

**UNITED STATES OF AMERICA**  
**NUCLEAR REGULATORY COMMISSION**

**Title:                BRIEFING ON PART 100 FINAL RULE ON  
                         REACTOR SITE CRITERIA - PUBLIC MEETING**

**Location:            Rockville, Maryland**

**Date:                Wednesday, June 12, 1996**

**Pages:              1 - 49**

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION  
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BRIEFING ON PART 100 FINAL RULE  
ON REACTOR SITE CRITERIA  
- - -  
PUBLIC MEETING

Nuclear Regulatory Commission  
One White Flint North  
Rockville, Maryland

Wednesday, June 12, 1996

The Commission met in open session, pursuant to notice, at 10:00 a.m., Shirley A. Jackson, Chairman, presiding.

COMMISSIONERS PRESENT:

- SHIRLEY A. JACKSON, Chairman of the Commission
- KENNETH C. ROGERS, Commissioner
- GRETA J. DICUS, Commissioner

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1 STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:  
2 JOHN C. HOYLE, Secretary of the Commission  
3 KAREN D. CYR, General Counsel  
4 JAMES TAYLOR, EDO  
5 THEMIS SPEIS, Deputy Director, Office of Nuclear  
6 Regulatory Research  
7 ANDREW MURPHY, Chief, Structural and Geological  
8 Engineering Branch, RES  
9 LEONARD SOFFER, Technical Assistant, Office of the  
10 EDO  
11 THOMAS KING, Deputy Director, Division of Systems  
12 Technology, RES  
13 FRANK MIRAGLIA

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

1  
2 CHAIRMAN JACKSON: Good afternoon everyone. The  
3 purpose of this meeting is for the NRC staff to brief the  
4 Commission on a final rule to amend reactor siting  
5 requirements in 10 CFR Parts 50, 52, and 100. This includes  
6 the establishment of a new Appendix S to 10 CFR Part 50 for  
7 use by future applicants.

8 The Commission recognizes that much effort has  
9 been expended on these rule changes which were originally  
10 published, I understand, for public comment in 1992.

11 I have requested the staff to respond to several  
12 questions which I had given after a Chairman's briefing in  
13 order to clarify aspects of the proposed rule changes.

14 In general, the questions were related to three  
15 aspects of the proposed rule changes.

16 First, the application of Part 100 to operating  
17 reactors and future use of the proposed rule changes. For  
18 example, new source term applications.

19 Second, the difference of opinion between Research  
20 and NRR regarding the time frame for when the new source  
21 term should be applied, namely, the question of the first  
22 two-hour period or worst two-hour period.

23 Third, the less prescriptive aspects of the new  
24 rule. For example, population density and the changes to  
25 the operating basis earthquake.

1           The Commission is interested in discussing how  
2 these issues are dealt with in the proposed final rule  
3 before the Commission, and we are also interested in your  
4 consideration of input from the Advisory Committee on  
5 Reactor Safeguards regarding these issues.

6           The Commission realizes the significance of the  
7 Part 100 rule. One of the briefing papers referred to this  
8 rule as the regulatory pillar for reactor safety and public  
9 health and safety, a pedigree of those features inherent in  
10 the design that prevent or mitigate consequences of  
11 accidents. That shows you that all these things are read  
12 deeply.

13           We look forward to discussing the aspects of these  
14 rule changes with you today. I understand that copies of  
15 your presentation are available at the entrance to the  
16 meeting.

17           Do my fellow Commissioners have any opening  
18 comments?

19           COMMISSIONER ROGERS: Nothing.

20           COMMISSIONER DICUS: No.

21           CHAIRMAN JACKSON: Mr. Taylor, please proceed..

22           MR. TAYLOR: Good afternoon. With me at the table  
23 are frank Miraglia, Andy Murphy, Themis Speis, Len Soffer,  
24 and Tom King.

25           The staff considers this to be an important rule

1 since it reflects not only the experience gained over more  
2 than 30 years in siting and licensing of over 100 nuclear  
3 power plants, but also because it incorporates major  
4 advances in our understanding of the earth sciences and  
5 reflects significant research insights in the area of  
6 fission product releases resulting from severe accidents.

7 The rule also states basic reactor site criteria  
8 and makes explicit the Commission's longstanding policy that  
9 reactors should be located away from very densely populated  
10 centers.

11 With that, I will ask Themis Speis to continue.

12 MR. SPEIS: Thank you, Mr. Taylor.

13 Chairman Jackson, Commissioners. I don't want to  
14 repeat what has been said, but we will be able to give you  
15 some of the salient aspects of this proposed final rule. Of  
16 course the details are described here and we will be  
17 addressing the questions that Chairman Jackson raised. We  
18 are asking for approval from the Commission about this as a  
19 final rule.

20 [Slide.]

21 MR. SPEIS: The first viewgraph shows the outline  
22 of the presentation.

23 I will briefly go over the chronology of the  
24 events that have brought us here today. Also, I will give  
25 you an overview of the present rule.

1           Then we have broken the presentation down into two  
2 parts, one covering the seismic aspects and the other one  
3 covering the radiological aspects.

4           As you can see, under the seismic aspects we will  
5 cover the seismic and geologic siting criteria, the use of  
6 probabilistic seismic hazards in determining the design  
7 basis ground motion, and also will address the earthquake  
8 engineering criteria.

9           Then we will go to the radiological part of the  
10 rule and we will discuss in some more detail some of the  
11 major developments and experience in reactor siting and  
12 explicitly address the proposed revisions and then give you  
13 the final elements of the rule that we are asking permission  
14 from the Commission to publish.

15           [Slide.]

16           MR. SPEIS: The chronology.

17           Some of these things will be discussed later on by  
18 Len and Dr. Murphy. I just want to give you kind of a brief  
19 capsule.

20           As has been said already, this may be one of the  
21 oldest. I will defer that to our general counsel if that is  
22 the oldest or one of the oldest. That was back in 1962.

23           Then, 11 years later, the Atomic Energy Commission  
24 put out Appendix A, which dealt with the seismic issues.  
25 Both of these rules were when the AEC was in charge.

1           In 1990 we came up with a plan to revise Part 100,  
2 but the first proposed revision went out in October 1992.  
3 We had grandiose ideas at that time of decoupling, siting  
4 from design, and as you will hear later on from Len, it  
5 didn't quite materialize that way because of the extensive  
6 comments that we received.

7           The proposed rule was withdrawn in 1994, and then  
8 the second proposed revision was issued for comment in 1994.

9           Here we are in front of you to discuss the final  
10 rule.

11           [Slide.]

12           MR. SPEIS: I think it is very important to  
13 provide the context of phase 1. This is viewgraph number 4.  
14 I hope you see the color copy in front of you.

15           For background, I would like to say that from the  
16 knowledge and the insights that we have gained from  
17 extensive research on severe accident processes and  
18 phenomena as well as the many risk studies that have been  
19 performed we have learned that risks are dominated by severe  
20 accidents, that is, core melt accidents where the  
21 containment has either failed or bypassed. Therefore, one  
22 might ask why these risk insights have not been totally  
23 taken into consideration in this proposed rulemaking but  
24 instead this rulemaking only partially addresses the  
25 insights gained from severe accident research.

1           When I am talking about partially, we are  
2           addressing the behavior of the release of radioactivity as a  
3           nuclear power plant undergoes a severe accident. Also, it  
4           is fair to say that the distance itself, which is addressed  
5           in the rule, which Len will talk about, takes severe  
6           accident into consideration to some extent.

7           The answer is that the final rule which we will be  
8           discussing today is the first step in our overall plan to  
9           address this issue. That is the upper part of the drawing.

10          The middle part shows the insights, the technology  
11          that went into the final rule that we will be talking about  
12          today.

13          The later part, step 2, is something else that  
14          will be coming in the future. This is taken completely into  
15          consideration, the severe accident challenges. As all of us  
16          know, a severe accident has two attributes, the radioactive  
17          part and the energy part, the pressures and temperatures.  
18          So right now we are only taking into account the radioactive  
19          part.

20          Those other attributes of a severe accident  
21          already have been considered in the staff's review of GE  
22          advanced boiling water reactor and the Combustion  
23          Engineering System 80+ design. Those things now are going  
24          through the certification process.

25          We already have put out an advanced notice of

1 proposed rulemaking to codify generically the severe  
2 accident challenges into our regulations, but the Commission  
3 told us back in 1993 in an SRM to wait for the outcome of  
4 the certifications where severe accident considerations are  
5 considered on a plant-specific basis instead of generically,  
6 and then we will come back and see how and to what extent we  
7 can address the totality of severe accident challenges, that  
8 is, the radioactive part and the loads part, generically in  
9 Part 50 or Part 100.

10 I know that when you people discussed this issue  
11 with the ACRS they raised this question. Also, when this  
12 rule was reviewed by the CRGR in their letter to Mr. Taylor  
13 they raised this question. But I want to make sure that you  
14 have the complete picture in front of you now.

15 [Slide.]

16 MR. SPEIS: With that, I will summarize the  
17 current rule.

18 Basically, the current rule requires that a  
19 determination be made of an exclusion area which is  
20 immediately around the reactor. No residents are allowed in  
21 it.

22 Also a determination has to be made of the low  
23 population zone which is outside the exclusion area. Even  
24 though it may contain some residents, no densely populated  
25 centers are allowed.

1           There is, of course, the population center  
2 distance, which may be no closer than one and one-third  
3 times the low population zone radius.

4           The way the exclusion area and the LPZ are  
5 determined is a postulated source term is assumed to go into  
6 the containment, to exist in the containment  
7 instantaneously. It is constant; it's flat; it does not  
8 have the time behavior that the new source term has. Then,  
9 by using that source term and the criteria of 25 rem to the  
10 body and 300 rem to the thyroid, one determines the  
11 exclusion area size and the LPZ radius.

12           There are no numeric criteria in the rule itself,  
13 but there is guidance in reg. guides 1.3, 1.4, 1.145, and  
14 4.7, and 4.7 are the reg. guides that contain the .4 miles  
15 as the distance between the reactor and the exclusion area.

16           The present Appendix A specifies seismic and  
17 geologic site criteria.

18           With those brief remarks, I would like to turn it  
19 over to Dr. Murphy, who will go forward and discuss the  
20 seismic aspects of the rule.

21           MR. MURPHY: I will start on page 7.

22           [Slide.]

23           MR. MURPHY: My presentation will include a  
24 description of the reasons why we got involved in the  
25 revision to Appendix A, the objectives to that revision, and

1 then I will touch on the highlights both in the earth  
2 sciences and in earthquake engineering aspects of it.

3 As noted already, Appendix A has been around since  
4 1973 and since that time there have been significant  
5 advances in both the earth sciences and seismic engineering.

6 Within the earth sciences the two items that are  
7 of particular note in my mind are the advances in the use of  
8 probabilistic techniques to keep track of the uncertainties  
9 that are involved in the parameters in setting out a safe  
10 shutdown earthquake ground motion, which is the parameter  
11 that we are looking for here, and also in the occurrence of  
12 ground motions in excess of one G that have been observed  
13 principally in the last five to ten years.

14 Under the seismic engineering we are looking at  
15 advances in well studied after shock studies, I will call  
16 them, where we have had an opportunity to go in and see what  
17 damage has occurred to industrial facilities and then to  
18 factor that into use for critical facilities such as nuclear  
19 power plants.

20 A second item would be that the current regulation  
21 contains requirements as well as regulatory guidance. Part  
22 of the difficulty with the guidance actually is that it is  
23 in the rule and in a number of cases it has been treated as  
24 if it were actually requirements, and that has led to some  
25 difficulties within the licensing arena.

1           The third item is the conflicting interpretations  
2 that are given to some of the terminology that is used  
3 within the current rule. This would be terms like tectonic  
4 province or capable fault or understanding what micro and  
5 macro seismicity was all about. Here we have ended up with  
6 an extremely time-consuming and protracted licensing  
7 process.

8           Another item of specific note are the difficulties  
9 that have been associated with the operating basis  
10 earthquake definition and requirements. The current  
11 regulation has in effect three definitions of the operating  
12 basis earthquake, and these have been in a number of cases  
13 conflicting definitions.

14           Another note here is that we have both the  
15 operating basis earthquake and the safe shutdown earthquake  
16 ground motions that are used for design. It has occurred in  
17 a number of cases where the operating basis earthquake has  
18 controlled factors in the design process. We found that  
19 that is not appropriate.

20           Another requirement associated with the operating  
21 basis earthquake is that if the operating basis earthquake  
22 is exceeded, if the ground motion is exceeded at the power  
23 plant, the plant is required to shut down. It had been the  
24 staff interpretation for a long time that this was a  
25 decision that was made by the licensee, but there had been a

1 legal determination that this was not actually the case and  
2 that if an operating basis earthquake happens today it is  
3 incumbent upon the staff to require the utility to shut  
4 down. There is no guidance at this stage on exactly what  
5 exceedance means, and this has led to difficulty in a number  
6 of cases with small nearby earthquakes producing apparently  
7 large accelerations that in fact were non-damaging  
8 accelerations.

9 [Slide.]

10 MR. MURPHY: On viewgraph 8 we look at the  
11 objectives of the proposed revision. To a large extent  
12 these mirror the reasons why we undertook the revision.

13 The first one was the decoupling of the siting  
14 requirements from the design and engineering requirements.  
15 This was initially undertaken to facilitate Part 52  
16 applications. For the seismic case we have been able to  
17 decouple the siting from the engineering requirements. The  
18 siting requirements are contained within the new section  
19 100.23 and the engineering requirements are in Appendix S of  
20 Part 50.

21 We have also moved the detailed guidance from the  
22 regulation to a series of reg. guides so that this guidance  
23 would be available and it would actually be guidance rather  
24 than additional requirements.

25 We have updated the technical requirements in the

1 regulation to reflect the knowledge gained in the last 20  
2 year or 25 years or better. Again, for the earth sciences  
3 this has principally been the introduction of the option to  
4 use probabilistic seismic hazard analysis techniques.

5 We have redefined the operating basis earthquake  
6 and are providing guidance on restart after an OBE triggered  
7 shutdown. We are also providing guidance on what is an OBE  
8 and when exceedance has occurred.

9 [Slide.]

10 MR. MURPHY: This viewgraph highlights the  
11 requirements that are proposed to be in the regulation for  
12 geological siting criteria. The current regulation amounts  
13 to approximately eight pages in the Code of Federal  
14 Regulations. The new streamlined section 100.23 is now  
15 about a column or a half a page in that document.

16 We have maintained the four items that we felt  
17 were specifically critical to the requirements. That is the  
18 requirement for investigation of the geological,  
19 seismological and geotechnical characteristics of the site,  
20 guidance on how these investigations to be carried out are  
21 included within the reg. guide 1.165.

22 We have provided guidance on determining the safe  
23 shutdown earthquake ground motion. Another significant  
24 point there is that we have provided guidance on carrying  
25 out the required uncertainty analysis with making this

1 determination.

2 We have maintained a requirement to investigate  
3 the potential for surface deformation and for the occurrence  
4 of seismically induced floods or water waves. So indeed we  
5 have taken a fairly cumbersome and detailed document and  
6 reduced the requirements in the regulation itself to a very  
7 streamlined document.

8 [Slide.]

9 MR. MURPHY: The next viewgraph touches on the  
10 earthquake engineering aspects of this revision. Very  
11 definitely, the most important thing that we have done in  
12 this revision is to redefine the operating basis earthquake.  
13 In redefining this one we have provided an option to any  
14 applicant.

15 The first is that if the applicant chooses to have  
16 the OBE equal to or less than 1/3 of the SSE, there is no  
17 explicit requirement for design or response analysis. This  
18 alleviates a considerable burden on the applicant.

19 If the applicant chooses to have an operating  
20 basis earthquake larger than 1/3 of the SSE, they are  
21 required to in effect go through the same analysis that is  
22 on the books today. An applicant might choose to have an  
23 operating basis earthquake larger than 1/3 for economic  
24 reasons, to balance the cost of potentially having to shut  
25 down if an operating basis earthquake occurs versus the

1 up-front costs of carrying out the OBE analysis according to  
2 the various codes.

3           The next item within the earthquake engineering  
4 aspects is that we have now taken care of the lack of  
5 guidance that has been out there for determining whether or  
6 not an OBE has been exceeded and what the plant operator has  
7 to do in shutting down the facility, and then providing  
8 guidance on what has to be done after the facility has been  
9 shut down to bring it back on line.

10           The two documents that provide this guidance are  
11 endorsements of documents prepared by the Electric Power  
12 Research Institute.

13           [Slide.]

14           MR. MURPHY: The last page in my viewgraphs,  
15 number 11, is a list of the regulatory guidance that we are  
16 providing to go along with this new regulation.

17           The first one is a fairly comprehensive document  
18 that tells how to carry out the required geological and  
19 seismological investigations and then how to proceed with  
20 the determination of the safe shutdown earthquake and how,  
21 if the applicant selects to go this route, to use the  
22 probabilistic techniques to track the uncertainty that has  
23 been involved in determining the safe shutdown earthquake  
24 ground motion.

25           The next document is a revision of the Standard

1 Review Plan Section 2.5.2, which outlines, as it says here,  
2 the staff duties in carrying out a review, including use of  
3 the probabilistic procedures.

4 The next two standard review plan sections, as it  
5 says here, have conformable changes.

6 The next regulatory guide is a revision of an  
7 existing guide that tells the applicant about what kind of  
8 seismic instrumentation we expect to be at the plant.

9 The next two reg. guides are the ones I referred  
10 to just a while ago about the plant shutdown procedures for  
11 exceeding the OBE and then the plant restart facilities.

12 If there are no questions, I will turn it back.

13 CHAIRMAN JACKSON: There are questions. I want to  
14 be sure that the Commission understands what is to be in the  
15 reg. guides versus in revisions to the regulation. I am  
16 going to ask you about some areas that I am interested in.

17 The definitions of very densely populated and low  
18 population density, where are they? Are they in the rule or  
19 are they in the reg. guides?

20 MR. MURPHY: I would defer that question to Len  
21 Soffer. We do not address them in the seismic portions.

22 MR. SOFFER: We are getting into the radiological  
23 aspects, Madam Chairman.

24 CHAIRMAN JACKSON: If you want me to wait, then  
25 I'll wait.

1           Let's talk about the safe shutdown earthquake.  
2    You kind of talked about the guidance is primarily  
3    probabilistic. Can you be a little more explicit?

4           MR. MURPHY: Yes, I can. What we have suggested  
5    through the regulatory guide is that the applicant carry out  
6    probabilistic seismic hazard analysis. What this in effect  
7    means to start with is that the applicant has a choice of  
8    using the EPRI or the Livermore techniques for carrying out  
9    an analysis. Those techniques are acceptable at this stage  
10   because the staff has already examined the databases and the  
11   computer codes that are used for those techniques.

12           If the applicant chooses, they can go and use in  
13   effect their own probabilistic analysis techniques. The  
14   only requirement would be that they would have to be  
15   reviewed by the staff before the results would be accepted.

16           CHAIRMAN JACKSON: How do they migrate from the  
17   use of EPRI and Livermore techniques to the actual selection  
18   of a safe shutdown earthquake?

19           MR. MURPHY: Let's step through the Livermore  
20   process, and it would be very similar to the EPRI process.  
21   Basically, they make the calculations and then carry out a  
22   thing we call de-aggregation, which is to find out what  
23   rings or annuli around a site with different magnitude for  
24   each ring, how much contribution they make to the ground  
25   motion at the site or to the seismic hazard at the site.

1           The applicant may carry out a set of calculations  
2 looking at the contribution from an annulus that is from 25  
3 to 30 kilometers from the site with magnitudes from 5 to  
4 5-1/2 and then from 5-1/2 to 6 and look at the contributions  
5 that these would then make to the ground motion at the site,  
6 hazard at the site.

7           On this basis the applicant will in effect graph  
8 or plot this information, some of it in a computer format,  
9 so that they are able to tell what earthquake would control  
10 the ground motion at the site. This would then be  
11 equivalent to the magnitude and distance pairs that we in  
12 effect use currently. The significant contribution, the  
13 ground motion for a particular site may come from a  
14 magnitude 5.3 earthquake at about 25 kilometers from the  
15 site.

16           The applicant then would use this information to  
17 develop and scale a spectra that would describe the ground  
18 motion, and this spectra would be the spectra that would be  
19 used to judge whether or not the design spectra for the  
20 facility was enveloped by this probabilistically determined  
21 spectra. In effect, if it passes, the design spectra that  
22 went along with the plant would be acceptable.

23           CHAIRMAN JACKSON: I'm not particularly familiar  
24 with these techniques, but the techniques to which you  
25 refer, they have included in them some kind of uncertainty

1 analysis that helps to provide the envelope that then  
2 propagates back into the design criteria?

3 MR. MURPHY: That's correct. The probabilistic  
4 techniques provide a vehicle for carrying the uncertainties  
5 about the various parameters on through the process so that  
6 we can put bounds on the magnitude and distance pairs that  
7 we achieve and also the bounds on the spectra that are used  
8 to check the design spectra.

9 CHAIRMAN JACKSON: In doing that bounding, are  
10 there confidence intervals that we specify or that would be  
11 specified?

12 MR. MURPHY: There would be confidence bounds that  
13 would come out of the analysis, that would go along as part  
14 of the analysis.

15 CHAIRMAN JACKSON: But we don't have any that we  
16 say are required?

17 MR. MURPHY: No, we do not.

18 CHAIRMAN JACKSON: Given whatever those confidence  
19 intervals are, the design in the end has to accommodate  
20 that; is that the point?

21 MR. MURPHY: That's correct.

22 MR. SPEIS: Chairman Jackson, on the SECY paper we  
23 briefly summarize the seven steps that we go through. If  
24 you and the Commissioners want to hear more about it, we can  
25 go through these.

1 CHAIRMAN JACKSON: Dr. Murphy has answered my  
2 questioned.

3 MR. SPEIS: We knew that was an important part of  
4 this and we tried to highlight it in pages 8 and 9 of the  
5 SECY paper.

6 CHAIRMAN JACKSON: Thank you. Why don't you go  
7 on. I'm probably going to come back to you on some of this  
8 later, but I want to hear the full story.

9 MR. SOFFER: Thank you.  
10 Viewgraph 13, please.

11 [Slide.]

12 MR. SOFFER: I would like to briefly describe the  
13 experience that we have in reactor siting in this country  
14 and the role of reactor siting.

15 Virtually every power reactor in the United States  
16 has been sited using Part 100. The construction permit for  
17 Big Rock Point was granted before Part 100 was promulgated.  
18 However, the operating license was issued after Part 100.

19 At the present time there are 110 operating  
20 reactors in the United States on 69 sites. There are about  
21 2,000 reactor years of U.S. operating experience. However,  
22 this doesn't constitute the entire base of our experience on  
23 reactor siting.

24 It's important to recognize there have been about  
25 an additional 20 reactor sites approved but where there are

1 presently no operating reactors, where operating reactors  
2 have been decommissioned or shut down. There are about ten  
3 sites that were reviewed but were not approved for a variety  
4 of reasons, some of them seismic, some of them population  
5 considerations, a number of other considerations. Even this  
6 does not represent the entire base, because there are a  
7 number of sites that I haven't quantified here where the  
8 review process was ongoing when the review terminated and  
9 consequently there was no decision.

10           Consequently, we have to recognize that there is  
11 very substantial basic siting experience that exists in the  
12 United States and numerous risk studies that have taken  
13 place since Part 100 was issued. These all indicate to us  
14 that the primary factors that influence public health and  
15 safety are reactor design, construction and operation.

16           Nevertheless, the siting factors are important for  
17 assuring, along with reactor design, that radiological doses  
18 from normal operation as well as postulated accidents would  
19 be acceptably low, that natural phenomena and potential  
20 man-related hazards in the site vicinity are described and  
21 are appropriately accounted for in the plant design, that  
22 the site characteristics are amenable to developing  
23 emergency plans and adequate security plans, and finally, to  
24 maintain the Commission's policy of siting reactors away  
25 from densely populated centers.

1           If I can go on the next viewgraph.

2           [Slide.]

3           MR. SOFFER: Part 100 has a number of important  
4 aspects, and it is important to recognize those.

5           First of all, it functions as a siting rule. It  
6 determines the important site parameters that are in the  
7 rule itself: The distance to the exclusion area boundary,  
8 the low population zone outer radius and the population  
9 center distance that provide acceptable separation distances  
10 between the plant and various members of the public.

11           In addition to its acting as a siting rule, it is  
12 important to recognize that it also serves as an important  
13 performance measure of the accident mitigation capability of  
14 the plant. It sets the requirements for things like  
15 containment leak rate, for the performance measure of  
16 fission product systems; it serves in a way as the  
17 radiological challenge for control room habitability for the  
18 operators, and a number of other important areas.

19           It also serves as one test of adequate protection  
20 of the public for a postulated degraded core accident and  
21 fission product release into containment as long as  
22 containment remains intact. It is important to recognize  
23 that before the Commission's safety goal Part 100 in a sense  
24 was one of the measures of adequate protection of the public  
25 by virtue of the fact that a postulated accident was

1 postulated and evaluated considering the site as well as the  
2 plant design.

3           It is also important to recognize those things  
4 that Part 100 doesn't do. It does not determine the  
5 containment design. This is done by the pressure and  
6 temperature conditions of either the loss of coolant  
7 accident or the steam line break accident, whichever one is  
8 more limiting. So the pressure and temperature conditions  
9 associated with a severe accident, as was mentioned by  
10 Dr. Speis, are not considered in determining the containment  
11 design.

12           It does not control severe accident risk. That  
13 risk is dominated by core melt accidents where containment  
14 fails or is bypassed, but neither does Part 100 totally deal  
15 with design basis accidents. It does reflect consideration  
16 of severe accidents by virtue of the population center  
17 distance criteria.

18           It has been very clear from the statement of  
19 considerations going back over 30 years that the population  
20 center distance criteria was added as a reflection of  
21 accidents that could occur beyond the design basis accidents  
22 that were contemplated at the time. This has been one of  
23 the reasons why the staff has continued to issue population  
24 guidance in the form of regulatory guides and kept this  
25 aspect in the forefront.

1           It also reflects consideration of severe accidents  
2 in the nature of the postulated fission product release. It  
3 is intended, as the regulation says, to represent a  
4 substantial core meltdown with appreciable release of  
5 fission products. Originally this was given in an  
6 accompanying document, TID 14844, that was issued along with  
7 the rule, and as our knowledge of severe accidents has  
8 improved over the years we are supplementing this with a  
9 revised accident source term formulation as well.

10           CHAIRMAN JACKSON: Before you go on, let me ask  
11 you this question and clarify something. You say that Part  
12 100 does not determine containment design and the fact that  
13 pressure/temperature conditions of a LOCA or steam line  
14 break determine that, but your second bullet says that it de  
15 facto determines containment performance, because you are  
16 saying it does set requirements for containment leak rate;  
17 is that correct?

18           MR. SOFFER: That's right. It does set  
19 requirements for allowable containment leak rate. That is  
20 correct.

21           CHAIRMAN JACKSON: So while it does not specify  
22 containment design, it de facto specifies containment  
23 parameters?

24           MR. SOFFER: Yes.

25           CHAIRMAN JACKSON: I will come back to this with

1 another question. Thank you.

2 MR. SOFFER: Let's go on to viewgraph 15.

3 [Slide.]

4 MR. SOFFER: The reasons for revising part 100  
5 are, first, to facilitate along with the issuance of Part 52  
6 its use of standardized design and early site permits, as we  
7 mentioned earlier.

8 Second, there was a recognition that the dose  
9 calculation was in effect regulating plant design in some  
10 ways more than siting in terms of regulating allowable  
11 containment leak rate, as we just mentioned, fission product  
12 cleanup system performance such as sprays and filters,  
13 isolation valve timing, drawdown time on a secondary  
14 containment annulus. All of these things were being  
15 influenced and strongly determined by the nature of the Part  
16 100 calculation.

17 We also wanted to revise Part 100 to incorporate  
18 some of the changes in siting practice and to allow for  
19 updated accident source terms, to make explicit the  
20 Commission's policy of requiring plants to be away from  
21 densely populated centers; to make explicit the fact that  
22 the staff has evaluated man-related hazards in the site  
23 vicinity, and yet this is not explicitly mentioned in Part  
24 100; to require that sites be amenable to the development of  
25 adequate security plans and emergency plans; and to update

1 the dose criterion to be more in accord with modern  
2 radiation protection practices and to be amendable with the  
3 development of a revised accident source term.

4 In addition, as Dr. Murphy mentioned, there were  
5 significant advances made in seismic analysis and earthquake  
6 engineering. Basically this effort was initiated about 1990  
7 with a staff recommendation to decouple siting from design.

8 [Slide.]

9 MR. SOFFER: This brought us to this first  
10 proposed revision that was issued in 1992. In this revision  
11 there was a genuine effort at decoupling. There were no  
12 dose calculations proposed for siting. There were numerical  
13 criteria for the exclusionary boundary size and there were  
14 numerical criteria on population density that were included  
15 and specified in the rule itself.

16 Subpart A would apply to current plants and  
17 Subpart B would apply to future plants. There were no  
18 proposed changes made for current plants.

19 This proposed revision elicited some very, very  
20 strong comments from a number of people, the major comment  
21 of which was that almost everyone -- in fact, I should say  
22 everyone did not favor the idea of eliminating dose  
23 calculations for siting purposes.

24 Generally speaking, industry felt that this  
25 provided a flexible performance-based measure and they

1 wanted to see it retained.

2 The public interest groups felt that it provided a  
3 valuable piece of insight and risk knowledge and felt that  
4 this should be retained by the Commission in its criteria.

5 In addition, a number of people felt that the rule  
6 itself was too prescriptive, that it was highly  
7 conservative, and that the incorporation of fixed numerical  
8 criteria in the rule was incompatible with the concerns of  
9 many in the international community. As a result, with  
10 consultation with the Commission at that time, the rule was  
11 withdrawn in March of 1994.

12 The second proposed revision was issued in October  
13 of 1994, and source term and dose criteria were relocated to  
14 Part 50.34 and retained for siting.

15 We proposed a new section 100.21, which would  
16 contain basic non-seismic criteria but without numeric  
17 values.

18 Numerical values for population density are in  
19 proposed Regulatory Guide 4.7.

20 And the dose criterion was changed from 25 rem  
21 whole body and 300 rem thyroid to 25 rem total effective  
22 dose equivalent, TEDE, and evaluated over any two-hour  
23 period.

24 [Slide.]

25 MR. SOFFER: Going on to the next viewgraph, I

1 want to give you some of the highlights of the public  
2 comments. The more detailed discussion of the highlights  
3 was provided to the Commission in a memorandum from  
4 Mr. Taylor sometime ago.

5 The industry comments were generally favorable but  
6 there were significant concerns in a number of areas. All  
7 of the industry felt that the use of TEDE was an appropriate  
8 measure but there was concern that the dose criterion of 25  
9 rem was more restrictive than the current criteria, although  
10 there was one comment that it was appropriate.

11 In the industry comments, there was no need felt  
12 for an organ capping dose or a separate organ dose.

13 And there was also a belief that the use of any  
14 two-hour period to evaluate the dose was confusing and  
15 illogical and introduced some inconsistencies.

16 The one public interest group that did comment  
17 found the rule generally unfavorable, believed that it was a  
18 significant retreat from decoupling, considered the use of  
19 TEDE acceptable and 25 rem appropriate, but believed that  
20 there should be a dose to any single organ, but no comment  
21 on the dose evaluation period itself.

22 CHAIRMAN JACKSON: Let me stop you there. I note  
23 that you are moving the dose criteria to Part 50 for future  
24 applicants, but it has been stated that the dose criteria  
25 are used not only for reactor siting but to assess whether

1 the plant continues to meet its design basis. How do you  
2 handle that dichotomy in terms of the use of the criteria  
3 and whether or not it should be highlighted at least in some  
4 descriptive way in regulations for operating reactors?

5 MR. MIRAGLIA: The intent of the final rule is to  
6 apply for only future designs.

7 CHAIRMAN JACKSON: I appreciate that. What I am  
8 saying is, if it is currently being used to assess whether  
9 currently operating reactors continue to meet their design  
10 bases, then de facto are you not using them for operating  
11 reactors?

12 MR. MIRAGLIA: Our current plan with respect to  
13 the application of the new source term insights for  
14 operating reactors is that we are working with the industry.  
15 The industry has proposed a framework for examining how this  
16 new source term would be used for operating reactors.

17 As a way of background, the siting rule in Part  
18 100 and our evaluation of plants that are currently  
19 operating are based upon design-basis accidents that go back  
20 long term into the regulations in our regulatory history.  
21 That requires a very stylized analysis of these kinds of  
22 accidents.

23 Because there were large uncertainties at the  
24 time, the application of these stylized analyses had lots of  
25 conservatisms in terms of release of material into

1 containment and how they were evaluated.

2           What we have done, consistent with the two phases  
3 that Dr. Speis indicated, is to do an integrated review of  
4 these changes of source term for the new designs. We have  
5 done that substantially and it is completed for the ABWR and  
6 the System 80+ in that we have examined that design against  
7 required design-basis accidents.

8           We have analyzed the severe accident  
9 considerations and insights against that design, which is a  
10 robust design because of the conservatisms in that process  
11 and superimposed those to say that the margins that we are  
12 providing by the design-basis accidents are also sufficient  
13 to consider severe accident considerations and accident  
14 management. So it has been an integrated package for those  
15 two designs.

16           That is an ongoing effort with respect to the  
17 AP-600, the passive design, and the application of these  
18 same kinds of concepts to operating reactors needs that kind  
19 of integrated approach: if we back off from certain  
20 conservatism margins, what impact does it have in terms of  
21 measuring the overall effectiveness of the design?

22           CHAIRMAN JACKSON: Apparently you already have  
23 some applications from licensees who want to utilize the new  
24 source term.

25           MR. MIRAGLIA: What we have done with those, Madam

1 Chairman, is we have expressed this concern of doing an  
2 integrated review to fully understand it. As a result, NEI  
3 has proposed a framework for piloting certain of these  
4 potential uses so that we could take a look at what pieces  
5 can we deal with, what is important for them on a priority  
6 basis from an industry perspective, what pieces of those  
7 source term changes the staff feels are firmly based on  
8 science that we understand what the impact would be that we  
9 could move at perhaps a faster pace, to evaluate that, come  
10 to the Commission in the fall and say here is our plan for  
11 implementing these changes for current reactors in an  
12 integrated kind of sense. That's the current plan.

13 CHAIRMAN JACKSON: Would this be in any sense  
14 taking you down a path of granting exemptions relative to  
15 operating reactors whose licensees want to make use of the  
16 new source term?

17 MR. MIRAGLIA: Since we haven't completed all of  
18 that review, I think one of the products that we would like  
19 to produce is what kind of changes would that be. Would it  
20 be change in guidance only? It may have to be changes in  
21 rules as well.

22 That is one of the things that we would try to  
23 look at and propose to the Commission in this integrated set  
24 of how we are going to look at the pilots, what do they  
25 suggest in terms of what is the appropriate regulatory

1 vehicles to move forward.

2 We didn't want to do it on a piecemeal basis for  
3 an individual plant because of what are the implications,  
4 the full plethora of regulatory implications such as  
5 exemptions, change in guidance, generic letters, or whatever  
6 the case may be.

7 CHAIRMAN JACKSON: With the plan that you have in  
8 mind or that you are going to be proposing, other than the  
9 pilots, you would not be contemplating changes for existing  
10 operating reactors until you have worked out the whole  
11 plethora of the implications; is that correct?

12 MR. MIRAGLIA: That's correct. I think there have  
13 been some instances where we have done some changes in terms  
14 of timing which are clearly consistent with previous  
15 Commission guidance that any changes we make need to be well  
16 founded on the technology and the research that supports the  
17 source term pieces, but to make major modifications and  
18 changes to that, we would come forward with a plan to say  
19 here's how we are going to work with the industry.

20 CHAIRMAN JACKSON: When you say changes, do you  
21 mean exemptions or do you mean changes in framework?

22 MR. MIRAGLIA: I think what we are looking at is  
23 modifications to the regulatory framework.

24 CHAIRMAN JACKSON: Let me go back to Mr. Soffer.  
25 Has there been resolution of this difference of opinion

1 between NRR and Research with respect to the "any" versus  
2 the first two-hour time frame?

3 MR. SOFFER: I will defer to Dr. Speis.

4 MR. SPEIS: I would say yes. The staff position  
5 as presented in the SECY paper is that we will go forward  
6 and recommend to the Commission any two hours.

7 I think the views were very clear. They were  
8 expressed and clarified. Both of them lead to a safe  
9 design. Our position dealt mostly with the issue of risk  
10 versus design basis.

11 CHAIRMAN JACKSON: And "any" addresses risk?

12 MR. SPEIS: Yes. I think it was helpful to all of  
13 us to put some of those things on the table. The Commission  
14 has all the information. We will be happy whichever  
15 direction the Commission decides to go.

16 MR. TAYLOR: Although we recommend "any."

17 [Laughter.]

18 MR. MIRAGLIA: I think Dr. Speis has accurately  
19 characterized it. One is a risk; the other is design basis.  
20 Since there is this design basis attribute left in the rule  
21 in terms of the efficacy of the design, the worst would be  
22 conservative.

23 CHAIRMAN JACKSON: So your unified position is  
24 any; is that what you are telling us?

25 MR. TAYLOR: Yes.

1 MR. SPEIS: Yes.

2 CHAIRMAN JACKSON: It's important that you come to  
3 some overall concurrence that makes sense as reflected in  
4 the SECY paper, because you are asking the Commission to  
5 make a decision based on that particular recommendation, and  
6 it has implications relative to things such as emergency  
7 planning, et cetera, and so it is very important that you  
8 have clarified any issues here. This is your opportunity if  
9 there is any additional clarification that needs to be made.

10 MR. MIRAGLIA: No.

11 CHAIRMAN JACKSON: Let me ask you about the 25 rem  
12 total effective dose equivalent. There was an ACRS letter  
13 that recommended that a careful definition of the TEDE  
14 limits that are mindful of organ dose weighting factors  
15 should be -- and some of this was referred to in some of the  
16 public comments -- included in the final rule. The question  
17 would be, is it clear that you recommend this particular  
18 dose limit based on latent cancer fatality risk?

19 MR. SOFFER: Yes. We are recommending this based  
20 on latent cancer fatality risk. We believe that this is  
21 consistent with other Commission regulations in this regard.

22 The industry raised a point of apparent  
23 contradiction in the sense of a conversion of 25 rem whole  
24 body and 300 rem thyroid to a latent cancer fatality risk.  
25 The staff computed that that would be approximately

1 equivalent to 27 rem, which we then rounded down,  
2 admittedly, and said that was pretty near equivalent to 25  
3 rem.

4           However, there are organ weighting factors in Part  
5 20 which would make the 25 rem whole body and 300 rem  
6 thyroid equivalent to 34, that is, the thyroid weighting  
7 factor is 0.03. So 25 times one plus 300 times .03 would  
8 give you 34. And the industry felt that there was a certain  
9 amount of unfairness in this where one equivalency came to  
10 27 and yet they were being asked to hold to 34.

11           There is a certain amount of inconsistency in  
12 this. The organ weighting factors in Part 20, we have  
13 discovered, are not entirely due to latent cancer fatality;  
14 they include additional factors as well.

15           However, we do not feel that this is a more  
16 restrictive criterion because the thyroid criterion has  
17 always been the limiting criterion in licensing. The  
18 highest dose that I can recall to which we have licensed a  
19 plant was approximately 10 rem whole body and very close to  
20 300 rem thyroid. When one equates this in a TEDE dose, this  
21 comes out to approximately 19 rem. So the use of 25 rem  
22 TEDE and converting the thyroid dose to a TEDE equivalent  
23 is, practically speaking, a slight relaxation.

24           CHAIRMAN JACKSON: In effect it is a slight  
25 relaxation relative to the potential thyroid dose; is that

1 correct?

2 MR. SOFFER: Yes, it is.

3 MR. MIRAGLIA: That's the rate for plants we have  
4 examined to date.

5 MR. SOFFER: Although in theory it can be argued  
6 that it is a restriction, in fact the thyroid dose has been  
7 the more limiting and it acts practically as a slight  
8 relaxation. Nonetheless, we feel that 25 rem is the  
9 appropriate dose criterion, and that is what the staff is  
10 recommending.

11 CHAIRMAN JACKSON: Thank you.

12 MR. SOFFER: If we can go on to number 18.

13 [Slide.]

14 MR. SOFFER: I would like to discuss some of the  
15 elements of the draft final rule. We are proposing to  
16 incorporate basic reactor site criteria in a new section,  
17 100.21. I will just go over these very briefly.

18 Site atmospheric dispersion characteristics must  
19 be such that doses for normal operation would be met and the  
20 consequences of postulated accidents would meet the dose  
21 criteria that are given in section 50.34.

22 Second, that potential hazards associated with  
23 physical characteristics of the site as well as man-related  
24 or human-related activities nearby must be shown to pose no  
25 undue risk to any plant that would be located on that site.

1           The site characteristics must be such that  
2 adequate security plans and measures can be developed and  
3 adequate emergency plans can be developed.

4           And finally, that reactor sites should be located  
5 away from very densely populated centers, that low density  
6 areas are preferred, and that other sites may be acceptable.

7           CHAIRMAN JACKSON: Let me reinstate my earlier  
8 question. Where are the definitions of these terms?

9           MR. SOFFER: If we can go to the next viewgraph,  
10 we will get there.

11           [Slide.]

12           MR. SOFFER: The proposed population criteria are  
13 in proposed revision of Regulatory Guide 4.7. I would like  
14 to say that, first of all, these reflect some consideration  
15 of severe accidents as well as reflecting conditions that  
16 are reflective of U.S. geography and demography.

17           What we are saying is that sites where the  
18 population density does not exceed 500 persons per square  
19 mile out at any distance out to 20 miles, that is, circular  
20 area out to 20 miles, are preferred sites.

21           The guide also states that reactors should not be  
22 located where the population density is well in excess of  
23 this above value.

24           Population projections are to be considered for  
25 about five years from initial site approval and the

1 transient population is to be factored in.

2 Population growth after site approval is expected,  
3 but changes should be factored into the site emergency  
4 plans.

5 As you will see, and I hope I am answering your  
6 question, the guide does not directly address the question  
7 of what is a densely populated site; it rather addresses the  
8 question by saying a population density below 500 people per  
9 square mile is a preferred site and that sites above this  
10 may be approved, depending upon safety or environmental  
11 considerations, but sites should not be located in areas  
12 that are well above this value.

13 It is interesting to recognize that the criterion  
14 of 500 people per square mile in effect does represent some  
15 kind of a standoff distance from cities of significant size.

16 For example, a population center of about 100,000  
17 people in practical terms cannot be located closer than ten  
18 miles because anything significantly closer than that would  
19 get you above 500 people per square mile. Similarly, a  
20 major metropolitan center of about a half a million or more  
21 in practical terms would have to be at least 20 miles away.  
22 These are the kind of standoff distances that the regulatory  
23 guide basically sets in terms of preferred distances, but it  
24 does not directly address the question of what is a densely  
25 populated area.

1           In part this is due to the fact that from  
2 demographic considerations it is very difficult to define  
3 densely populated areas in terms of density. Cities vary  
4 all over the place in terms of population density.

5           For example, cities in the Northeast tend to be  
6 rather high in population density. The District of  
7 Columbia, for example, has a population density of almost  
8 10,000 people per square mile. Manhattan has a population  
9 density of over 50,000 people per square mile. On the other  
10 hand, Los Angeles has a population density that is just a  
11 little over 2,000 people per square mile.

12           So trying to define a densely populated center in  
13 terms of density has often not worked out very well, and the  
14 guide does it in a much better way, in my opinion, by  
15 describing the total number of people within a fixed  
16 distance to the plant so that it tends to count all of the  
17 people and gets around some of the obvious difficulties of  
18 looking at political boundaries and subdivisions and  
19 suburbs. So I think this is a better way of doing it.

20           CHAIRMAN JACKSON: But even that is not totally  
21 disqualifying.

22           MR. SOFFER: Even that does not totally disqualify  
23 it. That is correct.

24           CHAIRMAN JACKSON: Let me ask you one other  
25 question. How is emergency planning actually to be factored

1 into site evaluation? In particular, I am thinking about  
2 the Commission's Seabrook decision that said that emergency  
3 planning is not site disqualifying. Is this going to  
4 overrule that decision or conflict with it?

5 MR. MIRAGLIA: I don't believe so. I think the  
6 emergency plans are looked at as another measure of defense  
7 in depth beyond the regulations in terms of safety. The  
8 defense in depth is the design, the siting of the facility,  
9 meeting the safety goals. The emergency plan is another  
10 aspect of defense in depth.

11 CHAIRMAN JACKSON: Would you provide the  
12 Commission with an explicit answer to that question.

13 MR. MIRAGLIA: Sure.

14 MR. SPEIS: Yes.

15 CHAIRMAN JACKSON: The other question I have is,  
16 how is the major accident for site evaluation purposes  
17 chosen?

18 MR. SOFFER: I'm sorry.

19 CHAIRMAN JACKSON: When you are doing site  
20 evaluations as opposed to design evaluations, how do you  
21 choose or decide what a major accident is?

22 MR. SOFFER: The major accident is essentially the  
23 same for both. It is a large fission product release into  
24 containment. The current licensing basis was essentially  
25 the source term formulation that was given in TID 14844.

1 For new plants we would probably propose using the revised  
2 source term, which is an amalgam of severe accident  
3 evolutions based on current plant understanding. But they  
4 are basically the same. They represent a significant  
5 degraded core accident, and the fission product release in  
6 that bounds what was released into containment from Three  
7 Mile Island, for example.

8 CHAIRMAN JACKSON: Okay.

9 MR. SOFFER: If we can go to viewgraph number 20.  
10 [Slide.]

11 MR. SOFFER: There are a number of risk insights  
12 that were developed as part of our thinking in developing of  
13 this rule. I would like to mention several of them.

14 The staff investigated how the size of the  
15 exclusion area would comport with meeting the Commission's  
16 safety goal. We examined this using risk insights from the  
17 NUREG-1150 plants.

18 It was determined that the prompt fatality  
19 quantitative health objective, the QHO of the safety goal,  
20 was met for all exclusion area boundary sizes of about 0.1  
21 mile or greater. We did not look at any exclusion area  
22 boundary sizes smaller than 0.1 mile. So for all the sizes  
23 that we looked at from 0.1 mile or greater the prompt  
24 fatality QHO was met.

25 The latent cancer fatality quantitative health

1 objective was also very easily met.

2 It is important to note that this size, 0.1 mile,  
3 encompasses all of our current operating plants and all of  
4 the sites that have been reviewed and approved by the staff.

5 Another important insight that comes out of this  
6 is that the staff investigated the individual risk of  
7 permanent relocation as a result of land contamination.

8 Using the insights from NUREG-1150, a severe  
9 accident release was examined that was characteristic of our  
10 present operating plants, and it was found that the risk of  
11 permanently relocating an individual was low at all  
12 distances, that it was less than about ten to the minus six  
13 per year. This is a reflection of the low frequency of such  
14 an event. And that this risk itself declined significantly  
15 beyond about 20 miles. This is a reflection of the effect  
16 that distance and wind direction have on mitigating such a  
17 severe event.

18 Consequently this distance of 20 miles has been  
19 factored into and considered in our revision of Regulatory  
20 Guide 4.7, and this is why I said Reg. Guide 4.7 represents  
21 not only the demographic considerations of the United States  
22 but also represents and reflects some consideration of  
23 severe accidents as well.

24 [Slide.]

25 MR. SOFFER: This is just finishing up the draft

1 final rules. I believe most of these have been mentioned  
2 and I don't want to go into great detail.

3 As has been mentioned, the source term and dose  
4 criteria for future plants have been relocated to Part  
5 50.34.

6 It is also important to recognize that we have  
7 left the licensing basis for current plants alone in Subpart  
8 A of Part 100. So the dose criteria really appear in two  
9 places.

10 Subpart A of Part 100 still contains 25 rem and  
11 300 rem thyroid for current plants and does not change the  
12 current licensing basis for those plants

13 Subpart B, which is applicable for future plants,  
14 moves the dose criteria to Part 50.34 and changes it to 25  
15 rem total effective dose equivalent, and that the dose to an  
16 individual is not to exceed that value for any two-hour  
17 period at the exclusion area boundary or for the course of  
18 the accident at the low population zone.

19 I would also like to mention in conclusion that  
20 both the Advisory Committee on Reactor Safeguards as well as  
21 our management review group, the Committee to Review Generic  
22 Requirements were briefed. ACRS recommended issuance of the  
23 rule and CRGR indicated that it had no objection to  
24 issuance.

25 The additional view by Research has been discussed

1 already. So unless there are any more questions, that  
2 concludes my presentation.

3 CHAIRMAN JACKSON: Commissioner Rogers, do you  
4 have anything?

5 COMMISSIONER ROGERS: Just a couple. Did you get  
6 any comments from the international community on the new  
7 version of the rule?

8 MR. SOFFER: Only indirectly. We received a  
9 comment from one law firm that has a number of international  
10 clients, and they were rather favorable and believe that  
11 this revision addressed most of their concerns.

12 COMMISSIONER ROGERS: That is good. We did hear a  
13 lot about the first version and it apparently did give some  
14 serious concerns elsewhere in the world.

15 You referred on slide 20 to your investigation of  
16 the safety goal versus the size of the exclusion area. How  
17 available will those studies be?

18 MR. SOFFER: The study is a NUREG that is in draft  
19 form and is presently undergoing a final review by the  
20 staff. We should be issuing it fairly soon, I believe.

21 CHAIRMAN JACKSON: I think that also would be very  
22 interesting to the international community. The fact that  
23 you have come down to a tenth of a mile would probably give  
24 considerable comfort to some of the people that were very  
25 concerned about the earlier version of the rule.

1           That's all I have.

2           CHAIRMAN JACKSON: Commissioner Discus.

3           COMMISSIONER DICUS: On slide 19, I was curious  
4 about how many of the current sites would meet this  
5 population density preference.

6           MR. SOFFER: You mean the preferred number of 500  
7 people per square mile?

8           COMMISSIONER DICUS: Yes.

9           MR. SOFFER: There are currently about six or  
10 seven sites that are above 500 people per square mile.  
11 These were all reviewed and approved before the current  
12 version of Reg. Guide 4.7 was issued in 1975. The three  
13 highest population density sites, of course, are Indian  
14 Point, Limerick and Zion, but there are a few others. I  
15 don't remember all of them by name, but I can get that  
16 information if you wish.

17          MR. SPEIS: I would like to add something to that  
18 point that is very important. These are the sites that the  
19 previous Commission ordered special restudies specific to  
20 Indian Point and Limerick and Zion.

21          CHAIRMAN JACKSON: If you look at the safety goal  
22 versus the exclusion area, they are bounded by that.

23          MR. SPEIS: Yes.

24          MR. SOFFER: Yes.

25          MR. SPEIS: In some cases changes were made to the

1 design to enhance it and make it more robust for severe  
2 accident challenges.

3 MR. MIRAGLIA: As Dr. Speis has indicated,  
4 specific PRA reviews were done on those three facilities  
5 that were mentioned.

6 CHAIRMAN JACKSON: This is a question I am not  
7 sure you can answer, but you did speak of your 30 years of  
8 license experience.

9 MR. MIRAGLIA: The Chairman is looking at me.  
10 [Laughter.]

11 CHAIRMAN JACKSON: Mr. Taylor was looking down.  
12 [Laughter.]

13 CHAIRMAN JACKSON: Is there any area that you  
14 think is particularly litigious?

15 MR. MIRAGLIA: In terms of the old plants, we just  
16 want to be cautious and make sure that we fully understand  
17 the ramification of any changes. In terms of the new  
18 plants, those processes have been open to the public and  
19 those issues have been considered in the context of the two  
20 design certifications and are ongoing for the AP-600.

21 CHAIRMAN JACKSON: I would like to thank you very  
22 much for briefing the Commission. You have presented to us  
23 a lot of information today that shows how much work you have  
24 done to improve these regulations and to lay the groundwork  
25 for future siting applications.

1           This is just a reiteration of an earlier point,  
2 but I know you have placed the dose criteria in Part 50 for  
3 future applicants, and that is appropriate, but particularly  
4 with respect to the new source term tackling this issue for  
5 operating plants remains open. As in some sense the ACRS  
6 has said, we have been using the Part 100 dose criteria as a  
7 surrogate for estimating certain of the consequences of  
8 design basis accidents.

9           The Commission looks forward to the work that you  
10 have outlined, Mr. Miraglia, and we would like you to come  
11 back to the Commission for guidance as you proceed, also to  
12 not proceed down a path where you are doing de facto  
13 exemptions. I think the pilots will help you address a lot  
14 of the issues.

15           Having said that, I think we would just urge you  
16 to continue to work on the open issues so that the rule is  
17 clear in how we apply it. I think the various reg. guides  
18 should be ready and promulgated as close to the rule,  
19 assuming we approve it, as possible, and that the rule can  
20 accommodate future applications where appropriate.

21           I do believe that the improvements in the seismic  
22 area are comprehensive and allow a clearer assessment of the  
23 issues. Very important and something that all of us are  
24 concerned about is that our regulations stay abreast of  
25 advances in the science, but it is also important that the

1 clarifications of the type presented today, for instance,  
2 clearly differentiating between safe shutdown earthquakes  
3 and operating basis earthquakes, are addressed in a timely  
4 manner.

5 I think we understand the rationale for moving to  
6 the use of the TEDE, but I think we should continue to study  
7 the issue of the organ dose weighting factors as used in  
8 Part 20 and evaluate whether their use may be warranted  
9 across the board for consistency.

10 Other than asking you for the specific answer to  
11 the question with respect to how emergency planning is  
12 treated and the fact that it is not site disqualifying a la  
13 the Commission's earlier Seabrook decision is an important  
14 answer you should provide to the Commission.

15 Are there any further comments from fellow  
16 Commissioners?

17 [No response.]

18 CHAIRMAN JACKSON: We are adjourned.

19 [Whereupon, at 4:15 p.m., the briefing was  
20 adjourned.]

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CERTIFICATE

This is to certify that the attached description of a meeting of the U.S. Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING ON PART 100 FINAL RULE ON  
REACTOR SITE CRITERIA - PUBLIC MEETING

PLACE OF MEETING: Rockville, Maryland

DATE OF MEETING: Wednesday, June 12, 1996

was held as herein appears, is a true and accurate record of the meeting, and that this is the original transcript thereof taken stenographically by me, thereafter reduced to typewriting by me or under the direction of the court reporting company

Transcriber: Michael Paulus

Reporter: Michael Paulus



*United States  
Nuclear Regulatory Commission*

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DRAFT FINAL RULE  
REVISION OF  
10 CFR PARTS 50, 100

JUNE 12, 1996

THEMIS SPEIS  
ANDREW J. MURPHY  
LEONARD SOFFER

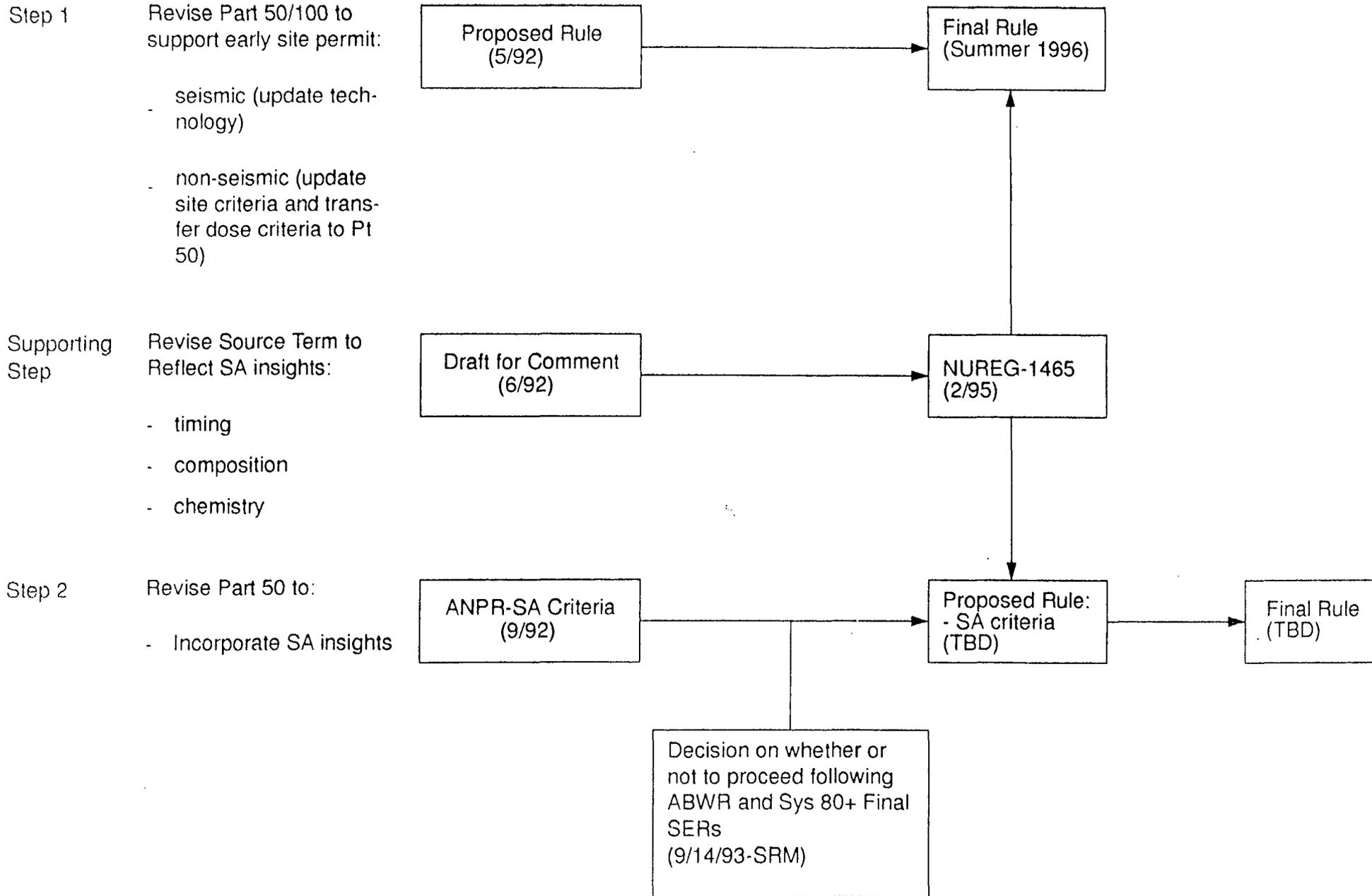
## OUTLINE

- CHRONOLOGY AND OVERVIEW OF CURRENT RULE
  
- SEISMIC ASPECTS OF PROPOSED REVISION
  - SEISMIC AND GEOLOGIC SITING CRITERIA
  - USE OF PROBABILISTIC SEISMIC HAZARDS IN DETERMINING DESIGN BASIS GROUND MOTION
  - EARTHQUAKE ENGINEERING CRITERIA
  
- RADIOLOGICAL ASPECTS OF PROPOSED REVISION
  - MAJOR DEVELOPMENTS AND EXPERIENCE IN REACTOR SITING
  - PROPOSED REVISIONS
  - ELEMENTS OF DRAFT FINAL RULE

## CHRONOLOGY

- 10 CFR 100 ISSUED - APRIL 1962
- 10 CFR 100, APPENDIX A ISSUED - NOV. 1973
- STAFF PROPOSED PLAN FOR REVISION TO PARTS 50/100 - OCT. 1990
- FIRST PROPOSED REVISION ISSUED FOR COMMENT - OCT. 1992
- FIRST PROPOSED REVISION WITHDRAWN - MAR. 1994
- SECOND PROPOSED REVISION ISSUED FOR COMMENT - OCT. 1994
- COMMENT PERIOD ON SECOND PROPOSED REVISION ENDS - MAY 1995

# OVERALL PLAN



## CURRENT RULE

- CURRENT RULE - 10 CFR 100 (APRIL 1962). REQUIRES:
  - EXCLUSION AREA - IMMEDIATE ZONE AROUND REACTOR. NO RESIDENTS.
  - LOW POPULATION ZONE (LPZ) - ZONE OUTSIDE EXCLUSION AREA. MAY CONTAIN RESIDENTS, BUT NOT DENSELY POPULATED CENTER.
  - POPULATION CENTER DISTANCE - MAY BE NO CLOSER THAN ONE AND ONE-THIRD TIMES THE LPZ RADIUS.
- FISSION PRODUCT RELEASE WITHIN CONTAINMENT POSTULATED. CONTAINMENT ASSUMED TO BE INTACT, BUT LEAKING. DOSES TO HYPOTHETICAL INDIVIDUALS MUST NOT EXCEED 25 REM WHOLE BODY AND 300 REM THYROID AT:
  - EXCLUSION AREA BOUNDARY (EAB) FOR 2 HRS AFTER ONSET OF RELEASE,
  - LPZ OUTER RADIUS FOR COURSE OF ACCIDENT (30 DAYS).
- NO NUMERIC CRITERIA FOR EXCLUSION AREA SIZE, LPZ AND POP. CENTER DISTANCE. STAFF GUIDANCE ON DOSE CALCULATIONS AND POPULATION DENSITY ARE IN REGULATORY GUIDES (1.3, 1.4, 1.145, 4.7).
- PRESENT APPENDIX A SPECIFIES SEISMIC AND GEOLOGIC SITE CRITERIA.

REVISION TO PART 100 APPENDIX A  
SEISMIC AND GEOLOGIC SITING CRITERIA  
FOR  
NUCLEAR POWER PLANTS

## WHY REVISION OF APPENDIX A IS NECESSARY

- APPENDIX A DOES NOT REFLECT THE ADVANCES IN EARTH SCIENCE AND SEISMIC ENGINEERING SINCE 1973
- CONTAINS REQUIREMENTS AND VERY DETAILED & PRESCRIPTIVE GUIDANCE
- CONFLICTING INTERPRETATIONS OF APPENDIX A OFTEN LED TO TIME CONSUMING DISCUSSIONS AND PROLONGED THE LICENSING PROCESS
- THERE HAVE BEEN DIFFICULTIES IN THE APPLICATION OF OPERATING BASIS EARTHQUAKE REQUIREMENTS
  - OBE IS AT LEAST 1/2 SSE (SAFE SHUTDOWN EARTHQUAKE) - AS APPLIED, POSSIBLE FOR OBE TO HAVE MORE DESIGN SIGNIFICANCE THAN SSE
  - SHUTDOWN IF OBE IS EXCEEDED, BUT NO CRITERIA FOR EXCEEDANCE OR GUIDANCE FOR SHUTDOWN OR RESTART - STAFF NOT LICENSEE INITIATED ACTION

## OBJECTIVES OF PROPOSED REVISION

- DECOUPLE SITING REQUIREMENTS FROM DESIGN OR ENGINEERING REQUIREMENTS  
- FACILITATE PART 52 APPLICATIONS
- MOVE THE DETAILED GUIDANCE FROM THE REGULATION TO REGULATORY GUIDES
- UPDATE THE TECHNICAL REQUIREMENTS IN THE REGULATION TO REFLECT  
CURRENT KNOWLEDGE
- REDEFINE OPERATING BASIS EARTHQUAKE (OBE)
- PROVIDE GUIDANCE ON RESTART FOLLOWING OBE TRIGGERED SHUTDOWN

REVISION TO APPENDIX A (10 CFR 100.23)  
GEOLOGICAL SITING CRITERIA

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.

REVISION OF APPENDIX A  
(EARTHQUAKE ENGINEERING) (10 CFR 50 APPENDIX S)

HIGHLIGHTS OF CHANGES IN EARTHQUAKE ENGINEERING:

- APPLICANT SELECTS THE OBE VALUE
  - \* IF OBE IS  $1/3$  SSE, NO EXPLICIT RESPONSE OR DESIGN ANALYSIS IS REQUIRED
  - \* IF OBE IS GREATER THAN  $1/3$  SSE, EXPLICIT RESPONSE AND DESIGN ANALYSIS ARE REQUIRED (CURRENT REQUIREMENTS)
- IF OBE IS EXCEEDED, ORDERLY SHUTDOWN IS REQUIRED
  - \* EXCEEDANCE CRITERIA AND SHUTDOWN/RESTART GUIDANCE PROVIDED
  - \* EXCEEDANCE CRITERIA AND SHUTDOWN/RESTART GUIDANCE ARE PROVIDED

## REGULATORY GUIDANCE

- REGULATORY GUIDE 1.165, GUIDANCE FOR DETERMINING THE SAFE SHUTDOWN EARTHQUAKE FOR NUCLEAR POWER PLANTS. THIS GUIDANCE IS PRIMARILY PROBABILISTIC, COUPLED WITH STRONG RELIANCE ON SITE-SPECIFIC INVESTIGATIONS
- REVISION TO SRP 2.5.2 OUTLINES HOW THE STAFF WILL REVIEW AN APPLICATION UNDER THE NEW REGULATION THAT USES THE PROBABILISTIC PROCEDURES
- REVISION OF SRP 2.5.1 AND 2.5.3 TO MAKE CONFORMABLE CHANGES BASED ON NEW REGULATION
- REVISION TO REGULATORY GUIDE 1.12 ON SEISMIC INSTRUMENTATION
- NEW REGULATORY GUIDES 1.166 AND 1.167 ON PLANT SHUTDOWN FOR OBE EXCEEDANCE AND FOR PLANT RESTART RESPECTIVELY

DRAFT FINAL RULE  
REVISION OF 10 CFR PARTS 50 AND 100  
RADIOLOGICAL ASPECTS

## U.S. EXPERIENCE AND THE ROLE OF REACTOR SITING

- VIRTUALLY ALL POWER REACTORS IN U.S. HAVE BEEN SITED USING PART 100. PRESENTLY, 110 OPERATING REACTORS IN THE U.S. ON 69 SITES. ABOUT 2000 REACTOR-YEARS OF U.S. OPERATING EXPERIENCE. ALSO:
  - ABOUT 20 SITES APPROVED; BUT PRESENTLY NO OPERATING REACTORS,
  - ABOUT 10 SITES REVIEWED BUT NOT APPROVED.
- SUBSTANTIAL BASE OF SITING EXPERIENCE EXISTS. NUMEROUS RISK STUDIES INDICATE THAT THE PRIMARY FACTORS THAT INFLUENCE PUBLIC HEALTH AND SAFETY ARE REACTOR DESIGN, CONSTRUCTION AND OPERATION.
- SITING FACTORS ARE IMPORTANT FOR:
  - ASSURING (WITH DESIGN) THAT RADIOLOGICAL DOSES FROM NORMAL OPERATION AND POSTULATED ACCIDENTS ARE ACCEPTABLY LOW,
  - THAT NATURAL PHENOMENA AND MAN-RELATED HAZARDS IN THE SITE VICINITY ARE DESCRIBED AND ACCOUNTED FOR IN PLANT DESIGN,
  - THAT SITE CHARACTERISTICS ARE AMENABLE TO DEVELOPMENT OF EMERGENCY PLANS AND SECURITY PLANS,
  - MAINTAINING COMMISSION POLICY OF SITING AWAY FROM DENSELY POPULATED CENTERS.

## PURPOSE OF PART 100

- DETERMINES SITE PARAMETERS (EAB, LPZ, POP.CTR. DIST.) PROVIDING ACCEPTABLE SEPARATION DISTANCES BETWEEN PLANT AND MEMBERS OF PUBLIC.
- PROVIDES A PERFORMANCE MEASURE OF THE ACCIDENT MITIGATION CAPABILITY OF THE PLANT. SETS REQUIREMENTS FOR CONTAINMENT LEAK RATE, FISSION PRODUCT CLEANUP SYSTEMS, ETC.
- SERVES AS ONE TEST OF ADEQUATE PROTECTION OF THE PUBLIC FOR A POSTULATED DEGRADED CORE ACCIDENT AND FISSION PRODUCT RELEASE INTO CONTAINMENT (AS LONG AS CONTAINMENT REMAINS INTACT).
- WHAT DOESN'T PART 100 DO?
  - DOES NOT DETERMINE CONTAINMENT DESIGN (THIS IS DONE BY PRESSURE/TEMPERATURE CONDITIONS OF LOCA/STEAM LINE BREAK).
  - DOES NOT CONTROL SEVERE ACCIDENT RISK. RISK IS DOMINATED BY CORE-MELT ACCIDENTS WHERE CONTAINMENT FAILS OR IS BYPASSED.

## REASONS FOR REVISING PART 100

- ISSUANCE OF PART 52 WITH USE OF EARLY SITE PERMITS
- RECOGNITION THAT DOSE CALC. AFFECTING PLANT DESIGN MORE THAN SITING.
  - ALLOWABLE CONTAINMENT LEAK RATE,
  - FISSION PRODUCT CLEANUP SYSTEM PERFORMANCE (SPRAYS, FILTERS),
  - ISOLATION VALVE TIMING, DRAWDOWN TIME ON SECONDARY CONT. ANNULUS.
- INCORPORATE CHANGES IN SITING PRACTICE AND ALLOW FOR UPDATED ACCIDENT SOURCE TERMS
  - REQUIRE PLANTS TO BE "AWAY FROM" DENSELY POPULATED CENTERS,
  - REQUIRE MAN-RELATED HAZARDS TO BE EVALUATED,
  - SITES CHARACTERISTICS MUST BE AMENABLE TO DEVELOPMENT OF ADEQUATE SECURITY PLANS AND EMERGENCY PLANS,
  - REVISE DOSE CRITERION TO REFLECT REVISED ACCIDENT SOURCE TERMS.
- INCORPORATE ADVANCES IN SEISMIC ANALYSIS AND EARTHQUAKE ENGINEERING
- EFFORT INITIATED IN 1990 TO DECOUPLE SITING FROM DESIGN.

PROPOSED REVISIONS  
(NON-SEISMIC)

- FIRST PROPOSED REVISION (OCT. 1992) - NO DOSE CALCULATIONS FOR SITING. NUMERICAL CRITERIA FOR EAB SIZE AND POP. DENSITY IN RULE. PROPOSED RULE TO CONSIST OF TWO SUBPARTS; SUBPART A FOR CURRENT PLANTS; SUBPART B FOR FUTURE PLANTS.
  
- MAJOR COMMENTS - DOSE CALCULATIONS SHOULD BE RETAINED. RULE TOO PRESCRIPTIVE, CONSERVATIVE, INCOMPATIBLE WITH CONCERNS OF INTERNATIONAL COMMUNITY. RULE WITHDRAWN MARCH 28, 1994.
  
- SECOND PROPOSED REVISION (OCT. 1994) - SOURCE TERM AND DOSE CRITERIA RELOCATED TO PART 50.34, AND RETAINED FOR SITING.
  - SECTION 100.21, CONTAINS BASIC NON-SEISMIC CRITERIA WITHOUT NUMERICAL VALUES.
  - NUMERICAL VALUES FOR POP. DENSITY IN REVISED REG. GUIDE 4.7.
  - DOSE CRITERION OF 25 REM TEDE. DOSE EVALUATED OVER ANY TWO-HOUR PERIOD.

PUBLIC COMMENT HIGHLIGHTS - (NON-SEISMIC)

- INDUSTRY (7 COMMENTS) - GENERALLY FAVORABLE; SIGNIFICANT CONCERNS IN SOME AREAS
  - USE OF TEDE IS APPROPRIATE
  - DOSE CRITERION OF 25 REM IS MORE RESTRICTIVE THAN CURRENT CRITERIA (ONE INDUSTRY COMMENT THAT 25 REM IS APPROPRIATE).
  - NO NEED FOR AN ORGAN "CAPPING" DOSE.
  - USE OF ANY 2 HOUR PERIOD TO EVALUATE DOSE CONFUSING, ILLOGICAL.
- PUBLIC INTEREST GROUP (1 COMMENT) - GENERALLY UNFAVORABLE. PROPOSED RULE IS A RETREAT FROM DECOUPLING.
  - USE OF TEDE ACCEPTABLE
  - DOSE CRITERION OF 25 REM APPROPRIATE
  - DOSE TO ANY SINGLE ORGAN SHOULD BE NO MORE THAN ONE-THIRD OF TOTAL
  - NO COMMENT ON DOSE EVALUATION PERIOD

## ELEMENTS OF DRAFT FINAL RULES

### BASIC REACTOR SITE CRITERIA (10 CFR 100.21)

- 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.
  
- POTENTIAL HAZARDS ASSOCIATED WITH PHYSICAL CHARACTERISTICS OF SITE (E.G., GEOLOGY, HYDROLOGY) AND HUMAN-RELATED ACTIVITIES NEARBY (E.G., INDUSTRY, AIRPORTS) WILL POSE NO UNDUE RISK TO 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; LOW DENSITY AREAS PREFERRED; OTHER SITES MAY BE ACCEPTABLE.

POPULATION CRITERIA  
(PROPOSED REVISION 2 OF REG. GUIDE 4.7)

- NUMERICAL VALUES REFLECT 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.

## RISK INSIGHTS

- STAFF INVESTIGATED MEETING SAFETY GOAL VS. SIZE OF EXCLUSION AREA. THIS BASED ON CURRENT PLANTS, USING RISK INSIGHTS FROM NUREG-1150.
  - PROMPT FATALITY QHO OF THE SAFETY GOAL ( $5 \times 10^{-7}$  PER YEAR) IS MET FOR ALL EAB SIZES OF ABOUT 0.1 MILE OR GREATER.
  - LATENT CANCER FATALITY QHO ( $2 \times 10^{-6}$  PER YEAR) EASILY MET.
  - THIS SIZE (0.1 MILE) ENCOMPASSES ALL CURRENT OPERATING PLANTS, AND ALL SITES REVIEWED AND APPROVED BY THE STAFF.
  
- STAFF INVESTIGATED INDIVIDUAL RISK OF PERMANENT RELOCATION AS A RESULT OF LAND CONTAMINATION. USING SEVERE ACCIDENT RELEASE BASED ON OPERATING PLANTS, RISK IS LOW (LESS THAN  $10^{-6}$  PER YEAR) AT ALL DISTANCES, AND DECLINES SIGNIFICANTLY BEYOND ABOUT 20 MILES.

ELEMENTS OF DRAFT FINAL RULES  
(CONTINUED)

SOURCE TERM AND DOSE CRITERIA (10 CFR 50.34)

- SOURCE TERM AND DOSE CRITERIA RELOCATED TO PART 50.34
- DOSE CRITERIA REVISED FROM 25 REM WHOLE BODY AND 300 REM THYROID TO 25 REM TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE).
- DOSE TO AN INDIVIDUAL AT EXCLUSION AREA BOUNDARY NOT TO EXCEED 25 REM TEDE FOR ANY TWO HOUR PERIOD FOLLOWING FISSION PRODUCT RELEASE AND AT LPZ OUTER RADIUS FOR DURATION OF ACCIDENT.
- MAY BE USED WITH CURRENT OR REVISED SOURCE TERMS.

ACRS AND CRGR REVIEW

- ACRS AND CRGR BRIEFED. ACRS RECOMMENDS ISSUANCE OF RULE. CRGR HAS NO OBJECTION TO ISSUANCE.

ADDITIONAL VIEW BY OFFICE OF RESEARCH

- OFFICE OF RESEARCH RECOMMENDS THAT DOSE BE EVALUATED FOR TWO HOUR PERIOD BEGINNING WITH FUEL FAILURE, RATHER THAN ANY TWO-HOUR PERIOD.