

AE-211

Report on the Personnel Dosimetry at
AB Atomenergi during 1964

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REPORT ON THE PERSONNEL DOSIMETRY AT
AB ATOMENERGI DURING 1964

K-A Edvardsson

Summary

This report presents the results of the personnel dosimetry at AB Atomenergi during 1964.

No doses exceeding the recommendations of ICRP were reported.

The sum of the reported external total body doses during the year was for AB Atomenergi 51.5 manrem which, distributed over the whole company personnel, corresponds to an average dose of about 35 mrem per year and person or less than 1 % of the maximum permissible dose.

31400 gamma films and 5800 neutron films were evaluated. The films were changed every month. Urine analyses numbered 2731 and whole body measurements 485.

A comparison is made between dose distributions at AB Atomenergi and at institutions in other countries. The fraction of all personnel carrying dosimeters and exposed to more than a nominal dose seems generally to have been less than 10 - 20 %.

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1. Introduction

The dosimeters used and the general lines on which the personnel dosimetry in the company is run have been described in earlier AE-reports (AE-126 and AE-147. Reports on the Personnel Dosimetry at AB Atomenergi during 1962 and 1963, respectively, by K-A Edvardsson and S Hagsgård.) Most of the previous descriptions apply also to 1964 but in the general lines there are some differences. The badge now contains only one film, which is changed every month.

2. Extent of dosimetry in the company

Personnel dosimetry was carried out at the following places during 1964:

Stockholm, Studsvik, Ågesta and the Institutt for Atomenergi in Norway.

In Stockholm there are a reactor (R1), uranium refinery plant, a fuel element factory and active laboratories.

The research station at Studsvik had during 1964 four reactors (R0, R2, R2-0 and FR-0), one Van de Graaff generator, laboratories for active metallurgy, isotope production, plant for disposal of active waste, laboratory for active chemistry and a number of other active laboratories.

In Norway a few AB Atomenergi employers were working in cooperation with the Institutt for Atomenergi on experiments concerning reprocessing of fuel elements.

At Ågesta Heat and Power Station (65 MW th) there is a heavy water reactor (R3) with workshop, laboratory and waste systems necessary for the operation.

The following abbreviations are used in the tables and diagrams for the different sections of the company:

FFD = Operation Group for Reactor R0

RMA = Active Metallurgical Research

RMB = Fuel Element Production

SIT = Section for Isotope Service

SSD = Operation Group for Materials Testing Reactor R2

SSH = " " " Reactor R1

SSS = Radiation Protection

SSW = Waste Disposal

STV = Local Administration (Workshop and service)

3. Results

During 1964 there has not been any exposure which has exceeded the norms recommended by ICRP. 31400 gamma films and 5800 neutron films were developed and evaluated in the company. 2731 urine analyses and 485 measurements of body activity were made. The number of employees at AB Atomenergi was about 1500. The total amount of measured and reported whole body exposures during 1964 was 51.5 manrem which, distributed over the whole personnel of the company, is equivalent to an average dose of about 35 mrem/year and person, or just below 1 % of the maximum permissible dose. Detailed figures for 1964 are given in the following tables and diagrams.

A comparison has been made between dose distributions at AB Atomenergi and at institutions in other countries and is here illustrated in diagrams (1a, 1b and 1c). The curves (solid) represent the cumulative dose for the monitored personnel. In most of the cases only a small part of the monitored personnel is actually exposed, and an attempt to estimate the exposed fraction has been made. In order to simplify the evaluations the compared material in the interval 0.1 - 6 rem/year has been approximated with the following equation:

$$f = f_0 e^{-\lambda d}$$

f = cumulative fraction of the monitored personnel exposed to a dose above d rem

f₀ = exposed fraction, i. e. fraction of monitored personnel exposed to more than a nominal dose

d = annual dose in rem

λ = empirical coefficient

Monitored personnel = persons with dosimeters.

In order to determine f₀ the curve has been extrapolated to d = 0.

According to these calculations often only 10 - 20 % of the monitored personnel should be referred to the exposed fraction. An exception is the Russian icebreaker Lenin, for which the exposed fraction is close to 100 %.

Table 1

	Exposed fraction f_o %	Median dose rem	λ
AB Atomenergi, Sweden	15.0	0.2	2.89
Danish Atomic Energy Commission Research Establishment, Risø, Denmark	3.3	0.5	1.39
Israel Atomic Energy Commission Soreq Research Establishment	24.0	0.3	2.10
South Africa Bureau of Standards	14.5	0.6	1.16
Atomic Energy of Canada Limited	35.0	0.6	1.16
Central Laboratory for Radiological Protection, Poland	25.0	1.1	0.63
Staatliche Zentrale für Strahlenschutz Deutschen Demokratischen Republik	9.5	0.9	0.77
The personnel of the nuclear power plant of the icebreaker Lenin, USSR	100.0	1.0	0.69
Oak Ridge National Laboratory	11.0	0.6	1.16
U S Atomic Energy Commission	13.0	0.7	0.99

The values for f_o depend upon the radiation protection criteria used, which groups are provided with dosimeters, and so on. At AB Atomenergi, Studsvik, we distribute a large number of dosimeters only for accidental or emergency purposes. These are evaluated regularly, however, and thus a large fraction of the personnel doing mainly administrative and non-radiological work is monitored without ever showing any exposures.

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Table 2

Number of evaluated films, urine analyses and whole body measurements during 1964.

Gamma films	31 400
Neutron films	5 800
Urine analyses	2 731
Whole body measurements	485

Table 3

Biological Monitoring

	Urine analyses								Σ 1963	Whole body measurements	
	Tritium	Gross α	Gross β	Phosphate β	Plutonium	Uranium	Cesium	Iodine			Polonium
Studsvik	42	75		82	128	13	32	9	3	384	485
Stockholm		29	14	20		1747				1810	
Ågesta	471									471	
Norway				22	21	20		3		66	
Σ										2731	485

Table 4

Number of reported persons and mean dose for these persons

	Whole company				Stockholm				Studsvik				Ågesta				Norway			
Quarter	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Number of persons	54	42	47	113	33	22	22	44	18	15	25	45	1	2	-	24	2	3	-	-
Mean dose in mrem	153	203	190	228	160	204	182	242	138	221	196	218	130	125	-	220	185	152	-	-

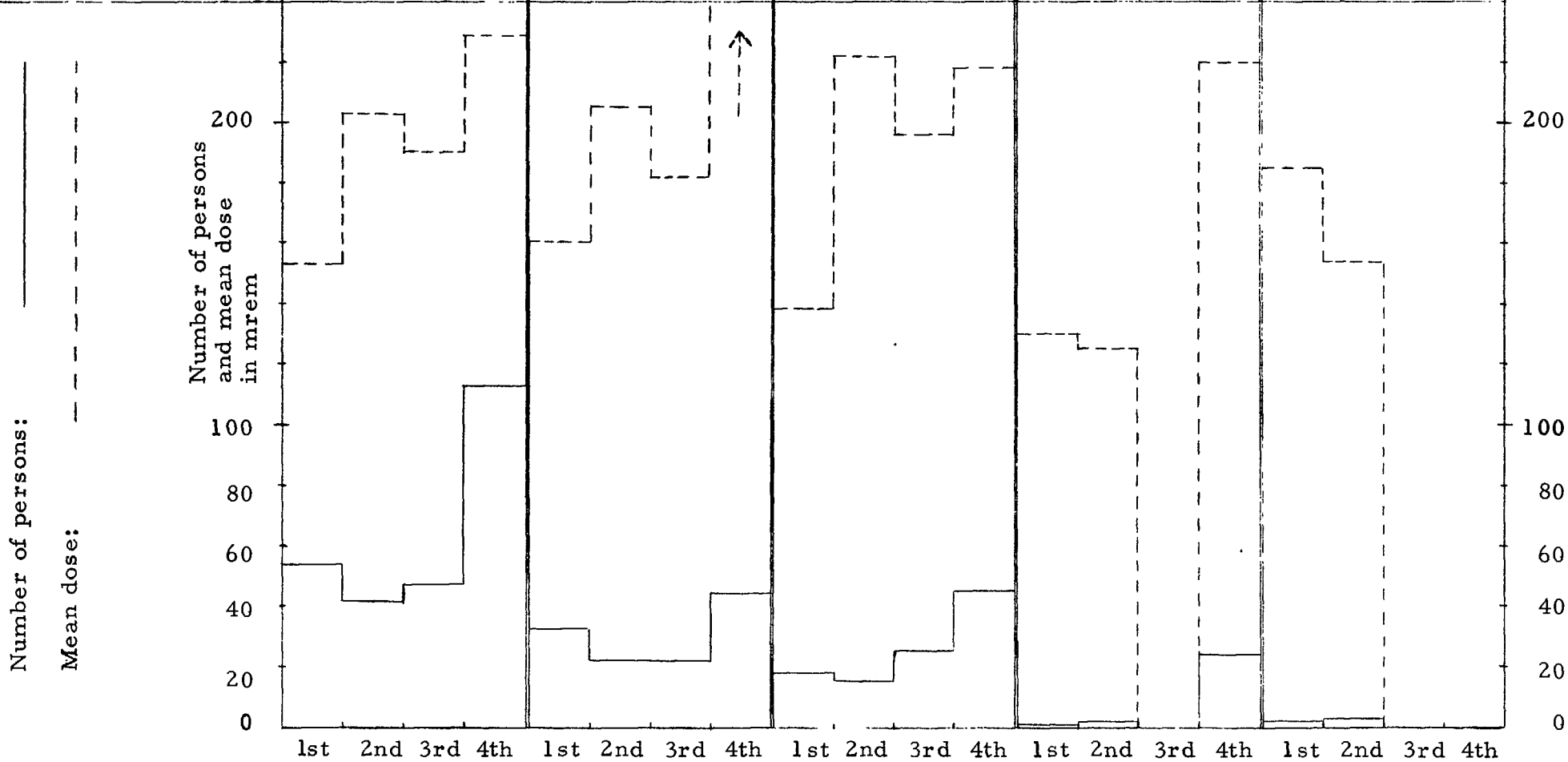


Table 5

Number of reported exposures during 1963 with quarterly dose ≥ 100 mrem.
 (Note: Number of reported exposures and number of exposed persons need not be the same.)

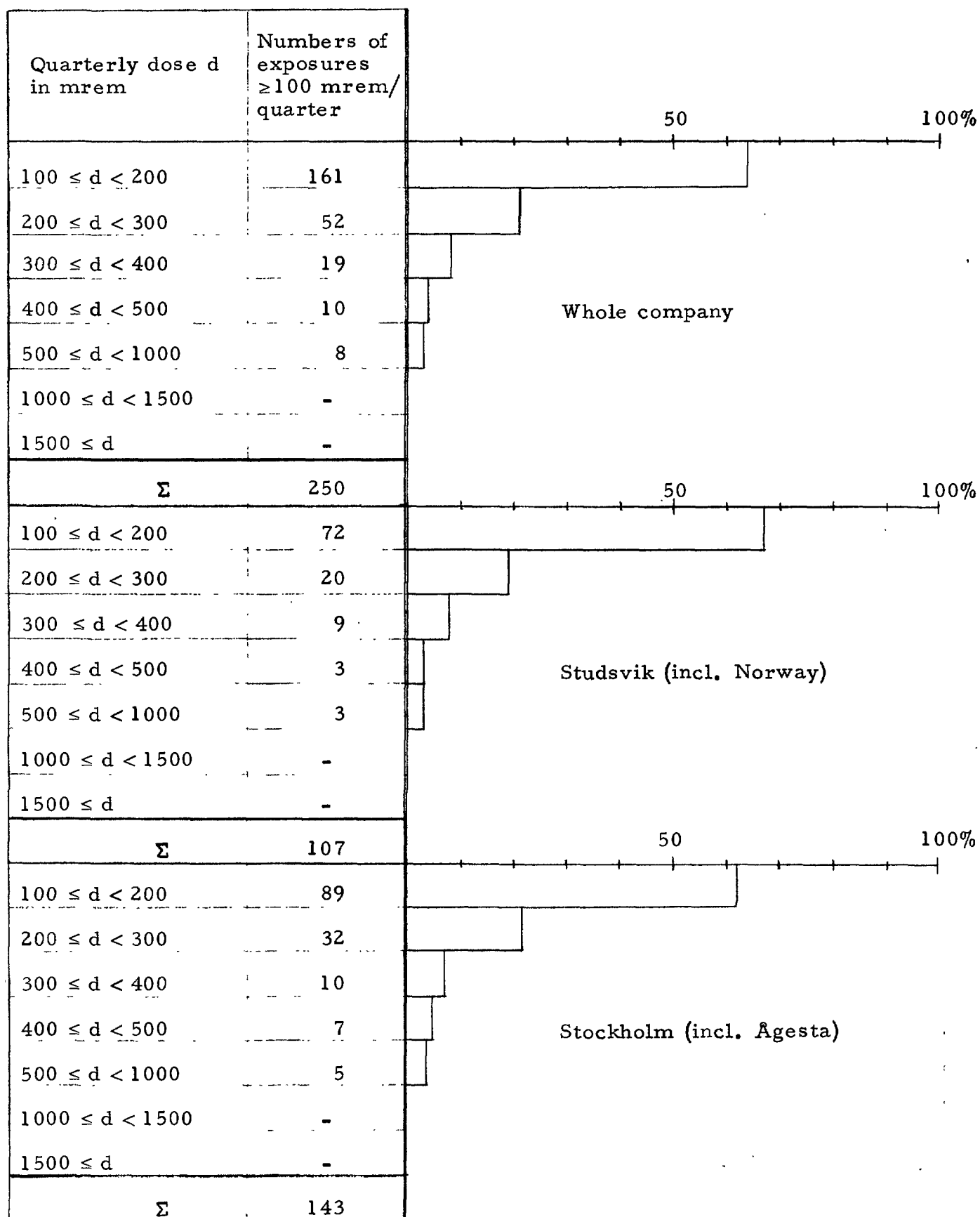


Table 6

Number of reported exposures (quarterly dose ≥ 100 mrem) in different working areas

Number of reported exposures

Studsvik

Number of reported exposures

Stockholm

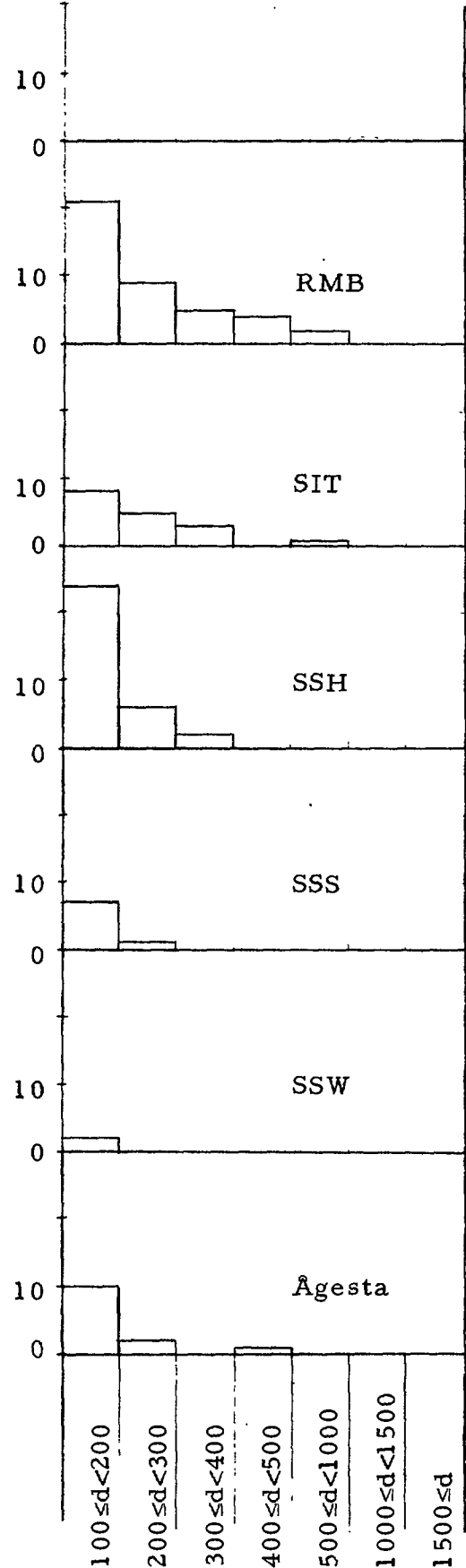
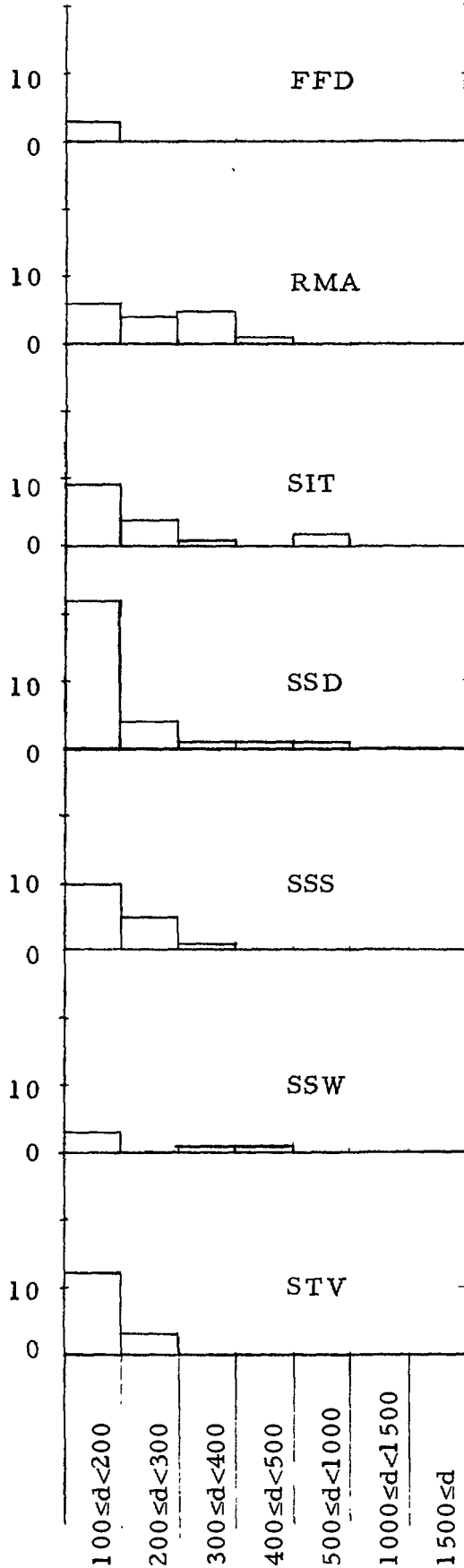


Table 7

Summary of the yearly doses during 1964

Yearly dose D in mrem	Whole company		Studsvik (incl. Norway)		Stockholm (incl. Ågesta)		D in % of max. permissible dose
	Number of persons	%	Number of persons	%	Number of persons	%	
D < 500	217	91	145	97	72	82	D < 10 %
500 ≤ D < 1500	21	9	5	3	16	18	10 % ≤ D < 30 %
1500 ≤ D < 5000							30 % ≤ D < 100 %
5000 ≤ D							
	238	100	145	100	88	100	

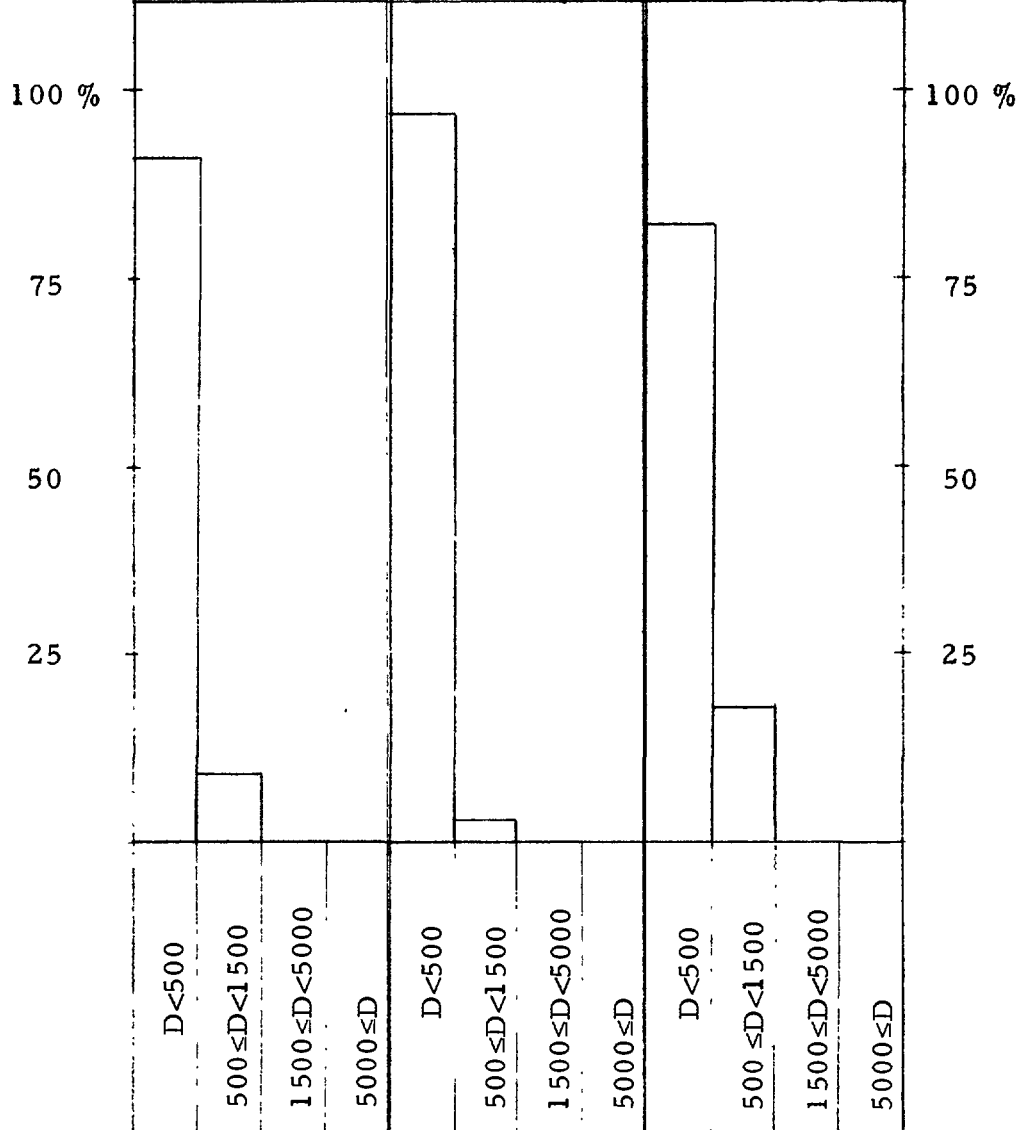
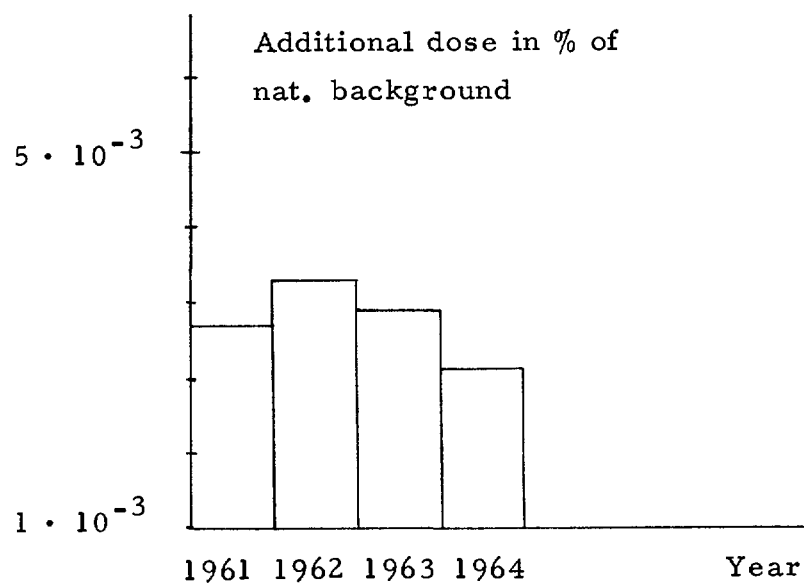


Table 8

The AE part of the genetic dose (external dose) in the Swedish population. (Population 8 millions. Normal background exposure assumed to be 0.3 R/year and person.)

Year	Manrem	Additional dose in % of nat. background
1961	61.7	$2.7 \cdot 10^{-3}$
1962	74.2	$3.3 \cdot 10^{-3}$
1963	64.2	$2.9 \cdot 10^{-3}$
1964	51.5	$2.1 \cdot 10^{-3}$



Nuclear Energy
107
Research Establishment

South Africa Bureau of Standards

1964

100%
Number of
exposed
persons in %

100%
Number of
exposed
persons in %

x workers with radioteleopes
o " " " x-rays

10

10

0.1

0.1

3 4 5

1 2 3 4 5

Rem/year

Rem/year

n=1595

Number of monitored persons:
Teletype users - 1190
Total - 3807

The average individual dose for all
radiation workers accumulated
during 1964 was 0.17 rem

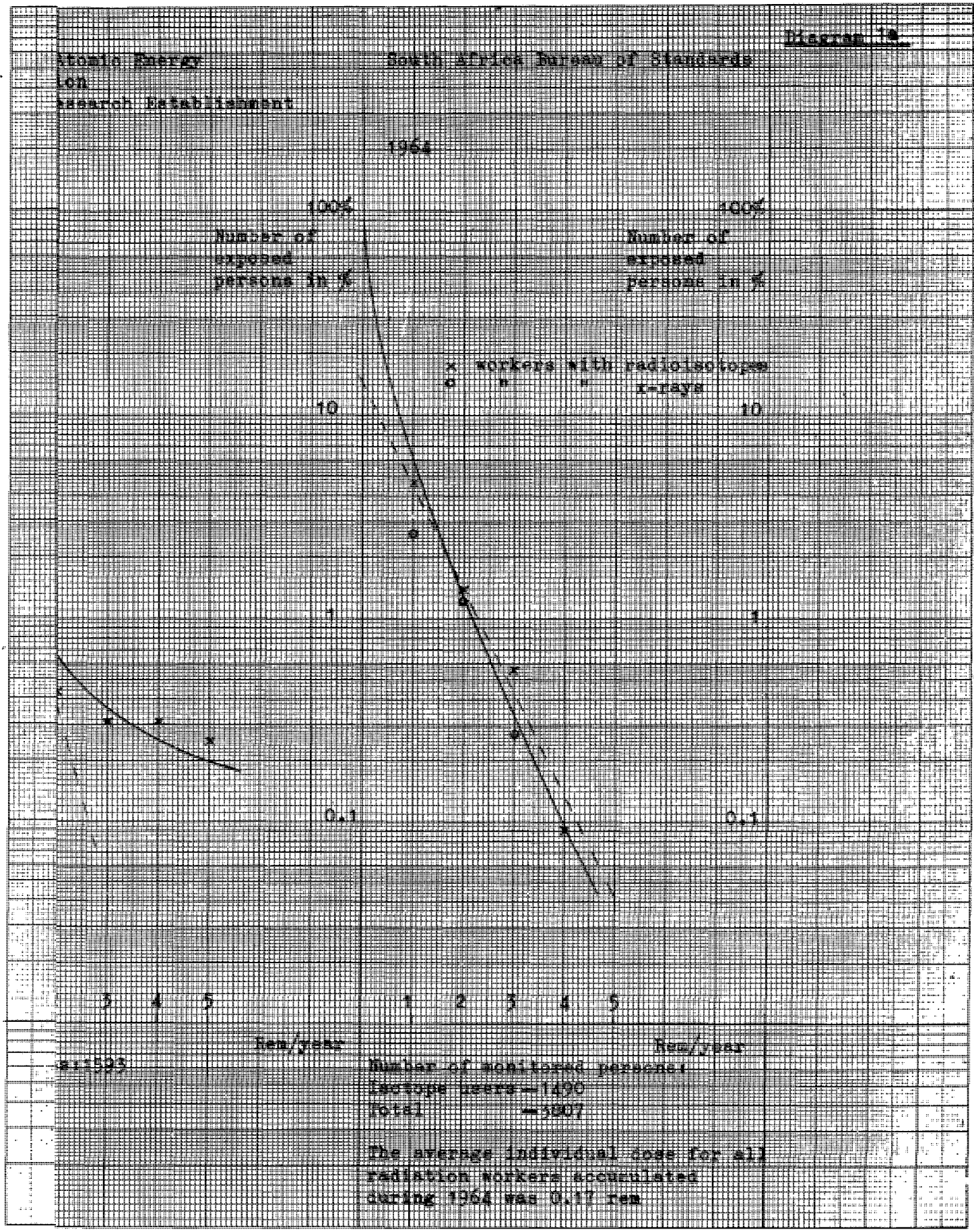
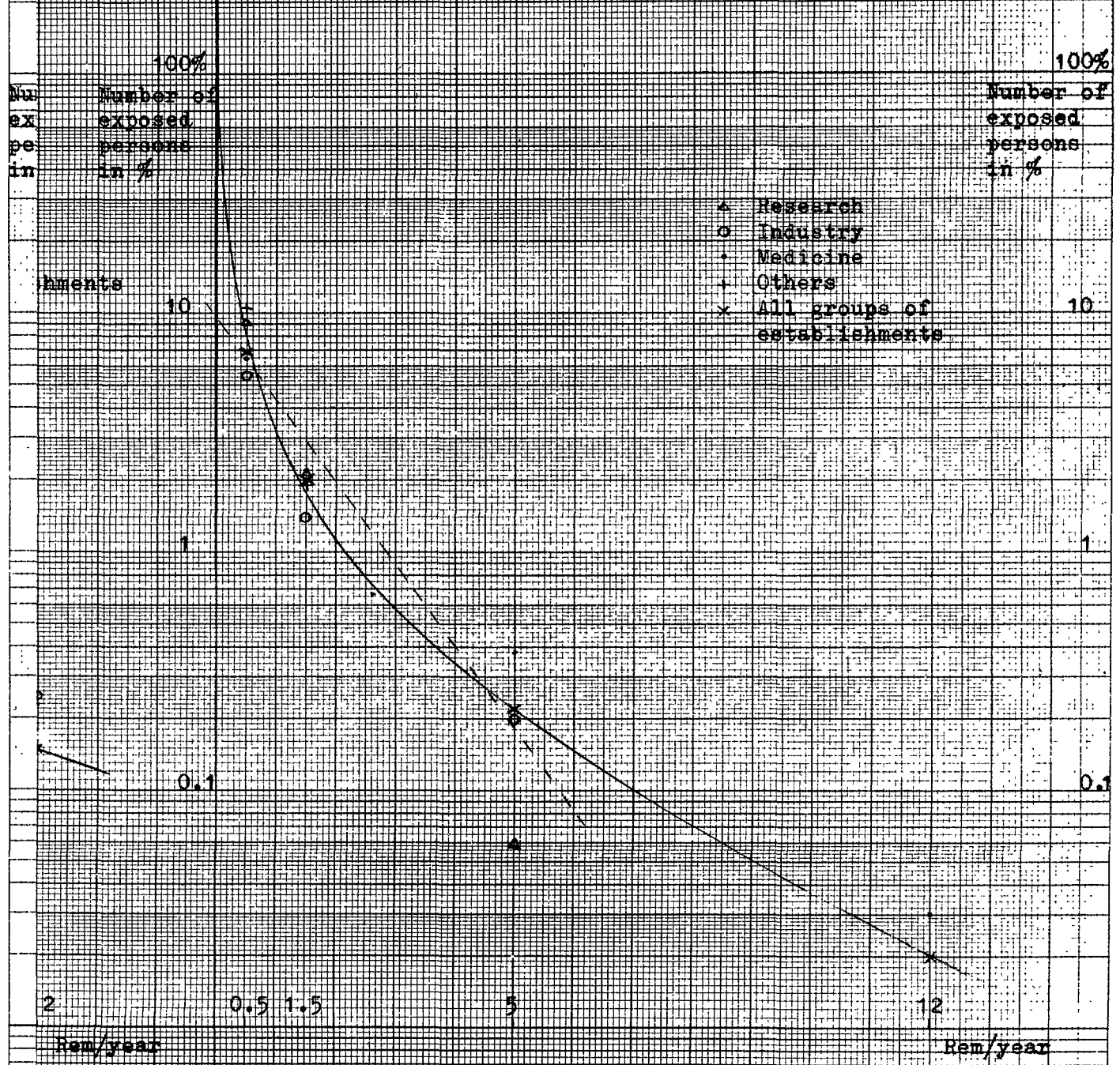


Diagram 1b

Staatliche zentrale FM-Strahlenschutz
 Deutschen Demokratischen Republik
 1963



Number of employees monitored by SZS 1963:

Research	1719
Industry	1779
Medicine	9845
Others	476
Total	13619

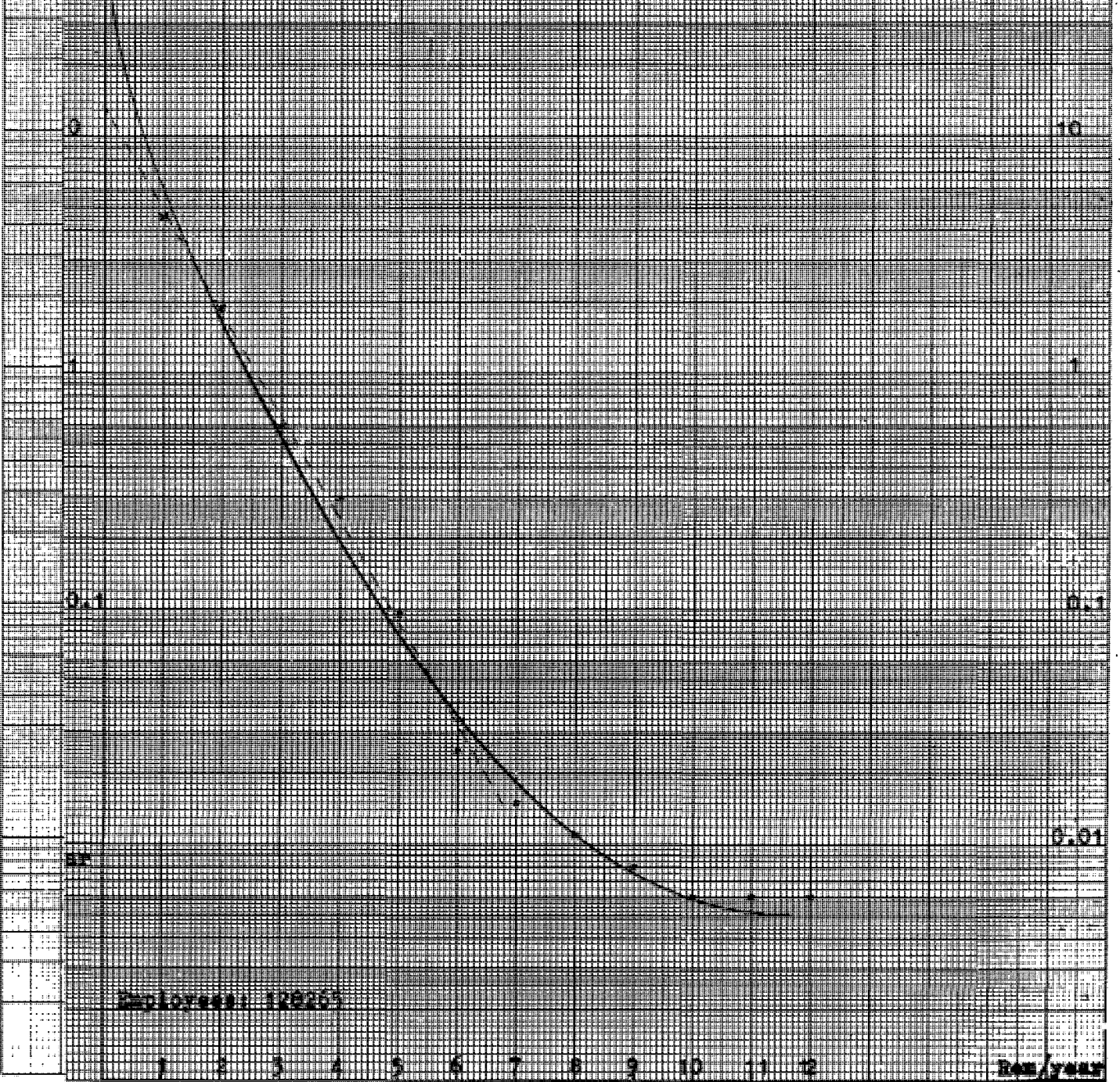
T-3 Elev. Energy Conversion

Diagram No.

1962

105
Num
expo
perm, %

100X
Number of
exposed
perm in %



Explosive 120251

RAM/YEAR

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