UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Title: BRIEFING ON ADDITIONAL CHANGES TO PART 100 RULEMAKING AND PROPOSED UPDATE ON SOURCE TERM

Location: ROCKVILLE, MARYLAND

Date: AUGUST 22, 1994

Pages: 40 PAGES

NEAL R. GROSS AND CO., INC.

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BRIEFING ON ADDITIONAL CHANGES TO PART 100 RULEMAKING AND PROPOSED UPDATE ON SOURCE TERM

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PUBLIC MEETING

Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland

Monday, August 22, 1994

The Commission met in open session, pursuant to notice, at 2:00 p.m., Ivan Selin, Chairman, presiding.

COMMISSIONERS PRESENT:

IVAN SELIN, Chairman of the Commission
KENNETH C. ROGERS, Commissioner
E. GAIL de PLANQUE, Commissioner

STAFF SEATED AT THE COMMISSION TABLE:

JOHN HOYLE, Acting Secretary

MARTIN MALSCH, Office of the General Counsel

JAMES TAYLOR, Executive Director for Operations

THEMIS SPEIS, Deputy Director, RES

FRANK MIRAGLIA, Deputy Director, NRR

ASHOK THADANI, Associate Director of Inspection and Technology Assessment, NRR

LEONARD SOFFER, Senior Technical Advisor, Severe Accident Issues Branch, RES

NILESH C. CHOKSHI, Section Leader, Structural and Seismic Engineering Branch, RES

P-R-O-C-E-E-D-I-N-G-S

2:00 p.m.

CHAIRMAN SELIN: Good afternoon.

The Commission is pleased to welcome members of the staff to brief us on proposed revisions to 10 CFR Part 100 and related changes in 10 CFR Part 50 and the associated draft regulatory guidance.

The proposed revisions describe basic reactor site criteria and reflect advancements in earthquake engineering and in the understanding of the earth sciences that pertain to the siting of power reactors.

The proposed rule changes and the reasons for proposing these changes were described in SECY-94-194, which is available as you come in.

I've gone through this fairly carefully. I think that the staff has done an extremely good job of explaining what is being proposed, why it is being proposed and has followed very carefully the guidance that was given after the last briefing that we had.

So, we're looking forward to this presentation, Mr. Taylor.

MR. TAYLOR: Good afternoon. With me at the table from NRR, Ashok Thadani and Frank Miraglia and from Research, Themis Speis and Len Soffer and

Nilesh Chokshi from the Office of Research.

This rule does reflect the experience gained by the staff over the past 30 years and siting about over 100 nuclear power plants, but also incorporates the knowledge and insights gained in the severe accident arena and associated risks. Also, the fission products released and their characteristics and the behavior of engineered safety features. The rule also incorporates major advances in our understanding of the earth sciences.

Finally, the staff has also been mindful of the Commission's safety goal and the actions and decisions involved in the review of certified designs.

With those thoughts, I'll ask Themis to begin the presentation.

DOCTOR SPEIS: Mr. Chairman, Commissioners.

(Slide) The first slide, please.

The first slide shows the outline of today's presentation. As you can see, it is really brief, at least in terms of the number of viewgraphs, and we have structured to address some of the key issues associated with the proposed rule. Of course, these are the issues that have been brought forth by the public in the public comment period and by the

Commission in its extensive dialogue with the staff.

After a brief discussion of the background, we will summarize the elements of the proposed rule, then address in more detail its non-seismic aspects, focusing first on the Part 100, the siting aspects, and then Part 50, the design aspects. Then we will repeat the same for the seismic aspects. Of course then we will conclude the presentation.

(Slide) The next viewgraph, please.

For some short background --

CHAIRMAN SELIN: It's clear to me. Taylor told you you could have a dozen slides and so you tried to cram as much information on each slide as possible.

DOCTOR SPEIS: At least the outline shows it. Can't win everything.

CHAIRMAN SELIN: Now you finally understand.

DOCTOR SPEIS: The current rule goes back to 1962, as all of us know, when the then Atomic Energy Commission issued 10 CFR 100 reactor site criteria. Also, soon thereafter in 1973, the AEC issued Appendix A to 10 CFR 100 on seismic and geologic siting criteria for nuclear power plants.

The rule requires that every reactor has

an exclusion area immediately around the reactor and a low population zone outside the exclusion area. The sizes of both are, of course, determined by dose calculations. Dose calculations are done by assuming a large fission product release into the containment, into an induct containment and then using this source term and the design basis, link it to the containment and taking into account the engineering safety features. Doses are calculated at these two boundaries, the exclusion area boundary and the low population zone. Of course, those doses have to make the Part 100 doses, the 25 rem to the whole body and 300 rem to the thyroid.

In the present rule, the plant design and the site are very closely coupled and with no numeric criteria in the rule for sizes of either of the two zones. Reg. Guide 4.7 provides guidance on the sizes of the zones and population density within 30 miles from the reactor.

So, that's the present rule in place. Going back to the earlier proposed rule, which was issued in 1992, it included a minimum exclusion area size of .4 miles and population density criteria of 500 persons per square mile out to 30 miles. Source terms and dose criteria were deleted for site

evaluation. And, of course, this is the use of the term -- thus the use of the term "decoupling," by deleting the source term and dose criteria from the site evaluation.

The rule also contained a dual approach to determining the safe shutdown earthquake using both probabilistic and deterministic approaches.

Extensive comments, both domestic and international, were received and were discussed with the Commission on August 3, 1993.

(Slide) The next viewgraph, please.

The Commission raised several concerns in its SRM of August 12, 1993. As a result of that, the staff briefed the Commission on March 1, 1994 and they recommended at that time that the non-seismic provisions of the proposed rule which were issued for public comment in 1992 be withdrawn, and also to revise Part 100 to incorporate basic siting criteria which includes requirements that reactors be sited away from densely populated centers. Numerical criteria would be in regulatory guides and also were recommended that the updated source term and dose calculations be relocated to Part 50.

COMMISSIONER ROGERS: Excuse me, before you go on.

DOCTOR SPEIS: Yes.

COMMISSIONER ROGERS: I don't think that's quite correct, what's in that bullet. In the first place, if you look at the SRM on that, I don't think that it substantiated numerical criteria in regulatory guides. I think it suggested that you consider neither -- numerical criteria in neither the rule or the reg. guides. It didn't by itself, I don't believe, endorse numerical criteria in reg. guides. It suggested the staff look at the possibility of not, if I recall correctly.

DOCTOR SPEIS: Yes. I think I didn't paraphrase it correctly.

COMMISSIONER ROGERS: I mean it wasn't that firm that --

DOCTOR SPEIS: Yes.

COMMISSIONER ROGERS: -- numerical criteria would be in regulatory guides.

COMMISSIONER de PLANQUE: It was the opposite.

COMMISSIONER ROGERS: Yes, right.

DOCTOR SPEIS: Okay. I accept that.

COMMISSIONER ROGERS: No numerical criteria that you look at, no numerical criteria in either the rule or the reg. guide.

The other thing is that there was another provision to look at and that you consider the no obviously superior alternative criterion. That seems to have been dropped out of this document totally. I'm not proposing that it be a criterion, but that was something that the staff was asked to look at in the SRM and it seems to have disappeared from the scene. So, I'd ask you to comment on that sometime. Do you want to do it now?

DOCTOR SPEIS: Do you want to talk about it now or --

COMMISSIONER ROGERS: As far as I'm concerned it's fine to do it now.

DOCTOR SPEIS: Do you want to start and then --

MR. MALSCH: Yes. I'll just mention we did give some consideration to that. The no obviously superior standard was adopted by the Commission years ago in case law and looking at alternative sites not under the Atomic Energy Act, not even from a population density standpoint but from a general NEPA environmental law standpoint. We're reluctant to use the same thing for NEPA and incorporate it as an Atomic Energy Act population density standard. We thought we'd just leave that the way it is.

But the fundamental underlying scheme under NEPA for looking at alternative sites, which is that you balance all relative considerations, safety, environmental, economic, is a part of the rule in that sense because when you're operating in an area of moderate population density, not low population density, not very high population density, the rule says lower population density sites are preferred but it's one factor to be considered among all the other factors. So, in that respect it's identical to the NEPA practice.

COMMISSIONER ROGERS: It would have been helpful just to --

MR. MALSCH: We perhaps should actually have included that precise discussion --

COMMISSIONER ROGERS: -- follow that from the SRM.

MR. MALSCH: But we did consider the issue.

COMMISSIONER ROGERS: Okay. Fine. Thank you.

DOCTOR SPEIS: We also recommended withdrawing the proposed Appendix D to Part 100 and streamlining the content of the seismic portion of Part 100 to make it the same as the siting part and

proceed with common resolution progression of the final rule in the seismic area.

The Commission approved the staff's proposal in its SRM dated March 28, '94. In the next viewgraph, I'll just briefly summarize the key items that we're proposing and then Len Soffer and Doctor Chokshi will go into some details.

The proposed revision 10 CFR 100 will consist of two subparts. Subpart A will be exactly the same as in the present current rule and, of course, it applies to current plans. We are doing this in order to preserve the licensing basis for existing plants.

A new Subpart B has been added which will be applicable to future plants and, of course, it would contain the basic site criteria that we're talking about. The non-seismic will be in Part 100.21 and the seismic in 100.23. Both of these will be without numerical values.

Also the proposed revisions to Part 50 would relocate source term and dose criteria to Section 50.34. I would like to mention here that there is no specific source term as referenced. What is referenced in the footnote is that the source term is supposed to be a large one that could only come

from a meltdown and appreciable fission products should be released into the containment. Thus, the way we're structuring it, you can use this with the existing source term in the TID or the revised source term that we're talking about for advanced LWRs or in some other source term that the Commission will approve in the future, for example for the CANDU reactor or any other reactor.

Also, we are -- the new Part 50 -- the new Appendix S to discuss in detail the earthquake engineering criteria.

With this brief overview, then Len Soffer will now go into some more detail of the non-seismic aspects.

MR. SOFFER: Thank you, Doctor Speis.

(Slide) Could I have viewgraph number 5, please?

The non-seismic aspects would basically involve revisions to three documents. There would be a new section in Part 100, in Subpart B of Part 100, a new Section 100.21, that would contain basic site criteria without numerical values. I will get into the details of all of these in subsequent viewgraphs.

There would be suggested numerical values for population density in a proposed revision to

Regulatory Guide 4.7 and an outline of that is given in the Commission paper. Finally there would be source term and dose criteria that would be relocated to Part 50.34 and there are a couple of changes to be noted in that one.

First of all, as Doctor Speis has pointed out, no specific source term would be referenced or required. The source term would be merely one that speaks in terms of an appreciable meltdown with subsequent release of a large amount of fission products into the containment. Consequently, it could be used with the current source term with revised source term efforts that are underway within the staff and industry and with new source terms for new designs that are coming along.

But the two changes that are being proposed are that we are proposing to change the criteria from 25 rem whole body and 300 rem thyroid to a single value of 25 rem total effective dose equivalent. I will get into that in a little more detail. And that the dose to an individual at the exclusion area boundary is not to exceed 25 rem TEDE for any two hour period following the release of fission products rather than the first two hours.

(Slide) Could I have the next viewgraph,

please?

The proposed basic reactor site criteria that would be incorporated in Section 100.21 I believe have been discussed before. Basically they would involve a requirement that site atmospheric dispersion characteristics would have to be evaluated and that there would be a requirement that the radiological doses for normal operation be met and that the radiological consequences for postulated accidents be acceptable as defined by the dose values in Section 50.34.

The physical characteristics of the site would have to be evaluated, such aspects as meteorology, geology, hydrology, wind characteristics, et cetera, and a determination made that the plant would be such that these characteristics would pose no undue risk to the plant.

Similarly there would have to be an evaluation of man-related potential hazards in the site vicinity, such as industrial facilities, airports, pipelines, et cetera, and a determination made that the plant design would be such that these man-related hazards or activities would pose no undue risk to the plant. There would have to be a determination that the site characteristics would be

such that adequate security plans and measures could be developed and that adequate emergency plans could be developed.

Finally, a requirement that reactor sites should be located away from very densely populated centers, that areas of low density are preferred and that other sites may be found acceptable. The wording of that is -- I will go into that in some more detail, but you've gotten a flavor of that from Mr. Malsch's discussion about the balancing of population in regard to other factors.

(Slide) Could I have the next slide, please?

The population criteria in the proposed rule would basically set up two tiers or three categories of sites with regard to population density, but without providing any kind of numerical values. First of all, there is a statement that reactors should be located away from very densely populated centers. A second statement that areas of low population density are preferred and finally a statement that sites that are not in either of the above two categories, consideration should be given to other factors such as safety, environmental or economics, and that such a site might be found

acceptable.

Let me go into a little bit more detail into some of the considerations that went into the rule, although I believe Mr. Malsch has already hit some of the high points. First of all there was the recognition that modern nuclear power plants can be sited even within densely populated centers and meet the Commission's safety goal. However, the Commission has indicated its policy that reactors should be cited away from very densely populated centers and that areas of low population density are preferred.

We felt that setting up a two tier system would allow for this expression of the Commission's policy and that examining factors involved in site selection for this in between category population was but one factor in the determination of site suitability and site evaluation and therefore there should be a balancing between safety, environmental, economic considerations. That was the basic reason why the rule is worded the way it is.

(Slide) Could I have the next viewgraph?

There is also a proposed revision of Regulatory Guide 4.7 that is included in the Commission paper, attached to the Commission paper. This does provide numerical values of population

density. It reflects, in our opinion, consideration both of severe accidents as well as U.S. geographic and demographic considerations. First of all, there is a statement that sites where the population density does not exceed 500 persons per square mile at any distance out to 20 miles are preferred. This basically is consistent with the present regulatory guide. The value of 500 persons per square mile is a reflection of U.S. geographic and demographic considerations. It also provides a standoff distance, an effective standoff distance for population centers of various sizes that we believe provides recognition of some of the severe accident considerations and the distance of 20 miles is also a reflection of severe accident considerations, including even considering land contamination aspects from very severe aspects.

We have also stated in the guide that reactors should not be located where the population density is well in excess of this value. We have declined to give a numerical value for this. I believe that there is good reason why a numerical value for this well in excess should not be given. First of all, an upper bound value is very difficult to define because, as noted earlier, the safety goal can be met even if nuclear power plants are located in

very densely populated areas. Second of all, I think from a practical point of view, although an upper bound value would assure compliance, that's not the real purpose. The real purpose is to encourage applicants to find sites in low density rather than to come in just below some upper bound value that would assure compliance.

We have also indicated that population projections should be considered for about a five year period from the time of initial site approval. If you are aware of the current regulatory guide, it asks to do population projections out to 40 years. This has been a troubling aspect for some time. We have been aware of the fact that population projections particularly for small areas around nuclear power plants become extremely problematic once you're going out to those kinds of projections in time. Consequently, we feel that it is desirable to look at future population but over a time scale where it looks like there is a reasonable source of data. Within that time period there are plenty of sources of data from local planning commissions, local governments that applicants as well as staff would have available to them.

Transient population is to be factored in

by weighting, as has been customary, and we have also included statements in the regulatory guide that population growth after the site is approved is to be expected and that such changes would be factored into the emergency plan for the site but that such changes by themselves would not be a basis for any operational restrictions on the plant.

In addition, reference to a minimum exclusion area size and a low population density size has been deleted from this regulatory guide.

COMMISSIONER de PLANQUE: Before you go on, it was clear that the initial version got a lot of reaction from the international community on the population criteria that were in the proposed rule.

MR. SOFFER: Yes.

COMMISSIONER de PLANQUE: How would you expect our international counterparts to respond to the current version based on the comments you saw before?

MR. SOFFER: Based on the comments that I saw as well as personal interaction with a number of them, I believe that the site criteria that are given in the proposed rule is something that virtually everyone could live with. They are good basic criteria. The numbers that are in the proposed reg.

guide are specific to conditions in the United States and I would not expect that every country would necessarily adopt them because we have taken pains to say that they represent the demographic criteria of the United States. I believe that most other countries would understand this and I don't think that this would cause the same level of concern in the international community.

COMMISSIONER de PLANQUE: Thank you.

MR. SOFFER: (Slide) If we could have viewgraph number 9, please.

I'd like to talk a little bit now about the revisions, the proposed revisions to Part 50. We have chosen to continue with a value of 25 rem total effective dose equivalent. The value of 25 rem -- there are several points that I want to make here. One is that the value of 25 rem is consistent with past practice. I want to emphasize that this dose is used as a measure of the accident mitigation capability of the plant, together with evaluating certain characteristics of the site. There is no implication that such doses would be acceptable for members of the public under accident condition. That footnote is in the original rule, in the current rule, and we believe it's worth emphasizing today as well.

The evaluation of 25 rem and the way it is done we believe is a very conservative evaluation when one considers all of the factors that go into it. The assumption of a degraded core of containment leaking at its maximum allowable rate, assuming a single failure in the fission product cleanup systems and individual at the site boundary, at the center line of the plume, et cetera, et cetera. So, we believe that this is a dose that is not likely to be experienced by any individual, much less exceeded by them.

A second point that I'd like to make is that we also were trying to basically fold two numbers, the 25 rem whole body and the 300 rem thyroid into one single value of total effective dose equivalent. In doing so, we were trying to achieve a level of risk that would be the same. Our intent was not to increase risk or decrease risk, but to remain risk-neutral. We looked at several criteria. We looked at the risk of latent cancer fatality and the risk of latent cancer incidents. They're not the same. We've given a little discussion on that, but I think the discussion covers that fairly well. We chose latent cancer fatality because it is carried in the Commission safety goal. It also leads to the lower value. We found that 25 rem whole body and 300

rem to the thyroid is approximately equivalent to 27 rem TEDE and we're recommending that 25 rem be used because we believe it is essentially the same number.

We are proposing to retain the dose evaluation at the exclusion area as well as the LPZ outer radius. For some time we considered that the low population zone was no longer of real benefit in siting. It does not have a purpose in emergency planning anymore and population criteria can be enunciated in another fashion. But then as we considered it in some further detail, we felt that a criterion to control the course of the accident dose was valuable for the plant design itself. So, we felt that a course of the accident dose calculation was worthwhile and since no other convenient distance presented itself, it was decided to retain it at the current low population zone boundary.

The dose criteria have been changed, as I say, from 25 rem whole body and 300 rem thyroid to 25 rem total effective dose equivalent. We believe there are two good reasons to do this. One is that it promotes a uniformity and consistency in treating the radiation doses to all body organs. In this sense, it is consistent with what's being done in Part 20. Secondly, it's amenable for use with a revised source

term. That includes other nuclides in addition to the noble gases and iodine.

Finally, the dose at the exclusion area boundary is to be evaluated for any two hour period after the fission product appearance because of improved understanding of fission product timing. When you have an instantaneous source term, as in the old -- or I should say the current TID, the highest dose of necessity comes in the first two hours because the source term is instantaneous. With a revised source term, that's not necessarily the case and we wanted to preserve the thought that the consequences -- there would be assurance that the consequences would not be above 25 rem for any two hour period, which is why we're proposing that this evaluation be carried over in effect a sliding window that has a duration of two hours.

With that I'll -- that concludes the presentation of the non-seismic aspects and I'll now turn it over to my colleague, Nilesh Chokshi.

DOCTOR CHOKSHI: Thank you.

(Slide) May I have viewgraph 10?

In the next three viewgraphs I'll discuss the seismic aspects of the proposed rule and the guidance document.

As we had proposed in March and which was approved in subsequent SRM, we have withdrawn Appendix B and included a new section in the Part 100 which describes the geologic and seismic siting factors. This section is streamlined version of Appendix B and it contains basic siting factors which must be included for site evaluation and the definitions such as the safe shutdown earthquake, response spectra, surface deformation which are essential to establish these factors.

The factors which are included in the rule are the investigation requirements to characterize geological, seismological and engineering aspects of the site. These characterizations are necessary to judge the adequacy of the site or to establish design conditions.

The rule states that the safe shutdown earthquake ground motion must be determined. It goes on to say that there are uncertainties in this estimate and that must be included or must be considered and the rule allows for probabilistic as well as non-probabilistic methods to use for this consideration.

The details of both the investigations that extend the scope and the procedure on how to

consider uncertainties are described in detail in the regulatory guide. The rule goes into the further factors from the site adequacy point of view. Things such as surface deformation, potential for liquefaction, susceptibility to the settlement, potential for seismic-induced floods from nearby sources or distant sources. Those are identified as a part of evaluation factors and from the adequacy of the site or for further consideration in the design in Part 50. So, the Part 100 is now a much shorter version of Appendix B outlining the basic requirements for the siting and basic design considerations.

(Slide) The viewgraph number 11, which contains the requirements for Part 50, all the engineering requirements, the current Appendix A includes both siting and engineering requirements in great detail. This Appendix S, we have removed those earthquake engineering requirements and located into this new appendix. The appendix which is included in this current version is not much changed from what was issued for the public comment. We received some comments on that particular division and we have made those changes. The changes are minor, most of them clarification of certain terms.

Again, this part of the rule also includes

basic definition and requirements. It includes requirement for the minimum safe shutdown earthquake ground motion level for which a nuclear power plant must be designed to. It defines the operating basis earthquake and requires shutdown if that operating basis earthquake is exited. The rule requires an instrumentation, instrumentation for the purpose of the prompt evaluation of plant response following an earthquake and for determination of shutdown requirements. Again, rule in parallel to the siting discusses the requirement for other conditions such as seismically-induced floods, water waves, surface deformations.

The most substantial change from the current Appendix A in the Appendix S, which was also in the proposed version for the public comment, is the requirement for the operating basis earthquake. In the old Appendix A, the operating basis earthquake was a design condition. Plants were to be designed for both safe shutdown earthquake and operating basis earthquake. In the proposed rule, the operating basis earthquake is primarily a shutdown inspection earthquake. There is an option there which allows for no design. In the ongoing Part 52 review of the standard designs, the staff has already taken position

that the use of the single earthquake is adequate. So, the rule is very consistent with what is going on in the design reviews of the standard ALWRs.

There are three guides associated with this part of the rule, guides on instrumentation, shutdown and restart after a shutdown. All these guides also have been devised to reflect comments. Again, the revisions are of minor nature. That's one of the reasons we did not include these guides, our outline of these guides in this Commission paper. They're essentially unchanged. However, the outlines for the geosciences guides and SRP sections have gone substantial change since the initial version and that those outlines were included in the Commission paper and that's the subject of my next viewgraph.

(Slide) As I mentioned, the rule requires the site investigations and also establishment of the safe shutdown earthquake with consideration of uncertainties. The proposed regulatory guide goes and defines one procedure which can be used to meet these requirements by an applicant. The procedure in the guide is primarily probabilistic, but with a very strong reliance on the investigations around the site and at the site to confirm the probabilistic database and models. The probabilistic models are basically

regional. For example, the Lawrence Livermore methodology is applicable east of the Rockies. So, it contains original basis source zonations and site investigations will confirm those zones.

Other purpose is to also characterize sites for the engineering design purposes and to make sure that there are no potential sources which would impact adversely on the adequacy of the site or which might impact the design basis.

The guide will include acceptance criteria regarding the probability of accidents of a certain basis ground motion. It includes the details of the required investigations in terms of size around the site, depth, what type of investigations and some of the techniques. It will include how to identify and characterize seismic sources and how to incorporate them in the probabilistlic analysis, how to update the probabilistic analysis. Then finally the guide also includes, and I think which is a part of Enclosure 7 in the Commission paper, a step-wise procedure how to use this probabilistic method to determine safe shutdown earthquake ground motion.

The revision to the standard review plan Section 2.5.2, vibratory ground motion, is structured for the staff to review an applicant's probabilistic

analysis. The proposed review will focus on how the site-specific investigations were carried out and how the results of these investigations were incorporated into the probabilistic analysis. The other part of the emphasis is on how the results of the probabilistic analysis in terms of design basis event compare with the past licensing decisions of the similar or nearby sites. I think that will be a very crucial judgment involved in that review.

I think together the proposed regulatory guide and the proposed standard review plan I think contains the key elements which were described to you in March which was basically, I think, characterized as a hybrid approach, if I believe, and it includes basically reliance on the probabilistic aspect.

So, in summary, in this proposed revision, the geosciences criteria will be in Part 100, in Section 100.23. The ultimate engineering requirements will be in Appendix S and then we will have several regulatory guides and SRP sections which will implement these requirements or which will outline the procedures to meet these requirements.

So, that's for the seismic part.

Doctor Speis?

DOCTOR SPEIS: (Slide) The last

viewgraph, please.

In conclusion, we're basically asking the Commission to approve the issuance of the proposed Part 100 and Part 50 revisions for public comments in the Federal Register and also we're asking for approval of the outlines of the regulatory guides and the standard review plan sections so we can meet into them and then put them out for public comment also.

That concludes our presentation.

CHAIRMAN SELIN: Commissioner Rogers?

COMMISSIONER ROGERS: Yes. First I wanted to say that I thought it was the -- I agree with the Chairman that I think it was a very well done piece of work, very carefully constructed and presented and well written. But there are a couple of questions that I'd just like to explore a little bit with you.

First, the applicability of this to designs which are going through the certification process now in whatever stage they are and that are prospective in front of us. What is the applicability of these new regulations to those designs, the ABWR, the System 80+, the AP-600 and any others that will come -- may come before us? We expect the CANDU application in the near future. What is the applicability to those designs?

MR. SOFFER: Well, the ABWR is -- we do not believe that this is applicable to the ABWR designs since that is proposed to be certified under the existing rules. If the ABWR were referenced with a site in a combined operating license after the effective date of this proposed rule, assuming it becomes effective, then we believe that the site would fall under this new rule. But I do not believe --

COMMISSIONER ROGERS: Not the design?

MR. SOFFER: But not the design.

DOCTOR THADANI: I think, Commissioner Rogers, perhaps I might comment on that.

We have done some calculations to see the 25 TEDE approach both for the ABWR and the System 80+ and concluded that those criteria would be made by those two designs.

MR. MIRAGLIA: I think the basic answer is that the staff was aware of the changes that we were contemplating and while the -- and consistent with Commission guidance the applicants could choose the new source term or the old source term. In the GE case, they stayed with the old source term. In the CE case, they took elements of the new source term. So, I think in the conduct of those reviews we were aware of the changes and we believe that one can come to the

conclusion, as Mr. Thadani just said, that they would meet those rules.

Within the design certification rulemaking, the specifics of the design will be certified within the context of the rulemaking and, as Len said, in the siting, those decisions are yet to be made. Depending upon the timing of the application and the timing of those decisions, that's when the applicability of these criteria would be met. But certainly the broad envelopes for the siting criteria were also considered within the context of the design of both the ABWR, System 80+ and the ongoing reviews.

COMMISSIONER ROGERS: Does that include the atmospheric dilution factors that you've referred to in the Federal Register notice?

MR. MIRAGLIA: Yes. In fact, I think if one looks at the specific ITAAC within both the two design certifications that are going forward, the ITAAC do include atmospheric dispersion factors such that the standoff values could be determined.

COMMISSIONER ROGERS: You talked a little bit in the seismic area on the target exceedance probability. I'm not quite clear exactly how that's used here and perhaps you could just clarify that a little bit for me.

DOCTOR CHOKSHI: Okay. In order to implement the probabilistic method, what we have done is looked at the past designs and looked at the site hazards for past designs and have calculated what is the probability of exiting those design bases. We have done that for a selected group of plants which were designed with recent much more modern criteria, and then we have selected a median of that probability value as the target probability that the new design will at least have a probability of non-exceedance, their design bases, equal to that probability.

For example, the population, the plant we selected, and the median value which comes out of this is $1x10^{-5}$ per year. The probability of exiting the design bases is $1x10^{-5}$ per year, and that is our target value for the new design. So, for the new design a site hazard will be calculated. You will enter the hazard coordinate probability and pick up the ground motion value.

COMMISSIONER ROGERS: Yes, but I think the little introductory explanation of how you came to that target value might be helpful. I didn't see that in the SECY. Maybe it's there and I just missed it, but --

DOCTOR SPEIS: It's kind of -- it's

somewhere. We have prepared a summary of the seismic --

COMMISSIONER ROGERS: And the terms used and the numbers --

DOCTOR SPEIS: -- in great detail and we'd like to make it available.

COMMISSIONER ROGERS: But how that came about wasn't clear to me.

DOCTOR SPEIS: Commissioner, what we just said is described on step B in detail, the second page of this handout.

COMMISSIONER ROGERS: I see. So this would be in the reg. guide?

DOCTOR SPEIS: Yes, this is kind of a -- since there is always a lot of questions in mixing the probabilistic and deterministic, we put that into some detailed fashion here.

COMMISSIONER ROGERS: Well, I think just the explanation that you gave, which, as soon as you said it, then I understood what you were talking about, how you got it, but just where it came from. How you used it was clear, but where it came from wasn't.

DOCTOR CHOKSHI: And it's shown in this page 2 of this.

DOCTOR SPEIS: This is step B in the process.

COMMISSIONER ROGERS: Right. Well, I don't think you need all that, but just a few words to explain where that came from.

DOCTOR CHOKSHI: And this is including the outline of the reg. guide.

COMMISSIONER ROGERS: Yes, right. Right.

You've mentioned in the geoscience assessments that considerable latitude in judgement has to be available. To what extent have you really thought about formalizing in any way the use of expert opinion in resolving these seismic issues? This is an area that is being wrestled with in the waste area particularly, waste problems, and it has come up. It was used in 1150, as you know, and there have been a number of considerations as to how one uses expert opinion and where it comes in and what the -- what limitations may be on its use. To what extent have you though about that in connection with this rule?

DOCTOR CHOKSHI: The primary purpose for going to a probabilistic method was specifically that reason, because there are quite a few expert differing interpretations of the same data. The probabilistic methods, the Lawrence Livermore hazard methodology or

EPRI methodology includes this different expert elicitations. Those are part of the database.

For example, in the Lawrence Livermore methodology there were ten seismic source experts which gave several versions of their own zonations, so those are all part of the database. And when we mention that that's regional basically, because it was elicited on a regional basis, that's where the site-specific investigations come into play to make sure those regional elicitations are still valid. So the probabilistic database contains these various interpretations, differing opinions, and that was the primary purpose for going through this probabilistic method.

COMMISSIONER ROGERS: But you're not thinking of introducing anything more beyond that, is that it?

DOCTOR CHOKSHI: No. I think one of --

COMMISSIONER ROGERS: The use of that work does involve expert opinions, and to that extent they would be involved.

DOCTOR CHOKSHI: Also, there was in the Commission paper there's -- every ten years we will take a look at it, and that's precisely for the same reason, that reason, because things will be changing

and interpretations will be changing, so that's to continue this process.

COMMISSIONER ROGERS: Very good.

There's one point that I found a little bit troubling and that is dealing with the decision to shut down the plant following an earthquake has to be made within eight hours. That strikes me as a rather long time and, if the plant hasn't shaken itself down, then there is eight hours to determine whether it should be shut down or not and that's to be based on some inspections, walk-downs, and I guess looking at records.

DOCTOR CHOKSHI: Right.

COMMISSIONER ROGERS: Have you given any thought to the necessity of prioritizing the systems that should be examined immediately following an earthquake to see whether, even though they seem to be working, there might be some question about their robustness after the event? To take eight hours to find that out seems to me a long time. I wonder if you could comment on that.

MR. MIRAGLIA: I think the key point to make here is what we're trying to do in separating that out of the rule is that this is really an operational kind of decision.

COMMISSIONER ROGERS: Yes.

MR. MIRAGLIA: It requires instrumentation and analysis, walk-downs and things of that nature. Within the context of the inspection procedures themselves there are priority systems to go look at primarily the safety systems and then you look at the balance of plant and then there are decisions looking at what's happened within the context of the site environs and does that raise other kinds of issues. The eight hours just appeared to be based upon experience where we've had these issues. It's a very small fraction of the safe shut-down. There's substantial margin in the plant and the eight hours was just based upon that kind of experience.

COMMISSIONER ROGERS: Essentially, you're going back to the operability requirements --

MR. MIRAGLIA: Yes.

COMMISSIONER ROGERS: -- normally in place and leaving it to the licensee, in a sense, to take the responsibility if there's any question about anything that they --

MR. MIRAGLIA: That's correct. They see serious degradation and they question function, then it could be done much, much sooner. But it was to set a time frame so it didn't go on for very, very long.

COMMISSIONER ROGERS: So that some very careful detailed analyses over eight hours might reveal something that wasn't immediately obvious?

MR. MIRAGLIA: That's correct. That's the rationale.

COMMISSIONER ROGERS: Yes. Okay. Very good.

Well, thank you very much. That's all I have.

COMMISSIONER de PLANQUE: I have no specific questions, but I think you did a wonderful job, especially on all your explanations of the changes that were made from the previous version, so I would commend you for that job.

DOCTOR SPEIS: Thank you.

CHAIRMAN SELIN: What's the schedule from here on in, assuming the Commission approves the publication fairly quickly?

DOCTOR SPEIS: It's a four month comment period and, assuming that we don't experience difficulties this time, we should be able to evaluate the comments in a few months.

CHAIRMAN SELIN: So early next year?

MR. TAYLOR: Yes. I think early, sometime in the new year.

DOCTOR SPEIS: So probably sometime in the spring. We're anxious to go forward because maybe Len and I are not going to be across from you next year.

CHAIRMAN SELIN: You'll retire.

MR. MIRAGLIA: Is that official?

CHAIRMAN SELIN: Okay. This is a very nice job. It really is. And, you know, it's been over some rough areas but I think it's resulted in a first-rate product.

DOCTOR SPEIS: This has been a collective effort between us and NRR, Len and Chokshi and Ashok and Congel, who's not here now. All of these people worked very hard to get this shaped up to where it is today.

COMMISSIONER ROGERS: Very fine job.

CHAIRMAN SELIN: Thank you very much.

DOCTOR SPEIS: Thank you.

(Whereupon, at 2:54 p.m., the above-entitled matter was adjourned.)

CERTIFICATE OF TRANSCRIBER

This is to certify that the attached events of a meeting of the United States Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING ON ADDITIONAL CHANGES TO PART 100 RULEMAKING AND PROPOSED UPDATE ON SOURCE TERM

PLACE OF MEETING: ROCKVILLE, MARYLAND

DATE OF MEETING: AUGUST 22, 1994

were transcribed by me. I further certify that said transcription is accurate and complete, to the best of my ability, and that the transcript is a true and accurate record of the foregoing events.

Carol Lynch

Reporter's name: Peter Lynch

COMMISSION BRIEFING

ON

PROPOSED REVISIONS TO 10 CFR PART 100

AND 10 CFR PART 50

THEMIS P. SPEIS
LEONARD SOFFER
NILESH C. CHOKSHI
OFFICE OF NUCLEAR REGULATORY RESEARCH
U.S. NUCLEAR REGULATORY COMMISSION

AUGUST 22, 1994

OUTLINE OF PRESENTATION

- BACKGROUND
- ELEMENTS OF PROPOSED RULE CHANGES
- NON-SEISMIC ASPECTS
  - PART 100
  - PART 50
- SEISMIC ASPECTS
  - PART 100
  - PART 50
- CONCLUSION

BACKGROUND

CURRENT RULE (1962)

- FISSION PRODUCT RELEASE POSTULATED INTO CONTAINMENT. DOSES AT EXCLUSION AREA BOUNDARY (EAB) AND LOW POPULATION ZONE (LPZ) OUTER RADIUS NOT TO EXCEED 25 REM WHOLE BODY AND 300 REM THYROID.

- PLANT DESIGN AND SITE CLOSELY COUPLED WITH NO NUMERIC CRITERIA IN RULE FOR SIZES OF EAB AND LPZ. REG. GUIDE 4.7 (1975) PROVIDES GUIDANCE ON EAB SIZE AND POPULATION DENSITY WITHIN 30 MILES FROM THE REACTOR.

PROPOSED RULE (OCT. 1992)

- MINIMUM EXCLUSION AREA SIZE OF 0.4 MILES AND POPULATION DENSITY CRITERIA OF 500 PERSONS PER SQUARE MILE OUT TO 30 MILES. SOURCE TERMS AND DOSE CRITERIA DELETED FOR SITE EVALUATION.

- "DUAL" APPROACH TO SEISMIC WITH EQUAL WEIGHTS TO BOTH PROBABILISTIC AND DETERMINISTIC.

- EXTENSIVE COMMENTS, BOTH DOMESTIC AND INTERNATIONAL, WERE RECEIVED AND DISCUSSED WITH THE COMMISSION ON AUGUST 3, 1993.

BACKGROUND (CONTINUED)

- COMMISSION RAISED SEVERAL CONCERNS IN SRM OF AUGUST 12, 1993; STAFF BRIEFED COMMISSION ON MARCH 1, 1994, AND RECOMMENDED
  - NON-SEISMIC PROVISIONS OF PROPOSED RULE ISSUED FOR COMMENT IN OCTOBER 1992 SHOULD BE WITHDRAWN.
  - REVISE PART 100 TO INCORPORATE BASIC SITING CRITERIA, INCLUDING REQUIREMENT THAT REACTORS BE SITED "AWAY FROM" DENSELY POPULATED CENTERS. NUMERICAL CRITERIA WOULD BE IN REGULATORY GUIDES. RELOCATE UPDATED SOURCE TERM AND DOSE CALCULATIONS TO PART 50.
  - WITHDRAW PROPOSED APPENDIX B TO PART 100; STREAMLINE CONTENT OF SEISMIC PORTION OF PART 100 (INCORPORATE GUIDANCE INTO REGULATORY GUIDES), AND PROCEED WITH COMMENT RESOLUTION AND PREPARATION OF FINAL RULE.
- COMMISSION APPROVED STAFF PROPOSAL IN SRM DATED MARCH 28, 1994.

ELEMENTS OF PROPOSED RULE CHANGES

- PROPOSED REVISED 10 CFR PART 100 WOULD CONSIST OF TWO SUBPARTS
  - SUBPART A - IDENTICAL TO CURRENT RULE (APPLIES TO CURRENT PLANTS)
  - NEW SUBPART B WOULD CONTAIN BASIC SITE CRITERIA (NON-SEISMIC AS WELL AS SEISMIC), WITHOUT NUMERICAL VALUES.
- PROPOSED REVISIONS TO PART 50 WOULD
  - RELOCATE SOURCE TERM AND DOSE CRITERIA TO SECTION 50.34
  - ADD NEW APPENDIX S (EARTHQUAKE ENGINEERING CRITERIA)

NON-SEISMIC ASPECTS

- NON-SEISMIC SITE CRITERIA, IN SECTION 100.21, WOULD CONTAIN BASIC SITE CRITERIA WITHOUT NUMERICAL VALUES.

- NUMERICAL VALUES FOR POPULATION DENSITY WOULD BE IN REVISED REG.GUIDE 4.7.

- SOURCE TERM AND DOSE CRITERIA RELOCATED TO PART 50.34

  - DOSE CRITERIA TO BE CHANGED FROM 25 REM WHOLE BODY AND 300 REM THYROID TO 25 REM TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE).

  - DOSE TO AN INDIVIDUAL AT THE EXCLUSION AREA BOUNDARY NOT TO EXCEED 25 REM TEDE FOR ANY TWO HOUR PERIOD FOLLOWING RELEASE OF FISSION PRODUCTS.

  - NO SPECIFIC SOURCE TERM REQUIRED; MAY BE USED WITH CURRENT OR REVISED SOURCE TERMS.

PROPOSED BASIC REACTOR SITE CRITERIA IN PART 100

- SITE ATMOSPHERIC DISPERSION CHARACTERISTICS MUST BE SUCH THAT:
  - RADIOLOGICAL DOSES FOR NORMAL OPERATION WILL BE MET, AND
  - RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS WILL MEET THE DOSE CRITERIA IN SECTION 50.34.
- PHYSICAL CHARACTERISTICS OF THE SITE (METEOROLOGY, GEOLOGY, HYDROLOGY, ETC.,) WILL POSE NO UNDUE RISK TO THE PLANT.
- MAN-RELATED ACTIVITIES IN SITE VICINITY (INDUSTRIAL FACILITIES, AIRPORTS, ETC.,) WILL POSE NO UNDUE RISK TO THE PLANT.
- SITE CHARACTERISTICS MUST BE SUCH THAT
  - ADEQUATE SECURITY PLANS AND MEASURES CAN BE DEVELOPED, AND
  - ADEQUATE EMERGENCY PLANS CAN BE DEVELOPED.
- REACTOR SITES SHOULD BE LOCATED AWAY FROM VERY DENSELY POPULATED CENTERS; AREAS OF LOW DENSITY ARE PREFERRED. OTHER SITES MAY BE FOUND ACCEPTABLE.

POPULATION CRITERIA
(PROPOSED RULE)

- PROPOSED RULE ESTABLISHES THREE CATEGORIES OF SITES WITH REGARD TO POPULATION DENSITY OR PROXIMITY, BUT WITHOUT NUMERICAL VALUES.

  - REACTORS SHOULD BE LOCATED AWAY FROM VERY DENSELY POPULATED CENTERS;

  - AREAS OF LOW POPULATION DENSITY ARE PREFERRED;

  - FOR SITES NOT IN EITHER OF ABOVE TWO CATEGORIES, CONSIDERATION WILL BE GIVEN TO OTHER FACTORS, SUCH AS SAFETY, ENVIRONMENTAL OR ECONOMICS, AND SITE MIGHT BE FOUND ACCEPTABLE.

POPULATION CRITERIA
(PROPOSED REVISION OF REG. GUIDE 4.7)

- NUMERICAL VALUE OF POPULATION DENSITY REFLECTS CONSIDERATION OF SEVERE ACCIDENTS AND U.S. GEOGRAPHIC/DEMOGRAPHIC CONDITIONS.
  - SITES WHERE POPULATION DENSITY DOES NOT EXCEED 500 PERSONS PER SQ. MILE AT ANY DISTANCE OUT TO 20 MILES ARE PREFERRED.
  - REACTORS SHOULD NOT BE LOCATED WHERE THE POPULATION DENSITY IS WELL IN EXCESS OF ABOVE VALUE.
  - POPULATION PROJECTIONS TO BE CONSIDERED FOR ABOUT 5 YEARS FROM INITIAL SITE APPROVAL; TRANSIENT POPULATION ALSO FACTORED IN.
  - POPULATION GROWTH AFTER SITE APPROVAL EXPECTED; CHANGES TO BE FACTORED INTO SITE EMERGENCY PLANS.
- REFERENCE TO MINIMUM EXCLUSION AREA AND LPZ SIZES DELETED.

REVISIONS TO PART 50

- o VALUE OF 25 REM CONSISTENT WITH PAST PRACTICE. THE DOSE IS USED AS A MEASURE OF ACCIDENT MITIGATION CAPABILITY OF THE PLANT, TOGETHER WITH SITE. DOES NOT IMPLY THAT SUCH DOSES ARE ACCEPTABLE FOR THE PUBLIC UNDER ACCIDENT CONDITIONS.

- o DOSE EVALUATION AT EXCLUSION AREA AND LPZ OUTER RADIUS MAINTAINED.

- o DOSE CRITERIA TO BE CHANGED FROM 25 REM WHOLE BODY AND 300 REM THYROID TO 25 REM TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE).
  - PROVIDES A RISK CONSISTENT METHODOLOGY TO ASSESS RADIOLOGICAL IMPACT OF ALL RELEVANT NUCLIDES UPON ALL BODY ORGANS (CONSISTENT WITH PART 20);
  - AMENABLE FOR USE WITH REVISED SOURCE TERMS THAT INCLUDES OTHER NUCLIDES IN ADDITION TO NOBLE GASES AND IODINE.

- o DOSE AT EXCLUSION AREA BOUNDARY TO BE EVALUATED FOR <u>ANY</u> TWO-HOUR PERIOD AFTER FISSION PRODUCT APPEARANCE, BECAUSE OF IMPROVED UNDERSTANDING OF FISSION PRODUCT TIMING.

SEISMIC ASPECTS

NEW SECTION 100.23, ENTITLED "GEOLOGIC AND SEISMIC SITING FACTORS" HAS BEEN STREAMLINED AND CONTAINS BASIC SITING REQUIREMENTS. THESE ARE:

- GEOLOGICAL, SEISMOLOGICAL & ENGINEERING CHARACTERISTICS OF SITE MUST BE INVESTIGATED.

- SAFE SHUTDOWN EARTHQUAKE GROUND MOTION MUST BE DETERMINED.

- POTENTIAL FOR SURFACE DEFORMATION MUST BE DETERMINED.

- DESIGN BASES FOR SEISMICALLY INDUCED FLOODS & WATER WAVES MUST BE DETERMINED.

PART 50 REVISION TO EARTHQUAKE ENGINEERING REQUIREMENTS

- APPENDIX S TO PART 50 & ITS THREE ASSOCIATED REGULATORY GUIDES HAVE BEEN REVISED TO REFLECT PUBLIC COMMENTS - RELATIVELY MINOR CHANGES.

- IT IS INCLUDED IN THE PENDING PUBLIC COMMENT PACKAGE FOR COMPLETENESS.

REGULATORY GUIDANCE

- DRAFT REGULATORY GUIDE, DG-1032, GUIDANCE FOR DETERMINING THE SAFE SHUTDOWN EARTHQUAKE FOR NUCLEAR POWER PLANTS. THIS GUIDANCE IS PRIMARILY PROBABILISTIC, COUPLED WITH STRONG RELIANCE ON SITE-SPECIFIC INVESTIGATIONS.

- PROPOSED REVISION TO SRP 2.5.2 OUTLINES HOW THE STAFF WILL REVIEW AN APPLICATION UNDER THE NEW REGULATION THAT USES THE PROBABILISTIC PROCEDURES.

- THE ELEMENTS OF THE HYBRID APPROACH TO THE SITING CRITERIA (DESCRIBED DURING PREVIOUS COMMISSION BRIEFINGS) ARE CONTAINED IN THE ABOVE REGULATORY GUIDE AND STANDARD REVIEW PLAN SECTION

RECOMMENDATIONS

- COMMISSION APPROVE ISSUANCE OF PROPOSED PART 100 AND PART 50 REVISIONS FOR PUBLIC COMMENT IN FEDERAL REGISTER.

- COMMISSION APPROVE OUTLINES OF DRAFT REGULATORY GUIDES AND STANDARD REVIEW PLAN SECTION.

BACKUP VIEWGRAPHS

TOTAL EFFECTIVE DOSE EQUIVALENT

- TOTAL EFFECTIVE DOSE EQUIVALENT EQUALS DEEP DOSE EQUIVALENT (EXTERNAL EXPOSURES) PLUS COMMITTED EFFECTIVE DOSE EQUIVALENT (INTERNAL EXPOSURES).

- DEEP DOSE EQUIVALENT IS THE SAME AS PRESENT WHOLE BODY DOSE.

- THE COMMITTED EFFECTIVE DOSE EQUIVALENT IS OBTAINED BY MULTIPLYING THE DOSE TO A GIVEN ORGAN BY A WEIGHTING FACTOR APPLICABLE TO THAT ORGAN AND SUMMING OVER ALL BODY ORGANS.

RISK EQUIVALENCY OF CURRENT DOSE CRITERIA AND TEDE

- STAFF EXAMINED CURRENT DOSE CRITERIA TO SELECT A TEDE VALUE EQUIVALENT IN RISK.
- RISK OF LATENT CANCER FATALITY VS. CANCER INCIDENCE NOT THE SAME.
- RISKS ASSOCIATED WITH CURRENT DOSE CRITERIA:

  -FOR 25 REM WHOLE BODY
  RISK OF LATENT CANCER FATALITY = 2.5×10^{-2}
  RISK OF LATENT CANCER INCIDENCE = 5×10^{-2}

  -FOR 300 REM THYROID
  RISK OF LATENT CANCER FATALITY = 2.1×10^{-3}
  RISK OF LATENT CANCER INCIDENCE = 2.1×10^{-2}

- BASED ON RISK OF LATENT CANCER FATALITY, CURRENT DOSE CRITERIA ARE EQUIVALENT TO 27 REM TEDE.
- BASED ON RISK OF CANCER INCIDENCE, CURRENT DOSE CRITERIA ARE EQUIVALENT TO ABOUT 35 REM TEDE.
- LATENT CANCER FATALITY RISK USED IN SAFETY GOAL; THIS ALSO LEADS TO SELECTION OF LOWER VALUE OF 27 REM TEDE.

POLICY ISSUE

(Notation Vote)

July 27, 1994 SECY-94-194

FOR: The Commissioners

FROM: James M. Taylor
Executive Director for Operations

SUBJECT: PROPOSED REVISIONS TO 10 CFR PART 100 AND 10 CFR PART 50, AND NEW APPENDIX S TO 10 CFR PART 50

PURPOSE:

To obtain Commission approval to publish for public comment proposed revisions to reactor siting regulations and associated draft regulatory guides for use by future applicants. These proposed revisions describe basic reactor site criteria and reflect advancements in the earth sciences and earthquake engineering with regard to siting power reactors.

SUMMARY:

This paper and accompanying enclosures contain proposed revisions to 10 CFR Part 100 and 10 CFR Part 50, and a proposed new Appendix S to 10 CFR Part 50.

The proposed revised Part 100 consists of two subparts. To preserve the licensing basis for existing plants, subpart A would be identical to the present rule. Subpart B, applicable to future plants, would contain basic nonseismic site criteria, without numerical values, in a new proposed Section 100.21, "Nonseismic Siting Criteria." Seismic criteria would appear in a new Section 100.23, "Geologic and Seismic Siting Factors." Proposed guidance on population density and Safe Shutdown Earthquake Ground Motion are contained in outlines of draft regulatory guides. Staff review criteria of the vibratory ground motion are provided in an outline of a draft standard review plan section.

Revisions to 10 CFR Part 50 would contain source term and dose criteria (Section 50.34) and earthquake engineering criteria (new Appendix S).

Contact:
Leonard Soffer, RES
415-6574

Dr. Andrew J. Murphy, RES
415-6010

NOTE: TO BE MADE PUBLICLY AVAILABLE AT COMMISSION BRIEFING ON AUGUST 22, 1994

BACKGROUND:

On April 12, 1962, the Atomic Energy Commission (AEC) issued 10 CFR Part 100, "Reactor Site Criteria" (27 FR 3509). On November 13, 1973, the AEC issued Appendix A to 10 CFR Part 100, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," (38 FR 31279).

A proposed rule to revise Part 100, Appendix A to Part 100, and sections of Part 50 was published for comment on October 20, 1992 (57 FR 47802). The proposed rule change combined two separate initiatives dealing with non-seismic and seismic issues, and included a minimum distance to the exclusion area boundary of 0.4 miles, guideline limits for population density, and required both probabilistic and deterministic seismic hazard evaluations. The comment period, extended twice, expired on June 1, 1993.

Extensive comments, both domestic and international, were received. The Commission was briefed on August 3, 1993, on the status of the proposed rule and the nature of the comments received. In an SRM dated August 12, 1993, the Commission raised several concerns regarding the prescriptive aspects of the proposed revisions to Part 100 as well as its form and content. In response, the staff prepared an options paper, SECY-94-017, dated January 26, 1994, which recommended (1) that the non-seismic provisions of the proposed revision to 10 CFR Part 100 be withdrawn, (2) that Part 50 be revised to use updated source term and dose calculations for evaluating plant design, and that Part 100 be revised to emphasize siting aspects by including basic site criteria, and (3) that the proposed revision of Part 100 regarding the seismic provisions be streamlined and be permitted to continue through the NRC regulatory review process for completing the rulemaking. In an SRM dated March 28, 1994, the Commission approved the staff recommendations; however, due to the substantive nature of the changes to be made to the rule the Commission stated that both parts were to be resubmitted for Commission review and reissued for public comment prior to the final rulemaking. Also, outlines of the draft regulatory guides and standard review plan section were to be submitted to the Commission for review, to demonstrate how the basic site criteria are to be implemented. The draft regulatory guides and standard review plan section will also be issued for public comment after receiving Commission approval of the outlines.

DISCUSSION:

Elements of Proposed Rule Changes:

As discussed in SECY-94-017, the proposed revised Part 100 would consist of two sub-parts. To preserve the licensing basis for existing plants, Subpart A would be identical to the existing rule. Also, Appendix A would be retained for existing plants.

Subpart B to Part 100 would be applicable to future plants, that is, power reactor site applications (early site permits or construction permits) received on or after the effective date of the final rule, and would contain basic non-seismic site criteria as well as seismic criteria. Non-seismic

criteria, without any numerical criteria, would be located in Section 100.21, "Non-Seismic Siting Criteria", while seismic criteria would be incorporated into Section 100.23, "Geologic and Seismic Siting Factors." Appendix B to Part 100, proposed in the first revision published in October 1992, would be eliminated.

The source term and dose criteria are proposed to be located in Section 50.34 while the earthquake engineering criteria for future plants are to be incorporated in a new Appendix S to Part 50. No specific source term would be referenced in Section 50.34; a footnote would require that it be "...assumed to result in substantial meltdown of the core with subsequent release into the containment of appreciable quantities of fission products." Hence, this guidance could be used with the current source term, updated LWR accident source terms, or source terms approved for other designs, such as CANDU. The dose criteria in Part 50.34 would require that the dose to an individual located at any point on the exclusion area boundary for any 2 hour period following the postulated fission product release not exceed 25 rem total effective dose equivalent (TEDE), and that the dose to an individual located at any point on the outer boundary of the low population zone for the course of the accident also not be in excess of 25 rem TEDE.

NON-SEISMIC ASPECTS:

Basic Site Criteria:

Non-seismic site criteria for future plants would be located in a new Section 100.21 of Subpart B to 10 CFR Part 100. This would contain basic site criteria, without any numerical criteria. With regard to population density, the proposed rule would state that:

> 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 acceptable.

Although numerical criteria are not proposed to be stated in the rule, the staff has included an outline of a proposed revision of Regulatory Guide 4.7 (Enclosure 6) that would contain population density guidance.

Revision of 10 CFR Part 50:

Source term and dose calculations would be relocated to Section 50.34. Two changes should be noted.

First, the proposed rule would contain a single dose criterion of 25 rem total effective dose equivalent (TEDE), replacing the present dose criteria of 25 rem to the whole body, and 300 rem to the thyroid gland.

The total effective dose equivalent (TEDE) concept is consistent with Part 20 and is defined as the sum of the deep dose equivalent (for external exposures) plus the committed effective dose equivalent (for internal exposures). The deep dose equivalent is the same as the present whole body dose, while the committed effective dose equivalent is the sum of the products of doses to selected body organs times weighting factors applicable to each organ.

The numerical value of 25 rem is consistent with past practice and carries that practice forward. It is important to recognize that the Part 100 dose evaluation is a conservative evaluation of a dose that is unlikely to be realized, much less exceeded, by an actual individual, in the event of an accident. Rather, the dose is used as a measure of performance of the accident mitigation capability of the plant, combined with adverse atmospheric dispersion characteristics of the site. When considered together with all of the accompanying assumptions (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 (e.g., sprays), adverse site dispersion characteristics, an individual presumed to be located at the exclusion area boundary at the centerline of the plume for a specified period with no protective actions assumed), the performance required of the plant and site to meet this dose value is considered very stringent.

As an illustration of the conservatism of this calculation, the maximum whole body dose received by an actual individual during the Three Mile Island accident was estimated to be about 0.1 rem.

The use of total effective dose equivalent (TEDE) was selected not only because it provides a risk consistent methodology to assess the radiological impact of all relevant nuclides upon all body organs, but also because such a methodology is amenable for use with revised accident source terms for future plants that include additional nuclides other than the noble gases and iodine.

The staff has examined the current dose criteria of 25 rem whole body and 300 rem thyroid in order to select a TEDE value equivalent in risk. This is discussed in more detail in Enclosure 5. Latent cancer fatality risk was chosen as the appropriate risk measure since quantitative health objectives (QHOs) have been established for it as an element of the Commission's Safety Goal. Based on risk of latent cancer fatality, a dose of 25 rem whole body and 300 rem thyroid is equivalent to about 27 rem TEDE. In contrast, if latent cancer incidence rather than fatality were used, the current dose criteria would correspond to a value of about 35 rem TEDE. Based on the above, the staff concludes that use of 25 rem TEDE as a dose criterion represents a value essentially equivalent in risk to the current dose criteria.

The staff has also examined implementing this dose guidance with respect to the Commission's Safety Goal policy. Since a dose of 25 rem TEDE cannot lead to a prompt fatality, the individual risk was compared to the Safety Goal's latent cancer fatality QHO of 2×10^{-6} per year. Assuming a core damage

frequency of no more than about 10^{-4} per reactor-year, (future reactors are expected to have a significantly lower frequency), the probability of a core damage accident occurring simultaneously with poor atmospheric dispersion conditions (5 percentile meteorology consistent with staff practice) is expected to be about 5×10^{-6} per reactor-year. An individual receiving a dose of 25 rem TEDE would incur a latent cancer fatality risk of about 2.5×10^{-2}. The total individual risk for this sequence would be about 10^{-7} per year, or about one order of magnitude lower than the QHO of the Safety Goal.

Consequently, the value of 25 rem TEDE, used as a figure of merit for plant design purposes, is consistent with past staff practice and provides a conservative standard for judging the accident mitigation capability of the plant and site. The staff believes it to be appropriate to use for new design considerations and recommends its endorsement by the Commission.

Despite the above discussion, the staff is continuing to assess the implications of the use of TEDE, and intends to solicit comments in the proposed Federal Register Notice on its adoption and whether 35 rem TEDE should be used based on an equivalency in risk for cancer incidence. Based on the comments received as well as additional evaluations, the value of 25 rem may be revised when the final rule is presented. The staff will keep the Commission informed as the rulemaking proceeds.

A second change is that although the time period that the hypothetical individual is assumed to be located at the exclusion area boundary is proposed to remain at a value of 2 hours, the time period would not necessarily commence with the onset of the postulated fission product release within containment, as in the present regulation. Because improved understanding of severe accident behavior shows that accidental fission product releases into containment occur over a period of several hours or more, a two hour period that commences with the onset of fission product release may not represent the highest dose that an individual could receive in any two-hour period (the original intent of Part 100). Hence, the staff is proposing that the Part 50 be revised to require that the dose to an individual at the exclusion area boundary not be in excess of 25 rem TEDE for *any* two hour period after the appearance of fission products within the containment.

Population Density Guidance:

An outline of a proposed revision of Regulatory Guide 4.7 containing population guidance is attached (Enclosure 6).

The draft guide contains numerical guidance on preferred population density as follows:

> A reactor preferably should be located such that at the time of initial site approval and within about 5 years thereafter, the population density, including weighted transient population, averaged over any

radial distance out to 20 miles (cumulative population at a distance divided by the circular area at that distance) does not exceed 500 persons per square mile. A reactor should not be located at a site whose population density is well in excess of the above value.

If the population density of the proposed site exceeds, but is not well in excess of the above preferred value, an analysis of alternative sites should be conducted for the region of interest with particular attention to alternative sites having lower population density. However, consideration will be given to other factors, such as safety, environmental, or economic considerations, which may result in the site with the higher population density being found acceptable. Examples of such factors include, but are not limited to, the higher population density site having superior seismic characteristics, better access to skilled labor for construction, better rail or highway access, shorter transmission line requirements, or less environmental impact upon undeveloped areas, wetlands, or endangered species.

Based upon severe accident risk insights, this guidance would facilitate emergency planning, and would reduce the probability of accidental radiation exposure of large numbers of people. Analyses also indicate that population density guidance beyond about 20 miles is not warranted since individual doses would be low and that residents of a city located more than about 20 miles from a reactor would be very unlikely to require permanent relocation as a result of an accident.

The proposed guidance on preferred population density also provides effective "standoff" distances to densely populated centers, depending on size. Approximate standoff distances to the nearest population center of 25,000 persons, a city of 100,000 persons, and a major metropolitan center of 500,000 persons, would be 4 miles, 10 miles and 20 miles, respectively. Staff experience as well as studies based upon demographic and geographic conditions for various regions of the United States indicate that this guidance allows for a good selection of potential reactor sites in all regions of the nation.

The guide also states that projected changes in population should be examined for the near-term period (generally, about 5 years) after initial site approval, that population growth in the site vicinity is normally expected and that such increases would be factored into the plant emergency plans but would not be considered for license renewal purposes or, by itself, used to impose other license conditions or restrictions upon an operating plant.

Hence, the staff believes that this proposed guide reflects the Commission's policy of siting reactors away from densely populated centers and incorporates consideration of severe accident risks as well as the geographic and demographic conditions of the United States.

SEISMIC ASPECTS:

The proposed changes to the regulations and guidance documents reflect new information and research results and comments from the public on the first proposed revision of the regulations. The proposed changes continue to reflect the philosophy of the first proposed revision that the regulation only contains the basic requirements and that the detailed guidance, which is contained in the current regulation, Appendix A to 10 CFR Part 100, be removed to guidance documents. Thus, the proposed regulation contains: a.) required definitions, b.) a requirement to determine the geological, seismological, and engineering characteristics of the proposed site, and c.) a requirement to determine the Safe Shutdown Earthquake Ground Motion (SSE) and its uncertainty, 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 balanced approach to determine the SSE are presented in the following section. The elements are the guidance that will be fully described in the guidance documents. A specific document explaining NRC staff's disposition of pertinent comments from the public comment period will be prepared coincident with the final rulemaking.

Geologic and seismic siting:

The proposed regulation, Section 100.23 to Part 100, would identify and establish basic requirements. Detailed guidance, that is, procedures acceptable to the NRC staff for meeting the requirements, would be contained in Draft Regulatory Guide DG-1032, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motions." An outline of DG-1032 is provided as Enclosure 7. NRC staff review guidelines will be provided in Draft Standard Review Plan (SRP) Section 2.5.2, Second Proposed Revision 3, "Vibratory Ground Motion." An outline for this section (i.e., SRP 2.5.2) is provided as Enclosure 8. Two other SRP sections, 2.5.1, "Basic Geologic and Seismic Information," and 2.5.3, "Surface Faulting," will also be revised to assure consistency among the proposed rule, SRP Section 2.5.2, and draft regulatory guide DG-1032. Because this does not involve substantial technical changes outlines for these SRP sections are not provided. A draft regulatory guide and draft standard review plan sections will be prepared and issued for public comment upon receipt of Commission approval of the outlines.

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 the uncertainty 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 cumbersome.

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 to not only 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 proposed revision to the regulation now 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.

In the proposed outline the staff has achieved an appropriate balance between deterministic and probabilistic seismic hazard evaluations to be used in the revision of the seismic and geologic siting criteria for nuclear power plants. The key elements of this balanced approach are:

a. Conduct site-specific and regional geoscience investigations.
   These investigations are performed to determine specific characteristics of the proposed site, such as, the presence or absence of potential seismic sources, capable faults on or near the site, characterization of the geological rock and soil strata, earthquake history of site and environs, etc. In addition to characterizing the site, these data are needed to verify that regional characteristics used in the LLNL and EPRI probabilistic seismic hazard assessments (PSHA) are valid for the proposed site.

b. Target exceedance probability is set by examining the design bases of more recently licensed nuclear power plants.
   The target exceedance probability is the median probability of exceeding the Safe Shutdown Earthquake (SSE) for operating nuclear power plant that were designed to Regulatory Guide 1.60 or to a

similar spectrum. This value has been determined to be 1E-5/year for LLNL PSHA.

c. Determine if information from geoscience investigations change probabilistic results.
The applicant conducts an evaluation that demonstrates that the data obtained from the site investigations (Step a. above) do not provide information that would necessitate revision of the existing seismic sources and their characteristics or attenuation models.

d. Conduct probabilistic seismic hazard analysis and determine ground motion level corresponding to the target exceedance probability.
The applicant conducts a LLNL or EPRI PSHA for the proposed site to obtain a seismic hazard curve, ground acceleration vs. annual probability of exceedance. The hazard curve is deaggregated to determine a seismic event described by an average earthquake magnitude and distance (distance from earthquake to the nuclear power plant site) which contributes most to the ground motion level corresponding to the target exceedance probability. This magnitude and distance is then used in subsequent steps to determine site-specific spectral shape.

e. Determine site-specific spectral shape and scale this shape to the ground motion level determined above.
The applicant will use the seismic event of magnitude and distance determined in Step c to develop site-specific spectral shape in accordance with SRP 2.5.2 procedures and additional guidance to be provided in draft Regulatory Guide DG-1032. The SRP procedures, in part, are based on use of seismic recorded motions or ground motion models appropriate for the event, region and site under consideration.

f. NRC staff review of ground motion.
The NRC staff will review the applicants proposed SSE ground motion to assure that it takes into account all available data including insights and information gained from previous licensing experience.

g. Update the data base and reassess probabilistic methods at least every ten years.
To keep the regulatory guidance on the probabilistic methods and their seismic hazard data base current, the NRC would reassess them at least every ten years and update it as appropriate.

Thus, the proposed outline requires thorough regional and site-specific geoscience investigations. The proposed approach reflects some of the comments of the U.S. utility industry. The U.S. Geological Survey provided a series of comments and recommendations that led to and can be met by the above integrated approach.

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 the Draft Standard Review Plan Section 2.5.2, Second Proposed Revision 3, "Vibratory Ground Motion."

The NRC staff's review approach to evaluate an application is described in Draft SRP Section 2.5.2. This review takes into account the information base developed in licensing more than 100 plants. This staff review is consistent with the intent of a USGS recommendation. 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 basis 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.

Earthquake Engineering

The proposed regulation is a new Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," to Part 50. Procedures acceptable to the NRC staff for meeting the requirements in the regulation are contained in three draft regulatory guides, a.) DG-1033, Third Proposed Revision 2 to Regulatory Guide 1.12, "Nuclear Power Plant Instrumentation for Earthquakes," b.) DG-1034, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Postearthquake Actions," and c.) DG-1035, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event."

There were no substantive changes to the regulation or guidance documents; therefore, outlines of these draft regulatory guides are not being forwarded for Commission approval.

COORDINATION: The Office of the General Counsel has reviewed this paper and has no legal objection.

RECOMMENDATIONS: That the Commission:

1. Approve the issuance of the enclosed draft Federal Register notice, regulatory analysis, environmental assessment, and OMB reporting package (Enclosures 1 to 4) for a 120-day public comment period.

2. Approve the enclosed outlines of draft regulatory guides and standard review plan section for issuance for public comment. These demonstrate how the basic siting criteria will be implemented.

3. Certify that this rule, if promulgated, will not have a significant economic effect on a substantial number of small entities pursuant to the Regulatory Flexibility Act of 1980 (5 U.S.C. 605 (b)).

4. Note:

   a. The proposed regulation and draft Federal Register Notice (Enclosure 1) will be published in the Federal Register for a 120-day public comment period.

   b. A notice of availability of a regulatory analysis (Enclosure 2) and an environmental assessment and finding of no significant environmental impact (Enclosure 3) will be supplied concurrently to the Public Document Room.

   c. Because Section 100.23 to Part 100 and Appendix S to Part 50 are new, an "information collection requirement" is being submitted to OMB for review (Enclosure 4). It is noted that the overall estimated burden on the staff and industry remains essentially the same; the proposed revision potentially reduces the required earthquake engineering analyses.

   d. A public announcement (Enclosure 9) will be issued when the notice of proposed rulemaking is filed with the Office of the Federal Register.

   e. The appropriate Congressional committees will be informed (Enclosure 10).

   f. Copies of the Federal Register notices will be distributed to all power reactor permitees and licensees. The notices will be sent to other interested parties on request.

g. The Chief Counsel for Advocacy of the Small Business Administration will be notified of the Commission's determination, pursuant to the Regulatory Flexibility Act of 1980 (5 U.S.C. 605 (b)), that these proposed regulations, draft regulatory guides, and draft standard review plan section will not have a significant economic effect on a substantial number of small entities.

h. A Backfit Analysis is not required for this proposed rule, because these amendments do not involve any provisions that would impose backfits as defined in 10 CFR 50.109(a)(1).

i. Draft regulatory guides and the standard review plan section will be prepared and issued for public comment upon receipt of Commission approval of the outlines (Enclosures 6 to 8).

James M. Taylor
Executive Director
for Operations

Enclosures:
1. Federal Register Notice of Rulemaking
2. Regulatory Analysis
3. Environmental Assessment
4. OMB Reporting Review Package
5. Risk Equivalence Between Current Dose Criteria and TEDE Values
6. Outline of Draft Regulatory Guide DG-4003, (General Site Suitability Criteria)
7. Outline of Draft Regulatory Guide DG-1032, (Seismic Sources)
8. Proposed Revision 3 to Standard Review Plan Section 2.5.2, (Vibratory Ground Motion)
9. Draft Public Announcement
10. Draft Congressional Letters

Commissioners' comments or consent should be provided directly to the Office of the Secretary by COB Monday, August 29, 1994.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Monday, August 8, 1994, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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ENCLOSURE 1

[7590-01]

NUCLEAR REGULATORY COMMISSION

10 CFR Parts 50, 52 and 100

RIN 3150-AD93

Reactor Site Criteria

Including Seismic and Earthquake Engineering Criteria for

Nuclear Power Plants

and Proposed Denial of Petition from Free Environment, Inc. et. al.

AGENCY: Nuclear Regulatory Commission.

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

SUMMARY: The Nuclear Regulatory Commission (NRC) is proposing to amend 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 proposed rule would allow 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. In addition, this proposed rule benefits from the public comments received on the first proposed revision of the regulations. The proposed 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 is also proposing to deny the remaining issue in petition (PRM-50-20) filed by Free Environment, Inc. et. al.

DATE: Comment period expires 120 days after date of publication in the Federal Register. Comments received after this date will be considered if it is practical to do so, but the Commission is able to assure consideration only for comments received on or before this date.

ADDRESSES: Mail written comments to: Secretary, U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Docketing and Service Branch.

Deliver comments to 11555 Rockville Pike, Rockville, Maryland, between 7:45 am and 4:15 pm, Federal workdays.

Copies of the regulatory analysis, the environmental assessment and finding of no significant impact, and comments received may be examined at the NRC Public Document Room at 2120 L Street NW. (Lower Level), Washington, DC.

FOR FURTHER INFORMATION CONTACT: Dr. Andrew J. Murphy, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 415-6010, concerning the seismic and earthquake engineering aspects and Mr. Leonard Soffer, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 415-6574, concerning other siting aspects.

SUPPLEMENTARY INFORMATION:

I. Background

The present regulation regarding reactor site criteria (10 CFR Part 100) was promulgated April 12, 1962 (27 FR 3509). 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. Because of possible renewed interest in power reactor siting, the NRC is proceeding with a rulemaking in this area. The Commission proposes to address the remaining issue in PRM-50-20 as part of this rulemaking action.

Appendix A to 10 CFR Part 100, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," 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) 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).

The proposed regulations published in 57 FR 47802 and draft guidance documents cited in 57 FR 55601 are withdrawn due to the substantive nature of the changes to be made in response to public comments and are replaced with the second proposed revision of the regulations cited herein.

II. Objectives

The objectives of this proposed 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 proposed 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. In addition, the proposed regulatory action will benefit from public comments received on the first proposed revision of the regulations and guidance documents,

The proposed regulatory action would 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.

Criteria not associated with the selection of the site 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 proposed regulation would not be applied to existing plants, the licensing bases for existing nuclear power plants must remain part of the regulations. Therefore, the non-seismic and seismic reactor site criteria for current plants would be retained as Subpart A and Appendix A to 10 CFR Part 100, respectively. The proposed revised reactor site criteria would be added as Subpart B in 10 CFR Part 100

and would apply to site applications received on or after the effective date of the final regulations. Non-seismic site criteria would be added as a new Section 100.21 to Subpart B in 10 CFR Part 100. The criteria on seismic and geologic siting would be added as a new Section 100.23 to Subpart B in 10 CFR Part 100. The dose calculations and the earthquake engineering criteria would be 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 proposed regulation would also make conforming amendments to 10 CFR Part 52; Section 52.17(a)(1) would be 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 1800 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, 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 has also had a long standing policy of siting reactors away from densely populated centers, and is continuing this policy in the proposed rule.

The Commission is proposing to incorporate basic reactor site criteria in the proposed rule to accomplish the above purposes.

The Commission proposes to retain source term and dose calculations to verify the adequacy of a site for a specific plant, but source term and dose calculations will be 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 would be referenced in Part 50. Rather, the source term would be 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 could be utilized with the source term currently used for light-water reactors, or used in conjunction with revised accident source terms, currently under development within the NRC staff as well as in the industry.

The proposed 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 would 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 would 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 proposing to retain this requirement for future reactors.

The proposed rule issued for comment in October 1992 proposed a minimum distance to the exclusion area boundary of 0.4 miles (640 meters), based upon the suggested value given in Regulatory Guide 4.7, without utilizing source term and dose calculations. This was based upon a conservative evaluation of the performance of fission product cleanup systems such as containment sprays or filter systems. Numerous comments were received stating that source term and dose calculations should be retained, and that the exclusion area distance should also be based upon a more realistic evaluation of actual fission product cleanup systems. In response to these comments, the Commission is proposing, in the present rule, to retain the use of source term and dose calculations, 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 would not be permitted. For plants that do not involve standardized designs, the source term and dose calculations would continue to 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.

In the proposed rule, the Commission is proposing two changes in this area.

First, the Commission is proposing 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 total effective dose equivalent concept is consistent with Part 20 of the Commission's regulations, and is defined as the deep dose equivalent (for external exposures) plus the committed effective dose equivalent (for internal exposures). The deep dose equivalent is the same as the present whole body dose, while the committed effective dose equivalent is the sum of the products of doses to selected body organs times weighting factors for each organ that are representative of the radiation risk associated with that organ.

The proposed use of the total effective dose equivalent, or TEDE, is 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 has examined 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. These risks consist of the risk of developing cancer some time after the exposure (latent cancer incidence), as well as a delayed risk of cancer fatality (latent cancer fatality). For a dose of 25 rem whole body, the individual risk of latent cancer fatality is estimated to be about 2.5×10^{-2}; the risk of latent cancer incidence is about twice that. For a dose of 300 rem thyroid, the risk of latent cancer fatality is about 2×10^{-3}; the risk of latent cancer incidence is about a factor of ten higher.

If the risk of latent cancer fatality is selected as the appropriate risk measure to be used, the current dose criteria represent a risk of about 2.7×10^{-2}. Using a risk coefficient of about 10^{-3} per rem, the risk of latent cancer fatality implied by the current dose criteria is equivalent to 27 rem TEDE. (BEIR V estimates a latent cancer fatality risk coefficient of about 5×10^{-4} per rem, if the dose is received over a period of days or more; however, if the exposure period is shorter, such as 2 hours, the risk coefficient is approximately double.)

If latent cancer incidence rather than fatality were used, the current dose criteria would correspond to a value of about 35 rem TEDE. The organ

weighting factor for the thyroid gland in Part 20 is 0.03, and is based upon risk of cancer incidence. Using this weighting factor, the current criteria of 25 rem whole body and 300 rem thyroid result in a TEDE of 34 rem (25 plus 300 X 0.03).

The Commission is proposing 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 current dose criteria are equivalent in risk to 27 rem TEDE, as noted above, the Commission is proposing 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.

Nevertheless, the Commission is specifically requesting comments on the use of TEDE. Comments are requested on whether the current dose criteria should be modified to utilize the total effective dose equivalent, or TEDE, concept. The Commission is also requesting comments on 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. Finally, because the thyroid weighting factor is equal to a value of 0.03, there exists a theoretical possibility that an accidental release composed only of iodine could result in a TEDE less than 25 rem, yet result in a thyroid dose of over 800 rem. Although the Commission believes that the likelihood that an actual accident would release only iodine is highly unlikely, comments are also requested as to 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.

The second change being proposed in this area is 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 Commission is proposing 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 is proposing 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 a hypothetical 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 is proposing that various two-hour periods be examined to assure that the dose to a hypothetical individual at the exclusion area boundary will not be in excess of 25 rem TEDE over any two-hour period after the onset of fission product release.

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 intends to require 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 proposing that the atmospheric dispersion characteristics of the site will be required to 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.

Before 1980, the LPZ generally defined the distance over which public protective actions were contemplated in the event of a serious accident. The regulations in 10 CFR 50.47 now requires plume exposure Emergency Planning Zones (EPZ) of about 10 miles for each plant.

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 proposing to retain 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 proposed rule would require 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 proposed rule would codify this practice.

F. Adequacy of Security Plans The proposed rule would require 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 would

entail a small secure area considerably smaller than that envisioned for the exclusion area.

G. Adequacy of Emergency Plans The proposed rule would also require that the site characteristics be such that adequate plans to carry out protective measures for members of the public in the event of emergency could be developed.

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) 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, because the wind is expected to blow in all directions with roughly the same frequency, the likelihood that radioactive material would actually be carried towards the city is reduced significantly 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 considers 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 proposing a two-tier approach with regard to population density and reactor sites. The proposed rule states that reactor sites should be located away from very densely populated centers, and also states that areas of low population density are, generally, preferred. The Commission believes that a site not falling within these two categories, although not preferred, could 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.

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 above 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 (50 km) from the reactor as a result of land contamination from a severe accident is very low.

Hence, the Commission concludes that the current 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 above, 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. 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 proposed change to 10 CFR Part 50 would relocate 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 would 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 in the proposed revision to Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to Part 100, are associated with the proposed seismic and earthquake engineering criteria rule making. These changes reflect new information and research results, and incorporate the intentions of this regulatory action as defined in Section III of this proposed rule including comments from the public on the first proposed revision of the regulations. A specific document explaining the NRC staff's disposition of pertinent comments will be prepared coincident with the final rulemaking.

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 proposed 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 Section 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.

The current regulation 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 proposed regulation would be 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 proposed regulation would be reduced considerably. This approach reflects the philosophy of the first proposed revision that the regulation only contains the basic requirements and that the detailed guidance, which is contained in the current regulation, Appendix A to 10 CFR Part 100, be removed to guidance documents. Thus, the proposed regulation contains: a.) required definitions, b.) a requirement to determine the geological, seismological, and engineering characteristics of the proposed site, and c.) a requirement to determine the Safe Shutdown Earthquake Ground Motion (SSE) and its uncertainty, 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 balanced approach to determine the SSE are presented in the following section. The elements are the guidance that will be fully described in the guidance documents.
The proposed regulation is a new section in Part 100 rather than an appendix to Part 100. The proposed regulation would identify and establish basic requirements. Detailed guidance, that is, the procedures acceptable to the NRC for meeting the requirements, would be contained in a draft regulatory guide to be issued for public comment as Draft Regulatory Guide, DG-1032,

"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 so little is known 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 to not only 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 proposed revision to the regulation now 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 staff has achieved an appropriate balance between deterministic and probabilistic seismic hazard evaluations to be used in the revision of the seismic and geologic siting criteria for nuclear power plants. The key elements of this balanced 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 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 proposed approach requires thorough regional and site-specific geoscience investigations. The proposed approach reflects some of the comments of the U.S. utility industry. The U.S. Geological Survey provided a series of comments and recommendations that led to and can be met by the above integrated approach.

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 the Draft Standard Review Plan Section 2.5.2, Second Proposed Revision 3, "Vibratory Ground Motion."

Methods acceptable to the NRC staff for implementing the proposed regulation are described in Draft Regulatory Guide DG-1032, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motions."

The NRC staff's review approach to evaluate an application is described in Draft SRP Section 2.5.2. This review takes into account the information base developed in licensing more than 100 plants. This staff review is consistent with the intent of a USGS recommendation. 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 basis 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.

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 proposed regulation would move 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 proposed 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. However, the proposed regulation 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, Appendix A, Section V(a)(2)) states that the maximum vibratory ground motion of the OBE is one half the maximum vibratory ground motion of the Safe Shutdown Earthquake ground motion. Also, the existing regulation (10 CFR, 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 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. 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.

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 proposed regulation would allow 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 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 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 VIII of this Proposed 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.

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 is 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 Operating Basis Earthquake 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 proposed regulation would treat plant shutdown associated with vibratory ground motion exceeding the OBE or significant plant damage as a condition in every operating license. A new paragraph 50.54(ee) would be 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 Proposed 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.

Draft Regulatory Guide DG-1034, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post-Earthquake Actions," is being developed to provide 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 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 being developed in Draft Regulatory Guide DG-1034 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. (This unavailability may be due to earthquake related damage.)

Draft Regulatory Guide DG-1035, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event," is being developed to provide 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 shall 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.

In Section 100.23 to 10 CFR Part 100, changes have been made to resolve questions of interpretation. As an example, definitions and required investigations stated in the proposed regulation would be significantly changed to eliminate or modify phrases 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 proposed relocation of the earthquake engineering criteria to Appendix S to Part 50 and the proposed 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 reference to both the Part 100 and Part 50 dose guidelines.

VI. Related Regulatory Guides and Standard Review Plan Section

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

1. DG-1032, "Identification and Characterization of Seismic Sources and Determination of Shutdown Earthquake Ground Motions." The draft 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 Proposed rule describes the key elements.

2. DG-1033, Third Proposed Revision 2 to Regulatory Guide 1.12, "Nuclear Power Plant Instrumentation for Earthquakes." The draft guide describes seismic instrumentation type and location, operability, characteristics, installation, actuation, and maintenance that are acceptable to the NRC staff.

3. DG-1034, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post-Earthquake Actions." The draft 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. DG-1035, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event." The draft 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. Draft Standard Review Plan Section 2.5.1, Proposed Revision 3, "Basic Geologic and Seismic Information." The draft 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. Draft Standard Review Plan Section 2.5.2, Second Proposed Revision 3 "Vibratory Ground Motion." The draft describes procedures to assess the ground motion potential of seismic sources at the site and to assess the adequacy of the SSE.

7. Draft Standard Review Plan Section 2.5.3, Proposed Revision 3, "Surface Faulting." The draft 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. DG-4003, Second Proposed Revision 2 to Regulatory Guide 4.7, "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 subsequent to the publication of the final regulations that would implement this proposed action.

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. 1.27, "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"

Minor and conforming changes to other Regulatory Guides and standard review plan sections as a result of proposed 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 proposed rule as set out below.

Copies of NUREG-0625, NUREG-1150, and NUREG/CR-2239 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, P.O. Box 37802, Washington, DC 20013-7082. Copies are also available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. A copy is also 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 20013-2171. Issued guides may also 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 Commission's Public Document Room, 2120 L Street, NW. (Lower Level), Washington, DC.

IX. Submission of Comments in Electronic Format

The comment process will be improved if each comment is identified with the document title, section heading, and paragraph number addressed. Commenters are encouraged to submit, in addition to the original paper copy, a copy of the letter in electronic format on 5.25 or 3.5 inch computer diskette; IBM PC/DOS or MS/DOS format. Data files should be provided in one of the following formats: WordPerfect, IBM Document Content Architecture/Revisable-Form-Text (DCA/RFT), or unformatted ASCII code. The format and version should be identified on the diskette's external label.

X. Questions

In addition to soliciting comments on all aspects of this rulemaking, the Commission specifically requests comments on the following questions.

A. Nonseismic Criteria.

1. Should the dose acceptance criteria be modified from 25 rem whole body and 300 rem to the thyroid to utilize the concept of total effective dose equivalent (TEDE), and if so, what TEDE value should be adopted?

2. Assuming that a dose acceptance criterion of 25 rem total effective dose equivalent (TEDE) is adopted, should an organ limitation or "capping" dose be included, and if so, what should such a limit be?

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 proposed regulation, if adopted, would not be 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 the public health and safety over the current regulations. The proposed amendments do not affect nonradiological plant effluents and have no other environmental impact.

The addition of Section 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. Base line 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 proposed 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 Mr. Leonard Soffer, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 415-6574, or Dr. Andrew Murphy, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 415-6010.

XII. Paperwork Reduction Act Statement

This proposed regulation amends information collection requirements that are subject to the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). This proposed regulation has been submitted to the Office of Management and Budget for review and approval of the paperwork requirements.

There is no public reporting burden related to the nonseismic siting criteria. Public reporting burden for the collection of information related to the seismic and earthquake engineering criteria 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 regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Information and Records Management Branch (MNBB 7714), U.S. Nuclear Regulatory Commission, Washington, DC 20555; and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-3019, (3150-0011 and 3150-0093), Office of Management and Budget, Washington, DC 20503.

XIII. Regulatory Analysis

The Commission has prepared a draft regulatory analysis on this proposed regulation. The analysis examines the costs and benefits of the alternatives considered by the Commission. The draft analysis is available for inspection in the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC. Single copies of the analysis are available from Mr. Leonard Soffer, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 415-6574, or Dr. Andrew J. Murphy, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 415-6010.

The Commission requests public comment on the draft regulatory analysis. Comments on the draft analysis may be submitted to the NRC as indicated under the ADDRESSES heading.

XIV. Regulatory Flexibility Certification

In accordance with the Regulatory Flexibility Act of 1980 (5 U.S.C. 605(b)), the Commission certifies that this proposed regulation will not, if promulgated, have a significant economic impact on a substantial number of small entities. This proposed regulation affects only the licensing and operation of nuclear power plants. Nuclear power plant site applicants do not fall within the definition of small businesses as defined in Section 3 of the Small Business Act (15 U.S.C. 632), the Small Business Size Standards of the Small Business Administrator (13 CFR Part 121), or the Commission's Size Standards (56 FR 56671; November 6, 1991).

XV. Backfit Analysis

The NRC has determined that the backfit rule, 10 CFR 50.109, does not apply to this proposed regulation, and therefore, a backfit analysis is not required for this proposed regulation because these amendments do not involve any provisions that would impose backfits as defined in 10 CFR 50.109(a)(1). The proposed 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 50 – Antitrust, Classified information, Criminal penalty, Fire protection, Incorporation by reference, 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 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. 553, the NRC is proposing to adopt the following amendments to 10 CFR Parts 50, 52 and 100.

PART 50 – DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

1. 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. 936, 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).

For the purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273), §§ 50.5, 50.46(a) and (b), and 50.54(c) are issued under sec. 161b, 68 Stat. 948, as amended (42 U.S.C. 2201(b)); §§ 50.5, 50.7(a), 50.10(a)-(c), 50.34(a) and (e), 50.44(a)-(c), 50.46(a) and (b), 50.47(b), 50.48(a), (c), (d), and (e), 50.49(a), 50.54(a)(i), (i)(l), (l)-(n), (p), (q), (t), (v), and (y), 50.55(f), 50.55a(a), (c)-(e), (g), and (h), 50.59(c), 50.60(a), 50.62(b), 50.64(b), 50.65 and 50.80(a) and (b) are issued under sec. 161i, 68 Stat. 949, as amended (42 U.S.C. 2201(i)); and §§50.49(d), (h), and (j), 50.54(w), (z), (bb), (cc), and (dd), 50.55(e), 50.59(b), 50.61(b), 50.62(b), 50.70(a), 50.71(a)-(c) and (e), 50.72(a), 50.73(a) and (b), 50.74, 50.78, and 50.90 are issued under sec. 161o, 68 Stat. 950, as amended (42 U.S.C. 2201(o)).

* * * * *

2. In §50.2, add 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 to read as follows:

§ 50.2 Definitions.

As used in this part,

* * * * * *

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/cm^2).

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 shutdown 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.

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).

* * * * *

3. 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, 50.48, 50.49, 50.54, 50.55, 50.55a, 50.59, 50.60, 50.61, 50.63, 50.64, 50.65, 50.71, 50.72, 50.80, 50.82, 50.90, 50.91, and Appendices A, B, E, G, H, I, J, K, M, N, O, Q, R, and S.

* * * * *

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

* * * * * *

(1) 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 release[6] 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:

(i) 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 rem[7] total effective dose equivalent (TEDE).

(ii) 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

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[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).

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.

* * * * *

5. In §50.34 paragraphs (a)(12) and (b)(10) are added to read as follows:

§ 50.34 Contents of applications; technical information.

(a) * * *

(12) On or after [EFFECTIVE DATE OF THE FINAL RULE], 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 of this part.

(b) * * *

(10) On or after [EFFECTIVE DATE OF THE FINAL RULE], 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, if the construction permit was issued prior to [EFFECTIVE DATE OF THE FINAL RULE], the applicant shall comply with the earthquake engineering criteria in Section VI of Appendix A to Part 100 of this chapter.

* * * * *

6. In §50.54, paragraph (ee) is added to read as follows:

§50.54 Conditions of licenses.

* * * * *

(ee) For licensees of nuclear power plants that have implemented the earthquake engineering criteria in Appendix S of 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.

7. 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 [EFFECTIVE DATE OF THE FINAL RULE]. However, if the construction permit was issued prior to [EFFECTIVE DATE OF THE FINAL RULE], the operating license applicant shall comply with the earthquake engineering criteria in Section VI of Appendix A to 10 CFR Part 100.

I. Introduction

Each applicant for a construction permit, operating license, design certification, or combined license is required by §50.34(a)(12), §50.34(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(ee), 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) of this chapter.

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) of this chapter.

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 to Part 100 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 to Part 100 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)(*1*) 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)(*1*) are satisfied. The design must take into account soil-structure interaction effects and the duration of vibratory ground motion.

(*1*) 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 OBE, 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.

(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, including aftershocks, 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 to Part 100 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

8. 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).

9. In §52.17, paragraph (a)(1)(vi) is 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 100 – REACTOR SITE CRITERIA

10. 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).

11. 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 Test 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 – Seismic and Geologic Siting Criteria for Nuclear Power Plants.

12. Section 100.1 is revised to read as follows:

§ 100.1 Purpose.

The purpose of this part is to establish approval requirements for proposed sites for commercial power and test reactors subject to Part 50 or Part 52 of this chapter.

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.

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, and that the site characteristics are amenable to the development of adequate emergency plans to protect the public and adequate security measures to protect the plant.

This approach incorporates the appropriate standards and criteria for approval of commercial power and test 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.

13. 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 commercial power and test reactors pursuant to the provisions of parts 50 or 52 of this chapter.

14. 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.

15. 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 100 should be addressed to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555, 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.

16. 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 1980 (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.

17. 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 Test Reactors.

18. Section 100.10 is added to read as follows:

§100.10 Factors to be considered when evaluating sites.

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

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

(a) Characteristics of reactor design and proposed operation including--

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

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

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

(4) 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.

(b) Population density and use characteristics of the site environs, including the exclusion area, low population zone, and the population center distance.

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

(1) Appendix A to Part 100, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," describes the nature of investigations required to obtain the geologic and seismic data necessary to determine site suitability and to provide reasonable assurance that a nuclear power plant can be constructed and operated at a proposed site without undue risk to the health and safety of the public. It describes procedures for determining the quantitative vibratory ground motion design basis at a site due to earthquakes and describes information needed to determine whether and to what extent a nuclear power plant need be designed to withstand the effects of surface faulting.

(2) Meteorological conditions at the site and in the surrounding area should be considered.

(3) Geological and hydrological characteristics of the proposed site may have a bearing on the consequences of an escape of radioactive material from the facility. Special precautions should be planned if a reactor is to be located at a site where a significant quantity of radioactive effluent might accidentally flow into nearby streams or rivers or might find ready access to underground water tables.

(d) Where unfavorable physical characteristics of the site exist, the proposed site may nevertheless be found to be acceptable if the design of the facility includes appropriate and adequate compensating engineering safeguards.

19. Section 100.11 is added to read as follows:

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

(a) As an aid in evaluating a proposed site, an applicant should assume a fission product release[1] from the core, the expected demonstrable leak rate from the containment and the meteorological conditions pertinent to his site to derive an exclusion area, a low population zone and population center distance. For the purpose of this analysis, which shall set forth the basis for the numerical values used, the applicant should determine the following:

(1) An exclusion area 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 to the whole body in excess of 25 rem[2] or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

(2) A low population zone of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a total radiation dose to the whole body in excess of 25 rem or a total radiation dose in excess of 300 rem to the thyroid from iodine exposure.

(3) A population center distance of 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. Where very large cities are involved, a greater distance may be necessary because of total integrated population dose consideration.

(b) For sites for multiple reactor facilities consideration should be given to the following:

(1) If the reactors are independent to the extent that an accident in one reactor would not initiate an accident in another, the size of the exclusion area, low population zone and population center distance shall be fulfilled with respect to each reactor individually. The calculated envelopes of each of the plants areas shall be overlayed of the areas such that the outermost composite boundary shall then be taken as the plant boundary.

(2) If the reactors are interconnected to the extent that an accident in one reactor could affect the safety of operation of any other, the size of the exclusion area, low population zone and population center distance shall be based upon the assumption that all interconnected reactors emit their postulated fission product releases simultaneously. This requirement may be reduced in

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[1]The fission product release assumed for these calculations should be based upon a major accident, hypothesized for purposes of site analysis or postulated from considerations of possible accidental events, that would result in potential hazards not exceeded by those from any accident considered credible. Such accidents have generally been assumed to result in substantial meltdown of the core with subsequent release of appreciable quantities of fission products.

[2] The whole body dose of 25 rem referred to above corresponds numerically to the once in a lifetime accidental or emergency dose for radiation workers which, according to NCRP recommendations may be disregarded in the determination of their radiation exposure status (see NBS Handbook 69 dated June 5, 1959). However, neither its use nor that of the 300 rem value for thyroid exposure as set forth in these site criteria guides are intended to imply that these numbers constitute acceptable limits for emergency doses to the public under accident conditions. Rather, this 25 rem whole body value and the 300 rem thyroid value have been set forth in these guides as reference values, which can be used in the evaluation of reactor sites with respect to potential reactor accidents of exceedingly low probability of occurrence, and low risk of public exposure to radiation.

relation to the degree of coupling between reactors, the probability of concomitant accidents and the probability that an individual would not be exposed to the radiation effects from simultaneous releases. The applicant would be expected to justify to the satisfaction of the Commission the basis for such a reduction in the source term.

(3) The applicant is expected to show that the simultaneous operation of multiple reactors at a site will not result in total radioactive effluent releases beyond the allowable limits of applicable regulations.

NOTE: For further guidance in developing the exclusion area, the low population zone, and the population center distance, reference is made to Technical Information Document 14844, dated March 23, 1962, which contains a procedural method and a sample calculation that result in distances roughly reflecting current siting practices of the Commission. The calculations described in Technical Information Document 14844 may be used as a point of departure for consideration of particular site requirements which may result from evaluation of the characteristics of a particular reactor, its purpose and method of operation.

Copies of Technical Information Document 14844 may be obtained from the Commission's Public Document Room, 2120 L Street NW., Washington, DC, or by writing the Director of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

20. Subpart B (§§100.20 - 100.23) is added 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 site-related characteristics would not prevent the development of a plan to carry out suitable protective actions for members of the public in the event of emergency.

(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) §100.23, "Geologic and seismic siting factors," of this part 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 Section 100.3 of this part;

(b) The population center distance, as defined in Section 100.3 of this part, 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) 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) Site characteristics must be such that adequate plans to take protective actions for members of the public in the event of emergency can be developed:

(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 acceptable[3].

* * * * *

§ 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 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 [EFFECTIVE DATE OF THE FINAL RULE]. However, if the construction permit was issued prior to [EFFECTIVE DATE OF THE FINAL RULE], the operating license applicant shall comply with the seismic and geologic siting criteria in Appendix A to Part 100 of this chapter.

(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

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[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.

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 ___ day of ____ .

For the Nuclear Regulatory Commission.

Samuel J. Chilk,
Secretary of the Commission.

ENCLOSURE 2

DRAFT REGULATORY ANALYSIS

PROPOSED REVISIONS OF 10 CFR PART 100, AND 10 CFR PART 50

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

STATEMENT OF THE PROBLEM

This Regulatory Analysis covers two considerations. First is the revision of 10 CFR Part 100, "Reactor Site Criteria," for future plants. The second consideration is the revision of Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100. Both considerations address the relocation of plant design criteria from Part 100 to 10 CFR Part 50. This is the second proposed revision of 10 CFR Part 100 and Appendix A 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, and Appendix A to 10 CFR Part 100) be reissued for public comment (Ref. 1).

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," sets forth 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 in the United States. Light-water commercial power reactors have accumulated about 1800 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

today's 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, concern and significant research on potential 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 75 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 major impetus for the proposed rule is possible increased interest in new nuclear power generation and the possibility that applicants will request site approval for new nuclear power plants. The Commission believes that, in the event such requests materialize, 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 (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 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 the proposed 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 will be 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 proposed regulatory action will apply 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 will state basic site criteria.

3. Source term and dose calculations would be 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 will be 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 proposed 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 proposed regulatory action will apply 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 revised regulation. However, if the construction permit was issued prior to the effective date of the regulation, the operating license applicant must comply with the seismic and geologic siting and earthquake engineering criteria in Appendix A to 10 CFR Part 100.

2. Criteria not associated with the selection of the site or establishment of the safe shutdown earthquake ground motion have been placed into Part 50. This action is consistent with the location of other design requirements in Part 50.

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

Earthquake engineering criteria will be 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) will be revised to reference Appendix S.

The proposed rule would also make conforming amendments to 10 CFR Parts 52 and 100.

Finally, in support of the above changes, several regulatory guides and standard review plan sections will be 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 rather than 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 renewed sense of urgency to initiate the proposed 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 will be 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 proposed 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 being 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 proposed 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 proposed rule involves no substantive changes in this

area.

3. Source Term and Dose Calculations. The proposed rule would relocate 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 will be 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 guidelines 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 will be 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 proposed regulatory action reflects changes intended to (1) benefit from the public comments associated with the first 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 proposed revision to the regulation now 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 staff has achieved an appropriate balance between deterministic and probabilistic seismic hazard evaluations to be used in the revision of the seismic and geologic siting criteria for nuclear power plants. The key elements of this balanced 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 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
- Update the data base and reassess probabilistic methods at least every ten years.

Thus, the proposed probabilistic rule is anchored by the Commission Severe Accident Policy and requires thorough regional and site-specific geoscience investigations. The proposed approach reflects some of the comments of the U.S. utility industry. The U.S. Geological Survey provided a series of comments and recommendations that led to and can be met by the integrated approach.

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 the Draft Standard Review Plan Section 2.5.2, Second Proposed Revision 3, "Vibratory Ground Motion."

The NRC staff's review approach to evaluate an application is described in Draft SRP Section 2.5.2. This review takes into account the information base developed in licensing more than 100 plants. This staff review is consistent with the intent of a USGS recommendation. 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 basis 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 proposed regulations would 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 proposed 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 proposed regulation would allow 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 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 VIII of this Proposed 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 proposed regulation would treat plant shutdown associated with vibratory ground motion exceeding the OBE or significant plant damage as a condition in every operating license. The shutdown requirement would be 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(ee) would be 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 Proposed Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," to 10 CFR Part 50. Draft Regulatory Guide DG-1034, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post-Earthquake Actions," is being 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). Draft Regulatory Guide DG-1035, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event," is being 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 proposed regulations has been limited to general guidance. The proposed regulations would 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 Draft Regulatory Guide, DG-1032, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motions."

7. Provide greater flexibility. The proposed regulations would 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 proposed 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 proposed regulations have been significantly changed to eliminate or modify phrases that were more applicable to only the western United States.

9. Clarify text. The proposed regulations would 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 may be a composite of several expected earthquakes.

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 proposed to be incorporated into the regulations as one of the basic site criteria. It has been a part of the staff review for many years. The proposed rule would involve 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 proposed rule would require 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 would impose no new requirements but require 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 proposed rule would require 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 would impose no new requirements but require 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 will now be required under Part 50 and used in evaluating plant features.

Seismic Siting and Earthquake Engineering Criteria

The costs associated with the proposed regulations are subdivided into two categories; the first is associated with the geosciences and site investigations (Section 100.23 to Part 100), the second is associated with earthquake engineering (Appendix S to Part 50).

Section 100.23 to Part 100

The overall cost impact associated with the geosciences and site investigation aspects of the proposed 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 will be 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 Draft Regulatory Guide DG-1035 "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 proposed regulation are neutral or reduced. Specific examples include:

1. Reduced OBE Analysis. The response analyses associated with the Operating Basis Earthquake Ground Motion (OBE) may be 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 time-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 differentiate 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) 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. The proposed regulation, Section 100.23 to Part 100, is still applicable only to nuclear power plants. The revision of Part 72 and Appendix A to Part 40, subject to the implementation of Section 100.23 to Part 100, should be a separate rulemaking initiative.

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 proposed 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 proposed 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.

The proposed 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) and replace it with the regulations pertaining to the geosciences and site investigations (Section 100.23 to Part 100) 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 proposed regulations would 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 proposed implementation of USI A-46, "Verification of Seismic Adequacy of Equipment in Operating Plants," and NRC Bulletin programs. Therefore, this regulatory action will be 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 to implement the proposed regulations for applicants for early site permits, design certifications, combined licenses, construction permits or operating license. In addition, the proposed 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 proposed regulations.

Current Regulatory Action

The current regulatory action consists of the following:

1. Revisions to §50.2, §50.8, §50.34, §50.54, and §52.17.

2. Revisions to §100.1, §100.2, §100.3, and §100.8.

3. Add Subpart B, §100.20, §100.21, §100.22, and §100.23.

4. Add a new Appendix S to Part 50, Earthquake Engineering Criteria for Nuclear Power Plants

5. Issue new Regulatory Guides for public comment:

a. DG-1032, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motions"

b. DG-1034, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post-Earthquake Actions"

c. DG-1035, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event"

6. Issue Revised Regulatory Guides for public comment:

a. Second Proposed Revision 2 to Regulatory Guide 4.7, "General Site Suitability Criteria for Nuclear Power Stations"

b. DG-1033, Third Proposed Revision 2 to Regulatory Guide 1.12, "Nuclear Power Plant Instrumentation for Earthquakes"

7. Issue Revised Standard Review Plan Section for public comment:

2.5.2, Vibratory Ground Motion.

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 proposed 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. If the construction permit was issued prior to the effective date of the proposed regulation, the operating license applicant must comply with the seismic and geologic siting and earthquake engineering criteria in Appendix A to Part 100.

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.

ENCLOSURE 3

DRAFT ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT

PROPOSED REVISION OF

10 CFR PART 100

AND

10 CFR PART 50

DRAFT ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT PROPOSED REVISION OF 10 CFR PART 100, AND 10 CFR PART 50

The Nuclear Regulatory Commission is amending its regulations to update the reactor siting criteria, seismic and geologic siting criteria, and earthquake engineering criteria for nuclear power plants. 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, and Appendix A to 10 CFR Part 100) be reissued for public comment. The nonseismic and seismic areas are discussed separately.

Identification of Proposed Action

Reactor Siting Criteria (Nonseismic)

Title 10 CFR Part 100, "Reactor Site Criteria," originally issued in April 1962, is proposed to be revised. The proposed revision will apply to applicants who apply for site approval on or after the effective date of the final regulation. Since the revision to the regulation will not be a backfit, the bases for existing nuclear power plants must remain in the same regulation. Therefore, the revised regulation on siting will be designated Subpart B of 10 CFR Part 100; the existing regulation will be designated Subpart A of 10 CFR Part 100.

Criteria not associated with site selection will be relocated into Part 50 consistent with the location of other design requirements in the regulation. Hence, source term and dose calculations will be relocated to Part 50.

The proposed rule would state basic site criteria including the need for the site characteristics to be such that radiological doses from both normal operation as well as postulated accidents should be acceptably low, that natural phenomena and man-made hazards should be appropriately factored into the design of the plant, that the site characteristics should be amenable to the development of emergency plans to protect the public and security measures to protect the plant. Reactor sites should also be located away from very densely populated centers, and that areas of low population density are, generally, preferred.

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," was originally issued as a proposed rule on November 25, 1971 (36 FR 22601); published as a final rule on November 13, 1973 (38 FR 31279); and became effective on December 13, 1973. There have been two amendments to Appendix A to 10 CFR Part 100. The first amendment, issued November 27, 1973 (38 FR 32575), corrected the final rule by adding the legend under the diagram. The second amendment resulted from a petition for rulemaking (PRM 100-1) requesting that an opinion interpreting and clarifying Appendix A with respect to the determination of the Safe Shutdown Earthquake be issued. 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 rule on January 10, 1977 (42 FR 2052).

The proposed amendment will apply 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 regulation. However, if the construction permit was issued prior to the effective date of the regulation, the operating license applicant shall comply with the seismic and geologic siting and earthquake engineering criteria in Appendix A to 10 CFR Part 100. Because the revised criteria presented in the proposed regulation will not be applied to existing plants, the licensing bases for existing nuclear power plants must remain part of the regulations. Therefore, the proposed revised criteria on seismic and geologic siting would be designated as a new Section 100.23, "Geologic and seismic siting factors," to 10 CFR Part 100, "Reactor Site Criteria," and would be added to the existing body of regulations.

Criteria not associated with site selection 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 Part 50. Hence, earthquake engineering criteria would be located in Appendix S to 10 CFR Part 50, "Earthquake Engineering Criteria for Nuclear Power Plants."

The proposed regulatory action incorporates changes that are intended to (1) benefit from the experience gained in applying the existing regulation, (2) resolve interpretative questions, (3) provide needed regulatory flexibility to incorporate improvements in the geosciences and earthquake engineering, and (4) simplify the language to a more "plain English" text.

Need for the Proposed Action

Reactor Siting Criteria (Nonseismic)

Since its initial promulgation in 1962, the Commission has approved more than 75 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 the site factors that influence risk and their range of acceptability.

Additionally, there has also been increased awareness, concern and significant research on potential nuclear accidents. 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) in 1975, and the issuance of NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," in December 1990, as well as the occurrence of the Three Mile Island accident in 1979, the Chernobyl accident in the Soviet Union in 1986, have greatly increased awareness, knowledge, and concerns in this area.

The substantial base of knowledge accumulated over the last 30 years on reactor 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 protec the plant.

The major impetus for the proposed rule is possible increased interest in new nuclear power generation and the possibility that applicants will request site approval for new nuclear power plants. The Commission believes that, in the event such requests materialize, the criteria for siting power reactors should provide basic site criteria that should reflect the significant experience learned since the regulation was first issued in 1962.

Seismic Siting and Earthquake Engineering Criteria

The experience gained in the application of the procedures and methods set forth in the current regulation and the rapid advancement in the earth sciences and earthquake engineering have made it necessary to update the 1973 criteria.

Environmental Impacts of the Proposed Action

Reactor Siting Criteria (Nonseismic)

Subpart B to Part 100 contains the considerations that will guide the Commission in its evaluation of the suitability of a proposed site for nuclear power plants after the effective date of the final regulation. The revision to Part 50 will contain the engineering considerations for evaluation of the suitability of the plant design. The amendment to 10 CFR Part 100 would reflect current licensing practice and would not change the radiological environmental impact. Stated differently, the proposed regulatory actions for future siting applications (10 CFR Part 100, Subpart B) are specifically based on maintaining the present level of risk of radiological releases as in the regulation (10 CFR Part 100, Subpart A) they replace.

Seismic Siting and Earthquake Engineering Criteria

Proposed Section 100.23 to 10 CFR Part 100 contains the seismic and geologic considerations that would guide the Commission in its evaluation of the suitability of sites proposed for nuclear power plants and the suitability of the nuclear power plant design bases established in consideration of the seismic and geologic characteristics of the proposed sites. Proposed Appendix S to 10 CFR Part 50 contains the earthquake engineering considerations that would guide the Commission in its evaluation of the suitability of the plant design bases. The revision of Appendix A to 10 CFR Part 100 as stated in Section 100.23 to 10 CFR Part 100 and Appendix S to 10 CFR Part 50 reflect current licensing practice in earthquake engineering and enhanced current staff practice in seismic and geologic siting through the use of probabilistic evaluations or other methods, such as sensitivity analyses, where applicable. The target exceedance probability is set by examining the design bases of more recently licensed nuclear power plants. Therefore, the radiological environmental impact offsite will not change. Stated differently, the proposed regulatory actions (Section 100.23 to Part 100 and Appendix S to Part 50) are specifically based on maintaining the present level of risk of radiological releases, thus having zero effect compared to the regulation (Appendix A to Part 100) they replace.

Onsite occupational radiation exposure associated with inspection and maintenance will not change. These activities are principally associated with baseline inspections of structures, equipment, and piping and 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. In addition, the proposed regulatory guide pertaining to seismic instrumentation (Third Proposed Revision to Regulatory Guide 1.12, "Nuclear Power Plant Instrumentation for Earthquakes") specifically cites occupational radiation exposure as a consideration in selecting the location of the instruments.

The proposed amendments do not affect non-radiological plant effluents and have no other environmental impact. Therefore, the Commission concludes that there are no significant non-radiological environmental impacts associated with the proposed amendments to the regulations.

Alternatives to the Proposed Action

As required by Section 102(2)(E) of NEPA (42 U.S.C.A. 4332(2)(E)), the staff has considered possible alternatives to the proposed action.

The first alternative considered by the Commission was to avoid initiating a rulemaking proceeding. This is not an acceptable alternative. Present accident source terms and dose calculations presently influence plant design requirements rather than siting. It is considered desirable to be able 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 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.

A second alternative considered was deletion of the existing regulation. This is not an acceptable alternative because these provisions form the licensing bases for many of the operating nuclear power plants and others that are in various stages of obtaining their operating license.

For the seismic siting and earthquake engineering areas, another alternative considered was replacement of the entire regulation with a regulatory guide. This is not acceptable because a regulatory guide is non-mandatory. The staff believes that there could be an increase in the risk of radiation exposure to the public if the siting and earthquake engineering criteria were nonmandatory.

The approach of establishing new sections of the regulations for revised requirements while retaining the existing regulations was chosen as the best alternative. The public will benefit from a clearer, more uniform and consistent licensing process subject to fewer interpretations. The NRC staff will benefit from improved implementation (both technical and legal)of the regulations, fewer interpretive debates, and increased regulatory flexibility. Applicants will derive the same benefits in addition to avoiding licensing delays caused by unclear regulatory requirements. Adopting revised siting and engineering criteria would increase the efficiency of regulatory actions associated with any resurgence of licensing activity.

Alternative Use of Resources

No alternative use of resources was considered.

Agencies and Persons Consulted

Reactor Siting Criteria (Nonseismic)

The NRC staff developed the enclosed rulemaking recommendations. No outside agencies or consultants were used in developing this rulemaking package. However, the rulemaking reflects the extensive public comments received during the first proposed revision. In addition, several public meetings were held to inform industry of the staff's efforts in revising the siting criteria.

Seismic Siting and Earthquake Engineering Criteria

During the development of the proposed regulations and supporting regulatory guides, the NRC staff had several public meetings with interested industry groups, principally, the Nuclear Energy Institute (NEI) (previously the Nuclear Management and Resources Council (NUMARC)) and the Electric Power Research Institute (EPRI). The NRC staff also obtained advice from the NRC Advisory Committee on Reactor Safeguards and comments from the U.S. Geological Survey (USGS) staff. As a proposed rule, the regulations will be released for public comment to encourage participation from the public and various organizations in the development of the regulations. For example, comments received from the public on the first proposed revision of the regulations were considered in the development of the second proposed revision of the regulations.

Finding of No Significant Impact

The Commission has determined under the National Environmental Policy Act of 1969, as amended, that the proposed amendments to 10 CFR Parts 50 and 100 that would relocate dose calculation requirements, specify siting criteria (population, seismic, and geologic), and specify earthquake engineering criteria for nuclear power plants, if adopted, would not have a significant effect on the quality of the human environment and that an environmental impact statement is not required.

This determination is based on the following:

1. The proposed amendments to the regulations reflect current practice, consistent with the staff's evaluation of applicant's safety analysis reports at the time of docketing, applicant's responses to staff initiated questions, and the results of research in the earth sciences and seismic engineering.

2. The foregoing environmental assessment.

3. The qualitative, deterministic, and probabilistic assessments pertaining to seismic events in NUREG-1070, NUREG-1233, and NUREG-1407 (References 1 through 3, respectively).

4. The Policy Statement on Severe Reactor Accidents Regarding Future Designs and Existing Plants, published August 8, 1985 (50 FR 32138), affirming the

Commission's belief that a new design for a nuclear power plant can be shown to be acceptable for severe accident concerns if the criteria and procedural requirements cited in 50 FR 32138 are met.

5. Commission approval, with modification, of the staff recommendation pertaining to site-specific Probabilistic Risk Assessments and analyses of external events. As stated in Reference 4: "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."

References

1. "NRC Policy on Future Reactor Designs, Decisions on Severe Accident Issues in Nuclear Power Plant Regulation," NUREG-1070, July 1985.

2. "Regulatory Analysis for USI A-40, "Seismic Design Criteria" Final Report," NUREG-1233, September 1989.

3. "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities, Final Report," NUREG-1407, June 1991.

4. 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.

ENCLOSURE 4

[7590-01]

NUCLEAR REGULATORY COMMISSION

Documents Containing Reporting or Recordkeeping Requirements: Office of Management and Budget (OMB) Review

AGENCY: U.S. Nuclear Regulatory Commission (NRC)

ACTION: Notice of the OMB review of information collection.

SUMMARY: The NRC has recently submitted to OMB for review the following proposal for the collection of information under the provisions of the Paperwork Reduction Act of 1980 (44 U.S.C. Chapter 35).

1. Type of submission, new, revision or extension: Revision

2. The title of the information collections:

Proposed Section 100.23, "Geologic and seismic siting factors," to 10 CFR Part 100, and Proposed Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," to 10 CFR Part 50. (Revision of Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100.)

3. The form number if applicable: Not applicable

4. How often the collection is required: On occasion

5. Who will be required or asked to report: Applicants for a construction permit, operating license, early site permit, design certification, or combined license for nuclear power plants.

6. An estimate of the number of responses annually: 1

7. An estimate of the total number of hours needed annually to complete the requirement or request: 164,000

8. An indication of whether Section 3504(h), Pub. L. 96-511 applies: Applicable

9. Abstract: Proposed Section 100.23 to 10 CFR Part 100 contains criteria associated with the selection of the nuclear power plant site and the establishment of the safe shutdown earthquake ground motion. Proposed Appendix S to 10 CFR Part 50 contains earthquake engineering criteria for nuclear power plants. In combination, these regulations will replace the criteria contained in Appendix A to 10 CFR Part 100.

Copies of the submittal may be inspected or obtained for a fee from the NRC Public Document Room, 2120 L Street, NW (Lower Level), Washington, DC.

Comments and questions can be directed by mail to the OMB reviewer:

Ronald Minsk

Office of Information and Regulatory Affairs (3150-0093 and 3150-0011)

NEOB-3019

Office of Management and Budget

Washington, DC 20503

Comments can also be submitted by telephone at (202) 395-3084.

The NRC Clearance Officer is Brenda Jo. Shelton, (301) 415-7232.

Dated at Bethesda, Maryland this day of 1994

For the Nuclear Regulatory Commission

Gerald F. Cranford, Designated Senior Official for Information Resources Management

OMB SUPPORTING STATEMENT, FOR

PROPOSED SECTION 100.23, "GEOLOGIC AND SEISMIC SITING FACTORS," TO 10 CFR PART 100 (OMB Clearance No. 3150-0093);

AND

PROPOSED APPENDIX S, "EARTHQUAKE ENGINEERING CRITERIA FOR NUCLEAR POWER PLANTS," TO 10 CFR PART 50 (OMB Clearance No. 3150-0011)

(SECOND PROPOSED REVISION OF APPENDIX A TO 10 CFR PART 100)

Description of the Information Collection

Seismic and Earthquake Engineering Criteria:

The first proposed revision of Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100, "Reactor Site Criteria," was published for public comment on October 20, 1992 (57 FR 47802). Due to the substantive nature of the changes to both 10 CFR Part 100 and Appendix A to Part 100, the Commission requested that both parts be reissued for another public comment.

Proposed Section 100.23, "Geologic and seismic siting factors," (paragraphs (c) and (d)) to 10 CFR Part 100, requires applicants to provide the types of information that show evidence of the size and frequency of occurrence of earthquakes, tectonic and nontectonic surface deformation, and seismically induced floods and water waves. From these seismic and geologic hazard data, applicants determine earthquake ground motion for the seismic design basis, design bases for seismically induced floods and water waves, the potential for surface deformation, and other design conditions that may be affected by earthquake ground motion, such as the potential for liquefaction, and soil and rock stability.

Proposed Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," (Criterion II and IV) to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires applicants to provide the design bases for a nuclear power plant that will ensure that structures, systems, and components important to safety will be able to withstand the natural phenomena specified in General Design Criterion 2 of Appendix A to 10 CFR Part 50 and Proposed Section 100.23 to 10 CFR Part 100 without loss of capability to perform their safety functions.

Proposed Section 100.23 to 10 CFR Part 100 and Proposed Appendix S to 10 CFR Part 50, in combination, are a revision of Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100. The proposed section and appendix apply to applicants who apply for an early site permit, design certification, or combined license pursuant to 10 CFR Part 52, or a construction permit or operating license pursuant to 10 CFR Part 50 on or after [EFFECTIVE DATE OF THE FINAL RULE]. However, if the construction permit was issued prior to [EFFECTIVE DATE OF THE FINAL RULE], the operating license applicant must comply with the seismic and geologic siting and earthquake engineering criteria

in Appendix A to 10 CFR Part 100. Appendix A to 10 CFR Part 100 will continue to serve as the criteria for the seismic and geologic siting and earthquake engineering for plants licensed or granted their construction permit before [EFFECTIVE DATE OF THE FINAL RULE].

It is anticipated that new plant applications could be submitted within a few years. This is based on the current and projected staff review of advanced reactor seismic design criteria related to the design certification of two evolutionary light-water reactor designs (the Advanced Boiling Water Reactor (ABWR) and the System 80+ Pressurized Water Reactor) and the Electric Power Research Institute (EPRI) Advanced Light Water Reactor Requirements Document. Based on NRC staff experience obtained from construction permit and operating license applications relative to Appendix A to 10 CFR Part 100, the review process for a construction permit, operating license, early site permit, design certification, or combined license, as it applies to Proposed Section 100.23 to 10 CFR Part 100 and Proposed Appendix S to 10 CFR Part 50, is expected to range from one to several years. The NRC staff reviews the Safety Analysis Report for six to twenty four months and, if necessary, generates a request for additional information. The applicant usually responds within 1 to 6 months, depending on the complexity of the issues. The average time is about 3 months. The responses are reviewed and a draft Safety Evaluation Report is written by the NRC staff. This document summarizes conclusions and highlights any outstanding issues. The staff arranges for a meeting and site visit to resolve any open issues. When the open issues have been resolved, the staff writes the final Safety Evaluation Report, which is published and used as a basis for the remainder of the NRC licensing process (the meeting with the Advisory Committee on Reactor Safeguards (ACRS) and hearing, as necessary, before the Atomic Safety and Licensing Board) which usually takes about 1½ years.

A. JUSTIFICATION

1. Need for the Collection of Information

The information required will be needed by the NRC to assess the adequacy of proposed seismic design bases (siting and engineering) and the design bases for other geological hazards for nuclear power plants in support of the agency's mission regarding adequate protection of the health and safety of the public from seismic events. It is to be submitted to the NRC as part of the application and supporting documentation for a construction permit, operating license, early site permit, design certification, or combined license for a nuclear power plant.

Moreover, Proposed Section 100.23 to 10 CFR Part 100 and Proposed Appendix S to Part 50, supplemented by the Standard Format, regulatory guides, and the Standard Review Plan, are used by applicants as general guidance in planning investigations of nuclear power plant sites and designing nuclear power plant structures, systems, and components important to safety to withstand the effects of natural phenomena such as earthquakes.

2. Agency Use of Information

The NRC reviews the geological and seismological information to determine the suitability of the proposed site for a nuclear power plant and the suitability of the plant design bases established on the proposed site. A construction permit, early site permit, standard design certification,

or combined license cannot be issued until these data have been reviewed and approved by the NRC.

New geological and seismological information that becomes known during the operating life of a plant is also evaluated on the basis of these criteria. The criteria also serve as the basis for ongoing NRC research in the earth sciences.

3. Reduction of Burden Through Information Technology

There are no legal obstacles to reducing the burden associated with this collection through information technology. Moreover, NRC encourages the use of such technology.

4. Effort to Identify Duplication

This information does not duplicate other information being provided to NRC.

5. Effort to Use Similar Information

All pertinent geological and seismological information concerning the nuclear site and the region around the site will be used in the analysis of that site, whether it is supplied by the applicant or not. Similarly, any available engineering and design data will be used, as applicable, in the design review of a proposed nuclear power plant whether it is a product of the criteria requirements or not. The availability of geological, seismological, or engineering data may reduce the applicant's efforts related to site investigation or design.

6. Effort to Reduce Small Business Burden

This information collection does not affect small businesses.

7. Consequences of Less Frequent Collection

Less frequent collection of information will result in serious delays in the licensing processes of nuclear power plants or potential additional risks to the health and safety of the public.

8. Circumstances Which Justify Variation From OMB Guidelines

There is no variation from the guidelines.

9. Consultations Outside the NRC

During the development of the proposed regulation, the NRC staff had several public meetings with interested industry groups (principally, the Nuclear Energy Institute (NEI), previously the Nuclear Management and Resources Council (NUMARC), and the Electric Power Research Institute (EPRI)) related to the seismic and earthquake engineering considerations. With respect to the seismic and geological proposed regulations, the NRC staff also obtained comments from the U.S. Geological Survey (USGS) staff during the development of the proposed regulations. As a proposed rule, the regulations will be released for public comment to encourage

participation from the public and other organizations in the development of the regulations.

10. Confidentiality of Information

Proprietary information is protected in accordance with the provisions specified in 10 CFR Part 2 of the NRC's regulations.

11. Justification for Sensitive Questions

These regulations do not require sensitive information.

12. Estimated Annual Cost to the Federal Government

Current NRC staff activities that are applicable to Proposed Appendix S to 10 CFR Part 50 relate to standard design certification. Specifically, the NRC staff is reviewing the design certification of two evolutionary light-water reactor designs (the Advanced Boiling Water Reactor (ABWR) and the System 80+ Pressurized Water Reactor) and the Electric Power Research Institute (EPRI) Advanced Light Water Reactor Requirements Document. There are no site-specific construction permit, operating license, early site permit, or combined license application evaluations that relate to the Proposed Section 100.23 to 10 CFR Part 100 or Proposed Appendix S to 10 CFR Part 50 being performed by the NRC staff.

Since activities related to Proposed Section 100.23 to 10 CFR Part 100 and Proposed Appendix S to 10 CFR Part 50 are limited, the following estimates also include NRC staff experience obtained from construction permit or operating license application evaluations relative to Appendix A to 10 CFR Part 100.

a. Section 100.23 to 10 CFR Part 100 - Geologic and Seismic Evaluations

Geologic and seismic staff evaluations required for a construction permit, operating license, early site permit, or combined license review can range from about 1,000 hours for a site with uncomplicated geology in a region of low seismicity to as many as 6,000 hours for very complex sites. The estimated average annual effort required to review the seismology and geology of an application is about 2,000 hours or $264,000 ($132 x 2,000 hours).

b. Appendix S to 10 CFR Part 50 - Earthquake Engineering Evaluations

Staff evaluations of nuclear power plant structures, systems, and components, to ensure that they will perform their safety function without loss of capability, average 60,000 hours per plant. The estimated annual staff burden is 12,000 hours per application. The staff review consists of an evaluation of several loads, one of them being the seismic event. Typical loadings that are considered in the design and staff evaluation of the structures, systems, and components include: dead load (equipment or building weight), live load (movable equipment load), earthquake, thermal effects, and pressure. It is estimated that twenty-five percent of the staff

evaluation is devoted to seismic-related issues. Therefore, the annual seismic-related portion of the staff review is approximately 3,000 hours (25 percent of 12,000 hours) or $396,000 ($132 x 3,000 hours).

c. Consultants

Consultants and staff from the U.S. Geologic Survey and Department of Energy Laboratories are employed by the NRC on a case-by-case basis to provide advice in activities related to staff reviews performed in accordance with Proposed Section 100.23 to 10 CFR Part 100 or Proposed Appendix S to 10 CFR Part 50. It is anticipated that an average annual effort for these consultants would not exceed 500 hours or $66,000 ($132 x 500 hours).

Total annual cost to the Federal Government for activities related to the proposed regulation is estimated to be $726,000 ($132 x 5,500 hours).

13. Estimate of Industry Burden

The estimated seismic and geological revisions burdens are as follows:

a. Section 100.23 to 10 CFR Part 100 - Geologic and Seismic Evaluations

This estimate is based on the requirement for gathering, analyzing, and synthesizing data. In order for applicants to provide the types of information that show evidence of the size and frequency of the occurrence of earthquakes, the last time there was displacement along faults at the site or in the region, or the potential for fault offset during the life of a nuclear power plant, extensive research and analysis must be conducted. This effort involves the analysis of voluminous amounts of drawings, logs, maps, seismic and other geophysical records, and reports. It is estimated that the industry burden will be, on the average, 24,000 hours per applicant. The estimated annual burden is 8,000 hours per applicant or $1,056,000 ($132 x 8,000 hours).

b. Appendix S to 10 CFR Part 50 - Earthquake Engineering Evaluations

This estimate is based on the requirement that nuclear power plant structures, systems, and components important to safety are designed to withstand the effects of earthquakes without loss of capability to perform their safety functions. In order for applicants to provide information that shows the functionality of structures, systems, and components to vibratory ground motion, suitable analysis, testing, or qualification methods are employed.

References 1 and 2 were used to obtain an estimate of seismic-related costs in nuclear power plant design and construction. The incremental cost estimate provided in Table 1 is based on Table 1 of Reference 1, modified as follows: (1) updated to January 1, 1994, costs, (2) increased the Safe Shutdown Earthquake Ground Motion from 0.2g to 0.3g, and (3) increased distribution system and engineering costs.

It is estimated that the industry burden associated with the seismic engineering (staff-related costs) of nuclear power plant structures, systems, and components will average $103,000,000 per application. The estimated annual burden per application will average $20,600,000 or approximately 156,000 hours ($132 x 156,000 hours approximately equals $20,600,000). This cost estimate may be reduced by additional savings associated with standardized plant designs, and more significantly, by elimination of analyses and design associated with the Operating Basis Earthquake Ground Motion (OBE) as stated in Proposed Appendix S to 10 CFR Part 50.

The total annual burden on industry for activities related to the proposed regulations is estimated to be $21,664,800 ($132 x 164,000 hours).

14. Reasons for Change in Burden

The burden estimates for 10 CFR Parts 50 and 100 are being adjusted upward to account for one anticipated respondent to Section 100.23 to Part 100 and Appendix S to Part 50. Appendix A to Part 100 remains in effect and continues to have burden associated with it.

15. Publication for Statistical Use

This information is not collected for statistical purposes.

B. COLLECTION OF INFORMATION EMPLOYING STATISTICAL METHODS

Section 100.23 of 10 CFR Part 100 allows for the acquisition of statistical data and the use of statistical methods, but does not require them.

References

1. NUREG/CR-1508, "Evaluation of the Cost Effects on Nuclear Power Plant Construction Resulting from the Increase in Seismic Design Level," April 1981.

2. Stevenson and Associates, "Differential Design and Construction Cost of a Nuclear Power Plant Safety Related Piping Systems as a Function of Seismic Intensity and Time Period of Construction for New and Operating Plants and Current Simplified Seismic Design Initiatives," Draft, July 1990.

Enclosures:

Table 1, Summary of Incremental Cost Estimate
Table 2, Estimate of Burden Required of Industry and Federal Government, Appendix B to 10 CFR Part 100.
Table 3, Estimate of Burden Required of Industry and Federal Government, Appendix S to 10 CFR Part 50.

TABLE 1
SUMMARY OF INCREMENTAL COST ESTIMATE

0.3G Safe Shutdown Earthquake Ground Motion vs
No Seismic Design Requirement

ITEM	COST ESTIMATE [1]
Engineering	$103,000,000 [2]

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[1] Based on Table 1 in Reference 1, modified as follows:

a. Updated costs to January 1, 1994. Assumed an inflation and escalation rate of 8.0 percent between January 1977 and 1985, and 5.0 percent between January 1985 and 1994 (consistent with Table 7.2 of Reference 2). A factor of 2.4 was used.

b. Increased Safe Shutdown Earthquake Ground Motion from 0.2g to 0.3g. Based on Figures 1 and 2 of Reference 1, a cost factor of 2 was used.

c. Increased Distribution System Engineering costs. In addition to the cost increases calculated by Steps (a) and (b), new engineering costs for piping, based on Tables 5.10 and 5.11 of Reference 2 were used. ($63,984,090 with seismic design and restraints, $6,344,920 without seismic design and restraints.) The costs were updated from January 1990 to January 1994 by assuming inflation and escalation rate of 5.0 percent, consistent with (a). A cost factor of 1.2 was used.

[2] The total cost estimate does not reflect potential savings associated with the use of a standardized plant design or elimination of analyses and design associated with the proposed rulemaking. Therefore, the cost estimate may be reduced.

TABLE 2
ESTIMATE OF BURDEN REQUIRED OF INDUSTRY AND FEDERAL GOVERNMENT

Section 100.23 to 10 CFR Part 100
(Revision of 10 CFR Part 100, Appendix A)

TASK	HOURS OR DOLLARS
ESTIMATED AVERAGE ANNUAL BURDEN HOURS PER RESPONSE	8,000
NUMBER OF RESPONDENTS ANNUALLY	1
ESTIMATED TOTAL ANNUAL BURDEN HOURS	8,000
ESTIMATED TOTAL ANNUAL COST TO INDUSTRY	$1,056,000
ESTIMATED TOTAL ANNUAL STAFF HOURS	2,000
ESTIMATED NRC CONSULTANT HOURS	200
ESTIMATED ANNUAL COST TO THE FEDERAL GOVERNMENT (STAFF + CONSULTANT HOURS)	2,200

TABLE 3
ESTIMATE OF BURDEN REQUIRED OF INDUSTRY AND FEDERAL GOVERNMENT

Appendix S to 10 CFR Part 50
(Revision of 10 CFR Part 100, Appendix A)

TASK	HOURS OR DOLLARS
ESTIMATED AVERAGE ANNUAL BURDEN HOURS PER RESPONSE	156,000
NUMBER OF RESPONDENTS ANNUALLY	1
ESTIMATED TOTAL ANNUAL BURDEN HOURS	156,000
ESTIMATED TOTAL ANNUAL COST TO INDUSTRY	$20,600,000
ESTIMATED TOTAL ANNUAL STAFF HOURS	3,000
ESTIMATED NRC CONSULTANT HOURS	300
ESTIMATED ANNUAL COST TO THE FEDERAL GOVERNMENT (STAFF + CONSULTANT HOURS)	3,300

ENCLOSURE 5

Enclosure 5

Risk Equivalence Between Current Dose Criteria and Total Effective Dose Equivalent (TEDE) Values

1. It is desired to determine the numerical value of total effective dose equivalent (TEDE) corresponding to the current dose criteria of 25 rem whole body and 300 rem thyroid.

2. To determine this, the risk imposed upon an individual as a result of receiving the current dose criteria (25 rem whole body and 300 rem thyroid) should be the same as for the dose in terms of total effective dose equivalent (TEDE).

3. At this dose value, prompt fatality is precluded. There is a possibility of latent cancer incidence and as well as latent cancer fatality. However, the risk of latent cancer incidence is not the same as the risk of latent cancer fatality.

4. The risks associated with the current criteria are as follows:

   - For a dose of 25 rem whole body

     Risk of latent cancer fatality = 10^{-3} per rem* X 25 rem = 2.5 X 10^{-2}

     Risk of latent cancer incidence = 5 X 10^{-2}

   - For a dose of 300 rem thyroid

     Risk of latent cancer fatality = 7 X 10^{-6} X 300 = 2.1 X 10^{-3}

     Risk of latent cancer incidence = 7 X 10^{-5} X 300 = 2.1 X 10^{-2}

5. Based on latent cancer fatality, the current dose criteria represent a risk of 2.5 X 10^{-2} plus 2.1 X 10^{-3} = 2.7 X 10^{-2}. Using a risk coefficient of 10^{-3} per rem for both whole body exposure and total effective dose equivalent, the current dose criteria is equivalent to about 27 rem TEDE.

6. Based on latent cancer incidence, the current dose criteria represent a risk of 5 X 10^{-2} plus 2.1 X 10^{-2} = 7.1 X 10^{-2}. Using a risk coefficient of 2 X 10^{-3} per rem for cancer incidence, the current dose criteria is equivalent to about 35 rem TEDE. The thyroid organ weighting factor of 0.03 given in Part 20 is based upon risk of cancer incidence and its use yields a value of 34 rem TEDE (25 plus 0.03 X 300), in close agreement with 35 rem TEDE.

* From BEIR V, the risk is 5 X 10^{-4} per rem if the dose is received over a period of a few days or more; if received over a period of 2 hours, the risk is approximately twice that.

ENCLOSURE 6

OUTLINE OF DRAFT REGULATORY GUIDE DG-4003
(Proposed Revision 3 to Regulatory Guide 4.7)

GENERAL SITE SUITABILITY CRITERIA FOR NUCLEAR POWER REACTOR SITES

A. Introduction

B. Discussion

C. Regulatory Position

1. Exclusion Area Size:

A determination should be made, in keeping with the requirements of 10 CFR Part 50, that the exclusion area size is such that, the dose to an individual will not be in excess of the value given in 10 CFR Part 50, for any 2 hour period following the onset of the postulated fission product release.

2. Nearby transportation routes, industrial and military facilities:

10 CFR Part 100.21 requires that, "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."

Potentially hazardous facilities and activities within 5 miles of a proposed site, and major airports within 10 miles of a proposed site, should be identified. If a preliminary evaluation of potential accidents at these facilities indicates that the potential hazards from shock waves and missiles approach or exceed those of the design basis tornado of the region or potential hazards such as flammable vapor clouds, toxic chemicals, or incendiary fragments exist, the suitability of the site should be determined by a detailed evaluation of the degree of risk imposed by the potential hazard.

The identification of design basis events resulting from the presence of hazardous materials or activities in the vicinity of a nuclear power station is acceptable if the design basis events include each postulated type of accident for which a realistic estimate of the probability of occurrence of potential exposures in excess of the dose value in 10 CFR Part 50.34(a)(1) exceeds approximately 10^{-7} per year. Because of the difficulty of assigning precise numerical values to the probability of occurrence of the types of potential hazards generally considered in determining the acceptability of sites for nuclear stations, judgment must be used as to the acceptability of the overall risk presented by an event.

In view of the low probability events under consideration, the probability of occurrence of the initiating events leading to potential consequences in excess of the 10 CFR Part 50.34(a)(1) dose guideline should be based on assumptions that are as realistic as is practicable. In addition, because of the low probability events under consideration, valid statistical data are often not available to permit accurate quantitative calculation of probabilities. Accordingly, a conservative calculation showing that the probability of occurrence of potential exposure in excess of the 10 CFR Part 50.34(a)(1) guideline is approximately 10^{-6} per year is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower.

The effects of design basis events have been appropriately considered if analyses of the effects of those accidents on the safety-related features of the proposed nuclear station have been performed and appropriate measures (e.g., hardening, fire protection) to mitigate the consequences of such events have been taken.

To evaluate the suitability of sites in detail for potential accidents involving hazardous materials and activities at nearby industrial, military, and transportation facilities, the studies described in Section 2.2 of the Standard Review Plan (NUREG-0800) should be made.

3. Security plans:

10 CFR Part 100.21 requires that "site characteristics must be such that adequate security plans and measures can be developed."

Generally, 100 meters to any vital structure or vital equipment would provide space sufficient to satisfy security measures specified in 10 CFR Part 73.55 (e.g., protected area barriers, detection equipment, isolation zones, etc.).

4. Emergency plans:

10 CFR Part 100.21 requires that "site characteristics must be such that adequate plans to take protective measures for members of the public in the event of emergency can be developed."

An examination and evaluation of the site and its vicinity, including the population distribution and transportation routes, should be conducted to determine whether there are any characteristics that would prevent the development of adequate emergency plans to protect the public in the event of emergency.

Special population groups, such as those in hospitals, prisons, or other facilities that could require special needs during an emergency should be identified.

Physical characteristics of the proposed site, such as egress limitations from the area surrounding the site, that could pose a significant impediment to the development of emergency plans, should be identified.

An evacuation time estimate (ETE) should be performed to estimate the time periods that would be required to evacuate various sectors of the plume exposure emergency planning zone (EPZ), including the entire EPZ. The evacuation time estimate analysis is an emergency planning tool that assesses, in an organized and systematic fashion, the feasibility of developing emergency plans for a site. Guidance on performing an ETE analysis is given in Appendix 4 to NUREG-0654/FEMA-REP-1, Revision 1. The value of the ETE analysis is in the methodology required to perform the analysis rather than in the calculated ETE times. While lower ETEs may reflect favorable site characteristics from an emergency planning standpoint, there is no minimum required evacuation time in the regulations which an applicant has to meet.

5. Population Considerations:

10 CFR Part 100.21 states that, "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 acceptable."

Locating reactors away from densely populated centers is part of the NRC's defense-in-depth philosophy and facilitates emergency planning and preparedness as well as reducing potential doses and property damage in the event of a severe accident. Numerical values in this guide are generally consistent with past NRC practice and reflect consideration of severe accidents, as well as the demographic and geographic conditions characteristic of the United States.

A reactor preferably should be located such that at the time of initial site approval and within about 5 years thereafter, the population density, including weighted transient population, averaged over any radial distance out to 20 miles (cumulative population at a distance divided by the circular area at that distance), does not exceed 500 persons per square mile. A reactor should not be located at a site whose population density is well in excess of the above value.

If the population density of the proposed site exceeds, but is not well in excess of the above preferred value, an analysis of alternative sites should be conducted for the region of interest with particular attention to alternative sites having lower population density. However, consideration will be given to other factors, such as safety, environmental, or economic considerations, which may result in the site with the higher population density being found acceptable. Examples of such factors include, but are not limited to, the higher population

density site having superior seismic characteristics, better access to skilled labor for construction, better rail or highway access, shorter transmission line requirements, or less environmental impact upon undeveloped areas, wetlands, or endangered species.

Transient population should be included for those sites where a significant number of people (other than those just passing through the area) work, reside part-time, or engage in recreational activities and are not permanent residents of the area. The transient population should be taken into account for site evaluation purposes by weighting the transient population according to the fraction of time the transients are in the area.

Projected changes in population within about 5 years after initial site approval should be evaluated for the proposed site and any alternative sites considered. Population growth in the site vicinity after initial site approval is normally expected and will be periodically factored into the emergency plan for the site, but population increases after initial site approval will not be considered for license renewal purposes or, by itself, used to impose other license conditions or restrictions upon an operating plant.

ENCLOSURE 7

OUTLINE OF DRAFT REGULATORY GUIDE DG-1032

IDENTIFICATION AND CHARACTERIZATION OF SEISMIC SOURCES AND DETERMINATION OF SAFE SHUTDOWN EARTHQUAKE GROUND MOTIONS

A. INTRODUCTION

B. DISCUSSION

1. Background (need for probabilistic seismic hazard analyses as shown by past licensing, and its advantages)

2. Approach (regional and site geosciences investigations and probabilistic seismic hazard analyses)

3. Stable Continental Region (Eastern and Central United States)

4. Plate Boundary Region (Western United States)

5. Determination of the SSE (summary of regulatory positions for developing Safe Shutdown Earthquake Ground Motions)

C. REGULATORY POSITION

1. Acceptable Scope of Geological, Geophysical, Seismological, and Geotechnical Investigations.

2. Identification and Characterization of Seismic Sources Significant to the Seismic Hazard.

3. Acceptable Probabilistic Seismic Hazard Analysis (PSHA) Procedures

4. Procedures for Determining the SSE Ground Motion.

D. IMPLEMENTATION

REFERENCES

APPENDIX A Definitions

APPENDIX B Acceptance Criteria for the Annual Probability of Exceedance Level for the Safe Shutdown Earthquake Ground Motions

APPENDIX C Development of Seismic Hazard Information Base and Determination of Controlling Earthquakes

APPENDIX D Geological, Seismological, and Geophysical Investigations to Characterize Seismic Sources

APPENDIX E Procedure for Evaluation of Seismic Sources

APPENDIX F Procedure to Determine the Safe Shutdown Earthquake Ground Motion

The proposed regulation states that the Safe Shutdown Earthquake Ground Motion (SSE) for the site should be determined taking into consideration the results of the site-specific geological, seismological and geophysical investigations and uncertainties inherent in SSE estimates. The regulation further states that the uncertainties can be addressed through an appropriate probabilistic seismic hazard methodology or through other means, such as, sensitivity analyses. The proposed regulatory guide will contain acceptable procedures for carrying out site-specific investigations and determining the SSE by an integrated approach. The proposed guide will no longer contain guidance for conducting both deterministic and probabilistic analyses. References to items, such as Deterministic Source Earthquake, are being eliminated.

The guidance for the site investigations and source characterizations are essentially the same as those contained in the version (DG-1015) issued for public comments earlier. The probabilistic criterion (an acceptable annual probability of exceedance) and the procedure to determine SSE have been revised. Essential elements of these two aspects are outlined below. Bases for these changes, in part, are comments by the industry representative Nuclear Energy Institute (NEI), U.S. Geological Survey (USGS), and others.

Probabilistic Criteria for Determining SSE

In the draft DG-1015, and also in the earlier version of the rule, it was stated that the annual probability of exceeding the Safe Shutdown Earthquake Ground Motion is considered acceptably low if it is less than the median annual probability computed from the current [EFFECTIVE DATE OF THE FINAL RULE] population of nuclear power plants (east of the Rocky Mountains). In the proposed DG-1032, this standard is changed by using the median annual probability computed for selected plants which have used Regulatory Guide 1.60, or a similar spectrum, as the design basis. Two basic reasons for this change are: (1) comments received from several organizations including the USGS; and (2) in the proposed procedure for determining the SSE discussed below, the design basis spectrum will be scaled at the ground motion level which corresponds to the annual probability of exceedance. A staff study shows that the proposed value of the annual probability of exceedance is appropriate for scaling the design spectrum.

The numerical value of the annual probability of exceedance corresponding to 1993 Lawrence Livermore National Laboratory (LLNL) median hazard curves is 1E-5 per year.

Acceptable Probabilistic Seismic Hazard Analysis (PSHA) Procedures

The following step by step description outlines an acceptable procedure to be followed by an applicant.

Step 1 Perform regional and site geological, seismological and geophysical investigations in accordance with Regulatory Position 1 and Appendix D.

Step 2 Perform evaluation of LLNL or EPRI (for central and eastern U.S. (CEUS) sites, east of the Rocky mountains; site-specific analysis otherwise) seismic sources in accordance with Appendix E to determine whether they are consistent with the site-specific data

gathered in Step 1 or need updating which will lead to higher hazard prediction.

Step 3 — Perform LLNL or EPRI probabilistic seismic hazard analysis (or site-specific for non-CEUS sites) using original or updated sources as determined in Step 2 for actual rock conditions in the free-field or by assuming rock conditions for non-rock sites to develop the seismic hazard information base discussed in Appendix C.

Step 4 — Determine the 5% damped spectral median ground motion levels at an average of 5 and 10 Hz, $S_{P,5\text{-}10}$, and at average of 1 and 2.5 Hz, $S_{P,1\text{-}2.5}$, for the annual probability level (1E-5/year for the LLNL analysis) described in Appendix B.

Step 5 — Deaggregate hazard in accordance with Appendix C to determine contributing earthquakes (i.e., magnitudes and distances which at given recurrence rates contribute most to the ground motion level of interest). These, $\bar{M}$ and $\bar{D}$ will dominate the hazard at ground motion levels of Step 4. Two magnitude and distance pairs will be determined as follows:

$\bar{M}_{5\text{-}10}$ and $\bar{D}_{5\text{-}10}$ corresponding to $S_{P,5\text{-}10}$

$\bar{M}_{1\text{-}2.5}$ and $\bar{D}_{1\text{-}2.5}$ corresponding to $S_{P,1\text{-}2.5}$

Step 6 — Using $\bar{M}_{5\text{-}10}$, $\bar{D}_{5\text{-}10}$ and $\bar{M}_{1\text{-}2.5}$, $\bar{D}_{1\text{-}2.5}$ and SRP 2.5.2 procedures (which may include use of ground motion models not included in the probabilistic seismic hazard analysis but are more appropriate for the source, region and site under consideration or represent latest scientific development) develop 5% damped response spectral shapes for the actual or assumed rock conditions.

Step 7 — Use $S_{P,5\text{-}10}$ to scale the response spectrum shape corresponding to $\bar{M}_{5\text{-}10}$, $\bar{D}_{5\text{-}10}$ determined in Step 6. Determine that this spectrum envelopes the ground motion spectrum for $\bar{M}_{1\text{-}2.5}$, $\bar{D}_{1\text{-}2.5}$, otherwise modify the shape to envelope the low frequency spectrum or use two spectra in the following steps. (Appendix F)

For the rock site go to Step 9.

Step 8 — For the non-rock sites, perform a site-specific soil amplification analysis considering uncertainties in site-specific geotechnical properties and parameters to determine response spectra at the free ground surface in the free-field for actual site conditions.

Step 9 — Compare the smooth SSE spectrum/spectra used in design (e.g., 0.3g, broad-band spectra used in ALWR designs) to spectrum/spectra determined in Step 7 for the rock site or determined in Step 8 for the non-rock sites to establish adequacy of the SSE spectrum/spectra.

To establish new site-specific SSE, develop a smooth spectrum/spectra using a standard broad band shape (for example, NUREG/CR-0098) which envelops the spectra of Step 7 or Step 8 as appropriate to site conditions.

ENCLOSURE 8

OUTLINE OF PROPOSED REVISION TO SRP 2.5.2

VIBRATORY GROUND MOTION

The proposed revision to the SRP will parallel the proposed Regulatory Guide (DG-1032) in terms of the staff's review procedure. The existing sections will be revised to be consistent with the definitions and guidance outlined in DG-1032. The staff will review the applicant's probabilistic analysis including how the results of site investigations are used to update the existing seismic sources in the probabilistic seismic hazard data base, how they are used to develop additional sources, or the way they are used to develop a new data base. The staff will also review the earthquake potential associated with each geological structure or seismogenic source which could affect the site to identify the controlling earthquake for each source (In the current licensing process, the controlling earthquake for each source has been at least as large as the maximum historic earthquake).

The adequacy of the SSE ground motion proposed by the applicant will be reviewed. In this review, the staff will consider effects on ground motion from the above discussed controlling earthquakes by assuming the controlling earthquake for each seismic source (geological structures or seismotectonic provinces) to be at its closest approach to the site. In addition, the staff will review the controlling earthquakes and associated ground motions derived from the applicant's probabilistic hazard analysis to assure that they are either consistent with the controlling earthquakes/ground motions used in licensing of (a) other licensed facilities at the site, (b) nearby plants, or (c) plants licensed in similar seismogenic regions, or reasons why they are not consistent are understood.

ENCLOSURE 9

DRAFT PUBLIC ANNOUNCEMENT

The Nuclear Regulatory Commission (NRC) announced that it is re-issuing proposed 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 proposed changes. The proposed 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 proposed regulations would benefit from public comments received from the first proposed issuance.

The proposed regulation 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 proposed 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.

The Commission is issuing the proposed revisions in the Federal Register for a 120-day public comment period.

ENCLOSURE 10

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

The Honorable Richard H. Lehman, Chairman
Subcommittee on Energy and Mineral Resources
Committee on Natural Resources
United States House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

Enclosed for the information of the Subcommittee are copies of a public announcement and a proposed revision to Title 10 of the Code of Federal Regulations which is to be published in the Federal Register.

The Nuclear Regulatory Commission is proposing to amend 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. This second proposed revision 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 second proposed revisions would benefit from public comments received.

The proposed regulation 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 proposed 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.

The Commission is issuing the proposed revisions for a one hundred twenty-day public comment period.

Sincerely,

Dennis K. Rathbun, Director
Office of Congressional Affairs

Enclosures:
1. Public Announcement
2. Federal Register Notice

cc: Representative Barbara Vucanovich

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

The Honorable Philip R. Sharp, Chairman
Subcommittee on Energy and Power
Committee on Energy and Commerce
United States House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

Enclosed for the information of the Subcommittee are copies of a public announcement and a proposed revision to Title 10 of the Code of Federal Regulations which is to be published in the Federal Register.

The Nuclear Regulatory Commission is proposing to amend 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. This second proposed revision 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 second proposed revisions would benefit from public comments received.

The proposed regulation 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 proposed 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.

The Commission is issuing the proposed revisions for a one hundred twenty-day public comment period.

Sincerely,

Dennis K. Rathbun, Director
Office of Congressional Affairs

Enclosures:
1. Public Announcement
2. Federal Register Notice

cc: Representative Michael Bilirakis

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

The Honorable Joseph I. Lieberman, Chairman
Subcommittee on Clean Air and Nuclear Regulation
Committee on Environment and Public Works
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

Enclosed for the information of the Subcommittee are copies of a public announcement and a proposed revision to Title 10 of the Code of Federal Regulations which is to be published in the Federal Register.

The Nuclear Regulatory Commission is proposing to amend 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. This second proposed revision 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 second proposed revisions would benefit from public comments received.

The proposed regulation 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 proposed 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.

The Commission is issuing the proposed revisions for a one hundred twenty-day public comment period.

Sincerely,

Dennis K. Rathbun, Director
Office of Congressional Affairs

Enclosures:
1. Public Announcement
2. Federal Register Notice

cc: Senator Alan K. Simpson