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Division of Licensing and Regulation

DEC 29 1961

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COMMENTS ON REACTOR SITE CRITERIA DRAFT 12/12/61

Attn: Joseph D. DiNunno

We have reviewed the draft paper on "Reactor Site Criteria" dated 12/12/61 and submit the following comments, suggestions, and recommendations. We will be glad to discuss these with you, at your convenience. Our attention has been devoted primarily to the relation of the "exposure values" to the overall problem of public safety. While you are personally familiar with the discussions which have led to agreement on the use of such values in connection with site criteria, these are very briefly summarized here, not only for the record but as background for subsequent comment.

AEC personnel concerned with standards of radiation protection have held that "limits" on exposures of personnel which might be expected in case of accident are meaningless unless established in connection with other factors bearing on the overall acceptability of the situation from which the accident might arise. An obvious factor which must always be considered in connection with the acceptability of the "limit" is the probability that an accident resulting in such an exposure will occur. (In the case of reactor siting, the situation is complicated by a spectrum of possible accidents with differing results.)

A second factor which must also be considered involves the reasons for creating the hazard--either in the absolute sense or in relation to possible alternatives. Unless the situation from which the hazard results is for the express benefit of the persons at risk, and unless the total benefit is proportional to the number of persons at risk, the individual exposure "limit" which represents an acceptable hazard will be less if larger numbers of persons are involved.

Much of the pressure for exposure "limits" in connection with reactor safety criteria is believed to have been from persons who consider that such limits can be established independently of such factors as those mentioned above. Some of the comments

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received by the AEC commending the use of exposure values in connection with the proposed criteria published February 1961 indicate lack of understanding of these inter-relationships. It is desirable that the present formulation of criteria should avoid such misunderstanding to the extent possible. In particular, as applied to the selection of reactor sites, it should be made clear that the exposure values proposed by the Commission were related to the very improbable accident involving the release from the reactor of 100% of the noble gases, 50% of the halogens and 1% of the solids in the fission product inventory. The current draft of the site criteria makes this less clear than before by relegating the basic assumptions to a TID document rather than to an Appendix of the regulation.

Article 100.11 (a) (1), page 14 of the draft, should be modified to read:

"...following a very unlikely postulated accident; i.e., the fission product release from a modern boiling water or a pressurized water reactor, of as much as 100% of the noble gases, 50% of the halogens and 1% of the solids in the fission product inventory would not receive...."

The following paragraph should be revised to read:

"...resulting from the fission product release postulated in (1) above...."

These changes may result in the necessity for other changes in the statement of considerations or in the text of the regulations.

The Background Discussion, page 5, Appendix "A", and the Statement of Considerations, page 1, Appendix "C", incorrectly state that the Commission has issued "exposure values which could be taken as reference limits in the design of reactors and in the evaluation of sites...." This statement should be rewritten to read:

"...particularly in the proposal to issue exposure values which could be used for reference in the evaluation of sites with respect to potential accidents of exceedingly low probability."

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The following sentence from page 1, Appendix "C", "It has long been recognized that such exposure dose limits are fundamental to any quantitative approach to site selection" should be deleted. It would be fallacious to assume that the provision of such dose "limits" provides any quantitative estimate of the risk to people involved in operating a reactor in a populated area unless one can also make quantitative estimates of the probabilities that accidents resulting in these and other doses may occur. To isolate the factor of dose values in statements such as this may be expected to foster the misconception that such dose values can provide guidance in establishing acceptable risks to people without definitely relating them to the probabilities of accidents which could occur.

The sentence, "...as reactor technology progresses, applicants who may develop alternate calculational techniques are...encouraged to demonstrate them to the Commission", occurring in the first paragraph of page 3, Appendix "B", is unfortunately worded. The idea is much better expressed by the statement on page 7, Appendix "A", "Applicants are free to demonstrate to the Commission the applicability and significance of consideration other than those set forth in the guides."

The meaning of the last six words of the first sentence of the second paragraph, page 3, Appendix "C", "A basic objective...." is not clear.

Both in the United States and abroad, there has been a tendency to interpret the doses used in these proposed site criteria as emergency dose limits which would be used as guides in case an accident were to occur. It is believed that the "NOTE" on this page contributes to this impression. We request that it be rewritten to read:

"NOTE: While 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), it is not used in these criteria as an "emergency dose." Rather, in conjunction with the extremely low probability that such an exposure might occur, this level is used to define a very small risk to individuals in the vicinity of the reactor. In the event that an accident were to occur, it is unlikely that the release of radioactive materials would be as great as postulated above. In any event, every effort would be made to limit exposures to much lower values. The risk defined by a possible dose of 300 rem to the thyroid is also very small."

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We have not undertaken to verify the statement, page 13, b, Appendix "D", "This would have far ranging effects on bone dose exposures...." but would be surprised to find bone doses a critical factor in exposure to fission products from an operating reactor immediately following an accident.

Does paragraph "C" on the same page mean that with a release of 100% of the noble gases, 50% of the halogens and 1% of the solids in the fission product inventory to a containment vessel with "standard leakage", under some atmospheric conditions, exposures to persons in surrounding areas in the first two hours would be as high as 2,500 rem whole-body and 30,000 rem thyroid dose? We would like to discuss this.

We are uncertain of the significance of the statement under "f", page 10, Appendix "A", "In the meantime, the industry may have acquired sufficient experience with engineered safeguards to make it possible to rely with more surety on such factors rather than isolation." Is it contemplated that as the population about a reactor increases, the Commission may require the licensee to modify his facility to include new "safeguards"? If so, we believe this should be clearly stated.

In considering the problem of future population growth over which the Commission has no direct control, does the Division of Licensing and Regulation make any distinction between its responsibility for public safety in the case in which it permits a reactor to be placed in an established population group and in the case in which the population grows around the reactor? This could, of course, be controversial. However, we feel that some distinction is appropriate.

CC: H. L. Price, Director of Regulation
C. K. Beck, Deputy Director of Regulation
N. H. Woodruff, Director, Division of Operational Safety

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REACTOR SITE CRITERIA

PROBLEM

1. To consider the publication of a guide on site criteria for power and testing reactors.

SUMMARY

2. On February 11, 1961, the Atomic Energy Commission published in the Federal Register for comment a notice of proposed rule making that set forth general criteria in the form of guides and factors to be considered in the evaluation of proposed sites for power and testing reactors. Numerous comments were received both from individuals and organizations, including several from foreign countries. General reaction was one of approval of the issuance of guidance by the Commission on the problem of reactor siting although numerous specific features were singled out for criticism. In particular, widespread objection was raised against the appendix section of the proposed guides in which was included an example of a calculation of environmental distance characteristics for a hypothetical reactor. The objections centered about the concern that the definitive values for key parameters used in the calculation suggested a degree of inflexibility to a guide that otherwise indicated consideration of the variations peculiar to specific sites and reactor plant designs.

3. The comments received have been considered and where deemed appropriate have been used as the basis for revisions incorporated into the rule as now proposed. The basic approach to reactor siting described in the notice published in February, 1961, has been retained. The significant differences are summarized as follows:

- a. Some editorial changes have been made to clarify the intent, particularly to emphasize the interim nature of the guides and to identify the criteria as being specific to the United States.
- b. The appendix wherein a calculational procedure was described for a hypothetical reactor has been deleted. This calculational procedure formerly in the appendix and related explanatory information are being incorporated into a Technical Information Document to be issued separately from the proposed guide. The TID is identified by footnotes in the proposed guide as a reference document that contains a calculational approach that results in distances roughly reflecting current siting practices.
- c. In describing the factors to be considered in evaluating sites, the format of material described has been reorganized to clarify the emphasis given to the characteristics of the reactor design and the proposed operation in evaluating a site and to eliminate undue concern of many who commented about the seeming rigidity of the distance factors as calculated by the method described in the Appendix.
- d. The proposed guide now specifically states that the guides are directly applicable to stationary power and testing reactors, thus eliminating the ambiguity about whether applicability to mobile plants was also intended.
- e. An additional section has been included to deal with the question of sites for multiple reactors.

4. The site criteria proposed as Appendix _____ includes the results of consultations with the ACRS. The staff met and discussed a draft of the criteria with the Environmental Subcommittee of the ACRS on November 29, 1961, revised the draft to reflect the discussions, and submitted the criteria as now proposed to the full committee at the December 8, 1961, meeting. The ACRS comments on the proposed criteria, indicating support for the recommendation to issue the criteria as guides, were forwarded to the Chairman, AEC, by ACRS letter dated _____. The ACRS letter is attached as Appendix _____.

STAFF JUDGMENTS

5. The Office of General Council, the Division of Reactor Development, the Division of Biology and Medicine, the Division of Compliance, and the Office of Radiation Standards concur in the recommendations of this paper. The Division of Public Information concurs in the proposed press release.

6. The Director of Regulation recommends that the Atomic Energy Commission:
- a. Approve publication in the Federal Register as a guide the proposed reactor site criteria for stationary power and test reactors, attached as Appendix "C".
 - b. Approve the issuance of the proposed news release attached as Appendix "E".
 - c. Note that a copy of the proposed criteria will be sent to the JCAE prior to publication in the Federal Register.
 - d. Note that this paper is unclassified.

APPENDIX "A"

BACKGROUND

1. The AEC has been attempting for some time to establish a more objective approach to the evaluation of sites proposed for stationary power and testing reactors. The AEC issued for public comment and published in the Federal Register on May 23, 1959, a notice of proposed rule making that set forth general criteria for evaluation of sites for power and testing reactors. That notice resulted in widespread reactions from the industry, with definite indication of opposition to formal siting regulations. AEC-R 2/20 contains excerpts of comments which the AEC received in writing together with comments made at meetings of the Technical Appraisal Task Force on Nuclear Power of the Edison Electrical Institute (EEI) on June 1, 1959, and the Atomic Industrial Forum on June 30, 1959.

2. In December, 1959, the General Manager appointed an Ad Hoc Committee to study the question of what the Commission could and should do in the way of establishing definitive standards and criteria in the field of nuclear reactor safety. In a report to the General Manager dated September, 1960, the Committee recommended, "there be established rules which may of necessity involve some degree of arbitrariness, by which sites that would be considered acceptable for locations of reactors could be selected."

3. Continued staff review of the problem of defining site criteria, including study of the comments of the May 23, 1959, issue led to a revised set of criteria set forth in AEC-R 2/19. These criteria were discussed by the Commission with the ACES on January 12, 1961. Revisions resulting from this discussion were incorporated into and circulated for consideration of the Commission in staff paper AEC-R 2/25.

4. The AEC issued for public comment and published in the Federal Register on February 11, 1961, a notice of proposed guides that set forth as 10 CFR 100 proposed criteria for reactor siting. The proposed guide as published and a summation of comments received are being circulated for information as staff paper AEC _____. The comments from the Atomic Industrial Forum are not included in AEC _____ because they have already been circulated separately as staff paper AEC R-2/32. The Commission met with representatives of the AIF on July 31, 1961, at which time views of the AIF were orally presented.

DISCUSSION

5. The many comments received by the Commission from individuals and organizations, including several from foreign countries, reflect the widespread sensitivity and importance of the subject of site selection for reactors. Thirty-four formal communications have been received on the guides published in February, 1961, including a proposed comprehensive revision by the Atomic Industrial Forum of the guides into an alternate form.

6. In these communications, there was widespread support of the Commission's proposal to issue guidance in some form on site selection and general acceptance of the basic factors included in the proposed guides, particularly in the issuance for the first time of exposure values which would be taken as reference [limits] in the design of reactors and in the evaluation of sites with respect to potential accidents of low probability of occurrence.

7. On the other hand, there were numerous features of the proposed criteria singled out for specific comments including suggestions for deletions, modifications and additions. The detailed changes proposed to the site criteria as

published for comment are shown in Appendix "B". The following summarizes those comments considered most significant and the staff conclusions with respect to each as reflected in the proposed guide shown by Appendix "C".

a. Example Calculations

A predominant point of objection centered around the inclusion of an example calculation of environmental distance characteristics as an appendix to the proposed rule. In this appendix definite numerical values were employed. The choice of these numerical values involved simplifying assumptions of highly complex phenomena, representing types of considerations presently applied in site calculations and resulting in environmental distance parameters in general accord with present siting practices. Nevertheless, these particular numerical values and the use of a single example calculation were widely objected to, primarily on the grounds that: (1) the definite numerical values presented an aspect of undue rigidity to the guides which otherwise appeared to allow considerable flexibility, (2) the example tended to emphasize unduly the concept of environmental isolation for reactors with minimum possibility being extended for eventual substitution thereof of engineering safeguards. Comments received included suggested deletion of the appendix, the inclusion of additional examples, or the publication of the example calculation other than in the regulation.

It is proposed that the example calculation formerly constituting the appendix to the guides be deleted and Appendix "C" has been

modified accordingly. In lieu thereof, some guidance as to calculational procedure has been incorporated in the text of the guide to indicate the considerations that led to establishing the exposure doses set forth as reference values. Recognizing further, the advantage of example calculations in providing preliminary guidance to application of the principles set forth, it is proposed to publish separately as an AEC technical information document the example calculation formerly a part of the earlier draft with supplementary explanatory information. A draft of the proposed TID is included for information as Appendix "D".

In addition, the "purpose" section of the proposed criteria clearly identifies these guides as an interim measure and states that "applicants are free to demonstrate to the Commission the applicability and significance of considerations other than those set forth in the guides".

b. Multiple Reactors at One Site

Comments were received to the effect that guidance had not been provided on the question of multiple reactors per site.

A section has been added to the proposed criteria setting forth the general principles that will be applied in considering sites for multiple reactor installations. In essence, the staff view is that if reactors at a site are independent to the extent that an accident in one does not result in a simultaneous accident or disruption of operation of adjacent reactors, the isolation factors defined by

the exclusion, evacuation and population center distances can be determined on the basis of the reactor that could release the greatest amount of radioactive material. If interconnections exist that could affect the safety of either, then distances would have to be based upon the sum of potential effects from both.

c. Emphasis on Isolation

Considerable comment was received to the effect that too much emphasis was being given in the guides to the distance factors and plant isolation and not enough to the engineered safety features designed into the reactor plants.

The staff believes this view to have been an undue concern by those who were reading into the guides more than the words stated. Nonetheless, it has been possible with some rearrangement of the order of presentation of the "factors to be considered" in part 100.10 to clarify the intent that site evaluation definitely includes the "characteristics of reactor design and proposed operation". This rearrangement follows a suggestion made by the AIF on this point.

This question of degree isolation and the manner of treating it in our proposed criteria were of particular concern to foreign countries such as Japan where the availability of sites is quite limited. The proposed revision should placate this concern to some extent. In addition, a paragraph has been included in the statement of considerations stating that "these criteria are based

upon a weighing of factors characteristic of conditions in the United States and do not necessarily represent an appropriate balance of considerations for geographical areas where conditions may be different.

d. Population Center Distance

Objections to this concept were raised because of its apparent arbitrary derivation. (1 1/3 times the outer boundary of the low population zone.)

Although objections were voiced about this method of calculating this distance, no one came forth with any more definitive ways. It was suggested that isolation from large population centers be defined in terms of a "man-rem" concept. Although this is a possibility and the statement of considerations stated that the AEC was studying this concept, neither the industry nor the AEC has yet derived a practical way to apply such a concept to reactor siting. In the meantime, the 1 1/3 factor together with others set forth in the guides should provide for distances from population centers roughly equivalent to current siting practices.

e. Applicability to Mobile Reactors

Comments were received to the effect that application of the criteria to mobile reactors would prevent entry and operation of nuclear powered ships in ports.

Although the general safety concepts embodied in these criteria are applicable to all power reactors, these guides were not meant

to be directly applicable to other than stationary plants and modification of the proposed regulation has been made accordingly.

f. Population Growth

Some comments pointed out that siting factors included considerations of population distribution and land use surrounding proposed sites but did not indicate how future population growth might affect sites initially approved.

For such a question, there is no complete and definitive answer. The guides tend to require distances that forestall this problem for the near future. In the meantime, the industry may have acquired sufficient experience with "engineered safeguards" to make it possible to rely with more surety on such factors rather than isolation.

CONCLUSION

8. Although it is generally recognized that insufficient experience with reactors has been accumulated to permit the writing of definitive standards that would provide a quantitative correlation of all factors significant to the question of acceptability of reactor sites, it is possible to provide more guidance than currently exists as to the factors considered by the Commission in evaluating reactor sites. The proposed guide shown in Appendix "B" is intended as an interim measure until the state of the art allows more definitive standards to be developed. The guide is a starting point that gives the nuclear community an understanding of the basis on which the Commission will review proposed sites while providing flexibility and freedom for any applicant to

demonstrate the applicability and significance of considerations other than those set forth in the guides. The proposed guides do not represent a different approach to reactor siting than has been used to date but rather they represent an attempt to articulate those practices. Application of these criteria will result in reactor sites in general agreement with those approved to date but sufficient flexibility has been provided to allow for considerations that might lead to locations that vary from current practice.

9. The proposed guides will not eliminate the need for a large degree of subjective judgment by both the AEC and industry in the selection of sites for reactors. However, the publication of these guides is considered a significant step towards making such evaluations more objective. By identifying the guides as an interim measure, there is an implied AEC obligation to continue efforts to define more explicitly reactor siting standards.