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COLLECTIVE DOSE COMMITMENTS DUE TO REPORTED RADIOACTIVE RELEASES FROM NUCLEAR POWER PLANT SITES IN 1976

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This is a summary of a study done for the Nuclear Regulatory Commission's Office of Management and Program Analysis

UNDER A RELATED SERVICES AGREEMENT WITH THE U.S. DEPARTMENT OF ENERGY

DISCLAIMER

COLLECTIVE DOSE COMMITMENTS DUE TO REPORTED RADIOACTIVE RELEASES FROM NUCLEAR POWER PLANT SITES IN 1976

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In a continuation of last year's study, collective radiation dose commitments were estimated for all operating water-cooled nuclear power plant sites, utilizing atmospheric and liquid radioactivity releases reported to the Nuclear Regulatory Commission for 1976. Results are presented of collective dose commitments from these release pathways to four population groups: infant, child, teen-ager, and adult residing between 2 and 80 km from each site.

Typical individual doses were estimated for each site and for all the sites together. The sites were rated as to their power output per unit population dose and per unit average individual dose.

Results for 1976 operating reactors indicate a reduction of overall collective dose from those operating in 1975 even though more electrical energy was generated in 1976.

COLLECTIVE DOSE COMMITMENTS DUE TO REPORTED RADIOACTIVE RELEASES FROM NUCLEAR POWER PLANT SITES IN 1976

This study is a continuation of last year's study, estimating the dose commitments due to 1975 releases, which was documented in PNL 2439.

SLIDE 1 - The primary objective of this study was to obtain an estimate of the 50-year population dose commitments for 58 commercial nuclear power reactors operating at 43 sites during 1976 using radionuclide releases to both air and water as measured by the operators and reported to the NRC. In addition, for the airborne pathway, we determined the distribution of individual dose commitments for the population residing in the vicinity of the reactor sites.

SLIDE 2 - Both airborne and waterborne pathways were considered for the population residing within 2 and 80 kilometers from each of the sites.

SLIDE 3 - In addition to total body dose commitment, dose commitments to other organs were estimated.

SLIDE 4 - Four age groups within the populations were considered. The distribution for the United States was used for each site. The dose commitment factors as given in the NRC Regulatory Guide 1.109 were used.

Standard NRC models as reported in the Regulatory Guides were used along with site data obtained from the Environmental Statements.

SLIDE 5 - For the airborne pathway, the area between 2 and 80 kilometers was divided into 16 sectors and 10 annuli, making a total of 160 subregions in all. Separate air concentrations and ground surface concentrations were calculated for each subregion using the NRC model used in the program, XOQDOQ. Approved site diffusion climatology data were used to generate the concentrations. Dose commitments to the population in each segment were estimated for the air submersion, inhalation and ground contamination pathways. For the estimate of dose commitment from the ingestion of food crops and animal products, an averaging method was used. An average ground surface concentration weighted for area was found for the 160 subregions. This value was used for the calculation of dose commitment from ingested food crops and animal products instead of the surface concentration for each of the subregions, since it was assumed that considerable transfer of food products across subregion boundaries would occur.

For the liquid pathway, plant effluents were assumed to be diluted using factors given in the corresponding Environmental Statements and using standard generic factors when such data were not available from the E.S.

SLIDE 6 - A wide variation was found in the calculated dose commitments to the populations living around the 43 reactor sites. Another way of comparing these dose commitments is to divide them by the electric power generated in 1976 by the corresponding reactors on each site. This resulting factor represents a cost in person-rem to produce electric power for each reactor site. These factors also varied considerably, as you can see in the slide, but not quite as much as the dose commitments. In general, sites having a high population dose commitment had a high "cost-benefit" factor and vice-versa; however, the correlation was far from perfect.

SLIDE 7 - For the airborne pathway, the population dose commitment for each subregion (160 in all) was divided by the corresponding population to obtain an average dose commitment to an individual in that particular

subregion. Using this information, a histogram was constructed for each site showing the fractions of the total population which received individual dose commitments within a particular range. Hopefully, this type of histogram shows more clearly the distribution of individual dose commitments in the local populations. In other words, we wanted to show more clearly how the population dose commitment was distributed on a per capita basis. Note that in this study, we have puposely avoided the dose commitment estimate to the so-called "maximum individual" who may indeed live closer than 2 kilometers to the site.

SLIDES 8 and 9 - As you can see from the example slides, the distributions vary greatly from site to site.

SLIDE 10 - The total population considered at risk in this study, that is the persons residing between 2 and 80 kilometers of each of the 43 sites, was estimated to be 90 million in 1976. We calculated in this study that an average dose commitment to an individual would be 0.008 millirem, and the geometric mean, 0.0009. Note that the average individual doses are well below background.

1976 DOSE COMMITMENTS FROM COMMERCIAL NUCLEAR POWER PLANTS

OBJECTIVES OF STUDY

- CONTINUE 1975 STUDY* FOR 1976 RELEASES
- ESTIMATE POPULATION DOSE COMMITMENTS FROM OPERATING COMMERCIAL POWER REACTORS AT 43 SITES USING REPORTED RADIONUCLIDE RELEASES
- DETERMINE DISTRIBUTION OF INDIVIDUAL DOSE COMMITMENTS FOR PUPULATIONS CONSIDERED

*PNL-2439

PATHWAYS CONSIDERED

AIRBORNE

- AIR SUBMERSION
- CONTAMINATED GROUND
- INHALATION
- INGESTION OF FOOD CROPS & ANIMAL PRODUCTS

WATERBORNE

- INGESTION OF DRINKING WATER
- INGESTION OF FISH & INVERTEBRATES

3

ORGANS CONSIDERED

AIRBORNE

- TOTAL BODY
- THYROID
- BONE
- GI-TRACT
- LIVER
- LUNG

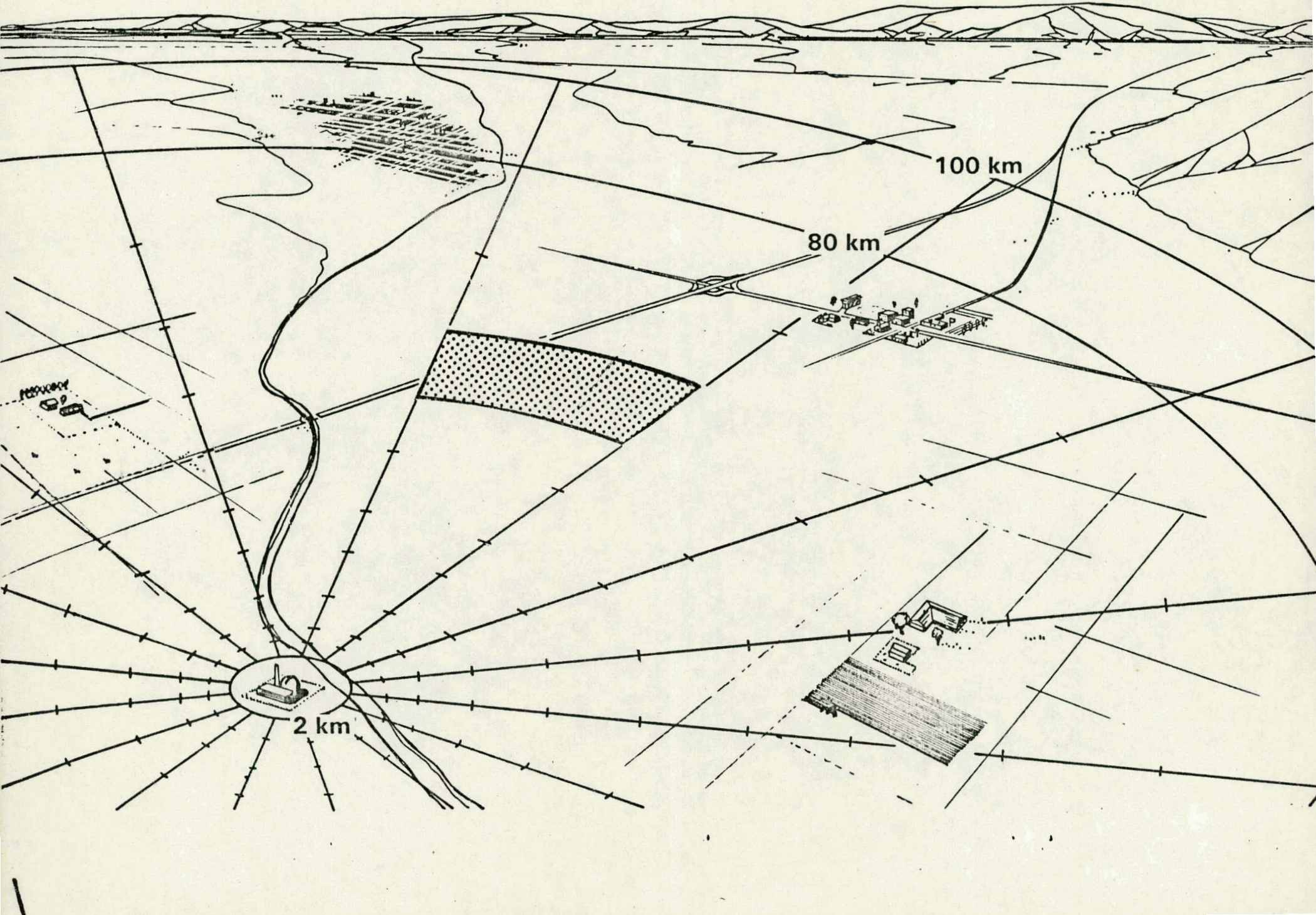
WATERBORNE

- TOTAL BODY
- THYROID
- BONE
- GI-TRACT
- LIVER

POPULATION GROUPS CONSIDERED

GROUP	AGE LIMITS	PER CENT
INFANT	0- 1 YR	1.4
CHILD	1-11 YR	16.0
TEEN	11-17 YR	11.7
ADULT	> 17 YR	70.9
		100

AIRBORNE PATHWAY

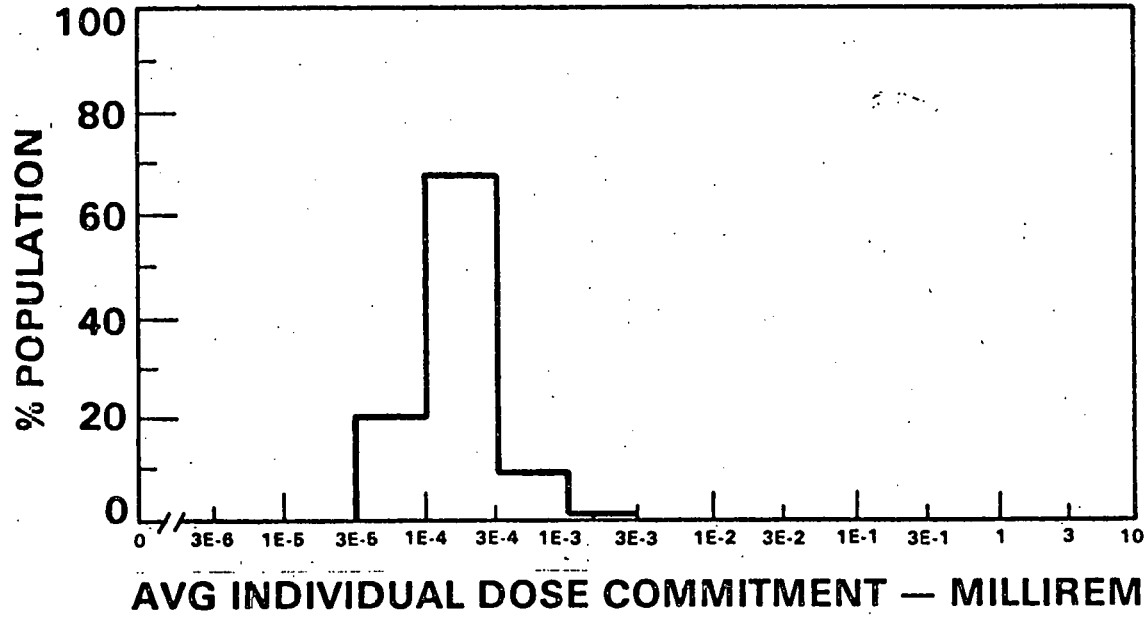


DOSE COMMITMENT SUMMARY

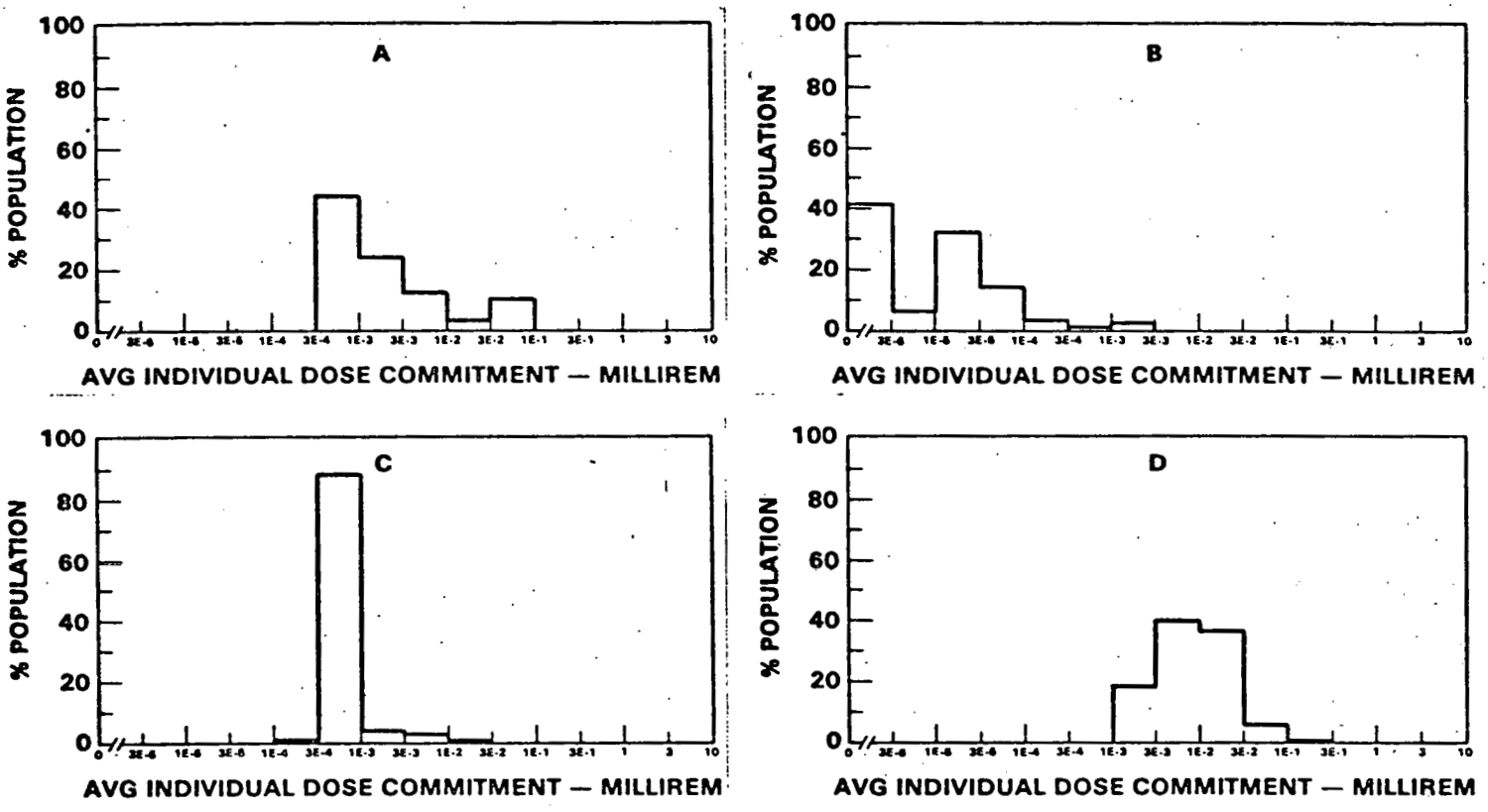
	Dose Commitment (Person-REM)		Cost/Benefit (Person-REM)/TWATT-HR)	
	1976	1975	1976	1975
HI	160	750	69	190
LO	0.0002	0.008	0.0034	0.0027
MEAN	11	34	2.6*	7.7*
OVERALL TOTAL	470	1300	--	--

*Weighted by TW-HR produced

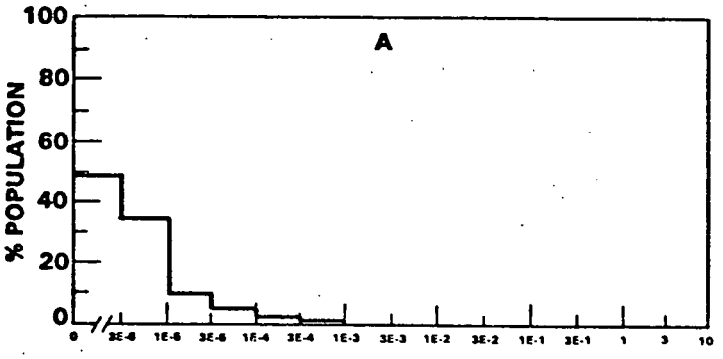
HISTOGRAM OF INDIVIDUAL DOSE DISTRIBUTION FOR AIRBORNE PATHWAY

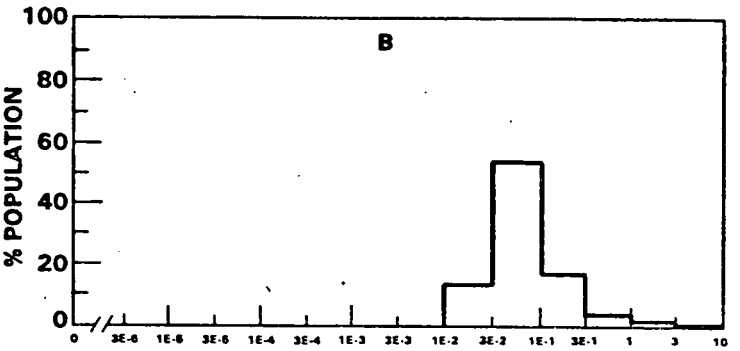


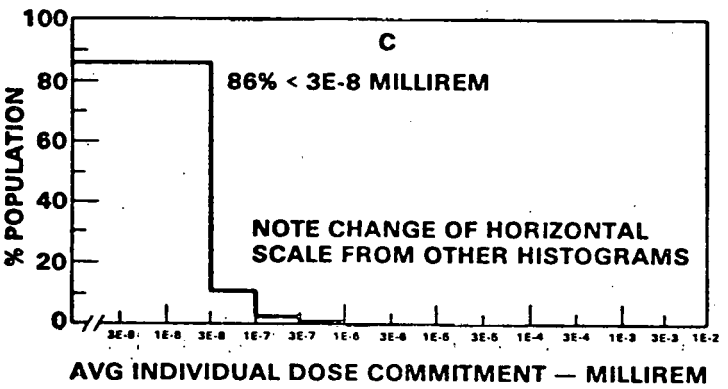
EXAMPLE HISTOGRAMS I

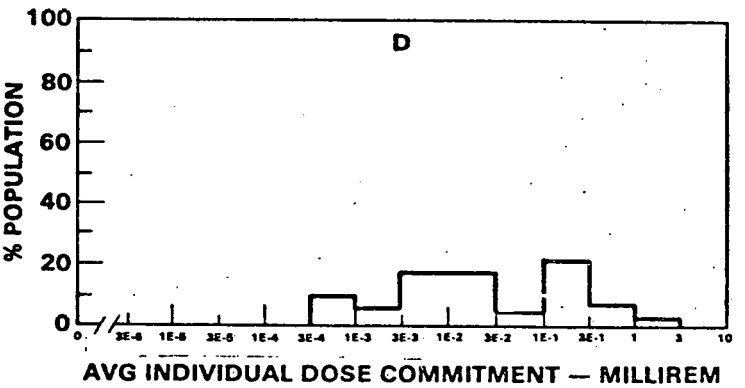


EXAMPLE HISTOGRAMS II









FRACTION OF TOTAL POPULATION RECEIVING VARIOUS
INDIVIDUAL DOSE COMMITMENTS FOR ALL SITES, 1976