendix A to Part 100 under III(c) and VI(a). With the relocation of the earthquake engineering criteria to Appendix S to Part 50 and the relocation and modification to dose guidelines in §50.34(a)(1), the definition of safety-related structures, systems, and components is included in Part 50 definitions with references to both the Part 100 and Part 50 dose guidelines.

VI. Related Regulatory Guides and Standard Review Plan Sections

The NRC is developing the following regulatory guides and standard review plan sections to provide prospective licensees with the necessary guidance for implementing the final regulation. The notice of availability for these materials will be published in a later issue of the Federal Register.

1. Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Shutdown Earthquake Ground Motions." The guide provides general guidance and recommendations, describes acceptable procedures and provides a list of references that present acceptable methodologies to identify and characterize capable tectonic sources and seismogenic sources. Section V.B.3 of this rule describes the key elements.

2. Regulatory Guide 1.12, Revision 2, "Nuclear Power Plant Instrumentation for Earthquakes." The guide describes seismic instrumentation type and location, operability, characteristics, installation, actuation, and maintenance that are acceptable to the NRC staff.

3. Regulatory Guide 1.166, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post-Earthquake Actions." The guide provides guidelines that are acceptable to the NRC staff for a timely evaluation of the recorded seismic instrumentation data and to determine whether or not plant shutdown is required.

4. Regulatory Guide 1.167, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event." The guide provides guidelines that are acceptable to the NRC staff for performing inspections and tests of nuclear power plant equipment and structures prior to restart of a plant that has been shut down because of a seismic event.

5. Standard Review Plan Section 2.5.1, Revision 3, "Basic Geologic and Seismic Information." This SRP Section describes procedures to assess the adequacy of the geologic and seismic information cited in support of the applicant's conclusions concerning the suitability of the plant site.

6. Standard Review Plan Section 2.5.2, Revision 3 "Vibratory Ground Motion." This SRP Section describes procedures to assess the ground motion potential of seismic sources at the site and to assess the adequacy of the SSE.

7. Standard Review Plan Section 2.5.3, Revision 3, "Surface Faulting." This SRP Section describes procedures to assess the adequacy of the applicant's submittal related to the existence of a potential for surface faulting affecting the site.

8. Regulatory Guide 4.7, Revision 2, "General Site Suitability Criteria for Nuclear Power Plants." This guide discusses the major site characteristics related to public health and safety and environmental issues that the NRC staff considers in determining the suitability of sites.

VII. Future Regulatory Action

Several existing regulatory guides will be revised to incorporate editorial changes or maintain the existing design or analysis philosophy. These guides will be issued as final guides without public comment subsequent to the publication of the final regulations.

The following regulatory guides will be revised to incorporate editorial changes, for example to reference new sections to Part 100 or Appendix S to Part 50. No technical changes will be made in these regulatory guides.

1. 1.57, "Design Limits and Loading Combinations for Metal Primary Reactor Containment System Components."
2. 1.59, "Design Basis Floods for Nuclear Power Plants."
3. 1.60, "Design Response Spectra for Seismic Design of Nuclear Power Plants."
4. 1.83, "Inservice Inspection of Pressurized Water Reactor Steam Generator Tubes."
5. 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis."
6. 1.102, "Flood Protection for Nuclear Power Plants."
7. 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes."
8. 1.122, "Development of Floor Design Response Spectra for Seismic Design of Floor-Supported Equipment or Components."

The following regulatory guides will be revised to update the design or analysis philosophy, for example, to change OBE to a fraction of the SSE:

1. 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors."
2. 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors."
3. 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

4. 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants."
5. 1.124, "Service Limits and Loading Combinations for Class 1 Linear-Type Component Supports."
6. 1.130, "Service Limits and Loading Combinations for Class 1 Plate- and Shell-Type Component Supports."
7. 1.132, "Site Investigations for Foundations of Nuclear Power Plants."
8. 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants."
9. 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants (Other than Reactor Vessels and Containments)."
10. 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants."

Minor and conforming changes to other Regulatory Guides and standard review plan sections as a result of changes in the nonseismic criteria are also planned. If substantive changes are made during the revisions, the applicable guides will be issued for public comment as draft guides.

VIII. Referenced Documents

An interested person may examine or obtain copies of the documents referenced in this rule as set out below.

Copies of NUREG-0625, NUREG-1061, NUREG-1150, NUREG-1451, NUREG-1462, NUREG-1503, and NUREG/CR-2239 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Mail Stop SSOP, Washington, DC 20402-9328. Copies also are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. A copy also is available for inspection and copying for a fee in the NRC Public Document Room, 2120 L Street, NW. (Lower Level), Washington, DC.

Copies of issued regulatory guides may be purchased from the Government Printing Office (GPO) at the current GPO price. Information on current GPO prices may be obtained by contacting the Superintendent of Documents, U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328. Issued guides also may be purchased from the National Technical Information Service on a standing order basis. Details on this service may be obtained by writing NTIS, 5826 Port Royal Road, Springfield, VA 22161.

SECY 79-300, SECY 90-016, SECY 93-087, and WASH-1400 are available for inspection and copying for a fee at the NRC Public Document Room, 2120 L Street, NW. (Lower Level), Washington, DC.

IX. Summary of Comments on the Proposed Regulations.

A. Reactor Siting Criteria (Nonseismic).

Eight organizations or individuals commented on the nonseismic aspects of the second proposed revision. The first proposed revision issued for comment in October 20, 1992, (57 FR 47802) elicited strong comments in regard to proposed numerical values of population density and a minimum distance to the exclusion area boundary (EAB) in the rule. The second proposed revision (October 17, 1994; 59 FR 52255) would delete these from the rule by providing guidance on population density in a Regulatory Guide and determining the distance to the EAB and LPZ by use of source term and dose calculations. The rule would contain basic site criteria, without any numerical values.

Several commentators representing the nuclear industry and international nuclear organizations stated that the second proposed revision was a significant improvement over the first proposed revision, while the only public interest group commented that the NRC had retreated from decoupling siting and design in response to the comments of foreign entities.

Most comments on the second proposed revision centered on the use of total effective dose equivalent (TEDE), the proposed single numerical dose acceptance criterion of 25 rem TEDE, the evaluation of the maximum dose in any two-hour period, and the question of whether an organ capping dose should be adopted.

Virtually all commenters supported the concept of TEDE and its use. However, there were differing views on the proposed numerical dose of 25 rem and the proposed use of the maximum two-hour period to evaluate the dose. Virtually all industry commenters felt that the proposed numerical value of 25 rem TEDE was too low and that it represented a "ratchet" since the use of the current dose criteria plus organ weighting factors would suggest a value of 34 rem TEDE. In addition, all industry commenters believed the "sliding" two-hour

window for dose evaluation to be confusing, illogical and inappropriate. They favored a rule that was based upon a two hour period after the onset of fission product release, similar in concept to the existing rule. All industry commenters opposed the use of an organ capping dose. The only public interest group that commented did not object to the use of TEDE, favored the proposed dose value of 25 rem, and supported an organ capping dose.

B. Seismic and Earthquake Engineering Criteria.

Seven letters were received addressing either the regulations or both the regulations and the draft guidance documents identified in Section VI (except DG-4003). An additional five letters were received addressing only the guidance documents, for a total of twelve comment letters. A document, "Resolution of Public Comments on the Proposed Seismic and Earthquake Engineering Criteria for Nuclear Power Plants," is available explaining the NRC's disposition of the comments received on the regulations. A copy of this document has been placed in the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC. Single copies are available from Dr. Andrew J. Murphy, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone (301) 415-6010. A second document, "Resolution of Public Comments on Draft Regulatory Guides and Standard Review Plan Sections Pertaining to the Proposed Seismic and Earthquake Engineering Criteria for Nuclear Power Plants," will explain the NRC's disposition of the comments received on the guidance documents. The Federal Register notice announcing the availability of the guidance documents will also discuss how to obtain copies of the comment resolution document.

A summary of the major comments on the proposed regulations follows.

Supplementary Information

Section III, Genesis (Application)

Comment: The Department of Energy (Office of Civilian Radioactive Waste Management), requests an explicit statement on whether or not § 100.23 applies to the Mined Geologic Disposal System (MGDS) and a Monitored Retrievable Storage (MRS) facility. The NRC has noted in NUREG-1451, "Staff Technical Position on Investigations to Identify Fault Displacement Hazards and Seismic Hazards at a Geologic Repository," that Appendix A to 10 CFR Part 100 does not apply to a geologic repository. NUREG-1451 also notes that the contemplated revisions to Part 100 would also not be applicable to a geologic repository. Section 72.102(b) requires that, for an MRS located west of the Rocky Mountain front or in areas of known potential seismic activity in the east, the seismicity be evaluated by the techniques of Appendix A to 10 CFR Part 100.

Response: Although Appendix A to 10 CFR Part 100 is titled "Seismic and Geologic Siting Criteria for Nuclear Power Plants," it is also referenced in two other parts of the regulation. They are (1) Part 40, "Domestic Licensing of Source Material," Appendix A, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Waste Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content," Section I, Criterion 4(e), and (2) Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel

and High-Level Radioactive Waste," Paragraphs (a)(2), (b) and (f)(1) of §72.102.

The referenced applicability of § 100.23 to other than power reactors, if considered appropriate by the NRC, would be a separate rulemaking. That rulemaking would clearly state the applicability of § 100.23 to an MRS or other facility. In addition, NUREG-1451 will remain the NRC staff technical position on seismic siting issues pertaining to an MGDS until it is superseded through a rulemaking, revision of NUREG-1451, or other appropriate mechanism.

Section V(B)(5), "Value of the Operating Basis Earthquake Ground Motion (OBE) and Required OBE Analysis."

Comment: One commenter, ABB Combustion Engineering Nuclear Systems, specifically stated that they agree with the NRC's proposal to not require explicit design analysis of the OBE if its peak acceleration is less than one-third of the Safe Shutdown Earthquake Ground Motion (SSE). The only negative comments, from G.C. Slagis Associates, stated that the proposed rule in the area of required OBE analysis is not sound, not technically justified, and not appropriate for the design of pressure-retaining components. The following are specific comments (limited to the design of pressure-retaining components to the ASME Boiler and Pressure Vessel Section III rules) that pertain to the supplemental information to the proposed regulations, item V(B)(5), "Value of the Operating Basis Earthquake Ground Motion (OBE) and Required OBE Analysis."

(1) Comment: Disagrees with the statement in SECY-79-300 that design for a single limiting event and inspection and evaluation for earthquakes in excess of some specified limit may be the most sound regulatory approach. It

is not feasible to inspect for cyclic damage to all the pressure-retaining components. Visually inspecting for permanent deformation, or leakage, or failed component supports is certainly not adequate to determine cyclic damage.

Response: The NRC agrees. Postearthquake inspection and evaluation guidance is described in Regulatory Guide 1.167 (Draft was DG-1035), "Restart of a Nuclear Power Plant Shut Down by an Seismic Event." The guidance is not limited to visual inspections; it includes inspections, tests, and analyses including fatigue analysis.

(2) Comment: Disagrees with the NRC statement in SECY-090-016 that the OBE should not control design. There is a problem with the present requirements. Requiring design for five OBE events at one-half SSE is unrealistic for most (all?) sites and requires an excessive and unnecessary number of seismic supports. The solution is to properly define the OBE magnitude and the number of events expected during the life of the plant and to require design for that loading. OBE may or may not control the design. But you cannot assume, before you have the seismicity defined and before you have a component design, that OBE will not govern the design.

Response: The NRC has concluded that design requirements based on an estimated OBE magnitude at the plant site and the number of events expected during the plant life will lead to low design values that will not control the design, thus resulting in unnecessary analyses.

(3) Comment: It is not technically justified to assume that Section III components will remain within applicable stress limits (Level B limits) at one-third the SSE. The Section III acceptance criteria for Level D (for an SSE) is completely different than that for Level B (for an OBE). The Level D

criteria is based on surviving the extremely-low probability SSE load. Gross structural deformations are possible, and it is expected that the component will have to be replaced. Cyclic effects are not considered. The cyclic effects of the repeated earthquakes have to be considered in the design of the component to ensure pressure boundary integrity throughout the life of the component, especially if the SSE can occur after the lower level earthquakes.

Response: In SECY-93-087, Issue I.M, "Elimination of Operating-Basis Earthquake," the NRC recognizes that a designer of piping systems considers the effects of primary and secondary stresses and evaluates fatigue caused by repeated cycles of loading. Primary stresses are induced by the inertial effects of vibratory motion. The relative motion of anchor points induces secondary stresses. The repeating seismic stress cycles induce cyclic effects (fatigue). However, after reviewing these aspects, the NRC concludes that, for primary stresses, if the OBE is established at one-third the SSE, the SSE load combinations control the piping design when the earthquake contribution dominates the load combination. Therefore, the NRC concludes that eliminating the OBE piping stress load combination for primary stresses in piping systems will not significantly reduce existing safety margins.

Eliminating the OBE will, however, directly affect the current methods used to evaluate the adequacy of cyclic and secondary stress effects in the piping design. Eliminating the OBE from the load combination could cause uncertainty in evaluating the cyclic (fatigue) effects of earthquake-induced motions in piping systems and the relative motion effects of piping anchored to equipment and structures at various elevations because both of these effects are currently evaluated only for OBE loadings. Accordingly, to account for earthquake cycles in the fatigue analysis of piping systems, the

staff proposes to develop guidelines for selecting a number of SSE cycles at a fraction of the peak amplitude of the SSE. These guidelines will provide a level of fatigue design for the piping equivalent to that currently provided in Standard Review Plan Section 3.9.2.

Positions pertaining to the elimination of the OBE were proposed in SECY-93-087. Commission approval is documented in a memorandum from Samuel J. Chilk to James M. Taylor, Subject: SECY-93-087 - Policy, Technical and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs, dated July 21, 1993.

(4) Comment: There is one major flaw in the "SSE only" design approach. The equipment designed for SSE is limited to the equipment necessary to assure the integrity of the reactor coolant pressure boundary, to shutdown the reactor, and to prevent or mitigate accident consequences. The equipment designed for SSE is only part of the equipment "necessary for continued operation without undue risk to the health and safety of the public." Hence, by this rule, it is possible that some equipment necessary for continued operation will not be designed for SSE or OBE effects.

Response: The NRC does not agree that the design approach is flawed. It is not possible that some equipment necessary for continued safe operation will not be designed for SSE or OBE effects. General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 requires that nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of earthquakes without loss of capability to perform their safety functions. The criteria in Appendix S to 10 CFR Part 50 implement General Design Criterion 2 insofar as it requires

structures, systems, and components important to safety to withstand the effects of earthquakes. Regulatory Guide 1.29, "Seismic Design Classification," describes a method acceptable to the NRC for identifying and classifying those features of light-water-cooled nuclear power plants that should be designed to withstand the effects of the SSE. Currently, components which are designed for OBE only include components such as waste holdup tanks. As noted in Section VII, Future Regulatory Actions, regulatory guides related to these components will be revised to provide alternative design requirements.

10 CFR 100.23

The Nuclear Energy Institute (NEI) congratulated the NRC staff for carefully considering and responding to the voluminous and complex comments that were provided on the earlier proposed rulemaking package (October 20, 1992; 57 FR 47802) and considered that the seismic portion of the proposed rulemaking package is nearing maturity and with the inclusion of industry's comments (which were principally on the guidance documents), has the potential to satisfy the objectives of predictable licensing and stable regulations.

Both NEI and Westinghouse Electric Corporation support the regulation format, that is, prescriptive guidance is located in regulatory guides or standard review plan sections and not the regulation.

NEI and Westinghouse Electric Corporation support the removal of the requirement from the first proposed rulemaking (57 FR 47802) that both

deterministic and probabilistic evaluations must be conducted to determine site suitability and seismic design requirements for the site. [Note: The commenters do not agree with the NRC staff's deterministic check of the seismic sources and parameters used in the LLNL and EPRI probabilistic seismic hazard analyses (Regulatory Guide 1.165, draft was DG-1032). Also, they do not support the NRC staff's deterministic check of the applicants submittal (SRP Section 2.5.2). These items are addressed in the document pertaining to comment resolution of the draft regulatory guides and standard review plan sections.]

Comment: NEI, Westinghouse Electric Corporation, and Yankee Atomic Electric Corporation recommend that the regulation should state that for existing sites east of the Rocky Mountain Front (east of approximately 105° west longitude), a 0.3g standardized design level is acceptable at these sites given confirmatory foundations evaluations [Regulatory Guide 1.132, but not the geologic, geophysical, seismological investigations in Regulatory Guide 1.165].

Response: The NRC has determined that the use of a spectral shape anchored to 0.3g peak ground acceleration as a standardized design level would be appropriate for existing central and eastern U.S. sites based on the current state of knowledge. However, as new information becomes available it may not be appropriate for future licensing decisions. Pertinent information such as that described in Regulatory Guide 1.165 (Draft was DG-1032) is needed to make that assessment. Therefore, it is not appropriate to codify the request.

Comment: NEI recommended a rewording of Paragraph (a), Applicability. Although unlikely, an applicant for an operating license already holding a construction permit may elect to apply the amended methodology and criteria in Subpart B to Part 100.

Response: The NRC will address this request on a case-by-case basis rather than through a generic change to the regulations. This situation pertains to a limited number of facilities in various stages of construction. Some of the issues that must be addressed by the applicant and NRC during the operating license review include differences between the design bases derived from the current and amended regulations (Appendix A to Part 100 and § 100.23, respectively), and earthquake engineering criteria such as, OBE design requirements and OBE shutdown requirements.

Appendix S to 10 CFR Part 50

Support for the NRC position pertaining to the elimination of the Operating Basis Earthquake Ground Motion (OBE) response analyses has been documented in various NRC publications such as SECY-79-300, SECY-90-016, SECY-93-087, and NUREG-1061. The final safety evaluation reports related to the certification of the System 80+ and the Advanced Boiling Water Reactor design (NUREG-1462 and NUREG-1503, respectively) have already adopted the single earthquake design philosophy. In addition, similar activities are being done in foreign countries, for instance, Germany. (Additional discussion is provided in Section V(B)(5) of this rule).

Comment: The American Society of Civil Engineers (ASCE) recommended that the seismic design and engineering criteria of ASCE Standard 4, "Seismic Analysis of Safety-Related Nuclear Structures and Commentary on Standard for Seismic Analysis of Safety-Related Nuclear Structures," be incorporated by reference into Appendix S to 10 CFR Part 50.

Response: The Commission has determined that new regulations will be more streamlined and contain only basic requirements with guidance being provided in regulatory guides and, to some extent, in standard review plan sections. Both the NRC and industry have experienced difficulties in applying prescriptive regulations such as Appendix A to 10 CFR Part 100 because they inhibit the use of needed latitude in judgement. Therefore, it is common NRC practice not to reference publications such as ASCE Standard 4 (an analysis, not design standard) in its regulations. Rather, publications such as ASCE Standard 4 are cited in regulatory guides and standard review plan sections. ASCE Standard 4 is cited in the 1989 revision of Standard Review Plan Sections 3.7.1, 3.7.2, and 3.7.3.

Comment: The Department of Energy stated that the required consideration of aftershocks in Paragraph IV(B), Surface Deformation, is confusing and recommended that it be deleted.

Response: The NRC agrees. The reference to aftershocks in Paragraph IV(b) has been deleted. Paragraphs VI(a), Safe Shutdown Earthquake, and VI(B)(3) of Appendix A to Part 100 contain the phrase "including aftershocks." The "including aftershocks" phrase was removed from the Safe Shutdown Earthquake Ground Motion requirements in the proposed regulation. The recommended change will make Paragraphs IV(a)(1), "Safe Shutdown Earthquake

Ground Motion," and IV(b), "Surface Deformation, of Appendix S to 10 CFR Part 50 consistent.

X. Small Business Regulatory Enforcement Fairness Act

In accordance with the Small Business Regulatory Enforcement Fairness Act of 1996 the NRC has determined that this action is not a major rule and has verified this determination with the Office of Information and Regulatory Affairs of OMB.

XI. Finding of No Significant Environmental Impact: Availability

The Commission has determined under the National Environmental Policy Act of 1969, as amended, and the Commission's regulations in Subpart A of 10 CFR Part 51, that this regulation is not a major Federal action significantly affecting the quality of the human environment and therefore an environmental impact statement is not required.

The revisions associated with the reactor siting criteria in 10 CFR Part 100 and the relocation of the plant design requirements from 10 CFR Part 100 to 10 CFR Part 50 have been evaluated against the current requirements. The Commission has concluded that relocating the requirement for a dose calculation to Part 50 and adding more specific site criteria to Part 100 does not decrease the protection of public health and safety over the current regulations. The amendments do not affect nonradiological plant effluents and have no other environmental impact.

The addition of §100.23 to 10 CFR Part 100, and the addition of Appendix S to 10 CFR Part 50, will not change the radiological environmental impact offsite. Onsite occupational radiation exposure associated with inspection and maintenance will not change. These activities are principally associated with base line inspections of structures, equipment, and piping, and with maintenance of seismic instrumentation. Baseline inspections are needed to differentiate between pre-existing conditions at the nuclear power plant and earthquake related damage. The structures, equipment and piping selected for these inspections are those routinely examined by plant operators during normal plant walkdowns and inspections. Routine maintenance of seismic instrumentation ensures its operability during earthquakes. The location of the seismic instrumentation is similar to that in the existing nuclear power plants. The amendments do not affect nonradiological plant effluents and have no other environmental impact.

The environmental assessment and finding of no significant impact on which this determination is based are available for inspection at the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC. Single copies of the environmental assessment and finding of no significant impact are available from Dr. Andrew J. Murphy, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone (301) 415-6010.

XII. Paperwork Reduction Act Statement

This final rule amends information collection requirements that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.).

These requirements were approved by the Office of Management and Budget, approval numbers 3150-0011 and 3150-0093.

The public reporting burden for this collection of information is estimated to average 800,000 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments on any aspect of this collection of information, including suggestions for reducing the burden, to the Information and Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet electronic mail to BJS1@NRC.GOV; and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0011 and 3150-0093), Office of Management and Budget, Washington, DC 20503.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

XIII. Regulatory Analysis

The Commission has prepared a regulatory analysis on this regulation. The analysis examines the costs and benefits of the alternatives considered by the Commission. Interested persons may examine a copy of the regulatory analysis at the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC. Single copies of the analysis are available from Dr. Andrew

J. Murphy, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone (301) 415-6010.

XIV. Regulatory Flexibility Certification

As required by the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission certifies that this regulation does not have a significant economic impact on a substantial number of small entities. This regulation affects only the licensing and operation of nuclear power plants. The companies that own these plants do not fall within the definition of "small entities" set forth in the Regulatory Flexibility Act or the size standards established by the NRC (April 11, 1995; 60 FR 18344).

XV. Backfit Analysis

The NRC has determined that the backfit rule, 10 CFR 50.109, does not apply to this regulation, and therefore, a backfit analysis is not required for this regulation because these amendments do not involve any provisions that would impose backfits as defined in 10 CFR 50.109(a)(1). The regulation would apply only to applicants for future nuclear power plant construction permits, preliminary design approval, final design approval, manufacturing licenses, early site reviews, operating licenses, and combined operating licenses.

List of Subjects

10 CFR Part 21 - Nuclear power plants and reactors, Penalties, Radiation protection, Reporting and recordkeeping requirements.

10 CFR Part 50 — Antitrust, Classified information, Criminal penalties, Fire protection, Intergovernmental relations, Nuclear power plants and reactors, Radiation protection, Reactor siting criteria, Reporting and recordkeeping requirements.

10 CFR Part 52 — Administrative practice and procedure, Antitrust, Backfitting, Combined license, Early site permit, Emergency planning, Fees, Inspection, Limited work authorization, Nuclear power plants and reactors, Probabilistic risk assessment, Prototype, Reactor siting criteria, Redress of site, Reporting and recordkeeping requirements, Standard design, Standard design certification.

10 CFR Part 54 - Administrative practice and procedure, Age-related degradation, Backfitting, Classified information, Criminal penalties, Environmental, Nuclear power plants and reactors, Reporting and recordkeeping requirements.

10 CFR Part 100 — Nuclear power plants and reactors, Reactor siting criteria.

For the reasons set out in the preamble and under the authority of the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974,

as amended, and 5 U.S.C. 552 and 553, the NRC is adopting the following amendments to 10 CFR Parts 21, 50, 52, 54, and 100.

PART 21 — REPORTING OF DEFECTS AND NONCOMPLIANCE

1. The authority citation for Part 21 continues to read as follows:

AUTHORITY: Sec. 161, 68 Stat. 948, as amended, sec. 234, 83 Stat. 444, as amended, sec. 1701, 106 Stat. 2951, 2953 (42 U.S.C. 2201, 2282, 2297f); secs. 201, as amended, 206, 88 Stat. 1242, as amended, 1246 (42 U.S.C. 5841, 5846).

Section 21.2 also issued under secs. 135, 141, Pub. L. 97-425, 96 Stat. 2232, 2241 (42 U.S.C. 10155, 10161).

* * * * *

2. In §21.3, the definition for Basic component (1)(i)(C) is revised to read as follows:

§ 21.3 Definitions.

Basic component. (1)(i) * * *

(C) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to those referred to in §50.34(a)(1) or §100.11 of this chapter, as applicable.

★ ★ ★ ★ ★

PART 50 — DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

3. The authority citation for Part 50 continues to read as follows:

AUTHORITY: Secs. 102, 103, 104, 105, 161, 182, 183, 186, 189, 68 Stat. 936, 937, 938, 948, 953, 954, 955, 956, as amended, sec. 234, 83 Stat. 1244, as amended (42 U.S.C. 2132, 2133, 2134, 2135, 2201, 2232, 2233, 2236, 2239, 2282); secs. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246, (42 U.S.C. 5841, 5842, 5846).

Section 50.7 also issued under Pub. L. 95-601, sec. 10, 92 Stat. 2951 (42 U.S.C. 5851). Section 50.10 also issued under secs. 101, 185, 68 Stat. 955 as amended (42 U.S.C. 2131, 2235), sec. 102, Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.13, 50.54(dd) and 50.103 also issued under sec. 108, 68 Stat. 939, as amended (42 U.S.C. 2138). Sections 50.23, 50.35, 50.55, and 50.56 also issued under sec. 185, 68 Stat. 955 (42 U.S.C. 2235). Sections 50.33a, 50.55a and Appendix Q also issued under sec. 102, Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.34 and 50.54 also issued under sec. 204, 88 Stat. 1245 (42 U.S.C. 5844). Sections 50.58, 50.91 and 50.92 also issued under Pub. L. 97-415, 96 Stat. 2073 (42 U.S.C. 2239). Section 50.78 also issued under sec. 122, 68 Stat. 939 (42 U.S.C. 2152). Sections 50.80 — 50.81 also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). Appendix F also issued under sec. 187, 68 Stat. 955 (42 U.S.C. 2237).

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4. Section 50.2 is revised by adding in alphabetical order the definitions for Committed dose equivalent, Committed effective dose equivalent, Deep-dose equivalent, Exclusion area, Low population zone, Safety-related structures, systems, and components and Total effective dose equivalent, and revising the definition for Basic component (1)(iii) to read as follows:

§ 50.2 Definitions.

* * * * *

Basic component.

(1) * * *

(iii) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to those referred to in §50.34(a)(1) or §100.11 of this chapter, as applicable.

* * * * *

Committed dose equivalent means the dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed effective dose equivalent is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues.

* * * * *

Deep-dose equivalent, which applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm (1000mg/cm²).

* * * * *

Exclusion area means that area surrounding the reactor, in which the reactor licensee has the authority to determine all activities including exclusion or removal of personnel and property from the area. This area may be traversed by a highway, railroad, or waterway, provided these are not so close to the facility as to interfere with normal operations of the facility and provided appropriate and effective arrangements are made to control traffic on the highway, railroad, or waterway, in case of emergency, to protect the public health and safety. Residence within the exclusion area shall normally be prohibited. In any event, residents shall be subject to ready removal in case of necessity. Activities unrelated to operation of the reactor may be permitted in an exclusion area under appropriate limitations, provided that no significant hazards to the public health and safety will result.

* * * * *

Low population zone means the area immediately surrounding the exclusion area which contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident. These guides do not specify a permissible population density or total population within this zone because the situation may vary from case to case. Whether a specific number of people can, for example, be evacuated from a specific area, or instructed to take shelter, on a timely basis will depend on many factors such as location, number and size of highways, scope and extent of advance planning, and actual distribution of residents within the area.

* * * * *

Safety-related structures systems and components means those structures, systems, and components that are relied on to remain functional during and following design basis (postulated) events 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; and
- (3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in § 50.34(a)(1) or § 100.11 of this chapter, as applicable.

* * * * *

Total effective dose equivalent (TEDE) means the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

* * * * *

5. In §50.8, paragraph (b) is revised to read as follows:

§ 50.8 Information collection requirements: OMB approval.

* * * * *

- (b) The approved information collection requirements contained in this part appear in §§50.30, 50.33, 50.33a, 50.34, 50.34a, 50.35, 50.36, 50.36a,

50.36b, 50.44, 50.46, 50.47, 50.48, 50.49, 50.54, 50.55, 50.55a, 50.59, 50.60, 50.61, 50.62, 50.63, 50.64, 50.65, 50.66, 50.71, 50.72, 50.74, 50.75, 50.80, 50.82, 50.90, 50.91, 50.120, and Appendices A, B, E, G, H, I, J, K, M, N, O, Q, R, and S to this part.

* * * * *

6. In §50.34, footnotes 6, 7, and 8 are redesignated as footnotes 8, 9 and 10 and paragraph (a)(1) is revised and paragraphs (a)(12), (b)(10), and (b)(11) are added to read as follows:

§ 50.34 Contents of applications; technical information.

(a)

* * *

(1) Stationary power reactor applicants for a construction permit pursuant to this part, or a design certification or combined license pursuant to Part 52 of this chapter who apply on or after [INSERT EFFECTIVE DATE OF THE FINAL RULE], shall comply with paragraph (a)(1)(ii) of this section. All other applicants for a construction permit pursuant to this part or a design certification or combined license pursuant to Part 52 of this chapter, shall comply with paragraph (a)(1)(i) of this section.

(i) A description and safety assessment of the site on which the facility is to be located, with appropriate attention to features affecting facility design. Special attention should be directed to the site evaluation factors identified in Part 100 of this chapter. The assessment must contain an

analysis and evaluation of the major structures, systems and components of the facility which bear significantly on the acceptability of the site under the site evaluation factors identified in Part 100 of this chapter, assuming that the facility will be operated at the ultimate power level which is contemplated by the applicant. With respect to operation at the projected initial power level, the applicant is required to submit information prescribed in paragraphs (a)(2) through (a)(8) of this section, as well as the information required by this paragraph, in support of the application for a construction permit, or a design approval.

(ii) A description and safety assessment of the site and a safety assessment of the facility. It is expected that reactors will reflect through their design, construction and operation an extremely low probability for accidents that could result in the release of significant quantities of radioactive fission products. The following power reactor design characteristics and proposed operation will be taken into consideration by the Commission:

(A) Intended use of the reactor including the proposed maximum power level and the nature and inventory of contained radioactive materials;

(B) The extent to which generally accepted engineering standards are applied to the design of the reactor;

(C) The extent to which the reactor incorporates unique, unusual or enhanced safety features having a significant bearing on the probability or consequences of accidental release of radioactive materials;

(D) The safety features that are to be engineered into the facility and those barriers that must be breached as a result of an accident before a

release of radioactive material to the environment can occur. Special attention must be directed to plant design features intended to mitigate the radiological consequences of accidents. In performing this assessment, an applicant shall assume a fission product release⁶ from the core into the containment assuming that the facility is operated at the ultimate power level contemplated. The applicant shall perform an evaluation and analysis of the postulated fission product release, using the expected demonstrable containment leak rate and any fission product cleanup systems intended to mitigate the consequences of the accidents, together with applicable site characteristics, including site meteorology, to evaluate the offsite radiological consequences. Site characteristics must comply with Part 100 of this chapter. The evaluation must determine that:

(1) An individual located at any point on the boundary of the exclusion area for any 2 hour period following the onset of the postulated fission product release, would not receive a radiation dose in excess of 25 rem⁷ total effective dose equivalent (TEDE).

(2) An individual located at any point on the outer boundary of the low population zone, who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its

⁶ The fission product release assumed for this evaluation should be based upon a major accident, hypothesized for purposes of site analysis or postulated from considerations of possible accidental events. Such accidents have generally been assumed to result in substantial meltdown of the core with subsequent release into the containment of appreciable quantities of fission products.

⁷ A whole body dose of 25 rem has been stated to correspond numerically to the once in a lifetime accidental or emergency dose for radiation workers which, according to NCRP recommendations at the time could be disregarded in the determination of their radiation exposure status (see NBS Handbook 69 dated June 5, 1959). However, its use is not intended to imply that this number constitutes an acceptable limit for an emergency dose to the public under accident conditions. Rather, this dose value has been set forth in this section as a reference value, which can be used in the evaluation of plant design features with respect to postulated reactor accidents, in order to assure that such designs provide assurance of low risk of public exposure to radiation, in the event of such accidents.

passage) would not receive a radiation dose in excess of 25 rem total effective dose equivalent (TEDE).

(E) With respect to operation at the projected initial power level, the applicant is required to submit information prescribed in paragraphs (a)(2) through (a)(8) of this section, as well as the information required by this paragraph, in support of the application for a construction permit, or a design approval.

* * * * *

(12) On or after [INSERT EFFECTIVE DATE OF THE FINAL RULE], stationary power reactor applicants who apply for a construction permit pursuant to this part, or a design certification or combined license pursuant to Part 52 of this chapter, as partial conformance to General Design Criterion 2 of Appendix A to this part, shall comply with the earthquake engineering criteria in Appendix S to this part.

(b) * * *

(10) On or after [INSERT EFFECTIVE DATE OF THE FINAL RULE], stationary power reactor applicants who apply for an operating license pursuant to this part, or a design certification or combined license pursuant to Part 52 of this chapter, as partial conformance to General Design Criterion 2 of Appendix A to this part, shall comply with the earthquake engineering criteria of Appendix S to this part. However, for those operating license applicants and holders whose construction permit was issued prior to [INSERT EFFECTIVE DATE

OF THE FINAL RULE], the earthquake engineering criteria in Section VI of Appendix A to Part 100 of this chapter continues to apply.

(11) On or after [INSERT EFFECTIVE DATE OF THE FINAL RULE], stationary power reactor applicants who apply for an operating license pursuant to this Part, or a combined license pursuant to Part 52 of this chapter, shall provide a description and safety assessment of the site and of the facility as in §50.34(a)(1)(ii) of this part. However, for either an operating license applicant or holder whose construction permit was issued prior to [INSERT EFFECTIVE DATE OF THE FINAL RULE], the reactor site criteria in Part 100 of this chapter and the seismic and geologic siting criteria in Appendix A to Part 100 of this chapter continues to apply.

* * * * *

7 In §50.49, paragraph (b)(1) is revised to read as follows:

§ 50.49 Environmental qualification of electric equipment important to safety for nuclear power plants.

* * * * *

(b)

* * *

(1) Safety-related electric equipment.³

(i) This equipment is that relied upon to remain functional during and following design basis events to ensure --

(A) The integrity of the reactor coolant pressure boundary;

(B) The capability to shut down the reactor and maintain it in a safe shutdown condition; and

(C) The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guidelines in §50.34(a)(1) or §100.11 of this chapter, as applicable.

(ii) Design basis events are defined as conditions of normal operation, including anticipated operational occurrences, design basis accidents, external events, and natural phenomena for which the plant must be designed to ensure functions (b)(1)(i)(A) through (C) of this section.

* * * * *

8. In §50.54, paragraph (ff) is added to read as follows:

§50.54 Conditions of licenses.

* * * * *

(ff) For licensees of nuclear power plants that have implemented the

³ Safety-related electric equipment is referred to as "Class 1E" equipment in IEEE 323-1974. Copies of this standard may be obtained from the Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017.

earthquake engineering criteria in Appendix S to this part, plant shutdown is required as provided in Paragraph IV(a)(3) of Appendix S. Prior to resuming operations, the licensee shall 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 and the licensing basis is maintained.

9. In §50.65, paragraph (b)(1) is revised to read as follows:

§ 50.65 Requirements for monitoring the effectiveness of maintenance at nuclear power plants

* * * * *

(b)

* * *

(1) Safety related structures, systems, or components that are relied upon to remain functional during and following design basis events to ensure the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition, and the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in §50.34(a)(1) or §100.11 of this chapter, as applicable.

* * * * *

10. Appendix S to Part 50 is added to read as follows:

APPENDIX S TO PART 50 - EARTHQUAKE ENGINEERING CRITERIA FOR NUCLEAR POWER PLANTS

General Information

This appendix applies to applicants for a design certification or combined license pursuant to Part 52 of this chapter or a construction permit or operating license pursuant to Part 50 of this chapter on or after [INSERT EFFECTIVE DATE OF THE FINAL RULE]. However, for either an operating license applicant or holder whose construction permit was issued prior to [INSERT EFFECTIVE DATE OF THE FINAL RULE], the earthquake engineering criteria in Section VI of Appendix A to 10 CFR Part 100 continues to apply.

I. Introduction

Each applicant for a construction permit, operating license, design certification, or combined license is required by §50.34(a)(12), (b)(10), and General Design Criterion 2 of Appendix A to this Part to design nuclear power plant structures, systems, and components important to safety to withstand the effects of natural phenomena, such as earthquakes, without loss of capability to perform their safety functions. Also, as specified in § 50.54(ff), nuclear power plants that have implemented the earthquake engineering criteria

described herein must shut down if the criteria in Paragraph IV(a)(3) of this appendix are exceeded.

These criteria implement General Design Criterion 2 insofar as it requires structures, systems, and components important to safety to withstand the effects of earthquakes.

II. Scope

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

III. Definitions

As used in these criteria:

Combined license means a combined construction permit and operating license with conditions for a nuclear power facility issued pursuant to Subpart C of Part 52 of this chapter.

Design Certification means a Commission approval, issued pursuant to Subpart B of Part 52 of this chapter, of a standard design for a nuclear power facility. A design so approved may be referred to as a "certified standard design."

The Operating Basis Earthquake Ground Motion (OBE) is 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 will remain functional. The Operating Basis Earthquake Ground Motion is only associated with plant shutdown and inspection unless specifically selected by the applicant as a design input.

A response spectrum is a plot of the maximum responses (acceleration, velocity, or displacement) of idealized single-degree-of-freedom oscillators as a function of the natural frequencies of the oscillators for a given damping value. The response spectrum is calculated for a specified vibratory motion input at the oscillators' supports.

The Safe Shutdown Earthquake Ground Motion (SSE) is the vibratory ground motion for which certain structures, systems, and components must be designed to remain functional.

The structures, systems, and components required to withstand the effects of the Safe Shutdown Earthquake Ground Motion or surface deformation 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 that could result in potential offsite exposures comparable to the guideline exposures of §50.34(a)(1).

Surface deformation is distortion of geologic strata at or near the ground surface by the processes of folding or faulting as a result of various earth forces. Tectonic surface deformation is associated with earthquake processes.

IV. Application To Engineering Design

The following are pursuant to the seismic and geologic design basis requirements of §100.23 of this chapter:

(a) **Vibratory Ground Motion.**

(1) **Safe Shutdown Earthquake Ground Motion.** The Safe Shutdown Earthquake Ground Motion must be characterized by free-field ground motion response spectra at the free ground surface. In view of the limited data available on vibratory ground motions of strong earthquakes, it usually will be appropriate that the design response spectra be smoothed spectra. The horizontal component of the Safe Shutdown Earthquake Ground Motion in the free-field at the foundation level of the structures must be an appropriate response spectrum with a peak ground acceleration of at least 0.1g.

The nuclear power plant must be designed so that, if the Safe Shutdown Earthquake Ground Motion occurs, certain structures, systems, and components will remain functional and within applicable stress, strain, and deformation limits. In addition to seismic loads, applicable concurrent normal operating, functional, and accident-induced loads must be taken into account in the design of these safety-related structures, systems, and components. The design of the nuclear power plant must also take into account the possible effects of

the Safe Shutdown Earthquake Ground Motion on the facility foundations by ground disruption, such as fissuring, lateral spreads, differential settlement, liquefaction, and landsliding, as required in §100.23 of this chapter.

The required safety functions of structures, systems, and components must be assured during and after the vibratory ground motion associated with the Safe Shutdown Earthquake Ground Motion through design, testing, or qualification methods.

The evaluation must take into account soil-structure interaction effects and the expected duration of vibratory motion. It is permissible to design for strain limits in excess of yield strain in some of these safety-related structures, systems, and components during the Safe Shutdown Earthquake Ground Motion and under the postulated concurrent loads, provided the necessary safety functions are maintained.

(2) Operating Basis Earthquake Ground Motion.

(i) The Operating Basis Earthquake Ground Motion must be characterized by response spectra. The value of the Operating Basis Earthquake Ground Motion must be set to one of the following choices:

(A) One-third or less of the Safe Shutdown Earthquake Ground Motion design response spectra. The requirements associated with this Operating Basis Earthquake Ground Motion in Paragraph (a)(2)(i)(B)(I) can be satisfied without the applicant performing explicit response or design analyses, or

(B) A value greater than one-third of the Safe Shutdown Earthquake Ground Motion design response spectra. Analysis and design must be performed to demonstrate that the requirements associated with this Operating Basis

Earthquake Ground Motion in Paragraph (a)(2)(i)(B)(I) are satisfied. The design must take into account soil-structure interaction effects and the duration of vibratory ground motion.

(I) When subjected to the effects of the Operating Basis Earthquake Ground Motion in combination with normal operating loads, 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 must remain functional and within applicable stress, strain, and deformation limits.

(3) **Required Plant Shutdown.** If vibratory ground motion exceeding that of the Operating Basis Earthquake Ground Motion or if significant plant damage occurs, the licensee must shut down the nuclear power plant. If systems, structures, or components necessary for the safe shutdown of the nuclear power plant are not available after the occurrence of the Operating Basis Earthquake Ground Motion, the licensee must consult with the Commission and must propose a plan for the timely, safe shutdown of the nuclear power plant. Prior to resuming operations, the licensee must 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 and the licensing basis is maintained.

(4) **Required Seismic Instrumentation.** Suitable instrumentation must be provided so that the seismic response of nuclear power plant features important to safety can be evaluated promptly after an earthquake.

(b) **Surface Deformation.** The potential for surface deformation must be taken into account in the design of the nuclear power plant by providing reasonable assurance that in the event of deformation, certain structures,

systems, and components will remain functional. In addition to surface deformation induced loads, the design of safety features must take into account seismic loads and applicable concurrent functional and accident-induced loads. The design provisions for surface deformation must be based on its postulated occurrence in any direction and azimuth and under any part of the nuclear power plant, unless evidence indicates this assumption is not appropriate, and must take into account the estimated rate at which the surface deformation may occur.

(c) **Seismically Induced Floods and Water Waves and Other Design Conditions.** Seismically induced floods and water waves from either locally or distantly generated seismic activity and other design conditions determined pursuant to §100.23 of this chapter must 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.

PART 52 — EARLY SITE PERMITS; STANDARD DESIGN CERTIFICATIONS; AND COMBINED LICENSES FOR NUCLEAR POWER PLANTS

11. The authority citation for Part 52 continues to read as follows:

AUTHORITY: Secs. 103, 104, 161, 182, 183, 186, 189, 68 Stat. 936, 948, 953, 954, 955, 956, as amended, sec. 234, 83 Stat. 1244, as amended (42 U.S.C. 2133, 2201, 2232, 2233, 2236, 2239, 2282); secs. 201, 202, 206, 88 Stat. 1242, 1244, 1246, as amended (42 U.S.C. 5841, 5842, 5846).

12. In §52.17, the introductory text of paragraph (a)(1) and paragraph (a)(1)(vi) are revised to read as follows:

§52.17 Contents of applications.

(a)(1) The application must contain the information required by § 50.33(a)-(d), the information required by § 50.34 (a)(12) and (b)(10), and to the extent approval of emergency plans is sought under paragraph (b)(2)(ii) of this section, the information required by § 50.33 (g) and (j), and § 50.34 (b)(6)(v). The application must also contain a description and safety assessment of the site on which the facility is to be located. The assessment must contain an analysis and evaluation of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site under the radiological consequence evaluation factors identified in § 50.34(a)(1) of this chapter. Site characteristics must comply with Part 100 of this chapter. In addition, the application should describe the following:

* * * * *

(vi) The seismic, meteorological, hydrologic, and geologic characteristics of the proposed site;

* * * * *

PART 54 — REQUIREMENTS FOR RENEWAL OF OPERATING LICENSES FOR NUCLEAR POWER PLANTS

- 13 The authority citation for Part 54 continues to read as follows:

AUTHORITY: Secs. 102, 103, 104, 161, 181, 182, 183, 186, 189, 68 Stat. 936, 937, 938, 948, 953, 954, 955, as amended, sec. 234, 83 Stat. 1244, as amended (42 U.S.C. 2132, 2133, 2134, 2135, 2201, 2232, 2233, 2236, 2239, 2282); secs. 201, 202, 206, 88 Stat. 1242, 1244, as amended (42 U.S.C. 5841, 5842).

* * * * *

14 In §54.4, paragraph (a)(1)(iii) is revised to read as follows:

§54.4 Scope.

(a) * * *

(1) * * *

(iii) The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in §50.34(a)(1) or §100.11 of this chapter, as applicable.

* * * * *

PART 100 — REACTOR SITE CRITERIA

15. The authority citation for Part 100 continues to read as follows:

AUTHORITY: Secs. 103, 104, 161, 182, 68 Stat. 936, 937, 948, 953, as

amended (42 U.S.C. 2133, 2134, 2201, 2232); sec. 201, as amended, 202, 88 Stat. 1242, as amended, 1244 (42 U.S.C. 5841, 5842).

16. The table of contents for Part 100 is revised to read as follows:

PART 100 - REACTOR SITE CRITERIA

Sec.

100.1 Purpose.

100.2 Scope.

100.3 Definitions.

100.4 Communications.

100.8 Information collection requirements: OMB approval.

Subpart A — Evaluation Factors for Stationary Power Reactor Site Applications Before [EFFECTIVE DATE OF THE FINAL RULE] and for Testing Reactors.

100.10 Factors to be considered when evaluating sites.

100.11 Determination of exclusion area, low population zone, and population center distance.

Subpart B — Evaluation Factors for Stationary Power Reactor Site Applications on or After [EFFECTIVE DATE OF THE FINAL RULE].

100.20 Factors to be considered when evaluating sites.

100.21 Non-seismic site criteria.

100.23 Geologic and seismic siting criteria.

APPENDIX A to Part 100 — Seismic and Geologic Siting Criteria for Nuclear Power Plants.

17. Section 100.1 is revised to read as follows:

§ 100.1 Purpose.

(a) The purpose of this part is to establish approval requirements for proposed sites for stationary power and testing reactors subject to Part 50 or Part 52 of this chapter.

(b) There exists a substantial base of knowledge regarding power reactor siting, design, construction and operation. This base reflects that the primary factors that determine public health and safety are the reactor design, construction and operation.

(c) Siting factors and criteria are important in assuring that radiological doses from normal operation and postulated accidents will be acceptably low, that natural phenomena and potential man-made hazards will be appropriately accounted for in the design of the plant, that site characteristics are such that adequate security measures to protect the plant can be developed, and that physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans are identified.

(d) This approach incorporates the appropriate standards and criteria for approval of stationary power and testing reactor sites. The Commission intends to carry out a traditional defense-in-depth approach with regard to reactor siting to ensure public safety. Siting away from densely populated centers has been and will continue to be an important factor in evaluating applications for site approval.

18. Section 100.2 is revised to read as follows:

§ 100.2 Scope.

The siting requirements contained in this part apply to applications for site approval for the purpose of constructing and operating stationary power and testing reactors pursuant to the provisions of Parts 50 or 52 of this chapter.

19. Section 100.3 is revised to read as follows:

§ 100.3 Definitions.

As used in this part:

Combined license means a combined construction permit and operating license with conditions for a nuclear power facility issued pursuant to Subpart C of Part 52 of this chapter.

Early Site Permit means a Commission approval, issued pursuant to subpart A of Part 52 of this chapter, for a site or sites for one or more nuclear power facilities.

Exclusion area means that area surrounding the reactor, in which the reactor licensee has the authority to determine all activities including exclusion or removal of personnel and property from the area. This area may be traversed by a highway, railroad, or waterway, provided these are not so close to the facility as to interfere with normal operations of the facility and provided appropriate and effective arrangements are made to control traffic on the highway, railroad, or waterway, in case of emergency, to protect the public health and safety. Residence within the exclusion area shall normally be prohibited. In any event, residents shall be subject to ready removal in case of necessity. Activities unrelated to operation of the reactor may be permitted in an exclusion area under appropriate limitations, provided that no significant hazards to the public health and safety will result.

Low population zone means the area immediately surrounding the exclusion area which contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident. These guides do not specify a permissible population density or total population within this zone because the situation may vary from case to case. Whether a specific number of people can, for example, be evacuated from a specific area, or instructed to take shelter, on a timely basis will depend on many factors such as location, number and size of highways, scope and extent of advance planning, and actual distribution of residents within the area.

Population center distance means the distance from the reactor to the nearest boundary of a densely populated center containing more than about 25,000 residents.

Power reactor means a nuclear reactor of a type described in §§50.21(b) or 50.22 of this chapter designed to produce electrical or heat energy.

A Response spectrum is a plot of the maximum responses (acceleration, velocity, or displacement) of idealized single-degree-of-freedom oscillators as a function of the natural frequencies of the oscillators for a given damping value. The response spectrum is calculated for a specified vibratory motion input at the oscillators' supports.

The Safe Shutdown Earthquake Ground Motion is the vibratory ground motion for which certain structures, systems, and components must be designed pursuant to Appendix S to Part 50 of this chapter to remain functional.

Surface deformation is distortion of geologic strata at or near the ground surface by the processes of folding or faulting as a result of various earth forces. Tectonic surface deformation is associated with earthquake processes.

Testing reactor means a testing facility as defined in §50.2 of this chapter.

20. Section 100.4 is added to read as follows:

§100.4 Communications.

Except where otherwise specified in this part, all correspondence, reports, applications, and other written communications submitted pursuant to

10 CFR Part 100 should be addressed to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, and copies sent to the appropriate Regional Office and Resident Inspector. Communications and reports may be delivered in person at the Commission's offices at 2120 L Street, NW., Washington, DC, or at 11555 Rockville Pike, Rockville, Maryland.

21. Section 100.8 is revised to read as follows:

§ 100.8 Information collection requirements: OMB approval.

(a) The Nuclear Regulatory Commission has submitted the information collection requirements contained in this part to the Office of Management and Budget (OMB) for approval as required by the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). OMB has approved the information collection requirements contained in this part under control number 3150-0093.

(b) The approved information collection requirements contained in this part appear in §100.23 and Appendix A.

22. A heading for Subpart A is added directly before §100.10 to read as follows:

Subpart A — Evaluation Factors for Stationary Power Reactor Site Applications before [EFFECTIVE DATE OF THIS REGULATION] and for Testing Reactors.

23. Sections 100.20, 100.21 and 100.23 are added to Subpart B to read as follows:

Subpart B — Evaluation Factors for Stationary Power Reactor Site Applications on or After [EFFECTIVE DATE OF THE FINAL RULE].

§100.20 Factors to be considered when evaluating sites.

The Commission will take the following factors into consideration in determining the acceptability of a site for a stationary power reactor:

(a) Population density and use characteristics of the site environs, including the exclusion area, the population distribution, and site-related characteristics must be evaluated to determine whether individual as well as societal risk of potential plant accidents is low, and that physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans are identified.

(b) The nature and proximity of man-related hazards (e.g., airports, dams, transportation routes, military and chemical facilities) must be evaluated to establish site parameters for use in determining whether a plant design can accommodate commonly occurring hazards, and whether the risk of other hazards is very low.

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

(1) Section 100.23, "Geologic and seismic siting factors," describes the criteria and nature of investigations required to obtain the geologic and seismic data necessary to determine the suitability of the proposed site and the plant design bases.

(2) Meteorological characteristics of the site that are necessary for safety analysis or that may have an impact upon plant design (such as maximum probable wind speed and precipitation) must be identified and characterized.

(3) Factors important to hydrological radionuclide transport (such as soil, sediment, and rock characteristics, adsorption and retention coefficients, ground water velocity, and distances to the nearest surface body of water) must be obtained from on-site measurements. The maximum probable flood along with the potential for seismically induced floods discussed in §100.23 (d)(3) of this part must be estimated using historical data.

§ 100.21 Non-seismic siting criteria.

Applications for site approval for commercial power reactors shall demonstrate that the proposed site meets the following criteria:

(a) Every site must have an exclusion area and a low population zone, as defined in §100.3;

(b) The population center distance, as defined in §100.3, must be at least one and one-third times the distance from the reactor to the outer boundary of the low population zone. In applying this guide, the boundary of

the population center shall be determined upon consideration of population distribution. Political boundaries are not controlling in the application of this guide;

(c) Site atmospheric dispersion characteristics must be evaluated and dispersion parameters established such that:

(1) Radiological effluent release limits associated with normal operation from the type of facility proposed to be located at the site can be met for any individual located offsite; and

(2) Radiological dose consequences of postulated accidents shall meet the criteria set forth in §50.34(a)(1) of this chapter for the type of facility proposed to be located at the site;

(d) The physical characteristics of the site, including meteorology, geology, seismology, and hydrology must be evaluated and site parameters established such that potential threats from such physical characteristics will pose no undue risk to the type of facility proposed to be located at the site;

(e) Potential hazards associated with nearby transportation routes, industrial and military facilities must be evaluated and site parameters established such that potential hazards from such routes and facilities will pose no undue risk to the type of facility proposed to be located at the site;

(f) Site characteristics must be such that adequate security plans and measures can be developed;

(g) Physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans must be identified;

(h) Reactor sites should be located away from very densely populated centers. Areas of low population density are, generally, preferred. However, in determining the acceptability of a particular site located away from a very densely populated center but not in an area of low density, consideration will be given to safety, environmental, economic, or other factors, which may result in the site being found acceptable³.

§ 100.23 Geologic and seismic siting factors.

This section sets forth the principal geologic and seismic considerations that guide the Commission in its evaluation of the suitability of a proposed site and adequacy of the design bases established in consideration of the geologic and seismic characteristics of the proposed site, such that, there is a reasonable assurance that a nuclear power plant can be constructed and operated at the proposed site without undue risk to the

³ Examples of these factors include, but are not limited to, such factors as the higher population density site having superior seismic characteristics, better access to skilled labor for construction, better rail and highway access, shorter transmission line requirements, or less environmental impact on undeveloped areas, wetlands or endangered species, etc. Some of these factors are included in, or impact, the other criteria included in this section.

health and safety of the public. Applications to engineering design are contained in Appendix S to Part 50 of this chapter.

(a) **Applicability.** The requirements in paragraphs (c) and (d) of this section apply to applicants for an early site permit or combined license pursuant to Part 52 of this chapter, or a construction permit or operating license for a nuclear power plant pursuant to Part 50 of this chapter on or after [INSERT EFFECTIVE DATE OF THE FINAL RULE]. However, for either an operating license applicant or holder whose construction permit was issued prior to [INSERT EFFECTIVE DATE OF THE FINAL RULE], the seismic and geologic siting criteria in Appendix A to Part 100 of this chapter continues to apply.

(b) **Commencement of construction.** The investigations required in paragraph (c) of this section are within the scope of investigations permitted by § 50.10(c)(1) of this chapter.

(c) **Geological, seismological, and engineering characteristics.** The geological, seismological, and engineering characteristics of a site and its environs must be investigated in sufficient scope and detail to permit an adequate evaluation of the proposed site, to provide sufficient information to support evaluations performed to arrive at estimates of the Safe Shutdown Earthquake Ground Motion, 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 must be determined based on the nature of the region surrounding the proposed site. Data on the vibratory ground motion, tectonic surface deformation, nontectonic deformation, earthquake recurrence rates, fault geometry and slip rates, site foundation material, and seismically induced floods and water waves must be obtained by reviewing pertinent

literature and carrying out field investigations. However, each applicant shall investigate all geologic and seismic factors (for example, volcanic activity) that may affect the design and operation of the proposed nuclear power plant irrespective of whether such factors are explicitly included in this section.

(d) **Geologic and seismic siting factors.** The geologic and seismic siting factors considered for design must include a determination of the Safe Shutdown Earthquake Ground Motion for the site, the potential for surface tectonic and nontectonic deformations, the design bases for seismically induced floods and water waves, and other design conditions as stated in paragraph (d)(4) of this section.

(1) **Determination of the Safe Shutdown Earthquake Ground Motion.** The Safe Shutdown Earthquake Ground Motion for the site is characterized by both horizontal and vertical free-field ground motion response spectra at the free ground surface. The Safe Shutdown Earthquake Ground Motion for the site is determined considering the results of the investigations required by paragraph (c) of this section. Uncertainties are inherent in such estimates. These uncertainties must be addressed through an appropriate analysis, such as a probabilistic seismic hazard analysis or suitable sensitivity analyses. Paragraph IV(a)(1) of Appendix S to Part 50 of this chapter defines the minimum Safe Shutdown Earthquake Ground Motion for design.

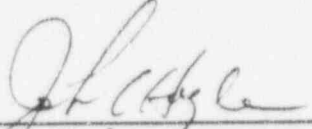
(2) **Determination of the potential for surface tectonic and nontectonic deformations.** Sufficient geological, seismological, and geophysical data must be provided to clearly establish whether there is a potential for surface deformation.

(3) Determination of design bases for seismically induced floods and water waves. The size of seismically induced floods and water waves that could affect a site from either locally or distantly generated seismic activity must be determined.

(4) Determination of siting factors for other design conditions. Siting factors for other design conditions that must be evaluated include soil and rock stability, liquefaction potential, natural and artificial slope stability, cooling water supply, and remote safety-related structure siting. Each applicant shall evaluate all siting factors and potential causes of failure, such as, the physical properties of the materials underlying the site, ground disruption, and the effects of vibratory ground motion that may affect the design and operation of the proposed nuclear power plant.

Dated at Rockville, Maryland, this 2nd day of December, 1996.

For the Nuclear Regulatory Commission.



John C. Hoyle,
Secretary of the Commission.