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Report on the Personnel Dosimetry at
AB Atomenergi during 1967

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REPORT ON THE PERSONNEL DOSIMETRY AT
AB ATOMENERGI DURING 1967

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SUMMARY

This report presents the results of personnel dosimetry at AB Atomenergi during 1967.

The external total body gamma dose for all employees (quarterly doses ≤ 100 mrem are not reported) corresponds to 140 manrem.

The highest external total body gamma dose during 1967 to one person was 5700 mrem.

24700 gamma films and 3900 neutron films were evaluated. 1988 urine analyses and 989 measurements of body activity were made.

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REPORT ON THE PERSONNEL DOSIMETRY AT
AB ATOMENERGI DURING 1967

Personnel dosimetry is applied at the company establishments at Studsvik and in Stockholm. The dosimeters used and the general lines on which the personnel dosimetry is run have been described in an earlier AE-report [1].

At Studsvik, the company research station, there are four nuclear reactors (R0, R2, R2-0 and FR0), a van de Graaff accelerator, laboratories for hot chemistry and metallurgy, a radioisotope production plant, a heavy water refinery plant, a plant for disposal of active waste, and a number of other active laboratories.

In Stockholm the company runs a nuclear reactor (R1), a uranium refinery plant, a fuel element factory and active laboratories.

At Studsvik as well as in Stockholm there are of course also various kinds of non-radioactive work. For practical reasons all persons employed at Studsvik are subject to personnel dosimetry. In Stockholm only those persons occupied at places of radiological work wear dosimeters.

In this report the personnel is divided into three groups as follows:

- 1) organisational units (sections) with personnel in radiological work under such conditions that the resulting doses might exceed $3/10$ of the annual maximum permissible doses recommended by ICRP.
- 2) organisational units (sections) with personnel occupied at places of radiological work under such conditions that the resulting doses are unlikely to exceed $3/10$ of the annual maximum permissible doses
- 3) organisational units (sections) in non-radiological work. The possible occupational doses can definitely be presumed to be below $1/10$ of the annual maximum permissible dose.

The quarterly external gamma radiation exposures are shown in tables 1 and 2. A summary of external gamma doses during 1967 is shown in table 3.

The internal exposures have been determined by urine analyses (table 4) and whole body measurements (table 5).

The maximum permissible yearly dose recommended by ICRP (5 rem) has been exceeded in one single case. The dose in this case was 5.7 rem.

There have been very few exposures to fast neutrons. The highest dose to a person was 210 mrem. (The lowest detectable dose is 20 mrem)

External β -ray exposures have mainly concerned hands and forearms and have not exceeded the limits recommended by ICRP.

Table 6 shows the gamma man-doses (external) from radiological work at AB Atomenergi since 1961, which are significant for the calculation of the genetic dose to the Swedish population. One may assume that the corresponding total national yearly man-dose is between 0.5 and 1 million manrem

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Table 1

External gamma irradiation during the quarters of the year (exposures ≤ 100 mrem/quarter not included).

Quarter	Studsvik				Stockholm ^{x)}			
	1	2	3	4	1	2	3	4
Number of exposed persons	82	57	82	73	16	24	22	24
Mean dose in mrem	411	402	392	364	216	255	374	331
Number of persons with no significant dose	763	788	763	772	189	181	183	181
Total number of persons ^{x)}	845				440			

^{x)}In Stockholm 235 persons, mainly administrative personnel, did not wear dosimeters.

Table 2

Number of external gamma radiation exposures, divided into the three personnel groups (see introduction p. 2).

Quarterly doses in mrem	Studsvik			Stockholm		
	Group 1 Number of exp.	Group 2 Number of exp.	Group 3 Number of exp.	Group 1 Number of exp.	Group 2 Number of exp.	Group 3 Number of exp.
100 < D \leq 500	208	4		36		
500 < D \leq 1300	71			2		
1300 < D \leq 2000	6					
2000 < D \leq 3000	1 ^{x)}					
3000 < D						

^{x)}2300 mrem

The highest quarterly external gamma dose to a woman was 880 mrem.

Table 3

Summary concerning external gamma doses during 1967 (quarterly doses ≤ 100 mrem are regarded as not significant. With the dosimeters used, the lowest detectable dose is 25 mrem).

Dose during 1967 in mrem	Studsvik					Stockholm				
	Number of persons					Number of persons				
	Group 1	Group 2	Group 3	Total	%	Group 1	Group 2	Group 3	Total	%
Persons with no significant dose	362	268	100	730	87	163	10		173	85
100 < D \leq 500	59	2		61	7	15			15	7
500 < D \leq 1500	42			42	5	15			15	7
1500 < D \leq 5000	11			11	1	2			2	1
5000 < D 1 ^{x)}				1						
Σ	475	270	100	845	100	195	10	235 ^{xx)}	205	100

x) 5700 mrem

xx) These persons, mainly administrative personnel, did not wear dosimeters.

Table 4

Biological monitoring. Urine analyses.

	Studsvik	Stockholm	Σ
Tritium	147	-	147
Plutonium	94	-	94
Uranium	3	1733	1736
Gross β	5	3	8
Strontium		3	3
	Σ	249	1739
			1988

Table 5

Number of whole body measurements during 1967 with abnormal body radioactivity [2]. The results have been divided into the two categories, acute/routine, depending on whether they were found in connection with incidents or found in routine control measurements. Most of these measurements can be assigned to personnel group 1, only a few to group 2.

Nuclide	Half-life (days)	Number of measurements	Number of measurements divided into type of work and per cent of reference level ^{x)}															
			Research reactors				Production of radionuclides				Chemistry and Metallurgy				Decontamination and Waste			
			< 1 %	1-10 %	10-100 %	> 100 %	< 1 %	1-10 %	10-100 %	> 100 %	< 1 %	1-10 %	10-100 %	> 100 %	< 1 %	1-10 %	10-100 %	> 100 %
Na 24	0.6	1					0/1											
Ar 41	1.8 h	1											0/1					
Sc 46	84	32	2/32	0/1			0/3						0/1			0/1		
Cr 51	27.8	8	1/3				1/2											
Mn 54	280	15	1/5										0/6			0/3		
Co 57	270	2					0/2											
Co 58	71	16	0/5										1/10					
Fe 59	45	8	1/7															
Co 60	5.3 y	227	16/49				5/65	0/3					3/45			1/40		
Zn 65	245	31	0/19															
Sr 85	64	4					0/4											
Zr 95-Nb 95	65	10	1/2				2/0						2/2			0/1		
Mo 99-Tc 99 ^m	2.8	17	4/10				3/10											
Ru 103	40	12	1/7				1/2									0/1		
Ag 110 ^m	253	38	14/16				0/3									0/5		
I 125 (thyroid)	60	27					0/3	0/15	0/9 ¹⁾									
Xe 131 ^m	12	1					0/1											
I 131	8.1	190	0/11	7/32	2/6 ²⁾		0/25	3/59	2/7 ²⁾				0/3	2/4	0/1	0/2	1/7	0/4
Te 132	3.25	2	1/0				1/10											
Xe 133	5.3	2					0/2											
I 133	0.85	20	1/1				2/0											
Cs 137	30 y	5					0/5											
Ce 144-Pr 144	284	1											1/10					
W 187	1	3	1/2															
Hg 197	2.7	2					0/2											
Hg 203	47	27					1/24	0/2										
Pb 203	2.2	1					0/1											
Pb 212	0.44	1											1/0					
Pa 233	27	1	0/1															

Reference level

Half life	Criterion
$T_{eff} < 4 \text{ days or } f_1^{xx}) < 0.01$	1/4 x maximum permissible yearly intake according to ICRP 1959 and 1962 (the lowest quoted figure)
$4 \text{ days} < T_{eff} < 13 \text{ weeks}$	1/4 x maximum permissible yearly dose
$T_{eff} > 13 \text{ weeks}$	MPBB

x) = Number of measurements divided into acute/routine

xx) f_1 = Fraction from G I tract to blood

1) = maximum dose : 4.5 rem (thyroid)

2) = " " 2.4 rem (thyroid)

Table 6

Gamma mandoses (external) from radiological work at AB Atomenergi since 1961, which are significant for the calculation of the genetic dose to the Swedish population.

<u>Year</u>	<u>Manrem</u>
1961	61.7
1962	74.2
1963	64.2
1964	51.5
1965	89.4
1966	114.0
1967	140.0

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