(1) A bench mark exclusion area of such size that an individual located at any point on its boundary for two hours immediately following onset of the maximum credible accident would receive a total radiation dose to the whole body of 25 rem or a total radiation dose of 300 rem to the thyroid from iodine exposure.

(2) A bench mark evacuation area of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the accident (during the entire period of its passage) would receive a total radiation dose to the whole body of 25 rem or a total radiation dose of 300 rem to the thyroid from iodine exposure.

(3) A bench mark population center distance of 133 1/3% of the distance from the reactor to the outer boundary of the evacuation area. An individual at this distance who is exposed to the radioactive cloud (during the entire period of its passage) would receive a total radiation dose in the range of 50 to 100 rems to the thyroid from iodine exposure.

The bench mark areas and distances are to be obtained through use of the table on the calculational techniques contained in Appendix "A", which are designed to incorporate conservative factors and assumptions.

The whole body dose of 25 rem referred to in the bench marks corresponds to the once in a lifetime accidental or emergency dose for radiation workers which the NCRP recommends may be disregarded in the determination of their radiation exposure status. (See Addendum dated April 15, 1958 to NBS Handbook 59). The NCRP has not published a similar statement with respect to portions of the body, including doses to the thyroid from iodine exposure. For the purpose of establishing bench mark areas and distances under the conditions assumed in the proposed rule, the whole body dose of 25 rem and the 300 rem dose to the thyroid from iodine are believed to be conservative values.

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As previously indicated, these bench marks are only a starting point in the evaluation of a proposed reactor location. The proposed rule specifies that the Commission will also consider

[redacted]

ANNEX 1 TO APPENDIX "D"

APPENDIX A

Suggestions for

Calculation of Bench Mark Areas and Distances

1. On the basis of ~~specified~~ suggested calculation methods and assigned values of parameters involved, which are described below bench mark areas and distances for reactors of various power levels ~~have been determined and are listed in the following table:~~ would be as follows.

Power Level (Thermal Megawatt)	Exclusion Distance (Miles)	Evacuation Distance (Miles)	City Distance (Miles)
1500	.70	13.3	17.7
1200	.60	11.5	15.3
1000	.53	10	13.3
900	.50	9.4	12.5
800	.46	8.6	11.5
700	.42	8.0	10.7
600	.38	7.2	9.6
500	.33	6.3	8.4
400	.29	5.4	7.2
300	.24	4.5	6.0
200	.21	3.4	4.5
100	.18	2.2	2.9
50	.15	1.4	1.9
10	.08	.5	.7

2. This table has been based upon the following assumptions:

a. The maximum credible accident will release to the atmosphere of the reactor building 100% of the noble gases, 50% of the halogens and 1% of the solids in the fission product inventory. This release is equal to 15.8% of the total radioactivity of the fission product inventory. Of the 50% of the halogens released, one-half is assumed to condense out on the internal surfaces of the reactor building or adhere to internal components.

b. The release of radioactivity from the reactor building to the environment occurs at a leak rate of 0.1% per day of the atmosphere within the building and the leakage rate persists throughout the effective course of the accident which, for practical purposes, is until the iodine activity has decayed away.

c. In calculating the doses which determine the size of the bench mark areas, radioactivity decay in the usual pattern has been assumed to occur during the time fission products are contained within the reactor building. No decay was assumed during the transit time after release from the reactor building.

d. No ground deposition of the radioactive materials that leak from the reactor building was assumed.

e. The atmospheric dispersion of material leaking from the reactor building was assumed to occur according to the following relationship:

$$X = \frac{2Q}{\pi u\, C_y\, C_z\, d^{2-n}}$$

where Q is rate of release of radioactivity from the containment vessel, the ("source term,"):

X is the atmospheric concentration of radioactivity at distance d from the reactor

u is the wind velocity

n is the atmospheric stability parameter

C_y and C_z are horizontal and vertical diffusion parameters resp.

π is a constant 3.1416.

f. Meteorological conditions of atmospheric dispersion were assumed to be those which are characteristic of the average "worst" (most favorable) weather conditions for average meteorological regimes over the country. For the purposes of these calculations, the parameters used in the equation in section e. above had values as follows:

$u = 1$ m/sec; $C_y = 0.40$; $C_z = 0.07$; $n = 0.5$

g. The isotopes of iodine were assumed to be controlling for the evacuation and city distances. The evacuation distance results from integrating the effects of iodine 131 through 135. The city distance equals the evacuation distance increased by a

h. The source strength for each iodine isotope was calculated to be as follows:

Isotope	Exclusion Q (curies/megawatt)	Evacuation Q (curies/megawatt)
I^{131}	.55	76.4
I^{132}	.68	1.40
I^{133}	1.19	18.5
I^{134}	.72	.91
I^{135}	1.04	5.4

These source terms combine the effects of fission yield under equilibrium conditions, radioactive decay during the holdup time in the reactor building, and the release rate from the reactor building.

i. For the exclusion distance, doses from both direct gamma radiation and from iodine in the cloud escaping from the reactor building must be calculated and the distance established on the basis of the effect requiring the greater isolation.

j. In calculating the thyroid doses which result from exposure of an individual to an atmosphere containing concentrations of radioactive iodine, the following conversion factors were used to determine the dose received from breathing a concentration of one curie per cubic meter for one second:

Isotope	Dose (rem)
I^{131}	329
I^{132}	12.4
I^{133}	92.3
I^{134}	5.66
I^{135}	25.3

k. The whole body doses at the exclusion and evacuation distances due to direct gamma radiation from the fission products released into the reactor building in the maximum credible accident were derived from the following relationships:

Annex 3 to Appendix "D"

Appendix A (Alternate 2)

Table of Bench Mark Areas and Distances

In establishing bench mark areas and distances the following table shall be used:

TABLE OF BENCH MARK LOCATION DISTANCES

Power Level (Thermal Megawatt)	Exclusion Distance (Miles)	Evacuation Distance (Miles)	City Distance (Miles)
1500	.70	13.3	17.7
1200	.60	11.5	15.3
1000	.53	10.0	13.3
900	.50	9.4	12.5
800	.46	8.8	11.8
700	.42	8.1	10.7
600	.38	7.2	9.6
500	.33	6.3	8.4
400	.29	5.4	7.2
300	.24	4.5	6.0
200	.21	3.4	4.5
100	.18	2.2	2.9
50	.13	1.4	1.9
10	.08	.6	.8

APPENDIX "E"

BENCH MARKS FOR SELECTED REACTORS

MW	Reactor	Exclusion Area: Bench Mark Distance (miles)	Exclusion Area: Actual Distance (miles)	Evacuation Area: Bench Mark Distance (miles)	Evacuation Area: Actual Pop. Density in Bench Mark Area (people/sq.mi.)	Population Center Distance: Bench Mark Distance (miles)	Population Center Distance: Actual Distance (miles)
630	Dresden	.39	.5	7.4	38	9.9	14
565	Con. Ed.	.37	.3	7.0	403	9.4	17
485	Yankee	.33	.5	6.2	33	8.3	21
300	EBDC	.24	.75	4.5	24	6.1	7.5
270	PWR	.23	.4	4.2	298	5.7	7.5
240	Consumers	.22	.5	3.9	28	5.2	135
240	Hallam	.22	.25	3.9	10	5.2	17
203	Pathfinder	.21	.5	3.5	25	4.6	3.5
202	PG&E	.21	.25	3.5	172	4.6	3
200	ICBWR	.21	.2	3.5	86	4.6	10
115	Phila. Elec.	.19	.57	2.4	29	3.2	21
60	NASA	.16	.5	1.6	53	2.1	3
60	CVTR	.16	.5	1.6	12	2.1	25
60	Jamestown (Orig. site)	.16	.3	1.6	1200	2.1	0.5
60	Jamestown (New site)	.16	.3	1.6	66	2.1	2.4
58	Elk River	.16	.23	1.5	40	2.0	20
50	VBWR	.15	.4	1.4	23	1.9	15
45	Piqua	.15	.14	1.4	960	1.8	27
40	Pt. Loma	.14	.25	1.2	0	1.6	3