For dairies in the Central Savannah River Area, the UAF averages about 30 m^2/day and the L_p averages 16 l/day. Cows are on forage throughout the year, but their diet is supplemented with imported corn and oats (about 50% supplement by weight in spring and summer months and 85% during fall and winter). It is assumed that the UAF remains constant throughout the year.

Using these values, Equation G-17 becomes:

$$D_c = \frac{3.6 \times 10^{10} f_m f_w \varepsilon}{m \lambda_v \lambda_e} \qquad \text{(G-18)}$$

VARIATIONS FROM THE DOSE MODEL

Dose calculations for the long-lived radionuclides carbon-14 and iodine-129 require the use of different techniques than those normally used for other radionuclides released to the environment from SRP operations. The modifications are necessary for calculating plant boundary dose to individuals and dose to the population within 100 km because transport data and dose conversion factors for these radionuclides are not available at this time to permit use of the "vector model." A conservative approach, called variously the "specific activity model" or the "equilibrium ratio model" is used. This approach assumes that carbon-14 and iodine-129 mix with their naturally occurring isotopes in the atmosphere, and that the presence of the SRP-made nuclides in man's body instantly comes into equilibrium with the ratio of SRP-made nuclide to natural nuclide abundance in the atmosphere. The bases and assumptions used for calculating dose from carbon-14 and iodine-129 are described in the following sections.

Carbon 14

Carbon-14 (half-life = 5730 years) is produced in SRP reactors by various reactions in the fuel, coolant, and core construction materials. The reactions accounting for most of ^{14}C production are:

$$^{17}O\ (n,\alpha)\ ^{14}C$$

$$^{14}N\ (n,p)\ ^{14}C$$

$$^{13}C\ (n,\gamma)\ ^{14}C$$

The (n,α) reaction with naturally occurring ^{17}O (0.039%) present in the heavy water coolant accounts for most of the ^{14}C produced at SRP. The nitrogen occurs as an impurity in the fuel, as dissolved gas, as nitric acid, and as impurity in the core material. Natural carbon-13 is a minor constituent present in structural materials of the reactor and its core.

A small fraction of the carbon-14 produced at SRP is released to the atmosphere as $^{14}CO_2$ and ^{14}CO from the production reactors and from the fuel and target chemical processing areas. These gases mix with natural carbon-12, 13, 14 present in the atmosphere, and then enter the world's carbon cycle. In the carbon cycle, the radiocarbon (man-produced and natural) and the natural nonradioactive carbon are incorporated into living material. After sufficient time has elapsed, the ratio of radiocarbon to total carbon in living matter will approach equilibrium with the ratio existing in the atmosphere, provided the ratio in the atmosphere is a constant over long periods of time.

For purposes of calculating dose to individuals and the population within a 100 km radius of SRP, it is assumed conservatively that any SRP released carbon-14 instantaneously reaches equilibrium in man at the same ratio as exists in the local atmosphere. The radiocarbon is incorporated in the tissues of man through ingestion of food and inhalation of CO and CO_2 in the air. For carbon taken into the body in this manner, the ICRP[3] suggests an effective half-life in the body of 10 days, or a mean life of 14.4 days. This half-life would appear to be too short for the "equilibrium ratio model" because it may be assumed that a small fraction of the radiocarbon replaces nonradioactive carbon in organic matter in human tissues. Therefore, it is assumed arbitrarily that the lifetime dose commitment from radiocarbon in the body is two times the dose received during the year of release of carbon-14 from SRP.

Monitoring measurements show SRP releases average about 86 Ci/yr of carbon-14 to the atmosphere in the form of ^{14}CO and $^{14}CO_2$ (primarily as $^{14}CO_2$). The calculated annual average concentration of carbon-14 in air at the plant boundary is 2.3×10^{-14} μCi/cc. The average concentration of natural carbon in air (as CO and CO_2) is 1.56×10^{-7} g/cc. Thus, the SRP-released carbon will be present in air at the plant boundary in the ratio of (2.3×10^{-14} μCi/cc):(1.56×10^{-7} g/cc) or 1.47×10^{-7} μCi ^{14}C/g of total carbon. This is the average at the plant boundary during the year of release. If it is assumed that the 1.26×10^4 g of carbon in the total body of "standard man" instantaneously reaches equilibrium with the ratio in air, it can be calculated that the total body of man contains an equilibrium content of 1.85×10^{-3} μCi of ^{14}C. This would result in a whole body dose of 0.025 mrem during the first year, and a lifetime dose commitment of 0.052 mrem (assuming lifetime dose commitment is twice the first year dose).

The average dose commitment to individuals in the population within 100 km of the center of SRP was calculated to be about 29%

of the dose commitment to the individuals at the plant boundary by methods described in Appendix F. Thus, the population dose within 100 km can be calculated:

$$\frac{(0.052 \text{ mrem})(0.29)(668{,}000 \text{ persons})}{1000 \text{ mrem/rem}} = 10.1 \text{ man-rem}$$

Carbon-14 is also produced in nature, primarily by the (n,p) reaction on nitrogen in the upper atmosphere. An estimated inventory of 2.4×10^8 Ci of ^{14}C exists in the environment from natural production. This material is in equilibrium, ∿90% in the deep oceans below 100 meters, ∿2% in the atmosphere, and ∿8% in the surface waters, sediments, and biosphere.[7] An additional 6.4×10^6 Ci of ^{14}C has been produced by atmospheric tests of nuclear weapons through 1971.[7,8] The presence of naturally-produced carbon-14 in man's body results in an annual dose of 1.02 mrem.[9] Thus, the population within a 100 km radius of SRP receives an annual dose from natural carbon-14 of:

$$\frac{(1.02 \text{ mrem})(668{,}000 \text{ persons})}{1000 \text{ mrem/rem}} = 681 \text{ man-rem}$$

The estimated population dose commitment of 10.1 man-rem from a year of operation of SRP is about 2% of the annual dose from naturally occurring carbon-14.

Based on recent measurements correlated to SRP reactor operating history, it was calculated that a total of approximately 2139 Ci of carbon-14 was released to the environment since startup of SRP, resulting in an estimated maximum whole body dose commitment of 1.5 mrem to an individual at the plant boundary and a population dose commitment of 291 man-rem. This population dose is about 2% of the 22-year dose from naturally occurring carbon-14.

Iodine-129

Iodine-129 (half-life = 1.59×10^7 years), produced as a fission product in reactor fuels and targets, is released to the atmosphere from fuel and target element chemical processing areas and mixes with the natural iodine-127 present in the atmosphere. The major vector for exposure of man is the grass-cow-milk chain. Minor vectors are vegetative food crops, meat from herbivorous animals, and inhalation. Vegetative food crops contain iodine both from foliar deposition and from root uptake from the soil, the former being more important during initial release but the latter probably important over extended periods of time because of the very long half-life of iodine-129. Little is known about the ultimate fate of iodine-129 in soil, but it is expected to migrate to the ocean and be diluted with the large inventory of natural iodine-127.

Iodine-129 releases to the atmosphere from SRP have not been routinely monitored because the low specific activity of this nuclide (1.73×10^{-4} Ci/g) and the low energy of radiations emitted during decay (beta-0.14 MeV, max, gamma-0.038 MeV) make accurate measurements difficult. However, short-lived iodine-131 is measured routinely and efficiency of removal of this nuclide from ventilation exhaust (discharged from 200-ft exhaust stacks) has been determined for the various methods used at SRP for chemical processing of reactor fuels and targets. During the period from 1954 through 1975, an estimated total of 4.3 curies of iodine-129 was released from exhaust stacks to the environment, based on iodine-131 removal efficiency for each chemical process and calculated amounts of iodine-129 that entered each process. If this material were released uniformly over 22 years of operation, the average annual release would be 0.2 Ci. At this rate of release, the concentration of iodine-129 in air at the SRP site boundary would average about 5.9×10^{-17} μCi/cc or 3.4×10^{-13} g/m^3 (not corrected for depletion by surface deposition). This would mix with stable iodine-127 in air, which is typically present in concentrations of 10^{-8} to 10^{-9} g/m^3 in this area. Thus, taking the mid-point of this range, the ratio of $^{129}I/^{127}I$ in air at the plant boundary would be about 6.8×10^{-5}. Ratios of up to 1.2×10^{-5} were measured in grass and 4×10^{-6} in soils at the plant boundary in 1971.[10]

Because cattle consume large quantities of pasture foods, bovine thyroids should be good indicators of the upper limit of the $^{129}I/^{127}I$ ratio in foods. Ratios of 0.8×10^{-6} (South Carolina average) up to 3.5×10^{-6} have been measured in bovine thyroids obtained from locations near SRP[11] (samples taken during 1966-1968). Because grass and bovine thyroid samples were not taken at the same time or place, the conservative assumption is made that bovine thyroids will approach the maximum ratio of $^{129}I/^{127}I$ found in grass near the plant perimeter, i.e., about 1×10^{-5}. If it were further assumed that the ratio in man's thyroid approaches that in cattle, the dose would be 0.8 mrem to an adult thyroid and 0.20 mrem to an infant thyroid per year (dose calculations based on: adult thyroid mass = 20 g, total iodine content = 0.007 g, infant thyroid mass = 2 g, total iodine content = 0.00018 g).[8] In the equilibrium ratio model, the dose to an adult's thyroid is higher than the dose to an infant's thyroid because of the greater total iodine (and iodine-129) concentration per unit mass of thyroid tissue. A large degree of conservatism is inherent in the calculations. The dose calculated by this approach is highly unlikely because man receives much of his iodine from sources other than local food crops, i.e., iodized table salt, imported foods, etc., and the $^{129}I/^{127}I$ ratio in man's thyroid would be lower than in bovine thyroids. However, for conservatism it was assumed that the thyroid dose at the plant perimeter is 0.8 mrem per year (for a 0.2 Ci release). The annual dose to the individual thyroid at the plant perimeter from the 1975 release of 0.14 Ci is 0.56 mrem.

At this time, not enough is known about the long-term behavior of iodine-129 in the environment to make estimates of lifetime dose commitment. However, because of limited residence time in the thyroid (half-life 138 days), dilution with natural stable ^{127}I, and downward migration out of root zones with rainwater infiltration, residual effects to the surrounding population from the small releases of ^{129}I are believed to be much smaller than the estimated doses during the year of release. The theoretical cumulative annual thyroid doses from release of ^{129}I to the atmosphere from SRP from 1954 through 1975 are calculated to be:

Individual at plant boundary	17 mrem
Average individual in 100 km radius	3.4 mrem
100 km population	2242 man (thyroid)-rem

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TABLE G-1

MAN-REM CALCULATIONS FOR 1975 ATMOSPHERIC RELEASES BY RADIAL INCREMENT

DST KM	WHOLE BODY GAMMA	TOTAL SKIN DOSE	TOTAL BODY DOSE	CRITICAL ORGAN					
				BONE	LUNG	THYROID	KIDNEY	LIVER	G I TRACT
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	8.0547E-01	6.1563E 00	4.0791E 00	4.0791E 00	4.0812E 00	7.5371E 00	4.0791E 00	4.0791E 00	4.0791E 00
25	1.4092E 00	1.1469E 01	7.5811E 00	7.5811E 00	7.5847E 00	1.3929E 01	7.5811E 00	7.5811E 00	7.5811E 00
30	2.3419E 00	2.1087E 01	1.3889E 01	1.3889E 01	1.3895E 01	2.5291E 01	1.3889E 01	1.3889E 01	1.3889E 01
35	3.2187E 00	3.1520E 01	2.0711E 01	2.0711E 01	2.0719E 01	3.7309E 01	2.0711E 01	2.0711E 01	2.0711E 01
40	4.4632E 00	4.8280E 01	3.1646E 01	3.1646E 01	3.1658E 01	5.6149E 01	3.1646E 01	3.1646E 01	3.1646E 01
45	6.2782E 00	7.6685E 01	5.0123E 01	5.0124E 01	5.0141E 01	8.7404E 01	5.0123E 01	5.0123E 01	5.0123E 01
50	7.4879E 00	9.8160E 01	6.4070E 01	6.4070E 01	6.4092E 01	1.1056E 02	6.4070E 01	6.4070E 01	6.4070E 01
55	7.9973E 00	1.0829E 02	7.0638E 01	7.0638E 01	7.0662E 01	1.2130E 02	7.0638E 01	7.0638E 01	7.0638E 01
60	8.3606E 00	1.1637E 02	7.5871E 01	7.5871E 01	7.5896E 01	1.2975E 02	7.5871E 01	7.5871E 01	7.5871E 01
65	8.5892E 00	1.2183E 02	7.9409E 01	7.9409E 01	7.9434E 01	1.3538E 02	7.9409E 01	7.9409E 01	7.9409E 01
70	8.8587E 00	1.2901E 02	8.4052E 01	8.4053E 01	8.4079E 01	1.4262E 02	8.4052E 01	8.4052E 01	8.4052E 01
75	9.0583E 00	1.3497E 02	8.7907E 01	8.7907E 01	8.7934E 01	1.4852E 02	8.7907E 01	8.7907E 01	8.7907E 01
80	9.3167E 00	1.4336E 02	9.3322E 01	9.3323E 01	9.3351E 01	1.5672E 02	9.3322E 01	9.3322E 01	9.3322E 01
85	9.4859E 00	1.4944E 02	9.7250E 01	9.7251E 01	9.7279E 01	1.6257E 02	9.7250E 01	9.7250E 01	9.7250E 01
90	9.6969E 00	1.5807E 02	1.0281E 02	1.0281E 02	1.0284E 02	1.7067E 02	1.0281E 02	1.0281E 02	1.0281E 02
95	9.8633E 00	1.6558E 02	1.0766E 02	1.0766E 02	1.0769E 02	1.7762E 02	1.0766E 02	1.0766E 02	1.0766E 02
100	1.0112E 01*	1.7737E 02	1.1526E 02	1.1527E 02	1.1530E 02	1.8850E 02	1.1526E 02	1.1526E 02	1.1526E 02

* 1.0112E 01 means 1.0112×10^1 or 10.112.

TABLE G-2

MAN-REM CALCULATIONS FOR 1975 ATMOSPHERIC RELEASES BY ISOTOPE

	POP DOSE	INDIVIDUAL WHOLE BODY DOSE, MILLIREM				AVERAGE ORGAN DOSE, PLANT PERIMETER, MILLIREM					
		PLANT PERIMETER		80 KM	100 KM						
	MAN-REM	AVE	MAX	AVE	AVE	BONE	LUNG	THYROID	KIDNEY	LIVER	G I TRACT
H3	9.603E 01	4.945E-01	6.696E-01	1.049E-01	8.327E-02	4.945E-01	4.945E-01	4.945E-01	4.945E-01	4.945E-01	4.945E-01
C14	8.988E 00	4.629E-02	6.267E-02	9.816E-03	7.793E-03	4.629E-02	4.629E-02	4.629E-02	4.629E-02	4.629E-02	4.629E-02
AR41	9.233E 00	1.197E-01	1.837E-01	4.799E-03	2.482E-03	1.197E-01	1.197E-01	1.197E-01	1.197E-01	1.197E-01	1.197E-01
KR85M	1.568E-02	1.447E-04	2.137E-04	1.143E-05	7.159E-06	1.447E-04	1.447E-04	1.447E-04	1.447E-04	1.447E-04	1.447E-04
KR85	4.158E-01	1.840E-03	2.559E-03	4.921E-04	3.974E-04	1.840E-03	1.840E-03	1.840E-03	1.840E-03	1.840E-03	1.840E-03
KR87	1.184E-04	1.583E-06	2.445E-06	6.029E-08	2.855E-08	1.583E-06	1.583E-06	1.583E-06	1.583E-06	1.583E-06	1.583E-06
KR88RB	3.400E-01	3.629E-03	5.455E-03	2.163E-04	1.245E-04	3.629E-03	3.629E-03	3.629E-03	3.629E-03	3.629E-03	3.629E-03
XE131M	4.885E-04	2.898E-06	4.110E-06	4.917E-07	3.788E-07	2.898E-06	2.898E-06	2.898E-06	2.898E-06	2.898E-06	2.898E-06
XE133	4.419E-02	2.692E-04	3.822E-04	4.372E-05	3.334E-05	2.692E-04	2.692E-04	2.692E-04	2.692E-04	2.692E-04	2.692E-04
XE135	6.361E-02	4.926E-04	7.132E-04	5.344E-05	3.654E-05	4.926E-04	4.926E-04	4.926E-04	4.926E-04	4.926E-04	4.926E-04
I-129	1.157E-01	8.956E-04	1.276E-03	9.621E-05	6.393E-05	8.956E-04	8.956E-04	5.607E-01	8.956E-04	8.956E-04	8.956E-04
I-131	2.657E-03	2.063E-05	2.940E-05	2.205E-06	1.465E-06	2.063E-05	2.063E-05	6.976E-03	2.063E-05	2.063E-05	2.063E-05
CO60	2.773E-07	2.708E-09	3.614E-09	1.839E-10	1.204E-10	2.708E-09	2.708E-09	2.708E-09	2.708E-09	2.708E-09	4.576E-09
SR8990	1.333E-06	1.302E-08	1.737E-08	8.840E-10	5.787E-10	5.107E-06	1.302E-08	1.302E-08	1.302E-08	1.302E-08	1.302E-08
NB95	4.590E-06	4.482E-08	5.982E-08	3.044E-09	1.993E-09	4.482E-08	6.561E-07	4.482E-08	4.482E-08	4.482E-08	4.482E-08
ZR95	9.736E-06	9.508E-08	1.269E-07	6.457E-09	4.227E-09	9.508E-08	1.204E-06	9.508E-08	9.508E-08	9.508E-08	9.508E-08
RU103	5.849E-08	5.712E-10	7.623E-10	3.879E-11	2.539E-11	5.712E-10	5.456E-08	5.712E-10	5.712E-10	5.712E-10	5.712E-10
RU106	4.503E-06	4.398E-08	5.869E-08	2.987E-09	1.955E-09	4.398E-08	1.701E-05	4.398E-08	4.398E-08	4.398E-08	4.398E-08
CS134	8.693E-07	8.489E-09	1.133E-08	5.765E-10	3.774E-10	8.489E-09	5.150E-08	8.489E-09	8.489E-09	8.489E-09	8.489E-09
CS137	2.878E-06	2.811E-08	3.751E-08	1.909E-09	1.249E-09	2.811E-08	2.211E-07	2.811E-08	2.811E-08	2.811E-08	2.811E-08
CE141	1.947E-08	1.902E-10	2.538E-10	1.291E-11	8.453E-12	1.902E-10	4.786E-09	1.902E-10	1.902E-10	1.902E-10	1.902E-10
CE144	4.358E-05	4.256E-07	5.680E-07	2.890E-08	1.892E-08	4.256E-07	6.764E-06	4.256E-07	4.256E-07	4.256E-07	4.256E-07
U235/8	2.234E-04	2.181E-06	2.911E-06	1.481E-07	9.696E-08	2.181E-06	8.996E-05	2.181E-06	2.181E-06	2.181E-06	2.181E-06
PU238	1.507E-02	1.471E-04	1.964E-04	9.993E-06	6.541E-06	1.471E-04	3.056E-04	1.471E-04	1.471E-04	1.471E-04	1.471E-04
PU239	4.822E-03	4.709E-05	6.284E-05	3.198E-06	2.093E-06	4.709E-05	8.535E-05	4.709E-05	4.709E-05	4.709E-05	4.709E-05
TOTALS	1.153E 02	6.680E-01	9.269E-01	1.204E-01	9.422E-02	6.680E-01	6.683E-01	1.235E 00	6.680E-01	6.680E-01	6.680E-01

TABLE G-3

BEAUFORT-JASPER WATER AUTHORITY
WATER TREATMENT PLANT

Water Treatment Capacity: 50,000,000 gal/day

Communities or Population Groups Served

Parris Island Marine Corps Recruit Depot
U. S. Naval Hospital, Beaufort, S. C.
Marine Corps Air Station, Beaufort, S. C.
Laurel Bay - Federal Housing Project
Beaufort, S. C.
Port Royal, S. C.
Chelsea and Chechessee Water Co.

Number of Consumers based on 1970 Census: 50,000

Source of Information:

Beaufort-Jasper Water Authority
Box 275
Beaufort, S. C. 29902

TABLE G-4

CHEROKEE HILL WATER TREATMENT PLANT
PORT WENTWORTH, GA.

Water Treatment Capacity: 45,000,000 gal/day

Customers (Primarily Industrial)	Amount Used, gal/mo
Continental Can Corp. (paper plant)	2.7×10^8
Union Camp (paper plant)	4×10^8
American Cyanimide	1.9×10^8
Kaiser Agricultural Chemical Co.	4×10^7
Savannah Electric Co.	3.2×10^6
American Oil Co.	3×10^6
Georgia Port Authority[a]	2.2×10^6
Coca Cola Bottling Co.[b]	1.3×10^6
Royal Crown Cola Bottling Co.[b]	3.2×10^5
Atlantic Creosoting Co.	1.25×10^6
Savannah Sugar Refinery	2.4×10^7
Continental Roofing Co.	6.8×10^5
Johns Mansville Co.	6.7×10^5
Chevron Oil Co.	2×10^5
Koppers Co.	4.7×10^5
Hubson Battery Mfg. Co.	1×10^5
St. Regis Paper Co.	8.6×10^3
Allied Chem. Co. - Indust. Chem. Div.	5.1×10^3
Estimated Number of Customers	
Industrial Workers	1×10^3
Seamen (effective man-year users)	2×10^3[a]
Beverages (effective man-year users)	1.7×10^4[b]
Total	2×10^4

Source of Information:

Cherokee Water Treatment Plant
Port Wentworth, Georgia

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a. Provides fresh water to incoming ships to Savannah Harbor. Assumes 1% of water delivered is consumed by crewmen.

b. Assumes 10% of water delivered is used for preparing bottled beverages.

TABLE G-5

DOSE CONVERSION FACTORS (D_c) FOR ATMOSPHERIC RELEASE VECTORS[a]

	Vectors								
	01[b]	02	03	04	05	05[c]	06	06[c]	07
	External	External	External	External	Internal				
Nuclide	Cloud Gamma Body	Submersion Beta Skin	Surface Deposition Gamma Body	Surface Deposition Beta Skin	Inhalation Organ	Inhalation Organ	Inhalation Body	Inhalation Body	Deposition Surface Water Organ
^{3}H		0	0	0	0	0	3×10^{6}	$3.2 \quad 10^{4}$	
^{14}C		0	0	0		0	2.3×10^{9}[e]	0	0
^{41}Ar		3.8×10^{6}	0	0	0	0	0	0	0
^{60}Co		-	5.0×10^{7}		3.0×10^{7} (LLI)	-	4.3×10^{7}	7.6×10^{7}	
^{83m}Kr		0	0	0	0	0	0	0	0
^{85m}Kr		1.8×10^{6}	0	0	0	0	0	0	0
^{85}Kr		1.9×10^{6}	0	0	0	0	0	0	0
^{87}Kr		1.1×10^{7}	0	0	0	0	0	0	0
$^{88}KrRb$		2.1×10^{7}	0	0	0	0	0	0	0
^{89}Sr					2.7×10^{8} (bone)	-	7.9×10^{6}	-	
^{90}Sr			6.0×10^{4}		1.8×10^{10} (bone)	-	4.6×10^{7}	*d*	
^{95}Zr					1.4×10^{9} (lung)	-	1.2×10^{8}	2.1×10^{8}	
^{95}Nb					4.5×10^{8} (lung)	-	3.3×10^{7}	5.7×10^{7}	
^{103}Ru			6.6×10^{3}		5.3×10^{8} (lung)	-	5.6×10^{6}	9.8×10^{6}	
^{106}Ru			1.6×10^{5}		8.1×10^{9} (lung)	-	2.1×10^{7}	3.6×10^{7}	
^{129}I					2.0×10^{10} (thyroid)[e]	2.9×10^{13} (thyroid)	3.2×10^{10}	3.4×10^{10}	
^{131}I		1.6×10^{6}	3.1×10^{5}		1.1×10^{10} (thyroid)	1.6×10^{10} (thyroid)	1.9×10^{7}	2.0×10^{7}	
^{133}I		0	0	0	2.9×10^{9} (thyroid)	0	4.2×10^{6}	0	0
^{131m}Xe		0	0	0	0	0	0	0	0
^{133m}Xe		0	0	0	0	0	0	0	0
^{133}Xe		9.1×10^{5}	0	0	0	0	0	0	0
^{135m}Xe		0	0	0	0	0	0	0	0
^{135}Xe		2.6×10^{6}	0	0	0	0	0	7.0×10^{8}	0
^{138}Xe		7.6×10^{6}							
^{134}Cs					3.8×10^{9} (lung)	-	7.5×10^{8}	7.0×10^{8}	
^{137}Cs			1.8×10^{6}		3.1×10^{9} (lung)	-	4.5×10^{8}	4.1×10^{8}	
^{141}Ce					2.9×10^{8} (lung)	-	1.2×10^{7}	2.1×10^{7}	
^{144}Ce			2.3×10^{5}		7.0×10^{9} (lung)	-	4.7×10^{8}	8.2×10^{8}	
^{147}Pm		0	0	0	1.4×10^{9} (bone)	0	5.0×10^{7}		
^{232}Th					4.3×10^{12} (lung)	-	1.8×10^{12}	*d*	
^{233}Pa					2.6×10^{8} (lung)	-	1.7×10^{7}	2.9×10^{7}	
^{233}U					3.8×10^{11} (lung)	-	9.5×10^{9}	*d*	
^{nat}U			0		3.3×10^{11} (lung)	-	8.2×10^{9}	*d*	
^{235}U					3.5×10^{11} (lung)	-	8.8×10^{9}	*d*	
^{236}U					3.6×10^{11} (lung)	-	9.0×10^{9}	*d*	
^{238}U					3.2×10^{10} (kidney)	-	8.2×10^{9}	*d*	
^{238}Pu		6.5×10^{5}			1.4×10^{12} (lung)[f]	-	1.3×10^{12}	*d*	
^{239}Pu			0		1.3×10^{12} (lung)[g]	-	1.6×10^{12}	*d*	
^{240}Pu					6.5×10^{13} (bone)	-	1.6×10^{12}	*d*	
^{241}Pu					9.4×10^{11} (bone)		1.9×10^{10}		
^{242}Pu		0	0	0	1.5×10^{12} (bone)	0	6.0×10^{13}		
^{241}Am					2.0×10^{13} (bone)	-	1.2×10^{12}	*d*	
^{242}Cm			0		4.0×10^{11} (liver)	-	2.5×10^{10}	*d*	
^{244}Cm					4.8×10^{11} (lung)	-	5.8×10^{11}	*d*	
^{252}Cf					1.6×10^{13} (bone)	-	3.8×10^{11}	*d*	

a. Dose conversion factors are in units of rem per $Ci\text{-}yr/m^3$.

b. Vector 01 calculated as integral part of the atmospheric dispersion program.

c. Infant

d. Nuclides with long effective half-lives not applicable to infants because of rapid changes in organ and body size during early years of growth.

e. Dose conversion factor applies to all ingestion and inhalation pathways.

f. Insoluble form. Soluble form factor is 5.3×10^{13} (bone).

g. Insoluble form. Soluble factor is 6.5×10^{13} (bone).

TABLE G-5 (CONTINUED)

	Vectors								
	08	09	10	11	12	13	13[b]	14	14[b]
	Internal	Internal	Internal	Internal	Internal	Internal	Internal	Internal	Internal
	Deposition Surface Water	Deposition Vegetable Crops	Deposition Vegetable Crops	Deposition Meat Products	Deposition Meat Products	Deposition Milk	Deposition Milk	Deposition Milk	Deposition Milk
Nuclide	Body	Organ	Body	Organ	Body	Organ	Organ	Body	Body
^{3}H						0	0	2.3×10^{8}	3.2×10^{8}
^{14}C									
^{41}Ar	0	0	0	0	0	0	0	0	0
^{60}Co									
^{83m}Kr	0	0	0	0	0	0	0	0	0
^{85m}Kr	0	0	0	0	0	0	0	0	0
^{85}Kr	0	0	0	0	0	0	0	0	0
^{87}Kr	0	0	0	0	0	0	0	0	0
$^{88}KrRb$	0	0	0	0	0	0	0	0	0
^{89}Sr									
^{90}Sr									
^{95}Zr									
^{95}Nb									
^{103}Ru									
^{106}Ru									
^{129}I									
^{131}I									
^{133}I						2.8×10^{13} (thyroid)	2.8×10^{14} (thyroid)	8.4×10^{10}	6×10^{11}
^{131m}Xe	0	0	0	0	0	0	0	0	0
^{133m}Xe	0	0	0	0	0	0	0	0	0
^{133}Xe	0	0	0	0	0	0	0	0	0
^{135m}Xe	0	0	0	0	0	0	0	0	0
^{135}Xe	0	0	0	0	0	0	0	0	0
^{138}Xe									
^{134}Cs									
^{137}Cs									
^{141}Ce									
^{144}Ce									
^{147}Pm									
^{232}Th									
^{233}Pa									
^{233}U									
^{nat}U									
^{235}U									
^{236}U									
^{238}U									
^{238}Pu									
^{239}Pu									
^{240}Pu									
^{241}Pu									
^{242}Pu									
^{241}Am									
^{242}Cm									
^{244}Cm									
^{252}Cf									

b. Infant

TABLE G-6

DOSE CONVERSION FACTORS (D_C) FOR LIQUID VECTORS[a]

Nuclide	21 Internal River Water Consumption Organ	22 Internal River Water Consumption Body
^{3}H	0	8.9×10^{1}
^{24}Na	5.2×10^{4} (LLI)	7.4×10^{2}
^{32}P	8.5×10^{4} (bone)	3.2×10^{3}
^{32}P	3.8×10^{4} (LLI)	-
^{35}S	4.5×10^{3} (testes)	1.1×10^{3}
^{51}Cr	5.5×10^{2} (LLI)	1.5
^{54}Mn	7.3×10^{2} (LLI)	1.3×10^{2}
^{59}Fe	1.6×10^{4} (LLI)	1.6×10^{3}
^{58}Co	9.3×10^{3} (LLI)	7.0×10^{2}
^{60}Co	2.5×10^{4} (LLI)	2.0×10^{3}
^{65}Zn	7.0×10^{3} (prostate)	2.8×10^{3}
^{65}Zn	6.5×10^{3} (liver)	-
^{89}Sr	9.2×10^{3} (bone)	2.7×10^{2}
^{90}Sr	6.6×10^{5} (bone)	1.6×10^{3}
^{91}Y	3.3×10^{4} (LLI)	1.6
^{95}ZrNb	1.3×10^{4} (LLI)	2.9
^{95}Nb	8.9×10^{3} (LLI)	7.8×10^{-1}
^{99}Mo	4.5×10^{3} (kidney)	3.4×10^{2}
^{103}Ru	7.8×10^{3} (LLI)	3.7×10^{1}
^{106}Ru	7.3×10^{4} (LLI)	1.4×10^{2}
^{124}Sb	3.7×10^{4} (LLI)	5.2×10^{2}
^{125}Sb	7.3×10^{3} (LLI)	2.1×10^{2}
^{129}I	4.5×10^{6} (thyroid)	5.6×10^{3}
^{131}I	8.4×10^{5} (thyroid)	1.5×10^{3}
^{134}Cs	0	4.5×10^{4}
^{137}Cs	0	2.7×10^{4}
^{140}BaLa	6.1×10^{4} (LLI)	5.6×10^{2}
^{140}La	3.6×10^{4} (LLI)	2.9×10^{-1}
^{141}Ce	9.4×10^{3} (LLI)	2.9×10^{-1}
^{144}Ce	7.3×10^{4} (LLI)	1.1×10^{1}
^{147}Pm	3.9×10^{3} (LLI)	1.2
^{233}U	2.7×10^{4} (LLI)	2.3×10^{2}
^{nat}U	2.5×10^{4} (LLI)	2.0×10^{2}
^{235}U	2.9×10^{4} (LLI)	2.1×10^{2}
^{236}U	2.5×10^{4} (LLI)	2.2×10^{2}
^{238}U	2.4×10^{4} (LLI)	2.0×10^{2}
^{239}Np	6.7×10^{3} (LLI)	3.1×10^{-2}
^{238}Pu	3.8×10^{5} (bone)	9.5×10^{3}
^{239}Pu	4.7×10^{5} (bone)	1.1×10^{4}
^{240}Pu	4.6×10^{5} (bone)	1.1×10^{4}
^{241}Am	2.2×10^{3} (kidney)	2.9×10^{4}
^{242}Cm	3.4×10^{4} (LLI)	5.9×10^{2}
^{244}Cm	2.4×10^{5} (bone)	1.4×10^{4}
^{252}Cf	1.2×10^{5} (LLI)	2.3×10^{3}

a. Dose conversion factors are in units of rem per Ci-yr/m^3

TABLE G-7

K FACTORS

Vector	Intake Rate/Day	K
Inhalation - adult	2×10^{7} cc	3.7×10^{11}
Inhalation - infant	3×10^{6} cc	5.55×10^{10}
Water - adult	1200 ml	2.22×10^{7}
Milk - infant	1000 ml	1.85×10^{7}
Food - adult	1000 g	1.85×10^{7}
Fish - adult	32.4 g (1/2 lb/wk)	6.0×10^{5}

TABLE G-8

K FACTORS FOR G.I. TRACT

Intake Mode	Intake Rate/Day	K
Inhalation - adult	2×10^{7} cc	1.9×10^{11}
Inhalation - infant	3×10^{6} cc	2.9×10^{10}
Water	1200 ml	1.1×10^{7}
Food	1000 g	9.3×10^{6}
Fish	32.4 g	3.1×10^{5}

TABLE G-9

G.I. TRACT CONSTANTS

Portion of G.I. Tract	t, days	τ, days	m, g
Stomach (S)	0	4.17×10^{-2}	250
Small Intestine (SI)	4.17×10^{-2}	1.7×10^{-1}	1100
Upper Large Intestine (ULI)	2.08×10^{-1}	3.33×10^{-1}	135
Lower Large Intestine (LLI)	5.42×10^{-1}	7.5×10^{-1}	150

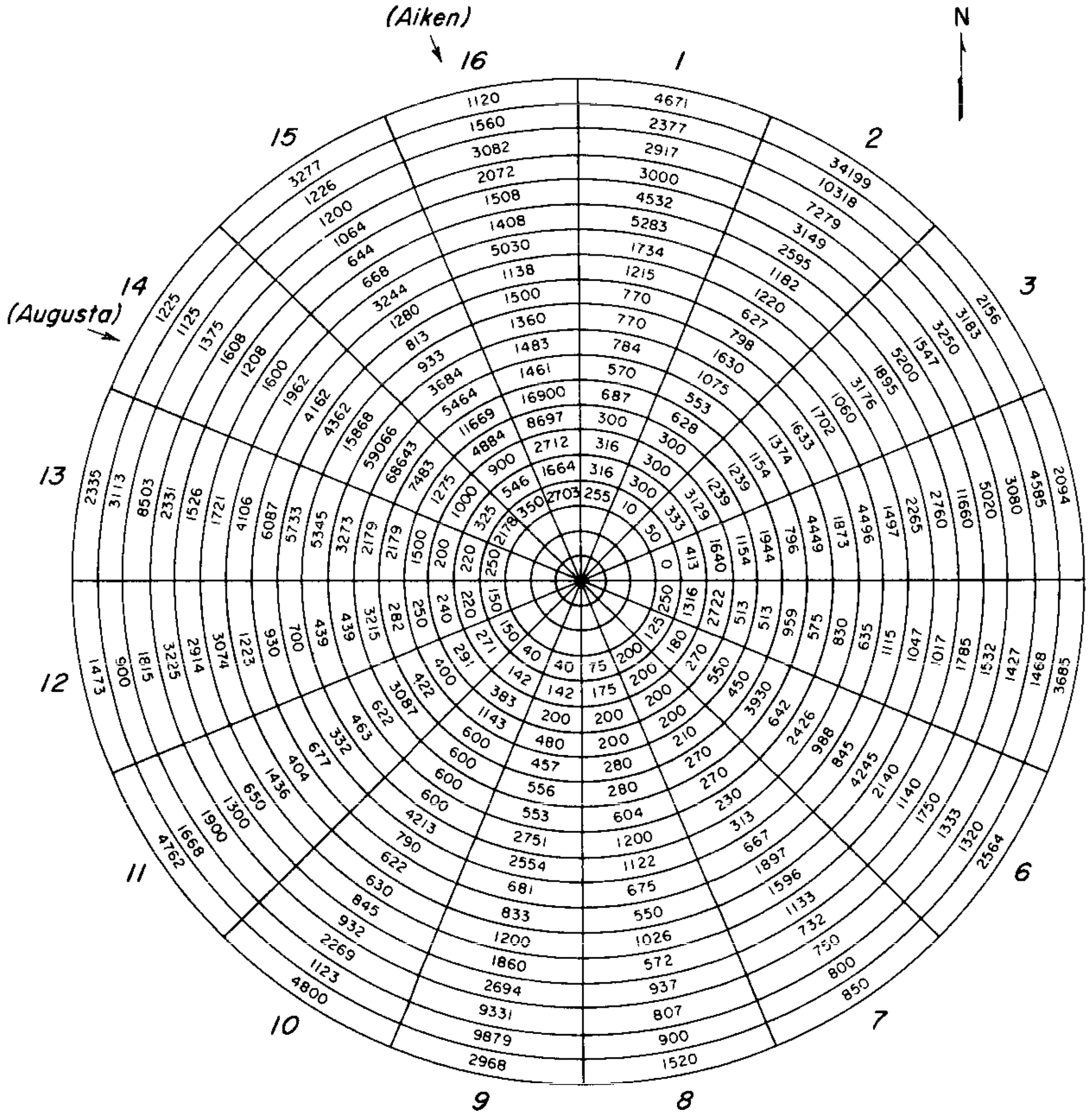


FIGURE G-1. Distribution of Population in Region Surrounding the Savannah River Plant

1970 Census

(Radial increments = 5 km)

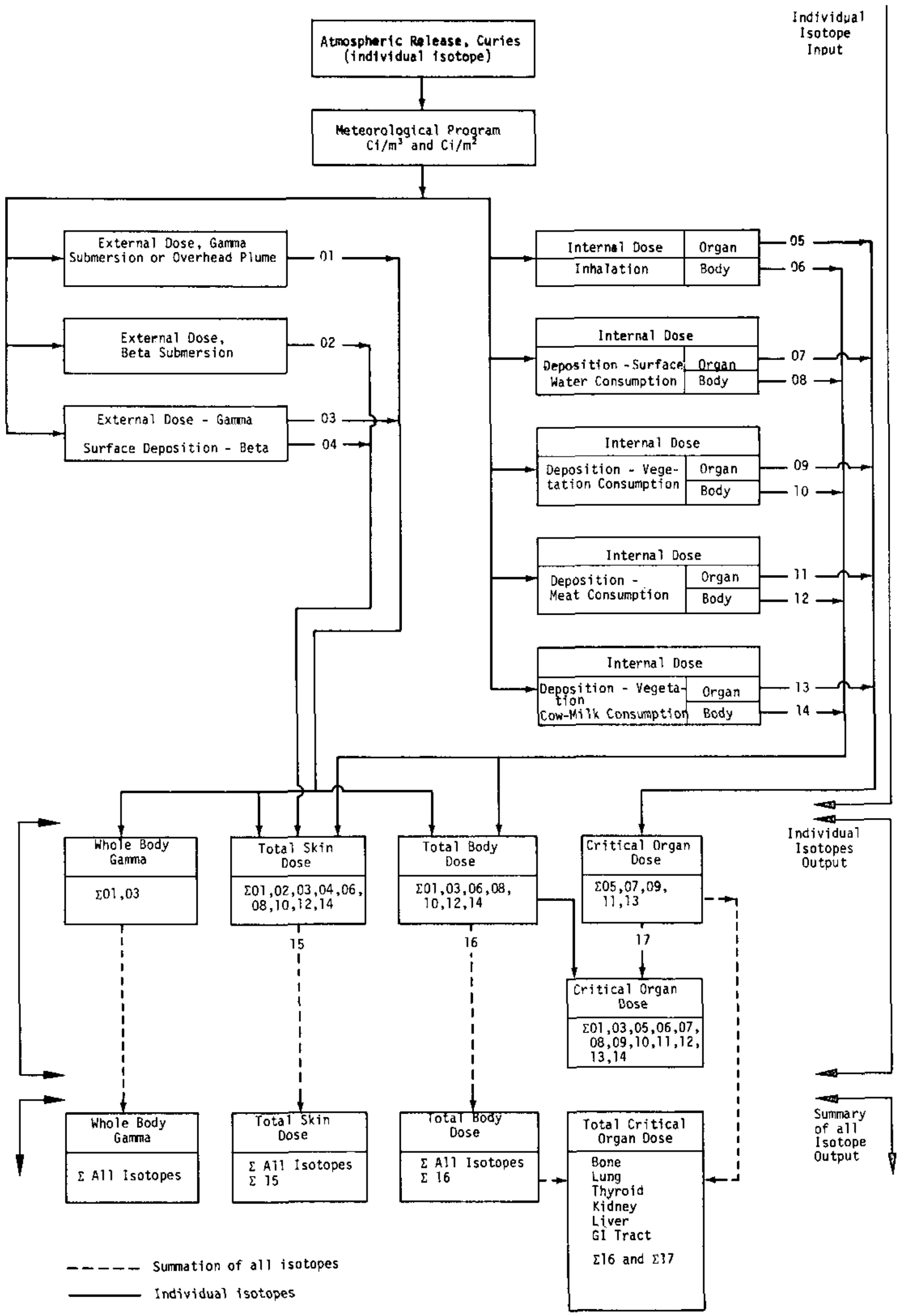
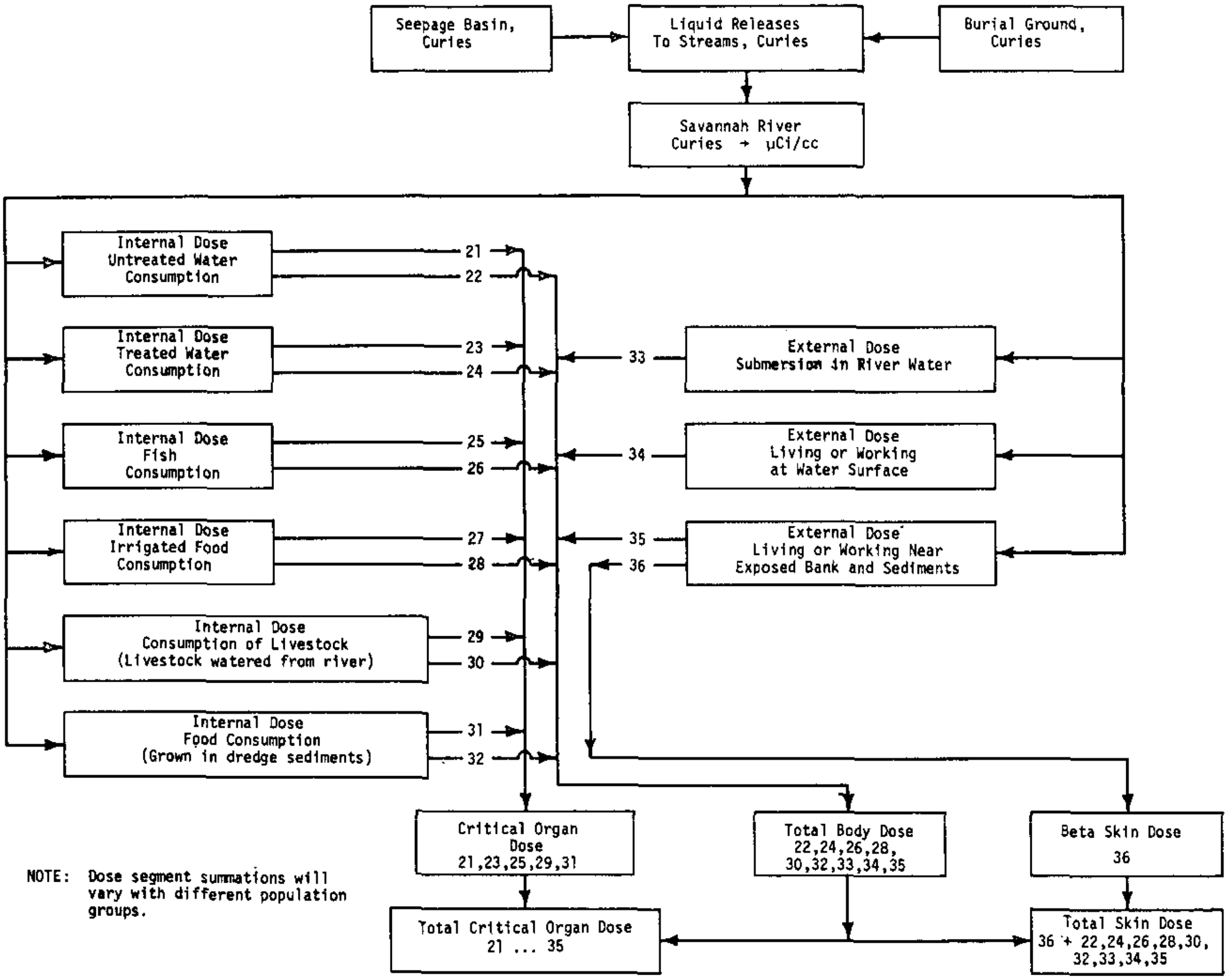


FIGURE G-2. Atmospheric Release Model



NOTE: Dose segment summations will vary with different population groups.

FIGURE G-3. Liquid Release Model

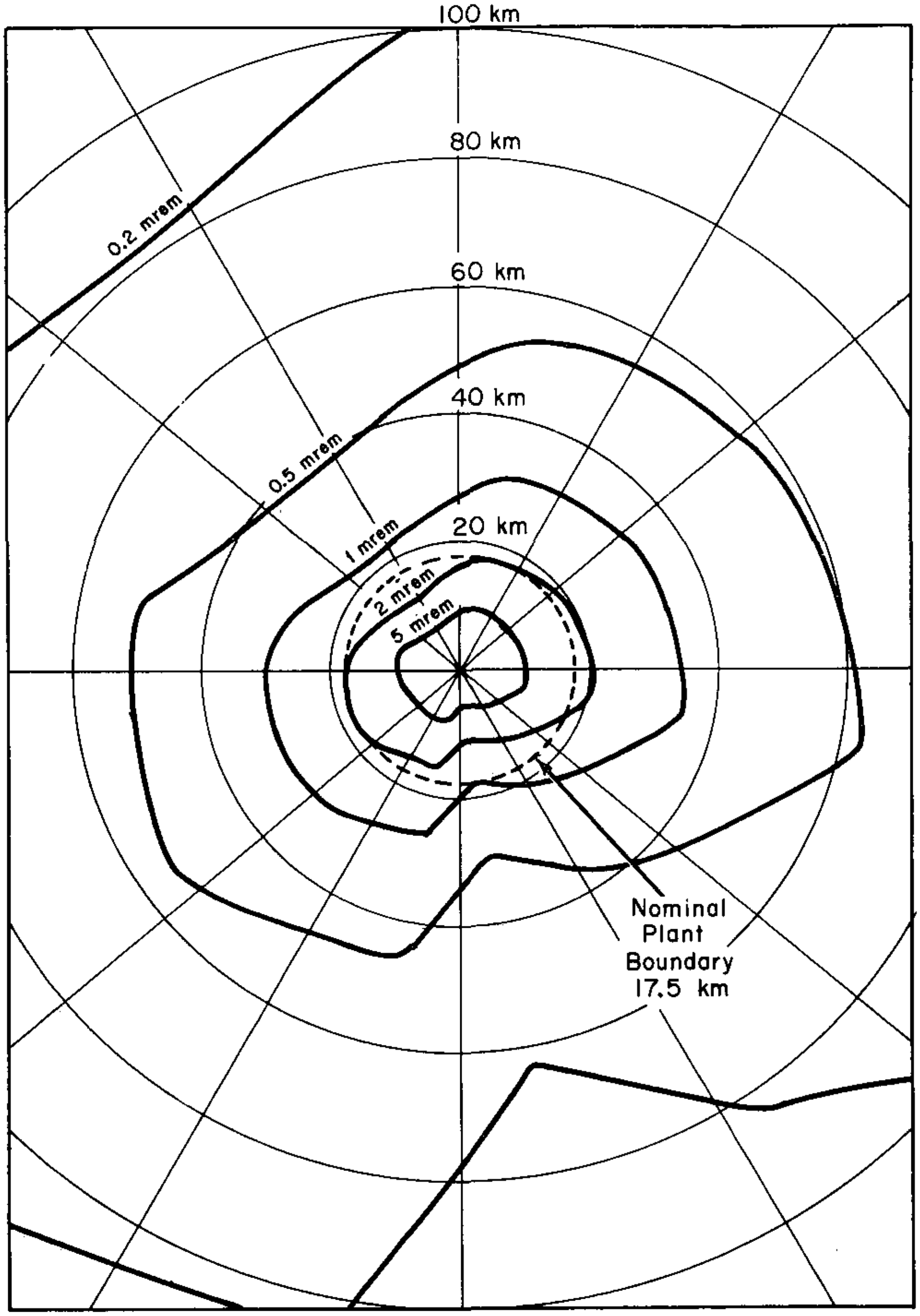


FIGURE G-4. Whole-Body Dose Commitment Isopleth for Atmospheric Releases in 1975