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Appendix A
~~APPENDIX A~~

Proposed
~~1~~ ~~AEC~~ Notice of Rule Making *(1959 issuance)* -call caps)

The Atomic Energy Commission issued for public comment and published in the Federal Register on May 23, 1959 the following Notice of Proposed Rule Making:

ATOMIC ENERGY COMMISSION

(10 CFR Chapter 1)

POWER AND TEST REACTORS

Notice of Proposed Rule Making

The Commission is considering the formulation of an amendment to its regulations to state site criteria for evaluation of proposed sites for nuclear power and test reactors and is publishing for comment safety factors which might be a basis for the development of site criteria.

In view of the complex nature of the environment, the wide variation in environmental conditions from one location to another and the variations in reactor characteristics and associated protection which can be engineered into a reactor facility, definitive criteria for general application to the siting problems have not been set forth.

All interested persons are invited to submit comments and suggestions on the following site factors and on development of definitive criteria for evaluation of sites for power and test reactors which might be incorporated in the Commission's regulations. All interested persons who desire to submit written comments and suggestions should send them to the U.S. Atomic Energy Commission, Washington 25, D.C., Attention: Division of Licensing and Regulation, within 30 days after publication of this notice in the FEDERAL REGISTER. (Editor's Note: This was subsequently extended to August 24.)

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Factors considered in site evaluation for power and test reactors:

a. **General.** The construction of a proposed power or test reactor facility at a proposed site will be approved if analysis of the site in relation to the hazards associated with the facility gives reasonable assurance that the potential radioactive effluents therefrom, as a result of normal operations or the occurrence of any credible accident, will not create undue hazard to the health and safety of the public.

b. **Exclusion distance around power and test reactors.** Each power and test reactor should be surrounded by an exclusion area under the complete control of the licensee. The size of this exclusion area will depend upon many factors including among other things reactor power level, design features and containment, and site characteristics. The power level of the reactor alone does not determine the size of the exclusion area. For any power or test reactor, a minimum radius on the order of one-quarter mile will usually be found necessary. For large power reactors a minimum exclusion radius on the order of one-half to three-quarter miles may be required. Test reactors may require a larger exclusion area than power reactors of the same power.

c. **Population density in surrounding areas.** Power and test reactors should be so located that the population density in surrounding areas, outside the exclusion zone, is small. It is usually desirable that the reactor should be several miles distant from the nearest town or city and for large reactors a distance of 10 to 50 miles from large cities. Where there is a prevailing wind direction it is usually desirable to avoid locating a power or test reactor within several miles upwind from centers of population. Nearness of the reactor to air fields, arterial highways and factories is discouraged.

d. **Meteorological consideration.** The site meteorology is important

in evaluating the degree of vulnerability of surrounding areas to the release of air-borne radioactivity to the environment. Capabilities of the atmosphere for diffusion and dispersion of air-borne release are considered in assessing the vulnerability to risk of the area surrounding the site. Thus a high probability of good diffusion conditions and a wind direction away from vulnerability areas during periods of slow diffusion would enhance the suitability of the site. If the site is in a region noted for hurricanes or tornadoes, the design of the facility must include safeguards which would prevent significant radioactivity releases should these events occur.

e. **Seismological considerations.** The earthquake history of the area in which the reactor is to be located is important. The magnitude and frequency of seismic disturbances to be expected determine the specifications which must be met in design and construction of the facility and its protective components. A site should not be located on a fault.

f. **Hydrology and geology.** The hydrology and geology of a site should be favorable for the management of the liquid and solid effluents, (including possible leaks from the process equipment). Deposits of relatively impermeable soils over ground water courses are desirable because they offer varying degrees of protection to the ground waters depending on the depth of the soils, their permeability, and their capacities for removing and retaining the noxious components of the effluents. The hydrology of the ground waters is important in assessing the effect that travel time may have on the contaminants which might accidentally reach them to the point of their nearest usage. Site drainage and surface water hydrology is important in determining the vulnerability of surface water courses to radioactive contamination. The characteristics and usage of the water/courses indicate the degree of

risk involved and determine safety precautions that must be observed at the facility in effluent control and management. The hydrology of the surface water course and its physical, chemical and biological characteristics are important factors in evaluating the degree of risk involved.

g. Interrelation of factors. All of the factors described in paragraph b through f of the section are interrelated and dictate in varying degrees the engineered protective devices for the particular nuclear facility under consideration, and dependence which can be placed on such devices. It is necessary to analyze each of the environmental factors to ascertain the character of protection it might afford for operation of the proposed facility and of the kind of restrictions it might impose on the proposed design and operation.

Dated at Germantown, Md., this 19th day of May 1959.

A. R. LUEDECKE,
General Manager.

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Appendix B

~~Reactions to the AEC's Proposed Reactor Site Rule-Making~~

In issuing its notice May 23 of Proposed Rule Making relative to the information of regulations on criteria for evaluating proposed sites for nuclear power and test reactors, including safety factors, the AEC invited comments.

What follows ^{relevant} excerpts of comments ^{are listed below} which the AEC received in writing, together with comments which were made at the EEI and AIF meetings on this subject.

The comments are related to paragraphs in the Commission's notice, the first of which was (a) General.

Section (a) GENERAL

|, Philip Sporn, President, American Electric Power Service Corp., and

Chairman of the AIF meeting, stated: "Any standard set up today, no matter how unreasonable and unnecessarily broad and supersafe, is going to be hard to re-do in the years to come.

"Whatever finally comes out in lieu of this particular rule should be clearly marked as not being a rule or regulation. It should be broad and not get into cold statements such as setting distances from large cities. Regulations will be millstones around the neck of an industry which is just starting. This particular set of rules should be suspended in the interim. It has already been a real service by bringing out the things it was designed to do."

2 Louis H. Roddis, Jr., President, Pennsylvania Electric Co., told the AIF meeting: "Anything as definitive as the issuance of a formal rule of the Commission is going to pose to the industry a problem. We do need a statement of what is needed in order to arrive at a balance of all these different factors, but it should not be formal."

3 Titus LeClair, Manager of Research and Development, Commonwealth Edison Co., told the AIF: "Is Dresden a large power reactor? It is today, but it is pretty small when compared to a plant of 500 megawatt capacity. We don't know what is large or small. These words in a regulation lead to considerable problems."

4 R. M. Casper, General Manager, Atomic Energy Division, Allis-Chalmers Manufacturing Co., wrote to the AEC: "... we feel strongly that it is too early to state quantitative rules which may be subject to misinterpretation by members of the general public. The wide difference between reactors, types of containment, etc., makes it particularly difficult to establish numerical rules, and we believe there will be a tendency to regard quantitative criteria as minimal safety requirements.

". . . We believe it would be most helpful if the Commission would issue a policy statement on site evaluation, outlining the information necessary and indicating when it will be required with respect to the project schedule."

5 James R. Fairman, Senior Vice President of Consolidated Edison and Chairman of the Technical Appraisal Task Force on Nuclear Power of EEI told the AIF: "I would much prefer it if the AEC would come up with a general statement of principles or guides, or with a list of things which need to be done, rather than a set of rules. Rules with set numbers could be too restrictive, and hold back progress. The objectives of the operators of nuclear power plants are no different from those of government: we want reactors which are safe, and we don't want to be tied down to figures which may quickly become outdated."

6 Francis K. McCune, Vice President, Genreal Electric Co., said at the AIF meeting: "If you don't put numbers down, you get into real trouble. There will not be a nuclear industry until things like this are done. There is a way to say this - the exclusion area should be large enough to provide for one, two or three specific requirements."

7 Manson Benedict, professor of nuclear engineering, Massachusetts Institute of Technology and member of the Advisory Committee on Reactor Safeguards, wrote to the AEC: "My first reaction is one of regret that a subject so unsettled and controversial as site selection criteria for nuclear reactors should have been published under the heading of 'Notice of Proposed Rule Making.' This seems to me to give to the text more of an official and regulatory character than you perhaps had in mind for it."

8 Walter A. Hamilton, Contracts Director of Nuclear Development Corporation of America wrote the AEC: "It is our conclusion that the proposed rule is

entirely appropriate as an internal document for the guidance of the Division of Licensing and Regulation and the statutory Advisory Committee on Reactor Safeguards. We would see no objection to widespread distribution of the proposed criteria for the guidance of possible licensees. We can see no advantage, and suspect possible serious future disadvantage, from formalizing these criteria by publication in 'The Federal Register'."

9 Chauncey Starr, Vice President of North American Aviation, Inc. and General Manager of the Atomics International Division, wrote to the AEC:

"... we feel that to proceed with the hurried enactment of regulations such as the proposed rule could effectively smother the infant industry ... Until such time as a logical, long-term power plant site plan is developed which does not hinder the industry's growth, the pattern of reviewing and evaluating ~~revh-pteodrf-tresvyot-enf-iyd-diyr-on-en-infibifuel-nedid-dhoulf-nr-venyinudd~~ each proposed reactor and its site on an individual basis should be continued."

10 James L. Morrisson, of Ginsburg, Leventhal, Brown and Morrisson, to the AEC: "The issuance (of the proposed rule making) does not discuss the Commission's role in evaluating sites. It does not indicate ~~whether~~ ^{whether} the Commission will offer the applicant assistance in making his selection from ~~whether~~ ^{whether} among several alternative sites under consideration, or ~~whether~~ it expects the applicant to come to the Commission only after he had made his selection, so that the Commission will then give a 'yes' or 'no' answer to the particular site selected. It also does not indicate whether the Commission will take any affirmative steps to encourage the selection of sites having unusually favorable characteristics or whether it will view its function as merely that of exercising a right to disapprove a site which it deemed unsuitable.

"Related to the foregoing is a question as to the point in time at which

the Commission will evaluate a site. Paragraph (a) refers to the possible evaluation of a site 'in the early phases of the project'. This phrase suggests the possibility of a site evaluation prior to the time when preliminary evaluation of design is made for purposes of construction permit --i.e., it suggests a 3-phase procedure consisting of: (1) site approval, (2) design approval and issuance of construction permit, and (3) issuance of an operating license.

"Such a procedure might have considerable merit."

|| Robert L. Wells, General Manager, Atomic Power Department, Westinghouse Electric Corp., to the AEC: "... we recognize the value of having a set of site selection criteria for guidance in connection with future plant design. Such a set of criteria will render a service in terms of defining design areas to be evaluated by the nuclear plant designer, insuring that important plant safety implications are adequately considered. However, we feel that the safety of a nuclear plant is dependent upon the combined effect of a large number of design variables of which site conditions are only a contributing factor.

"The criteria, of themselves, should not dictate engineering design but should serve to outline the problems leaving a maximum of design flexibility to the engineer. In this manner, the safety of the public can best be maintained."

| 2 Emerson Jones, Special Assistant to the General Manager, Consumers Public Power District (Nebraska), wrote to the AEC: "Until such a time as we obtain the reactor operation (and accident) experience needed to formulate specific rules, it would seem preferable to issue this same information as a policy statement of the Advisory Committee on Reactor Safeguards, rather than published as Commission rules."

13 Leonard F. C. Reichle, Nuclear Engineering Director, Ebasco Services, Inc.:

"The proposed rules emphasize only the characteristics of the site and environs. They virtually ignore the other two aspects which determine suitability, namely, the characteristics of the facility itself, including the state of knowledge and past experience, and the safeguard features which are incorporated in the facility. It is probably true that, with sufficient knowledge of the potential hazards, any facility can be designed with appropriate safeguards to permit operation anywhere with acceptable risk.

"As a rule, the prospective licensee selects a site for economic reasons and balances the cost of safeguard provisions against the added cost and inconvenience of a more isolated site. The AEC must similarly evaluate all factors to determine whether the overall hazard is acceptable. Because of the complex interplay of the many factors concerned, it is probably not practical to expect definitive standards. Some guide to the important factors considered by AEC and, if possible, the probable relative weights to be applied would be welcomed by industry."

14 Richard H. Peterson, General Counsel of Pacific Gas and Electric Co., wrote to the AEC: "... there is an extremely wide variation in environmental conditions from one location to another, as well as in reactor characteristics. We therefore question whether the criteria for site evaluation should be as specific as those set forth in the Notice of Proposed Rule Making."

15 Alex Radin, General Manager, American Public Power Association, wrote to the AEC: "In view of the present state of knowledge, the complexities of the problem and the variety of combinations of reactor designs and site conditions which can exist, it would be our recommendation that the Commission issue only broad and general guiding principles in respect to site safety factors at the

present time, and continue to evaluate each proposed reactor and site on a case-by-case basis."

Section (b) EXCLUSION DISTANCE AROUND POWER AND TEST REACTORS .

16 Manson Benedict, ^{of} M.I.T., quoted above under (a) General, stated to the AEC: "I particularly deplore the selection of specific minimum distances for the exclusion radii I think that the values of 1/4 mile for 'any power or test reactor' or 1/2 to 3/4 of a mile for 'large power reactors' are much greater than would necessarily be required for reactors of a proved type provided with adequate containment. I think that the publication of these specific numbers, even in a tentative regulation, will make it very difficult for the Commission to approve lower values at a later time."

17 B. John Garrick, Chief Nuclear Scientist of Holmes & Narver, Inc., wrote the Commission: "By the design and within the limits of credibility a reactor facility can be independent of certain site safety criteria.

"It is quite understandable why the AEC gave some number for typical exclusion distances. The advantage of such information is appreciated for it quickly gives an indication of the order of magnitude of land required to support the operation of a reactor.

"However, the information which would be of equal value would be the basis used by the AEC to arrive at the suggested exclusion distances. It is suspected that this basis derived from the direct radiation accompanying a maximum credible type contained accident with a possible contribution from the radioactive cloud resulting from containment leakage.

"The availability of the assumption used by the AEC would greatly assist the hazard analyst in selecting, for example, the emergency dose value to be used and the general type of release considered to be credible. Furthermore,

the availability of such information would promote the possibility of reducing or increasing the exclusion distance as more research information becomes available.

"In any event, there is some apprehension about the use of numbers in the context of rules and regulations where traditionally they have been found to become fixed, and long before they are revised, obsolete.

" ... the AEC could help most by making available to the nuclear industry its methods of review rather than its approval requirements (whether they be specific or general). There is a difference - the former in my opinion leaves the field wide open to imaginative analysis while the latter tends to be restrictive."

18 Dr. R. Rees, General Manager of Saxton Nuclear Experimental Corp. of Reading, Pa.: "Factor (b) of the proposed rule provides for an exclusion area under 'complete control' of the licensee. Since in many cases navigable waterways, railroads, highways or other occupied land may be involved over which it is not possible to obtain ownership, the words 'complete control' ~~seem~~ seem too strong. In the past the Commission has usually recognized the possibility of closing public rights of way in case of an emergency."

19 W. Kenneth Davis, Vice President, Bechtel Corp.: "Inasmuch as power reactors are usually situated on or near rivers, lakes or the ocean, it would seem desirable to make some statement concerning the treatment of such water areas as controlled or exclusion areas. Another special point also concerns the consideration of railroads, highways, and water traffic which often pass near sites suitable for large power plants. The ability to control such traffic would appear to be of importance."

20 Warren F. Stubbings, Associate Professor, Nuclear Science, of the

University of Cincinnati, wrote to the AEC: "The proposed exclusion areas are so large that the rule may prevent institutions or industries of moderate size from participating in the test or power reactor programs.

"... It is suggested that the basis of safety of operation be: (a) that there be adequate containment of the reactor by physical means, not by space, and (b) that the proposed rules on placement of and exclusion areas for reactors be applied only to reactors of untested types or those for test of extreme conditions."

2 | Jack Kl. Busby, President of Pennsylvania Power & Light Co., wrote to the AEC: "We believe it most desirable that the Commission formulate and publish general site selection guides but, in our opinion, it is undesirable to designate minimum exclusion distances around power and test reactors, minimum distances of such reactors to the nearest town and city, and maximum offsite population densities. The problem is to establish reasonable assurance that there will be no hazards to the public ... We suggest that all minimum distances and maximum population densities be eliminated from the proposed regulation and that such factors be given consideration only in relation to the proposed type, design and safeguards of the particular reactor."

2.2 William M. Breazeale, Babcock & Wilcox Co., wrote to the AEC: "It is not clear to us that it is desirable at this time to establish fixed, ~~substantive~~ exclusion areas around reactors and their containments - at least from a technical viewpoint. Under given meteorological conditions, the dose a person receives at the edge of an exclusion area following the 'maximum credible accident' is a unique function of the fission products held up in the reactor and the containment leak rate.

"It seems to us that the plant designer should be free to select the

the optimum combination of containment and exclusion area which will protect the public under the particular set of conditions associated with the proposed installations. Possibly at some future date when a great deal more reactor operating experience has been accumulated, an optimum exclusion area can be determined, but we doubt if such experience is available today."

23 R. D. Welch, Florida West Coast Nuclear Group, wrote to AEC: "...it would be better to avoid using distance measurements such as 1/2, 3/4 miles exclusion radii and 10-20 miles from cities for large power reactors. Such distances tend to become fixed in the public mind despite words of flexibility used in connection with them.

"The proposed regulation does not indicate that improvement in reactor design and safety experience may reduce the distances mentioned."

24 Robert L. Wells, of Westinghouse, quoted above, wrote to the AEC: "...we are quite concerned about the proposed rules pertaining to required exclusion areas. The safety of the public is a function of many factors, of which exclusion area is only one. Specifically, we feel that the safety of the public can best be maintained by proper engineering design consideration of all the important variables including reactor size and type, core safety cooling system, possibilities of release of fission products from the reactor system and subsequent leakage from the vapor container, exclusion area and meteorological conditions, to name but a few.

"The safety of the public cannot be insured by any single condition such as exclusion area, but rather is the certain result of the optimum combination of many interrelated factors. To specify minimum exclusion area is neither necessary nor sufficient."

Section c. POPULATION DENSITY AROUND POWER AND TEST REACTORS

25 Philip Sporn, of American Electric Power Service Corp., quoted above, remarked at the AIF committee meeting: "The British and the French keep their power reactor sites away from centers of population and we are trying to build on the periphery or on the very outside boundaries of our cities and towns. But the aim should be to come as close as possible to the heart of cities. Of course, a power reactor quite close to, or in, a city may require expensive additional safety structures as opposed to one in a wide exclusion area."

26 Channey Starr, of Atomics International, quoted above under (a) General, wrote to the AEC: "The impact of arbitrary population criteria would undoubtedly have a great effect upon the European market for the sale of U.S. made reactors because of the extremely high population densities of the majority of the Western European nations, and the fact that in view of the relatively advanced state of U.S. technology, criteria used here will be seriously considered for guidance in Europe."

"One must also consider the statement made in the section of the notice dealing with population densities: 'Nearness of the reactor to air fields, arterial highways and factories is discouraged.' Although such a rule might feasibly be enforced at the present time, the future growth of our country and of the nuclear industry could well be stifled by this or similar type regulations. Factories, for example, may some day be powered by their own nuclear energy systems."

27 Abel Wolman, Head of the Department of Sanitary Engineering and Water Resources at Johns Hopkins University, and member of the Advisory Committee on Reactor Safeguards and a consultant to the AEC told the EEI meeting: "The AEC and its advisors and the industry as a whole will have to investigate

construction of plants close to cities. It is obvious that this must be done gradually enough to develop knowledge concerning the safety factors involved. The day of 'tucking away plants geographically' as was done for weapons plants, will end in the next 10 or 15 years.

"When the English were selecting sites for their reactors they set distance criteria that the site teams tried to follow. When they couldn't comply with the distances, concessions were made. This illustrates the necessity for flexibility in rigid site rules. For example, it is not inconceivable that a nuclear plant might be approved for New York City at the present time if it were buried several hundred feet in solid rock."

28 James F. Fairman, of Consolidated Edison and Chairman of the Technical Appraisal Task Force on Nuclear Power of EEI, told the EEI:

"Indian Point, which is 24 miles north of New York City and on the east bank of the Hudson, was the most remote location we could find in our operating area. It is not only extremely difficult to acquire power plant sites within the area of New York City and Westchester County, but also expensive.

"In the long term Con Ed will want to put nuclear power plants as close to its load centers as possible, which means, of course, right in the city limits. The setting ^{of} any arbitrary exclusion area limits would place a high cost premium on power plants in metropolitan areas and discourage the use of engineering ingenuity to find the most practical solutions to safety problems in built-up areas.

"Engineering design measures can meet safety requirements at a cost, ~~is~~ For example, in the case of the Indian Point plant there was the problem of 'sky shine' if the containment sphere were filled with contaminated gases as a result of an 'incident.' This problem was solved by building an exterior biological shield to prevent atmospheric reflection of radiation

emanating from the top of the containment vessel down on the surrounding area.

"Con Ed intends to build another facility adjacent to the Indian Point plant and wants to avoid the necessity of having to evacuate personnel from the site in the event of a nuclear incident. We believe an atomic power station can be designed safe enough to be located in a heavy populated area although such a design would increase the cost."

29 William Webster, Executive Vice President of New England Electric System and President of Yankee Atomic Electric Co., said at the AIF meeting: "Our particular Yankee site is remote from cities and in a sparsely settled area. This has been fine this time, both from an insurance angle and in freeing us from any local objections,

"However, we regret, in a way, that we may have set too much of a precedent for 'remoteness! We are in a part of the country where atomic reactors have the best chance of being competitive and it will be a great shame if it is not possible to go ahead without having too burdensome requirements on where to build."

30 Mason Benedict, quoted above under (a) General and (b) Exclusion distance around power and test reactors: "The same general comment is offered in connection with the criterion that 'it is usually desirable that a reactor be several miles distant from the nearest town or city' and that large reactors should be 10 or 20 miles from large cities. Interpreted literally, this type of requirement would preclude the construction of power reactors where they would do the most good economically.

"This requirement may be necessary for reactors of an unproved type provided with inadequate containment, but certainly need not be so strict for well-contained reactors. I should have preferred to see a more highly qualified statement such as 'other things being equal, it is desirable to locate reactors

outside of densely populated areas.' When the purpose to be served by a reactor necessitates its construction close to or within a town or city, it is essential that the reactor be provided with dependable ~~containment~~ containment and other safeguards against the escape of radioactivity."

31 Pabbick J. Selak, Manager, Nuclear Engineering Development, Kaiser Engineers, proposed to the AEC: "Rather than establish a minimum distance from a 'large city', perhaps a better criterion would be to establish a maximum number of people who might receive an overexposure in the event of a 'maximum credible accident.' Then the reactor builder could determine, subject to AEC approval, the optimum combination of exclusion zone, distance from populated areas, containment features, and inherent safety features in the reactor-- which would provide adequate safety to the public at minimum cost."

32 Alex Radin, quoted above, wrote to the AEC: "Our principal concern is with paragraph (c) which relates to 'Population Density in Surrounding Areas.' A Commission regulation incorporating the language in this paragraph could result in restricting the use of nuclear power stations to a relatively few large utility systems in this country...Inasmuch as a major portion of the membership of this Association is comprised of municipally owned systems, the possibility that such a regulation might be adopted gives us serious concern.

"Most municipal systems locate their generating plants within the city limits or adjacent thereto for reasons of economy and, sometimes, because of specific legal requirements."

33 Hibbert Hill, Chief Engineer, Northern States Power Co., wrote the AEC:

"We are in accord with the Commission's evident view that a regulation is needed describing the safety factors which bear on a decision to issue or refuse a construction permit. We believe, however, that the issuance of such a regulation now must either be so indefinite that it would provide little

guidance, or contain numbers which are presently quite uncertain.

"For example, it is usually desirable, from the standpoint of economy and service reliability, that a power plant be near a center of population. The proposed regulation suggests 10 to 20 miles from large cities. The spread, 10 to 20 miles, is very material, and the concept of a 'large city' indefinite. We believe that such indefiniteness is highly undesirable in a regulation, and we fear that such numbers may become permanently frozen in the regulation.

"There is need for guidance in this area. We understand that the Commission has been working on a listing of the information required in an application for a construction permit, scheduled as to priority of submission, and containing information as to the time and procedures required by the Commission for consideration of the information and issuance of a permit. We think that such a list would provide valuable guidance, and should be issued as soon as it can be completed.

"A list as above would not only serve as a guide, but would, we believe, substitute to a degree for a regulation until a satisfactory regulation can be issued."

34 C. T. Cheve, Chief Engineer, Nuclear Projects, Stone & Webster Engineering Corp., wrote to AEC: "We agree, in general, with the idea of making these rules, since there has been some chaos because of the lack of them. The only matter we see which might cause a serious hardship is covered in Paragraph (c) in which it is suggested that large reactors should be 10-20 miles from large cities. "This may give a sense of security, but the point required perhaps a little more ^{careful review, because} ~~security, and that~~ the economics of nuclear power are going to be adversely affected by such a rule. One of the advantages of nuclear power plants which might overcome somewhat higher generating costs than obtained from combustible fuel-fired plants is that the nuclear plant might be located

closer to load centers because of its lack of dependence on railroad shipment of coal."

35 William M. Breazeale, of Babcock & Wilcox, who was ^{quoted} ~~quoted~~ above, wrote to the Commission: "...it may be desirable to develop a rule forbidding the operation of high power test reactors in the vicinity of cities or towns but we feel that it would be unnecessarily restrictive to make such a rule applicable to power reactors intended for routine operation."

36 The Nuclear Group of the Puerto Rico Water Resources Authority, writing to the AEC, said: "...Puerto Rico ...is a good example of a situation where the limiting figures in Paragraph (c) could seriously restrict the use of possible reactor sites ... Puerto Rico is an island with 2.3 millions inhabitants but only 35 miles wide in a north-south direction by 100 miles long in an east-west direction...Puerto Rico is located in the trade winds belt and these blow towards a western or southwestern direction most of the time, making the locations along the 35 miles of coast of the Island most attractive from a meteorological point of view, If the proposed regulations for distances from populated centers were applicable to the Island, it might rule out the use of the only sites that may be found to be suitable from other viewpoints.

"The situation in Puerto Rico may be typical of other islands or regions where similar conditions may prevail and a categorical requirement in distances may rule out the only possible sites which are found to be suitable from other considerations...it is recognized that the physical limitations of the site or its surroundings may be offset by more strict requirements in the containment and in other design characteristics of the installation."

Section d. METEOROLOGICAL CONSIDERATIONS

37 B. John Garrick, of Holmes & Narver, quoted above, stated to the AEC:

"Meteorological information contained in most hazards reports was nothing more than window dressing. It is difficult to see the need for anything other than average, adverse and peculiar (e.g. hurricanes, tornadoes, etc.) meteorological conditions associated with a given site...

"Concerning test reactors, for example...low pressures (1-6 psig) in containment vessels associated with maximum credible type accidents would require only a few hours before reaching equilibrium with the outside air. Under these circumstances, i.e. a day or so of fission product driving force, it would be unsound to assume anything other than adverse meteorology."

Section e. SEISMOLOGICAL CONSIDERATIONS

38 Richard H. Peterson, of Pacific Gas and Electric Co., quoted above, to the AEC: "With regard to seismological considerations the proposal provides that a site should not be located on a fault. In the West Coast area, where earthquakes are more common than in other parts of the country, the strict application of this proposal to an entire site area could eliminate many desirable locations. Structures can be built adjacent or near to earthquake faults to withstand severe shocks without failure. In California we know of no structure which has been severely damaged by an earthquake for which the designer and builder took earthquake forces into consideration. For these reasons if a prohibition against location on a fault be included at all, we suggest that it be limited to location of the reactor and auxiliaries."

39 W. Kenneth Davis, of Bechtel Corp., quoted above, to AEC: "WE should like to suggest that the last sentence in the relevant section be altered to state 'A site should not be located on an active fault.' Much of the United States is so thoroughly faulted that a flat statement such as is made in paragraph (e) appears unnecessary and over-limiting."

Section f. HYDROLOGY AND GEOLOGY

40 B. John Garrick, of Holmes & Narver, quoted above, wrote to the AEC: "It is conceivable that a site near a very large body of water, such as an ocean would have ground water movement, away from domestic water users and towards the ocean, offering an infinite dilution capability...A gross discharge of radioactive liquids into a sink of the type mentioned could be of little or no consequence while a similar discharge into impermeable soil could lead to confiscation of the immediate site."

41 Eugene S. Simpton of the U.S. Geological Survey and the Environmental and Sanitary Engineering Branch of the AEC at the EEI meeting: "Is it necessary that we accept the prospect of one or more nuclear reactors on the bank of each stream of any size in the U.S. in (say) 50 years from now? It may turn out that where large nuclear plants are concerned there is no economic alternative.

"On the other hand, it may be possible to build a plant reasonable distant from the river bank, and still be able to produce economic power. Undoubtedly, it costs money to pump water, but perhaps it may be necessary. I believe that this ~~tax~~ problem deserves serious consideration."

42 Francis K. McCune, of General Electric Co., wrote to the AEC: "... it is indicated that deposits of relatively impermeable soils over ground water courses are desirable because they offer some protection for the ground water. This raises the question whether, in order to protect the ground water, in many cases it may be desirable to select sites with permeable soil to permit advantage to be taken of the waste disposal capability of the soil. For example, at Hanford the permeability of the soils over the ground water is depended upon to conduct the liquids from which the radioisotopes have been removed by exchange in the soils, to the ground water. With impermeable sediments over the ground water table, one can run into situations where the drainage may

be to a point many miles away in completely unsuspected areas, making monitoring difficult."

43 Jack K. Busby, Pennsylvania Power & Light Company: "... economy requires the location of steam electric power plants on the banks of rivers in order to provide adequate water for cooling purposes. Any such river, along ~~with~~ ^{which} a power reactor is located, would not be 'under the complete control of the licensee' and the proposed regulation would seem to require the location of the reactor far enough from the river so that the river would not be within the exclusion distance. The very substantial increase in the cost of the reactor plant which would thereby result does not appear to be justified since there are likely to be few, if any, people on any such river in the vicinity of the reactor, most such rivers being used only for recreation purposes. Warning devices would be adequate to clear the river in the vicinity of the reactor, if necessary."

Section 4 INTERRELATION OF FACTORS

44 Robert L. Wells, of Westinghouse to the AEC: "The safety of the public can best be maintained by proper engineering design consideration of all the important variables including reactor size and type, core safety cooling system, possibilities of release of fission products from the reactor system and subsequent leakage from the vapor container, exclusion area and meteorological conditions, to name but a few."

ATOMIC ENERGY COMMISSION

REACTOR SITE CRITERIA

Report to the General Manager

by the Director, Division of

Licensing and Regulation

THE PROBLEM

1. To consider criteria proposed for use in the approval of sites for licensed power and test reactors, to explain the basis upon which the criteria were established, and to provide an understanding of the relative safety to the public that will result from ^{of the criteria} their application, in the site selection process.

SUMMARY

2. An applicant for a license to construct a power or test reactor is required by AEC regulations (10 CFR Part 50) to submit in support of his application a hazards summary report that includes details pertinent to the site proposed for the reactor. The current regulations do not indicate how the site data supplied by applicants will be evaluated by the AEC, or the specific criteria which will guide the AEC's consideration of proposed site suitability.

3 For reactors that have already been proposed, site approval or disapproval has been given after review and evaluation of the reactor design and the proposed location by the staff of the Division of Licensing and Regulation and the ACRS. Judgment has been based primarily upon the evaluation of the consequences of potential accidents, including an accident

representing an upper limit of hazard that could credibly occur. This evaluation process has also included analysis of the plant design and particularly the safeguards either inherently/part of the reactor or engineered into the plant complex for safety reasons.

43. The hazards reports as presented by the various applicants have shown a wide variation in estimating the magnitude of the maximum credible accident and in the dose calculational methods and, consequently, in the calculated exposure doses that might result to the offsite public in case of an accident. This situation is due partly to the differences in reactor plant design but even more to the different engineering judgments that can be made in analyzing possible consequences of accidents. AEC and ACRS review has emphasized evaluation of the safety factors that have been included in the plant design and evaluation of the conservatism represented in the analytical procedures as well as the numerical values derived. This subjective manner of arriving at judgment on site suitability has led to requests to have the AEC make more definitive the basis upon which the data are evaluated and to make more specific the safety criteria which govern the AEC's consideration of site suitability.

44. An attempt was made in May 1959 to establish a more objective approach to reactor site selection and evaluation by publishing proposed site criteria in the Federal Register. The reactions of the industry were widespread; most of those who commented were opposed to the proposed regulation but the reasons for the opposition were quite heterogeneous. The criteria proposed in 1959 and excerpts of written comments on them received

by the AEC are included in information paper AEC-R 2/20. It would appear from these comments that the industry, while pressing for criteria that would define the conditions of acceptability for proposed reactor sites, want such information in the form of guides but not in the form of a regulation.

5 The JCAE has shown continued interest over the past several years in AEC efforts toward formulating more definitive site criteria. During the hearings before the Subcommittee on Research and Development and the Special Subcommittee on Radiation of the JCAE on April 27, 1960, the criteria published by the AEC in the Federal Register in May 1959 were discussed with particular reference to the role of those criteria in the evaluation of a proposed reactor site at Jamestown, New York. Regarding the shortcomings of these earlier criteria, Chairman McCone expressed the view that the problem of site criteria was one that must be settled in order that builders of nuclear power plants might proceed with more assurance and that clarification of AEC site requirements appeared possible in the very near future. At that same hearing, Dr. C. R. McCullough, as a representative of the ACRS, stated that the ACRS believed the time had come to put site criteria in writing.

6 In December 1959, the General Manager established a special working group, in which experts from industrial organizations were included, to examine the question of what the Commission could and should do in the way of establishing standards and criteria in the field of nuclear safety. (This fact was reported by Commissioner Graham to the JCAE during the 202 hearings in February 1960.) In a report to the General Manager dated

September 29, 1960, (AEC-22/21) this Ad Hoc Committee recommended that the Commission "establish rules, involving of necessity some degree of arbitrariness, by which sites that would be considered acceptable for locations of reactors could be selected."

8. Proposed criteria (Appendix "D") have been prepared that describe the bases upon which the suitability of proposed reactor sites can be judged. As a beginning point, the criteria define three bench marks, stated in terms of areas and distances, for evaluation of proposed sites for a reactor of any given power level. These are (1) an exclusion area over which the licensee controls the access; (2) a zone surrounding the exclusion area in which the density of population is sufficiently low to permit evacuation in case of a catastrophic accident; and (3) a distance to the nearest population center in which more than 25,000 people reside. These areas and distances are determined upon the following assumptions: (1) the amount of radioactivity released to the environment will not exceed that expected from the accident considered to be "the maximum credible accident"; (2) the radiation dose to persons within the outer boundary of the evacuation area may be limited by the evacuation or other countermeasures sufficiently to prevent immediate or early manifestations of radiation injury; and (3) radiation doses to people in the nearest population center would not result in early manifestations of injury even without evacuation.^{1/} These iodine

^{1/}An equally important reason for the bench mark population center distance is to obtain reasonable assurance that no lethal exposures would occur in a large population center in the event of a maximum credible accident even under conditions of containment breach.

doses, if actually received by people, do not preclude the possibility of the production of a number of cases of leukemia or cancer in later years. However, it is believed that in view of the small probability of occurrence of accidents comparable to the "maximum credible accident," the hazard from such effects as well as from genetic effects is reasonably small. The criteria then provide for adjustment of these bench mark distances in each case in accordance with the unique features and circumstances of that individual reactor project. The proposed rule makes it clear that the bench mark distances are only a beginning point for preliminary guidance and have to be considered along with other equally important factors.

d. Draft criteria along the lines of those proposed in Appendix "D" were forwarded to the ACRS for review and comments. A copy of that draft ^{is contained in} ~~was circulated as~~ AEC-R 2/22. The ~~ACRS~~ ^{By} letter to the Chairman, AEC, dated September 26, 1960, (attached as Appendix "C-1"), ^{the ACRS} commented on the proposed criteria by stating that "while the Committee believes that the present document could be developed into a useful contribution to nuclear safety studies -- we cannot recommend that it be given the status of a Commission regulation." A similar recommendation is made in a letter of ~~X~~ October 22, 1960, from the ACRS to Chairman McCone (Appendix "C-2"). This letter, which also contains other material relevant to site criteria, is discussed further in Appendix "A".

10. There is no disagreement between the ACRS and the staff on the methods and the approach to site evaluation. An effort has been made in

the present revised draft of the regulation to take account of all the technical comments on the ACRS. The values stated in the ACRS letter have been used in the regulation except that we know of no practical way to deal with the concept of total population (man rem) dose limitations, but we do believe that the objective of the ACRS on this point is substantially achieved by the criteria proposed. The staff does not, however, agree with the ACRS recommendation that no regulation on the subject of site criteria should be published. The proposed regulation (Appendix "D") contains the same general approach to site criteria as the draft submitted to the ACRS. However, it has been modified to use the numbers recommended by the ACRS and to allow more flexibility in its use.

10. The proposed criteria represent a simplification of the complex technical problem that site selection presents and do not eliminate a large element of subjective judgment by the evaluators. Nonetheless, the criteria would give the industry, local health and safety authorities and the public a much clearer understanding of what the AEC does with the site information submitted for review, and the elements considered when site suitability is to be judged. The staff believes that the criteria reflect a conservative approach to the problem of siting of reactors with respect to potential hazards to surrounding populace. Should the Commission so desire, the criteria could be revised to reflect either more or less conservatism with respect to degree of isolation to be required in future reactor projects.

STAFF JUDGMENTS

11. The Division of Biology and Medicine, the Division of Reactor Development, the Office of General Counsel, and the Office of Health and Safety concur in the recommendation of this paper.

RECOMMENDATIONS

12. The General Manager recommends that the Atomic Energy Commission:

- a. Approve ^{publication in the Federal Register,} ~~the issuance~~ for comment, of the proposed Part 51 "Criteria for the approval of Sites for Power and Testing Reactors," ^{attached as Appendix D;}
- b. Note that the ^{proposed Part 51 in} ~~amendment shown by~~ Appendix "D" will be published in the Federal Register.

c. Note that a copy of the proposed regulation will be sent to the Joint Committee.

d. Note that an appropriate news release will be issued.

e. Consider the advisability of Commission discussion with the ACRS and subsequent review by the Commission before any of the foregoing actions are completed.

f. Note that this paper is unclassified.

~~SECRET~~

APPENDIX A

BACKGROUND

Introduction

1. The Atomic Energy Act did not lay down any specific criteria to be followed in the issuance of reactor licenses but left to the AEC the definition of such standards as it felt necessary to govern the design, location, and operation of nuclear facilities "in order to protect ~~the~~ health and minimize danger to life and property." The regulations issued to date by the AEC pertinent to reactor siting (10 CFR 50) deal principally with the information that must be submitted in support of license applications. This information is required to be submitted as a part of a "hazards summary report" and includes the following:

a) A description of the processes to be performed in the reactor and the nature and quantity of radioactive effluents expected to be produced.

b) A description of the facility in sufficient detail to allow evaluation of the adequacy of measures to minimize danger to persons both on-site and off-site.

c) A description of the site and the surrounding area, including pertinent meteorological, hydrological, geological and seismological data necessary for evaluating measures proposed for protecting the public from radioactive hazards.

2. Current regulations do not indicate, however, how the data supplied will be evaluated by the AEC, or the safety criteria which govern the AEC's consideration of proposed site suitability. Thus a prospective reactor plant builder is provided with little in the way of definitive guidance during the initial selection of a reactor site nor can he plan with any

assurance during the period his proposed site is under review by the AEC. Local safety authorities and the public near such reactor sites likewise have little to base judgment on as to how their interests are being protected other than a general awareness that within the AEC such projects are being reviewed with welfare of the public in mind.

3. One of the consequences of Commission silence regarding reactor site criteria policies is the possibility of development of divergent approaches and philosophies by various segments of the AEC involved in siting problems.

4. It is generally recognized that uncontrolled release to the atmosphere of the radioactive contents of a reactor system located in a densely populated area would result in public disaster. This awareness has led to the provision in the past of a considerable isolation area surrounding reactor installations. This was done on the theory that if enough distance was provided between a reactor and the perimeter of the controlled area, little or no jeopardy to the public would be involved.

5. The earlier concept of remoteness for reactor locations has undergone modification to the extent that plants with less isolation coupled with containment vessels have been judged adequate to protect the public health and safety. Although this change in concept is in the direction of bringing reactor plants closer to the demand centers, the nuclear power industry for economic reasons still presses for a further reduction in the conservatism inherent in such a concept.

6. Any further reduction in the concepts of isolation and containment for reactors will be largely dependent upon the ability to assess with more

certainty the circumstances and conditions under which loss of control of radioactive inventory might arise and the possible consequences of such an accident. The process of hazard analysis and site selection at this stage of technology is not a precise science, for the many variables involved are not precisely known nor has experience been sufficient to provide exact knowledge about the degree of conservatism that exists in past assumptions and guiding design criteria.

Present Practices in Site Evaluation

7. Judgment of suitability of a reactor site for a nuclear plant is a complex task. In addition to normal factors considered for any industrial complex such as nearby land use, water supply, soil and underlying rock characteristics, and site accessibility, are engineering features dictated by reactor hazards, including the hazards of radioactivity which vary with the type and size of plant to be built and the manner in which the potential radioactive effluents could be carried to the public.

8. A somewhat greater susceptibility to nuclear accidents might be attributed to test reactors versus power reactors because of the different utilization of the nuclear energy generated. However, the "upper limit of hazard" represented by the maximum credible accident is no greater for a test reactor than a power reactor of the same size, and is frequently less since the energy that is stored within the coolant system of the test reactor is less. However, the similarities between power and test reactor are considered sufficient to justify consideration of their hazards by common standards.

9. Proposed sites for power and test reactors are evaluated by both the staff of the Division of Licensing and Regulation and the ACRS. Information

supplied by the applicant is reviewed for answers to such questions as the following:

a. What is the size of the site and the location of the reactor on the property? This information fixes the exclusion radius for the reactor with respect to the nearest uncontrolled land.

b. What is the industrial and population distribution in the surrounding areas? This information is important in assessing the consequences of inadvertent release of radioactivity. The size of the required exclusion area will be affected by many factors including among other things reactor power level, design features and containment and site characteristics.

SS
c. What are the relevant features of hydrology, including location and number of nearby sources of drinking water or bathing facilities? This factor is important in evaluating the liquid waste disposal facilities proposed by the applicant. For example, the hydrology of the ground waters is important in assessing the effect travel time may have on the contaminants which might reach them to the points of nearest usage. Site drainage and surface water is important in determining the vulnerability of surface water sources to radioactive contamination. The characteristics and usage of the water sources often determine the safety precautions that must be observed at the facility in effluent control and management.

d. What are the significant meteorological factors? The persistence of inversions, the prevailing wind directions and velocities, and the rainfall become significant parameters in considering effects of airborne radioactivity. Capabilities of the atmosphere to diffuse and disperse an airborne release are considered in assessing the vulnerability to risk

of the areas surrounding the site. Thus, a high probability of good diffusion conditions and a wind direction pattern away from vulnerable areas during periods of slow diffusion would enhance the suitability of a site. On the other hand, if a site were in a region noted for hurricanes or tornadoes, it would be expected that the design of the facility include safeguards which would prevent significant radioactivity releases should one of those events occur.

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e. What has been the history of seismological disturbances in the area? Certain areas in the U. S. are known to have active faulted sub-surface structure and the requirements for buildings in such an area need added attention to possible consequences of ground tremors and shocks.

f. What is the soil structure for the site? This factor is important not only to design of the structural aspects of the facility but also to safety aspects relating to liquid waste storage and disposal. Highly permeable soils for example could lead to contamination of sub-surface aquifers from leaking storage containers. Impermeable soils on the other hand might lead to quick and uncontrolled runoff of liquid spills into nearby streams.

10. All the factors described are interrelated and dictate in varying degrees the engineered protective safeguards required for an individual facility. Therefore, site evaluation also includes consideration of the general features of the reactor/plant including power level, general plan of utilization and the safeguards planned to preclude or minimize inadvertent release of radioactive effluents.

11. An analytical test of the safeguards provided by site location and plant design is made through evaluation of a postulated accident, having consequences not expected to be exceeded by any other accident arising out of any other credible circumstances. Analysis is made of the consequences in terms of possible radiation exposure both to personnel at the facility and to the inhabitants of the surrounding public area. The conservatism of the assumptions made in arriving at the results and the acceptability of characteristics attributed to the safeguards provided are considered in assessing the numerical values derived. The judgment made is thus highly subjective. The many variables involved are not precisely known nor has experience been sufficient to provide exact knowledge about the degree of conservatism that exists in past design assumptions and guiding criteria.

History of the Problem

12. Attempts to become more objective through the use of definitive criteria have been complicated by a variety of situations including the following:

- SS | a. The industry, while pressing for criteria that would define the conditions of acceptability of proposed reactor sites, does not want such criteria in the form of regulations but rather in the form of "guides."

SS

b. The end objective in controlling reactor site location is to provide reasonable assurance that the public will not be subjected to undue hazards from operation of the facility. Any meaningful evaluation of the hazard associated with a particular accident must take into account the probability that the accident will occur, the resulting severity of exposures of individual persons to radiation, and numbers of persons at risk. While one cannot make quantitative and detailed evaluation of these factors, the present approach attempts to give to each the greatest consideration presently practicable. The probability of severe accidents is considered to be limited by technical reviews of reactor design and specifications, by conditions of license, and by inspection. Limitations of numbers of persons at risk are provided by exclusion, evacuation, and population center boundaries. Limits imposed on corresponding radiation doses are necessarily arbitrary since the related factors of probability of accident and numbers of persons cannot be closely defined. For the purposes of these criteria we have selected as limits doses which would not result in early manifestations of injury in case of the maximum credible accident and which are believed to involve a reasonably small probability that any individual receiving such a dose would suffer a serious consequence (such as leukemia or cancer) in later years.

The dose limits specified are 25 rem to the whole body and 300 rem to the adult thyroid. The degree of hazard associated with a dose of 25 rems to the whole body or to a major portion of the body has been qualitatively characterized in a statement by the NCRP that an accidental or emergency dose received only once in the lifetime of a person need not be included in the determination of the exposure status of the person exposed. There is no

equivalent recommendation for evaluation of accidental dose to the thyroid. On the basis of staff discussions, 300 r to the adult* thyroid has been used in these criteria.

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c. The analysis techniques applied to evaluation of hazards of reactor plant catastrophes cannot be considered to be precise. Experimental verification of parameters used is lacking and will probably remain so for years to come. As a consequence, both designers and evaluators have introduced conservative safety factors. There occurs, nevertheless, considerable variation in calculated results because of the different factors used. No one set of assumptions can be established as exact and appropriate to all situations. Appendix B presents further information on the factors involved and the effects on calculations of potential radiation hazards at the site boundaries and selected points beyond.

13. Notwithstanding these deterrents to the formulation of definitive site criteria the AEC has been attempting to establish a more objective approach to site evaluation. For example, 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 test reactors. That notice resulted in widespread reactions from the industry, with definite indication of opposition to formal siting regulations. AEC-72/20 contains excerpts of comments which the AEC received in writing together with

* If only adults were involved, the thyroid dose could be much higher. It is currently believed that (1) exposures resulting in a dose of this magnitude to the adult thyroid are likely to result in doses some two or three times as high in very small children; and (2) doses of these magnitudes to the thyroid of a small child has some probability of producing cancer of the thyroid in later years.

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.

14. In December, 1959, the General Manager appointed an Ad Hoc Committee to study the question of what the Commission can and should do at this time 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~~1959~~, 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."

15. A draft of criteria along the lines of the proposed regulation was submitted to the ACRS for review and comments. A copy of that earlier draft ^{is being} ~~was~~ circulated as AEC-R 2/22. The ACRS by letter to the Chairman, AEC, dated September 26, 1960 (Appendix ^{c-1} ~~1~~) expressed the view that the proposed criteria could be developed into a useful contribution to nuclear safety studies but the criteria document should not be given the status of a Commission regulation. A similar recommendation, together with additional comments, ^{was} ~~were~~ made by the ACRS in a letter of October 22, 1960 to Chairman McCone. (Appendix ^{c-2} ~~2~~)

DISCUSSION

16. The primary objections of the ACRS (Appendix ^{c-2} ~~2~~) to issuance of site criteria in the form of a regulation are concerns that:

- SS
- a. Quantitative criteria established at this time in regulations would become so firm as to hamper unduly adaptation or modification to keep pace with changes that may prove desirable as the industry develops.
 - b. From the technical viewpoint, the simplification represented by the criteria, and the fixation by regulation of formulae such as those proposed

for atmospheric dilution effects, accord too great a validity to expressions that are at best approximations.

SS | c. Regulations with set numbers would be too restrictive and would deter efforts in nuclear safety progress toward a better set of limits.

d. The appearance of quantitative numbers in a Federal regulation would reduce the interest of the applicant in remaining alert for unforeseen disadvantages of a site and taking corrective action accordingly.

e. The correctness of the numbers which could be selected now cannot be proved by experimental or empirical data and, therefore, such numbers would give a false sense of positiveness which could not be supported under detailed scrutiny.

17. The proposed criteria (Appendix "D") establish as bench marks for site evaluation three characteristic distances for a reactor of any given power level: (1) an exclusion distance, (2) a distance encompassing a surrounding zone of low population density, and (3) a distance to a defined population concentration. The criteria provide for evaluation of these bench mark distances in any individual case in accordance with the unique features and circumstances of that specific reactor project. The bench marks may be expressed in three different ways as shown in Annexes 1, 2 and 3 to Appendix "D". These alternate forms of presentation are included to assist in evaluation of the format in which such criteria might be published.

18. The first two bench mark distances and their corresponding dose limits as defined in the proposed regulation are as follows:

SS | a. Exclusion distance - At this distance following the onset of the maximum credible accident the total radiation dose received by an individual in two hours would not exceed 25 rem whole body exposure or 300 rem to the thyroid from radioactive iodine exposure.

SS
 b. Evacuation distance - The greatest distance from the facility at which the total radiation dose received by an individual located at such distance and exposed during the whole course of the maximum credible accident to the radioactive cloud resulting from the accident would be 25 rem to the whole body or 300 rem to the thyroid from radioactive iodine exposure.

19. If one could be absolutely certain that no accidents greater than the maximum credible accident would occur, then the two distances specified above would provide reasonable protection to the public under all circumstances. There does exist, however, a theoretical possibility that substantially larger accidents conceivably could occur. It is believed prudent at present, when the practice of nuclear technology does not rest on a solid foundation of extended experience, to provide protection against the most serious consequences of such theoretically possible accidents. A third bench mark distance, is, therefore, prescribed by which the reactor would be sufficiently removed from the nearest major concentration of people that no lethal exposures would occur in this population center even from an accident in which the containment is breached. The limit proposed for this third bench mark distance is defined in terms of possible radioactive effects under conditions of a contained maximum credible accident but represents the same distance that would insure no lethal doses in the event the containment is breached. The specification for this distance is:

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 * Population center distance - The distance from the facility at which the total radiation dose from the contained maximum credible accident received by an individual located at such a distance would be in the range of 50 to 100 rem to the thyroid from radioactive iodine exposure. It is fixed in the proposed regulation at 133-1/3% of the evacuation distance.

20. Provisions are made in the criteria for consideration of other relevant factors as well as the bench mark distances. The application of

these criteria depend to a substantial degree on the subjective evaluative judgments of the person responsible for final approval of a reactor site. Thus adoption of these criteria will not provide fully objective procedures for site selection. Rather these procedures define bench mark distances as a beginning point in the evaluation process. This would be in contrast to the methods which have been utilized to the present time. There has been no common point of departure and hence the entire process has depended upon subjective judgment.

21 20. The bench mark distance factors have been defined in the proposed regulation (Annex 1 to Appendix "B") in terms of integrated dose effects that might be experienced under the postulated accident. This method of presentation has the following advantages:

a. The potential radiations hazard expressed in integrated dose is the end form desired by the evaluator for judging the suitability of proposed sites.

SS b. Both the nuclear industry and the public think about nuclear hazards in terms of possible radiation doses. The criteria would thus be defined in terms likely to be best understood.

c. The position of the AEC would be clearly defined with respect to emergency dose limits that are now being used by much of the industry as reference limits for site selection and reactor plant design purposes.

22 The disadvantages to this form of presentation are:

a. The dose limits specified represent a certain degree of arbitrariness.

SS b. Limits on effluent releases from reactor installations during normal operations are currently specified in 10 CFR Part 20 in terms of nuclide

55 | One of the variables that has led to differences in calculations in the past has been the different conversion factors applied. Expressing distance factors in concentration limits will not eliminate this condition.

25-21. A third method of presenting the proposed criteria is shown by Annex 3 to Appendix D. In this annex, the bench mark distance factors as a function of power level have been calculated and presented in the form of a table. The basis upon which the table has been computed has been omitted. The advantage of such a scheme is its simplicity. A principal disadvantage is that the fundamental bases for establishing the bench marks are hidden. Of course, those bases could be explained by press releases, speeches, etc., but the staff feels that the best place to explain them is in the regulation itself.

26-22. After consideration of the relative merits of the various ways in which the criteria might be expressed, it is the opinion of the staff of the Division of Licensing and Regulation that the bench mark calculations as presented in the form shown in Annex 1 to Appendix D (combined with a precalculated table) wherein the distance factors are defined in terms of reference dose limits, will best serve the interests of both the nuclear industry and the public and most clearly defines the basis upon which the AEC intends to evaluate proposed reactor locations.

27-23. The calculational methods set forth in the criteria represent one approach which can be taken in the current state of the art. In this approach, highly complex phenomena involving parameters which vary over wide ranges of values, depending on detailed conditions and assumptions, are reduced to manageable dimensions by simplifying assumptions, specifying that certain secondary factors are to be ignored, and arbitrarily fixing the values of certain key parameters. In utilizing this method, it should be recognized:

a. That there is a substantial degree of artificiality and arbitrariness involved.

SS b. That the results obtained are only approximations, sometimes relatively poor ones, to the result which would be obtained if the effects of the full play of all the variables and influencing factors could be recognized - an impossibility in the present state of the art.

c. That the net effect of the assumptions and approximations is believed to give more conservative results than would be the case if more accurate calculations could be made. Further details on the conservatism involved are described in Appendix "B".

← Justification for criteria issuance in the form proposed is not upon its technical exactness but upon the value of having defined the basis upon which the AEC approaches judgments on reactor site suitability at this time.

28 ~~28~~ As an indication of what might be expected from the application of the proposed bench marks to the site selection process, the bench marks were applied to nineteen reactor projects that have been proposed or are currently authorized for construction. The results are tabulated in Appendix "E".