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ATOMIC ENERGY COMMISSION

IAEA - ISO MEETING ON REACTOR SITING

Note by the Secretary

The Deputy Director of Regulation has requested that the attached report be circulated for the information of the Commission.

W. B. McCool
Secretary

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CURRENT STATUS OF SITE SELECTION CRITERIA

Clifford K. Beck
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U.S. Atomic Energy Commission
Washington 25,D.C.

Atomic Industrial Forum - American Nuclear Society
Chicago, Illinois
November 7, 1961.

In the summer of 1960, at the Switzerland meeting of the General Committee on Reactor Safety of the International Standards Organization, a working group (#1) on Reactor Site Selection was established. The U.S., England and France were designated as member countries, with the U.S. to furnish the Chairman. Subsequently, your speaker was designated as the U.S. Representative to this working group, and hence as its Chairman.

As with all I.S.O. Committees, and the general I.S.O. Organization, it is the intention of this Working Group on Reactor Site Selection to explore the possibilities that approach to this problem in the different nations may have some elements of common practice and, hopefully, that there might eventually be developed some degree of uniformity in the exercise of this function.

At London, in March of this year, representatives to the Working Group from the countries named above, plus Canada and Germany, after extensive analysis and discussion of the reactor siting situation, decided two things:

1. That it was then unquestionably too early to identify any significant elements of common practice in site selection and hence too early to attempt any articulation of uniformity or agreement among the nations on this matter.

2. That there were significant indications of interest and activity in this problem in a number of countries and, hence, that another meeting about the end of 1961, for exchange of ideas and information among representatives from a somewhat larger number of nations, would be appropriate and timely.

The working Group was informed that IAEA had tentative plans for a small panel meeting on Reactor Siting scheduled for the Fall of 1961. Accordingly, discussions were opened between the Working Group #1 and the IAEA on the possibility of a jointly sponsored panel of invited experts from about 20 countries to be held in October. Agreement was quickly reached, and the meeting was scheduled for October 30-November 3, 1961.

The meeting was held last week as scheduled in Vienna, at the IAEA Headquarters. Some 30 persons from 16 countries were in attendance. Generally, these persons were in the category of experts on some aspects of reactor siting and were not official spokemen for national positions on this matter. However, most of these people were sufficiently involved in their nation's activities to contribute informed, though unofficial comments. Special efforts were made to have meteorologists present, and 4 or

5 persons who were experts on the general role of meteorology in reactor siting were in the meeting. Delegates from the USSR, though invited, did not attend.

Many of the delegates brought manuscripts of prepared statements to the meetings, and the first 2 1/2 days were used in having these statements presented and discussed. The remaining time was spent in general discussion and in debate on the content and form the record of this meeting should take.

The discussion revolved chiefly around three topics:

1. The general philosophical and procedural approach to the selection of sites for reactors, with some descriptions of practices in the countries represented.

2. The general contribution of the reactor, its potential accidents, the possible releases of fission products and the role of safeguards on the question of site selection.

3. Meteorology and its role in site selection.

The delegates agreed that there should be a report to the nuclear community from this 4-day discussion, and one is in preparation. The report will consist of two parts:

1. A general editorial introduction, including a summary of the complex nature of the site selection problem and some of the significant factors in the problem, an indication of the differences in opinions and approaches to the siting practice in different countries, and a caution on the interpretation to be given to the second part of the report.

2. The second part will consist of a collection of papers on the three general topics mentioned above, including those contributed by the individual participants to the meeting and others considered likely to be of value in such a general collection. There will be no recommendations or indicated preferred procedure or policy on reactor siting.

Since one conclusion reached in this conference was that no conclusions should be reached now on any common elements in reactor siting practices, it would be presumptious of me to make any attempt to interpret the sense of the conference for you. Rather, I will mention briefly the approach to reactor site selection, as I understand it, being taken in 4 different countries: Canada, United Kingdom, Germany, and the U.S. In attempting to be brief, I may not be fully accurate or complete, but I hope to convey the correct general position.

Canada:

In Canada, past practice has been for power and test reactors to be placed at sites having substantial isolation. That practice will undoubtedly be continued, but no rules or formulas have been developed, and there is likely to be none; rather, the present practice of choice by somewhat intuitive, subjective judgment on a case by case basis is likely to be continued. Meanwhile, however, as has been reported in the literature, considerable effort has been devoted in Canada to a probability method of approach to assessment of hazard or risk in

nuclear reactors. This method, attractive in basic principle, is handicapped by practical difficulties in the assignment of probability values to the assorted failures and malfunctions likely to occur; the assessment of potential damages likely to result, and the determination of an acceptable measure of the risk so determined. I do not consider it likely that this method will lead in the near future to a definitive procedure for selection of reactor sites.

Efforts are going forward in Japan, it might be noted, on a similar method of defining acceptable reactor sites.

United Kingdom:

The English are now in the process of putting finishing touches to the articulation of a new approach to the consideration of sites for nuclear reactors. The method consists of two separate and independent parts:

A. The comparative evaluation of suitability of sites, independently of any consideration of reactors that might be placed on the sites. For this they:

1. Assume a unit release of fission products, taken as 80-100% nobles; 25% iodines; 15% Ce and Te; >1% other products. Iodine turns out to be the controlling factor, so all else is ignored.

2. Assume that safety suitability of sites depends fully and only on exposure of people.

3. In the calculation of exposure, they:

   (a) Use condition F of Pasquil meteorology categories, an inversion condition which corresponds to 10-20% of time in England.

   (b) Assume that exposure damage is proportional to (atmospheric concentration)^2, i.e. that a person exposed to a given concentration is damaged 1/4 as much as a person exposed to a concentration 1/2 as much.

   (Thus persons close-in count much more heavily in evaluating a site. Beyond 12 or so miles, people generally count very little.)

   (c) Obtain 4 categories of comparative site acceptability by multiplying the number of people X (concentration)^2 at all distances and obtain index numbers which are then divided into 4 ranges. This procedure corresponds roughly to the determination of the population factor in insurance indemnity calculations for reactors in the United States.

B. There is the problem of matching a particular reactor with one of the categories of sites. Just how this is done, has not been fully worked out. A table has been calculated showing the quantities of iodine that could be released at each of the categories of sites without producing exposures to the thyroids of

children at the edge of the area (inversion condition F) in excess of 25 r. These values range from 10^3 to 10^4 curies.

Presumably then, if reactors were estimated to have a release likelihood lower than estimated iodine amounts for any category, it could be located at that category of site. However, considerable elements of subjective judgment are left in this process. The British do not propose to follow the practice of estimating the magnitude of the accidents having a credible likelihood of occurrence, or to relate their final decision to a Maximum Credible Accident.

Germany:

To my knowledge, there has been no indication of an official German approach to a reactor siting policy.

In practice, reactors have been located at sites having some degree of isolation which are otherwise suitable (cost, consumers, cooling water, etc.) and then a great effort in each case is made to insure that no exposures of the public in excess of 500 mrem can occur from the reactor under conceivable conditions. In at least some cases, less pessimistic assumptions are made about the magnitude of possible accidents than has been made for other reactors, and full credit is taken for the estimated effectiveness of all assorted safeguards. In some respects, this procedure consists in deciding where it is desirable to have the reactor located and then showing by appropriate assumptions and estimation of safeguard effectiveness that it is safe enough to be there.

This procedure involves detailed treatment of the maximum credible accident and exhaustive calculations on the full effectiveness of each safeguard feature, often in considerably more detail than would appear to be justified in view of the unprecise nature of some of the initial assumptions made.

One paper from Poland also supported the approach of guaranteeing "absolute safety" despite any possible accidents.

United States:

As you know, in March of this year we published for comment and discussion a set of guides to the selection of sites for power and test reactors. In these guides we identified the factors to be considered in selecting suitable sites for reactors. Included were: (1) a definition, within the context of the conservative factors and procedures outlined, of radiation exposure doses for the public which should not be exceeded by credible potential accidents in a given facility; (2) characteristics of the facility having a bearing on the type and magnitude of potential accidents therein; (3) physical characteristics of the site, including geology, hydrology, and meteorology; and (4) the population density and distribution in surrounding areas. It was indicated how these factors could be used to define successive zones of increasing population density in areas beyond the site confines. In an appendix, a numerical calculation was presented for hypothetical reactors, in which arbitrary values were assigned to various parameters involved in the calculation. Dimensions of population zones around the reactors were obtained

in this calculation which corresponded generally with reactor siting practice in the United States. It was stated in the guides that, in practice, each proposed reactor should be considered on its own merits, including the extent to which "unique or unusual features" having a bearing on "the probability and consequences of accidental releases" of radioactivity were present, and that, where a site had unfavorable characteristics, it might nevertheless be acceptable if "appropriate and adequate compensating safeguards" were provided.

It was intended that these "guides" would be used as guides, and that enough flexibility was incorporated therein to accommodate changes which might be suggested by the unique safeguards in any particular facility and by the cumulative operating experience with all reactors. However, many persons commented to us that the inclusion of a sample calculation in the appendix, containing assigned values to various parameters, suggested too much inflexibility in the guides and an indication that substantial isolation of reactors might be a permanent requirement for all future reactors.

The example we published was not intended to give these impressions. Clearly, we must make some revisions. Either by modification of the appendix, by eliminating it, or in some other way, we must make clear that inflexibility in the procedure, and insensitivity to future safeguards progress and accumulated reactor operating experience were not intended.

From these examples, the extensive discussions that we have just heard in the Vienna meeting and my own studies of this problem. I would summarize the situation with respect to reactor site selection as follows:

1. There is not now and probably will never be a definitive, unambiguous, objective procedure for unique determination of whether a given site is "adequately" safe for a particular reactor, or whether it is not... because such a determination would depend on the accidents that might occur in that reactor and their consequences. It is inherently impossible to have such information at the time the decision on acceptability of a given site has to be made.

2. As reactors are now being constructed, there is a very high probability of safety during their operating lifetime, or a very low probability that an accident of serious dimensions will occur, but this probability of a serious accident is not zero, and how large it is we do not know.

3. In this situation, there are three possible choices as to reactor site location policy:

a. Full dependence could be placed on safeguards -- both the "accident prevention" safeguards and the "consequences -- limiting" safeguards, so the reactor could be located anywhere.

b. No dependence could be placed on safeguards, in which case very large isolation distances would have to be provided.

c. There could be a compromise between these two; i.e., substantial dependence on safeguards, but some degree of isolation--just in case. This latter choice is the one customarily followed.

4. This compromise that may be agreed on in any given case, and more importantly, the policy principle followed on this point in any given country, not only depends on a substantial element of subjective judgment in the technical estimation of the degree of risk involved, but, also, let us face fully and state it candidly, such matters as national needs, national endowments in physical resources, public relations and other matters of similar nature.

For example, in the United States, where we do not have as pressing an urgency for alternate sources of power as exists in some other countries, and where we have an abundance of open spaces to choose from, our reactor siting policy may well be dissimilar from that of other countries whose over-all situation, obligations and needs may be different.

5. In this sense then, two comments may be made about the guides we have published:

a. Outlined therein is a procedural study of potential accidents and their consequences which in any reactor case has substantial intrinsic merit.

b. More importantly, these guides, somewhat arbitrarily, define procedures that lead to selection of reactor sites which are generally consistent with our current practices in locating reactors. I believe these location practices are likely to continue, as a general pattern, though each reactor must be considered on its own merits and the door is left open for deviation from this practice where there is a basis for believing that this may be justified.

The summary I have just stated is not in disagreement with the discussions in the conference of last week, and in particular, I believe there would be solid support everywhere for the necessity for each country to develop an approach to a policy of reactor siting in accordance with the circumstances and needs of that country.