ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

August 13, 1974

Honorable Dixy Lee Ray
Chairman
U. S. Atomic Energy Commission
Washington, D. C. 20545

Subject: ACRS DOCUMENTS RELATING TO SITING EVALUATION

Dear Dr. Ray:

In connection with recent matters related to the Freedom of Information Act, the ACRS has been requested to provide minutes of its meetings concerning the potential siting of power reactors at sites having greater surrounding population densities than sites previously approved. These minutes are being made available by the ACRS with minimum deletion. It should be noted that prior to the implementation of the FACA, the Committee's minutes were intended only for the internal use of the Committee and were not necessarily reviewed or certified as correct as now required by that Act. Accordingly, they should in general be regarded as informal reports meant to reflect the flavor and principal features of the meetings, rather than as detailed, or completely accurate accountings of the proceedings.

For those who read these documents, the following explanation may be helpful.

The Committee is concerned primarily with the avoidance of discharges of radioactive materials from nuclear power reactors under conditions which conceivably could lead to undue risks to public health and welfare.

To aid it in its work, the Committee retains a large group of consultants encompassing many disciplines. It is also aided by the reports and work reviews of the Regulatory Staff, the designers of the nuclear steam supply systems, the nuclear power plant architect-engineers, and a large number of research and development groups.

We have already accumulated in the United States, about two hundred reactor years of experience at commercial nuclear power stations without a major radioactive discharge or other nuclear related accident that has resulted in injury to the public. Since there have been no such accidents in the past, the probability of such accidents occurring in the future cannot be arrived at by any analysis of this experience. However, the Committee has from the beginning assessed, and continues to assess, the potential for and the possible consequences of postulated events. In pursuing this aspect of safety evaluation, the Committee thus continues to deal with highly unlikely but potentially very serious accidents. Examples of this type of accident are pressure vessel failure, a complete loss of power, or an uncontained loss of coolant accident. One aspect of such considerations is the comparison of the effects of the discharge of arbitrary quantities of radioactive material at different sites. This type of analysis was employed in a site comparison study of the Metropolitan Siting Subcommittee (subsequently called the Siting Evaluation Subcommittee).

The Siting Evaluation Subcommittee attempted to develop information which would aid the full Committee in the formulation of a policy on the siting of large power reactors at sites having greater surrounding populations than those previously approved. The need for such a policy had become apparent as a result of some actual applications and potential proposals involving sites having population characteristics somewhat "worse" than those for the most populous sites already approved.

The activities of the Subcommittee and of the full Committee toward this objective involved many meetings and discussions within the Committee and with the Regulatory Staff, the Commission, and representatives of the utilities and the nuclear industry. These activities contributed to the development of the position that large power reactors might be acceptable at sites having population densities somewhat greater than those previously approved, but only if certain kinds of improvements were made in their design and construction and if additional safeguards were provided. This position was expressed in various drafts of reports (letters) which were prepared in a formal manner in order to coalesce the views of the Committee into a coherent collegial position. This basic position was made public in the Committee's letter of September 10, 1969, relating to the proposed Newbold Island site.

In the course of the Subcommittee activity discussed above, two things became evident. First, a quantitative basis for comparing sites in terms of population distribution and density was needed, in order to compare one site with another in respect to population and to identify

those sites to which the proposed criteria would apply. And second, the criteria of 10 CFR Part 100 would not in themselves provide a quantitative basis for assessing the acceptability of more densely populated sites, since the quantitative limits of these criteria could be satisfied by providing additional engineered safety features in lieu of distance as a means of protecting the public against the consequences of the design basis accidents required to be considered.

The criteria of 10 CFR Part 100, together with other rules, criteria and guides promulgated by the AEC, provide a basis for the design of a large power reactor that would not present an undue hazard to the health and safety of the public at even a heavily populated site in the event of any of the postulated low-probability design basis accidents. However, an accident much worse than those considered and having a lower probability of occurrence (Class 9) could present a threat to the public which would require additional consideration of the population density surrounding the site.

For these reasons, the Subcommittee's approach to the development of a siting index to be used in identifying "worse" sites involved assumptions of arbitrary, large releases of radioactivity. This approach was explored as a possible means of development of a usable method for evaluating quantitatively, on a comparative basis, the population densities (and distributions) associated with reactor sites. The objective was to achieve an agreed-upon formula which utilizes the population data at a site to produce a single-number index (Site Population Index), the magnitude of which indicates whether the site is "better" or "worse" than another site (in respect to population), and by how much.

The objective described was not fully achieved. However, after prolonged effort there was developed a possible approach to a Site Population Index which the Committee thought could be used as an initial point of departure in a joint ACRS-Regulatory Staff effort directed toward eventual development of an Index suitable for public release and for use by both industry and the Regulatory bodies.

The principal general approach taken in the attempt to develop an Index was as follows. A series of hypothetical releases of large magnitude is postulated for the site under consideration, and the same series is postulated for a "reference" site. This reference site, as eventually conceived, is assumed to have a population density which is at every point equal to the arithemetic mean of the population densities at the corresponding points of the Indian Point and Zion sites, these being the most highly populated sites employed to date. The effects of the

assumed releases on the population at the considered site are then calculated on a simplistic but a consistent basis and compared to those similarly calculated for the reference site, the comparison being expressed in the form of a single-number Index.

The effects calculated are two: the man-rem exposures resulting from the releases; and, the number of people who would have to be evacuated or would otherwise be subjected to a dose exceeding some specified threshold value. The calculation of these effects is based on an assumed rate of attentuation of dose with distance from the reactor; usually dose is assumed as inversely proportional to distance to the three halves power.

For each of the postulated releases, the total "exposure" (man-rem) is found by the above process for the site under study, and for the reference site. The ratio between these two numbers is averaged over all releases considered. Likewise, for each of these releases, the number of hypothetical "evacuees" (or persons receiving threshold doses) is found for the site under study and for the reference site, and the ratio of these two numbers is averaged over all releases postulated. The two averages are then combined to give a single-number Index. The Index is unity for the reference site, less than 1 for a "better" (less populated) site, and greater than 1 for a "worse" site.

In the Index model last considered (and presented to the Regulatory Staff in 1970 for possible further development into a useful regulatory tool), the smallest release considered was arbitrarily assumed to cause doses of 25R at 0.5 miles, and the largest to cause doses of 25R at 6 miles. An arbitrary plume width was assumed. The lower cut-off dose for man-rem calculation was about 1R. The specified threshold dose value was taken as 25R.

In some earlier index models explored, the releases hypothesized were arbitrarily assumed to cause doses twenty times higher than those above, and the specified threshold dose value was taken to be 500R, also twenty times higher. Not surprisingly, with these arbitrarily high assumed releases and with a further arbitrary assumption of <u>no evacuation</u> of any portion of the populace, at highly populated sites very high man-rem exposures resulted and very high numbers of people were calculated to receive hypothetical doses of 500R or more, i.e., became "fatalities", as indicated in certain of the minutes. It is emphasized that these man-rem figures and "fatality" numbers do not result from analyses of specific or realistic accident sequences. It should also be noted that

associated estimates of the probability of concurrence of such consequences were not made except for general cognizance that such a probability is exceedingly low, and for the larger of the hypothetical consequences, probably decades below that of a Part 100 type release.

The exploration by the Committee of models which resulted in such numbers was done for purposes of comparison of one site with another (with identical calculations made at both sites), and not as a means of appraising any site on an absolute basis.

The Committee believes that a site population index of the general type treated represents a useful concept, and continues to employ informally the developmental index already formulated as an aid in judging on a comparative basis the population magnitudes at sites it is called upon to appraise.

A list of the ACRS full Committee and Subcommittee meeting minutes related to activities of the Subcommittee is attached.

Sincerely yours,

/s/ W. R.Stratton

W. R. Stratton
Chairman

Attachment:
As stated

ACRS MINUTES RELATIVE TO METROPOLITAN SITING

A) Full Committee Minutes

1) 62nd ACRS Meeting, March 11-13, 1965
2) Special ACRS Meeting, March 26-27, 1965
3) 63rd ACRS Meeting, May 13-15, 1965
4) 66th ACRS Meeting, September 9-11, 1965
5) 73rd ACRS Meeting, May 5-7, 1966
6) 74th ACRS Meeting, June 8-11, 1966
7) 83rd ACRS Meeting, March 9-11, 1967
8) 84th ACRS Meeting, April 6-8, 1967
9) 85th ACRS Meeting, May 11-13, 1967
10) 86th ACRS Meeting, June 8-10, 1967
11) 87th ACRS Meeting, July 6-8, 1967
12) 89th ACRS Meeting, September 7-9, 1967
13) 94th ACRS Meeting, February 8-10, 1968
14) 98th ACRS Meeting, June 5-8, 1968
15) 99th ACRS Meeting, July 24, 1968
16) 100th ACRS Meeting, August 8-10, 1968
17) 103rd ACRS Meeting, October 31-November 2, 1968
18) 105th ACRS Meeting, January 9-11, 1969
19) 107th ACRS Meeting, March 6-8, 1969
20) 108th ACRS Meeting, April 10-12, 1969
21) 110th ACRS Meeting, June 5-7, 1969
22) 111th ACRS Meeting, July 10-12, 1969
23) 112th ACRS Meeting, August 7-9, 1969
24) 113th ACRS Meeting, September 4-6, 1969
25) 114th ACRS Meeting, October 9-11, 1969
26) 115th ACRS Meeting, November 6-8, 1969
27) 116th ACRS Meeting, December 11-13, 1969
28) 119th ACRS Meeting, March 5-7, 1970
29) 126th ACRS Meeting, October 15-17, 1970
30) 127th ACRS Meeting, November 12-14, 1970
31) 128th ACRS Meeting, December 10-12, 1970
32) 129th ACRS Meeting, January 7-9, 1971
33) 130th ACRS Meeting, February 4-6, 1971
34) 155th ACRS Meeting, March 8-10, 1973

B) Subcommittee Minutes

1) Reactor Siting, March 20, 1965
2) Metropolitan Siting of Reactors, May 30, 1967
3) Metropolitan Siting, March 29, 1968
4) Metropolitan Siting, April 18, 1968
5) Metropolitan Siting, May 8, 1968
6) Metropolitan Siting, July 2, 1968
7) Metropolitan Siting, August 7, 1968

8) Metropolitan Siting, September 4, 1968
9) Site Evaluation, October 2, 1968
10) Site Evaluation, October 29, 1968
11) Site Evaluation, December 4, 1968
12) Site Evaluation, January 8, 1969
13) Site Evaluation, February 25, 1969
14) Site Evaluation, March 25, 1969
15) Siting Evaluation, May 7, 1969
16) Siting Evaluation, November 5, 1969
17) Siting Evaluation, December 10, 1969
18) Siting Evaluation, March 4, 1970
19) Siting Evaluation, April 8, 1970
20) Siting Evaluation, May 6, 1970
21) Siting Evaluation, June 10, 1970
22) Siting Evaluation, August 5, 1970
23) Siting Evaluation, September 16, 1970
24) Siting Evaluation, October 14, 1970
25) Siting Evaluation, December 8, 1970
26) Siting Evaluation, June 9, 1971
27) Siting Evaluation, January 5, 1973