

AE-126

Report on the Personnel Dosimetry at
AB Atomenergi during 1962

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REPORT ON THE PERSONNEL DOSIMETRY AT AB ATOMENERGI
DURING 1962

K. -A. Edvardsson and S. Hagsgård

Summary

This report presents the results of the personnel dosimetry at AB Atomenergi during 1962.

No doses exceeding the recommendations of ICRP have been reported.

The sum of the reported external total body doses (≥ 100 mrem/quarter) is for the whole of AB Atomenergi during this year 74.2 manrem corresponding to about 50 mrem/year and person or 1 % of the maximum permissible dose.

32500 gamma films and 6200 neutron films have been evaluated. The total number of urine analyses is 2700 and of whole body measurements 10.

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1. Used Dosimeters

The personnel control at AB Atomenergi consists of film dosimetry, urine analyses and whole body measurements. The film badge is a copy of the type used at Oak Ridge before 1959. The film is Du Pont 558. Calibration is done against Ra-226, X-ray and uranium beta. The same sort of badge, slightly modified, is used also for neutron films. The film parcel is here placed between two 1 mm thick Cd sheets. The film is Kodak Personal Neutron Monitoring Film, Type A. As a complement to the types mentioned above there are also wrist badges and pocket chambers. The pocket chambers used are Bendix, Type 862, 0 - 200 mr gamma radiation, Bendix, Type 609, 0 - 120 mrem thermal neutron radiation and Landis & Gyr Type EQC1, 0 - 200 mr gamma radiation. See Fig. 1.

The main part of the personnel at AB Atomenergi are provided with a film badge for measurement of gamma and beta radiation. The badge contains at least one film, which is changed every quarter. If the employee is working with activity, another film, which is changed every fortnight, must be worn. Both films are worn in the same badge. The neutron films, which are changed every fortnight, are given only to employee who are working where there is risk of neutron radiation. Urine analyses and whole body measurements are made at definite intervals and when so required.

2. The Extent of Dosimetry in the Company

Personnel dosimetry was carried out at the following places during 1962: Drottning Kristinas väg and Lövholmsvägen in Stockholm, Studsvik, Kvarntorp, and Institutt for Atomenergi in Norway.

At Drottning Kristinas väg in Stockholm there is a reactor (R1) and some active laboratories.

At Lövholmsvägen in Stockholm there is a fuel element factory and some active laboratories.

At the research station in Studsvik there are three reactors R0, R2 and R2-0, one van de Graaff generator, laboratories for active metallurgy, isotope production, plant for disposal of active waste and a number of other active laboratories.

At Kvarntorp uranitic slate is mined. During 1962, however, only maintenance work was going on there.

In Norway a few employees from our company were working in co-operation with the Institutt for Atomenergi on experiments concerning reprocessing of fuel elements.

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

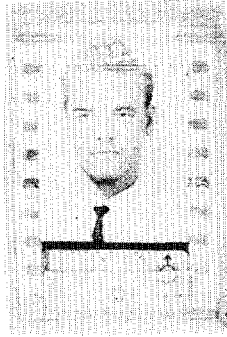
KFK = Nuclear Chemistry
RFX = Experimental Reactor Physics
RMA = Active Metallurgy
SR0 = Operation Group for Reactor R0
SR1 = Operation Group for Reactor R1
SR2 = Materials Testing Reactor R2
SSS = Radiation Protection
SSW = Waste Disposal
KPL = Uranium Refinery
RMB = Fuel Elements
KPK = Uranium Mill
FH = Local Administration, Stockholm (Workshop and service)
FV = - " - Studsvik - " -

3. The Way of Reporting Results

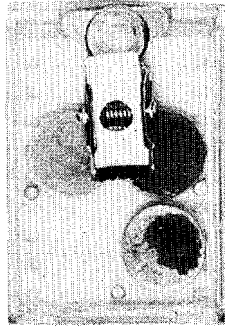
A report of exposures registered on fortnight films is sent to the chief responsible for the person's work and to the health physicist

in the plant where the person is working. Consequently the employees are not informed by routine about the exposure they have received, but they can at any time get to know it from their chief. Apart from the chief and the health physicist in the plant, reports of quarterly exposures, urine analyses and whole body measurements are sent to the company doctor, the Radiation Protection Board and the Institute of Radiophysics. These doses are communicated to the personnel on the same principles as mentioned above. The lowest dose which is reported during a fortnight period is 25 mrem and during a quarter 100 mrem.

A summary of data from the work during 1962 is presented here. The main part of the information is taken from the data published every quarter. During 1962 there has not been any exposure which has exceeded the norms recommended by ICRP. The number of employees at AB Atomenergi was during 1962 about 1500. The total amount of the measured external whole body doses (≥ 100 mrem/quarter) during 1962 was 74.2 manrem, which is equivalent to about 50 mrem/year and person or 1 % of the maximum permissible dose.



Front

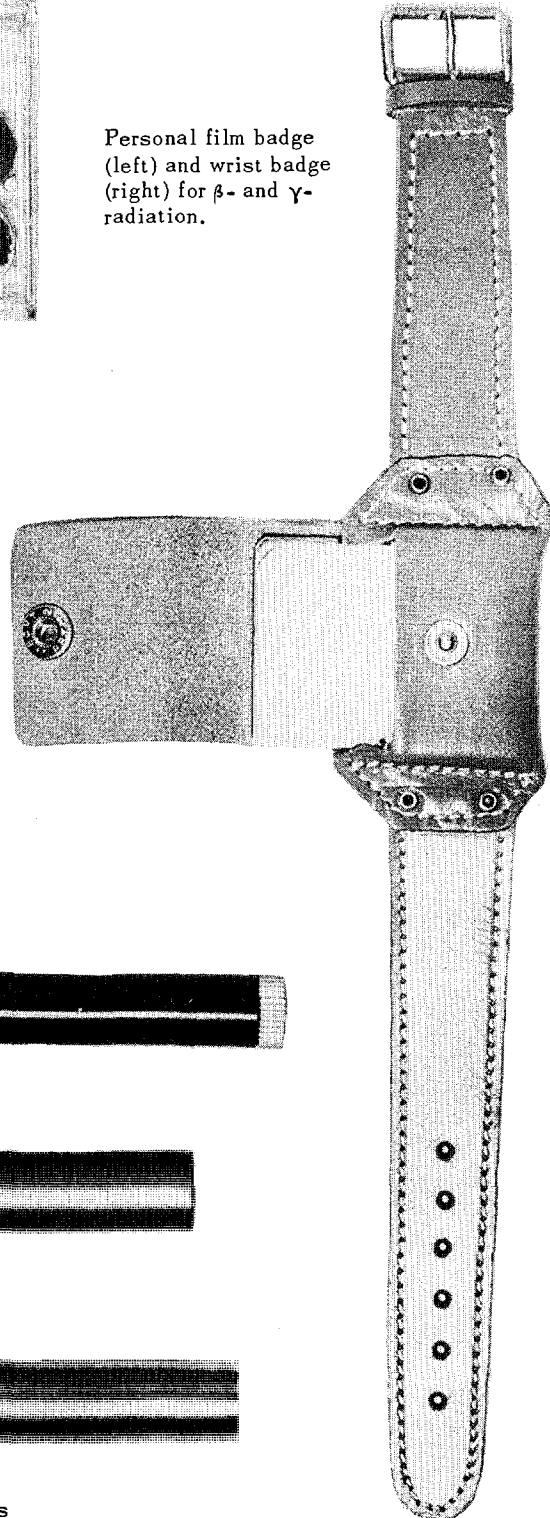


Back

Personal film badge
(left) and wrist badge
(right) for β - and γ -
radiation.



Film pack.
Du Pont 558
containing
Du Pont 508
(0.025-10 r)
Du Pont 1290
(10-1000 r)



Landis & Gyr EQC 1 0-200 mr



Bendix, Model No 862 0-200 mr



Bendix, Model No 609 0-120 mrems
Thermal neutron

Figure 1.

Table 1

Distributed dosimeter films during 1962.

	Studsvik	Stockholm
Gamma films	17 300	15 200
Neutron films	6 200	Neutron films for Stockholm are marked and evaluated at Studsvik.

Table 2

Biological monitoring. Number of values reported in the quarterly reports.

	Urine analyses. Number of samples.																Σ 1962
	Studsvik				Stockholm				Kvarntorp				Norway				
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	
Gross α	17	12	8	41									8	9	7		119
Gross β		4	8	12													24
Phosphate β	18	9	20	43	31	37	29	39					8	9	7		250
Plutonium			9	19	33	36	27	42					8	6	7		187
Uranium *)	2	1	1	1	25	10	16	21	7	1		3					88 *)
Cesium			6	8													14
Iodine														4	1		5
Tritium *)		15	33	2													50 *)
Σ	37	41	85	126	89	83	72	114	7	1		3	24	28	22		732

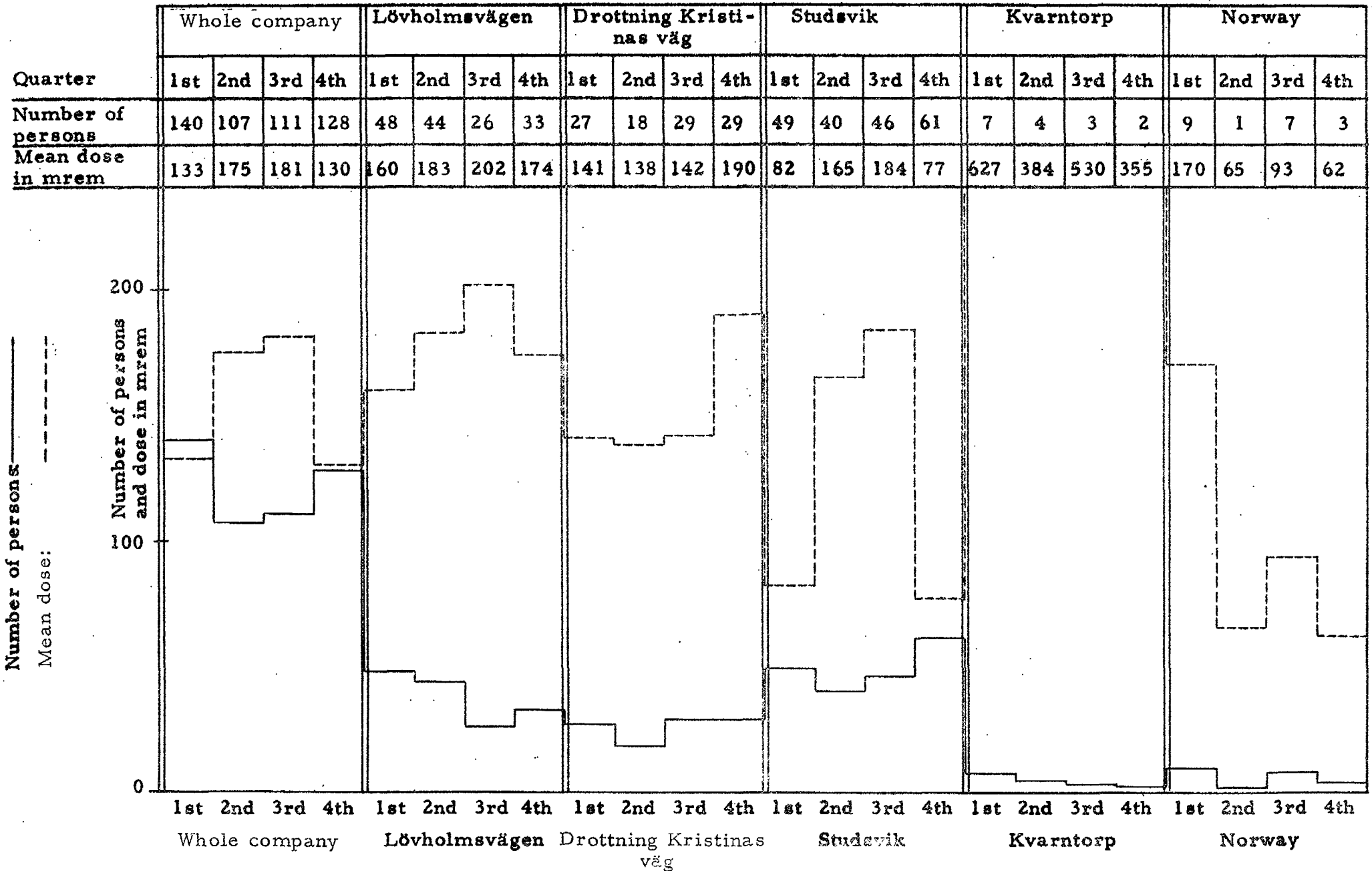
*) 1830 uranium samples and 183 tritium samples have been taken but only results exceeding $10^{-2} \mu\text{g/ml}$ and $10^{-3} \mu\text{C/ml}$, respectively, have been reported in the quarterly reports. All of the results from the other urine analyses are reported in the quarterly reports.

Human body counting. Number of persons.

	Studsvik	Stock- holm	Kvarn- torp	Norway
1st				
2nd				
3rd	5			
4th	5			
Σ	10			

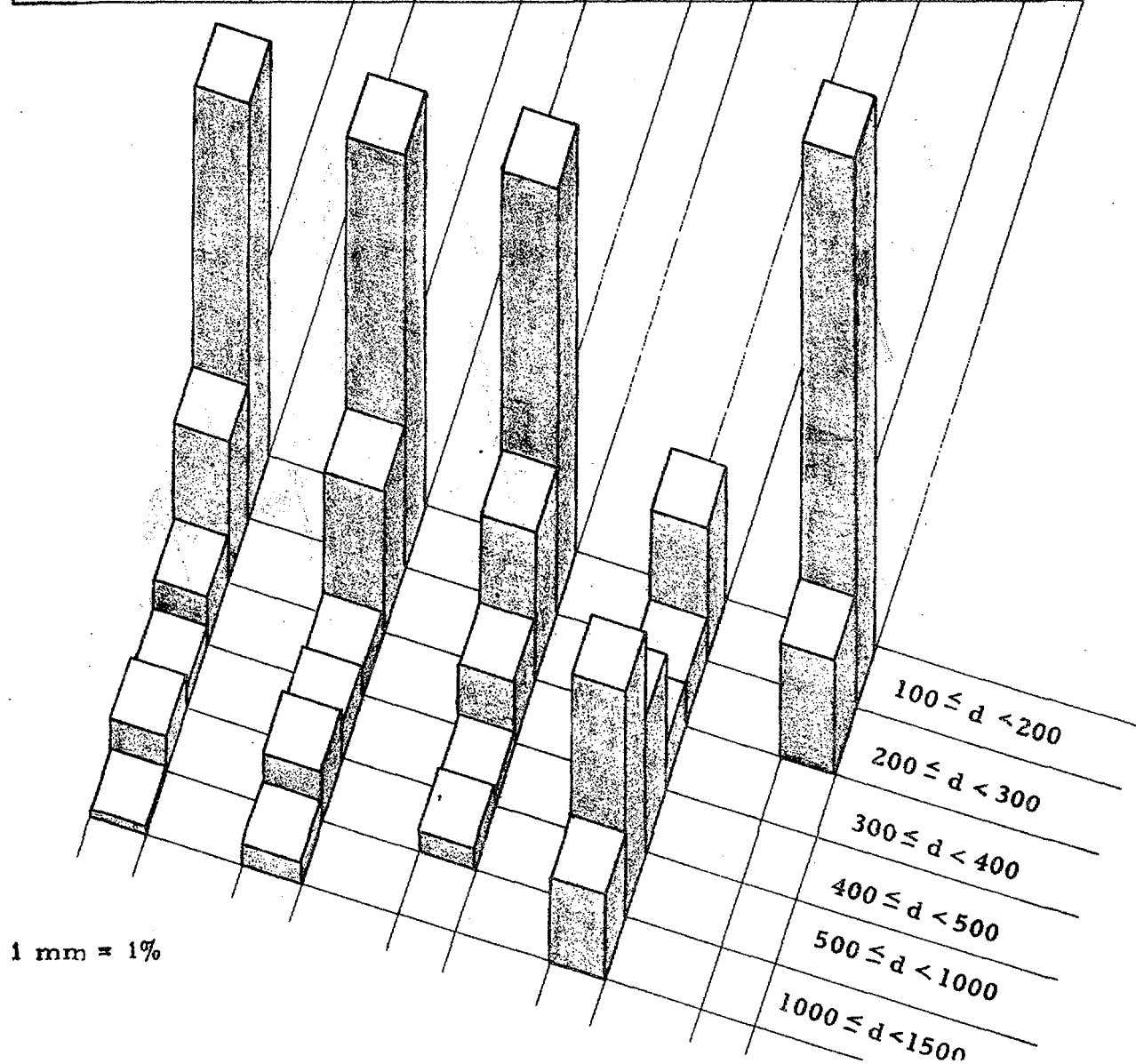
Table 3.

Number of reported persons (≥ 100 mrem/quarter) and the mean doses for these persons.



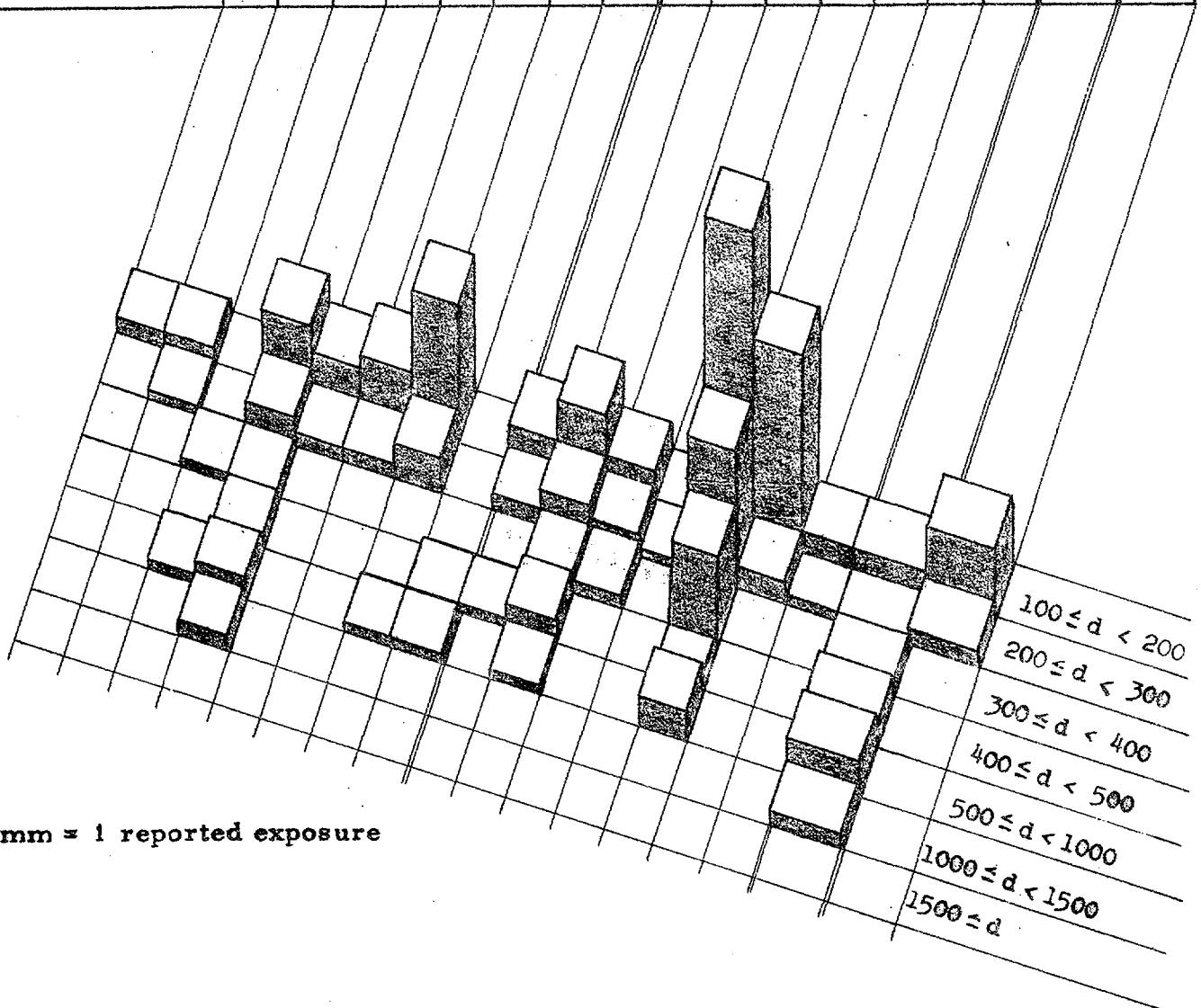
Number of reported exposures where the quarterly dose has been ≥ 100 mrem. (Note: Number of reported exposures and number of exposed persons need not be the same.)

Quarterly dose d in mrem	Number of reported exposures									
	Whole company		Studsvik		Stockholm		Kvarntorp		Norway	
		%		%		%		%		%
$100 \leq d < 200$	190	62	46	62	131	64	3	20	10	83
$200 \leq d < 300$	64	21	16	21	45	22	1	7	2	17
$300 \leq d < 400$	22	7	2	3	19	9	1	7		
$400 \leq d < 500$	10	3	3	4	4	2	3	20		
$500 \leq d < 1000$	15	5	5	7	5	3	5	33		
$1000 \leq d < 1500$	4	1	2	3			2	13		
$1500 \leq d$										
Σ	305	100	74	100	204	100	15	100	12	100



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

Quarterly dose d in mrem	Numbers of reported exposures in different working areas																
	Studsvik								Stockholm							Kvarn- torp	Nor- way
	FV	KFK	REF	RMA	SRO	SR2	SSS	SSW	FH	KFK	KPL	REF	RMB	SRI	SSS	KFK	
$100 \leq d < 200$	2	2		10	6	8	20		5	11	5	1	45	29	3	3	10
$200 \leq d < 300$		1		4	2	2	5		2	5	3	1	20	3	1	1	2
$300 \leq d < 400$			1	1						2	2		12			1	
$400 \leq d < 500$				1				1	1	3			2			3	
$500 \leq d < 1000$			1	3			1	1		1			4			5	
$1000 \leq d < 1500$				2												2	
$1500 \leq d$																	



Summary of the yearly doses during 1962

Yearly dose D in mrem	Whole company		Studsvik (incl. Norway)		Stockholm (incl. Kvarntorp)		D in % of max. permissible dose
	Numb. of persons	%	Numb. of persons	%	Numb. of persons	%	
D < 500	493	91.6	149	92.5	344	91.3	D < 10 %
500 ≤ D < 1500	42	7.8	12	7.5	30	7.9	10 % ≤ D < 30 %
1500 ≤ D < 5000	3	0.6			3	0.8	30 % ≤ D < 100 %
5000 ≤ D							
Σ	538	100.0	161	100.0	377	100.0	

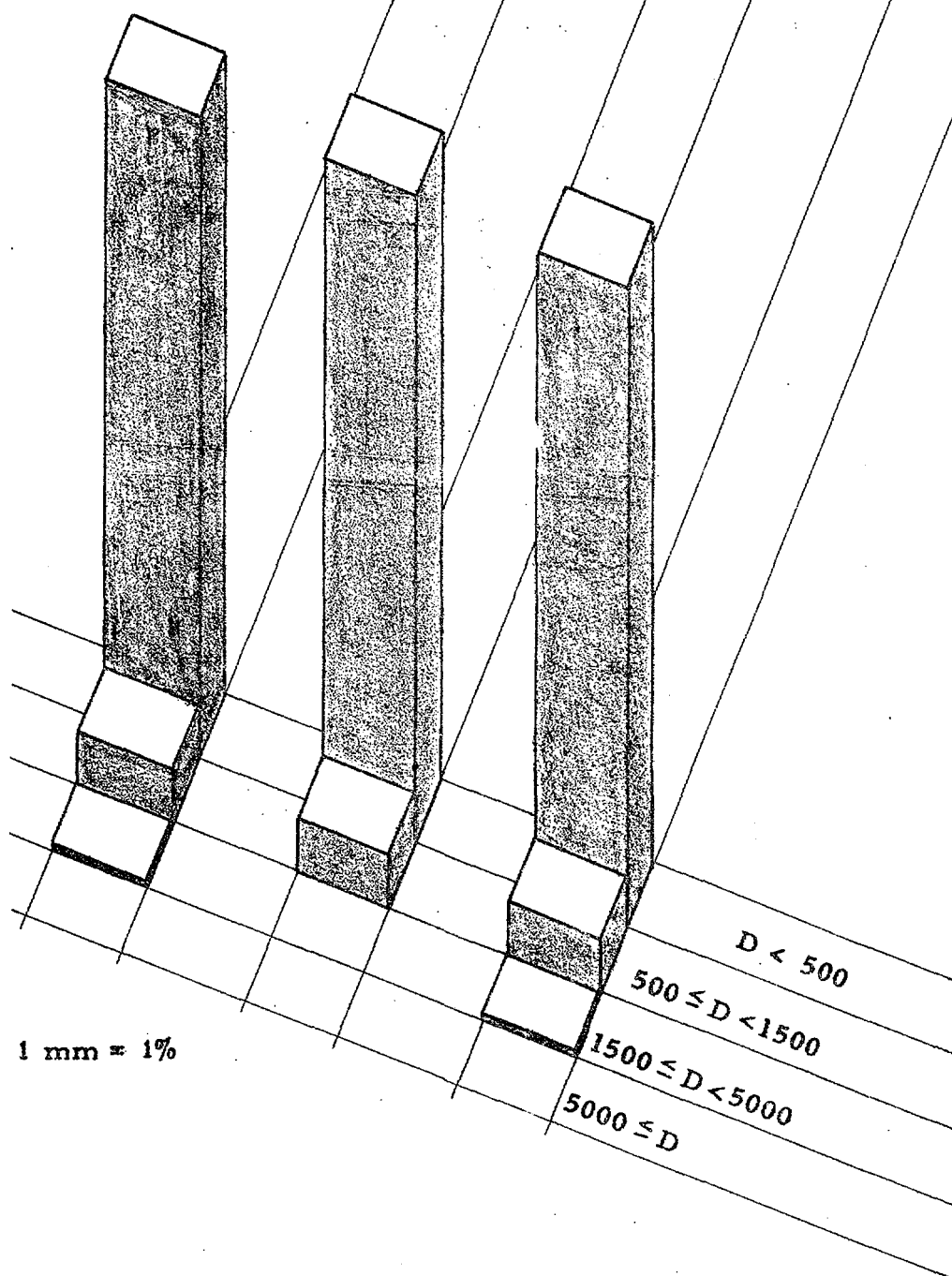
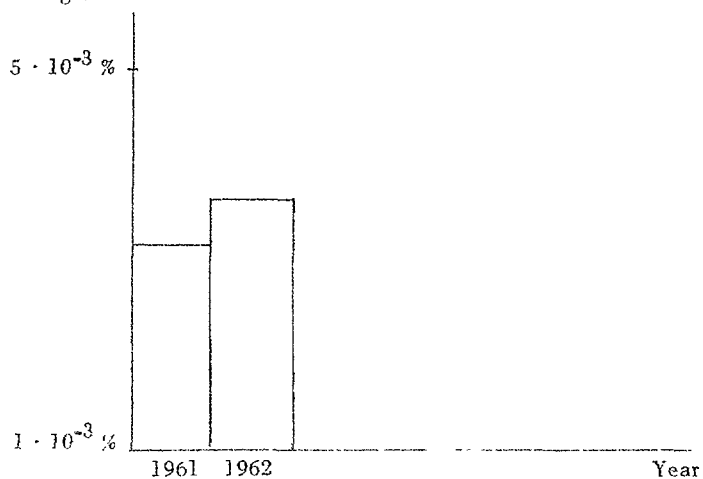


Table 7

The AE part of the genetical dose (external dose) on the Swedish population. (Inhabitants 7.5 mill. Normal background exposure 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	$3.3 \cdot 10^{-3}$

Additional dose
in % of nat.
background



No figures from earlier years are given in this table as the values are not directly comparable with the figures for 1961 and 1962 because of a change in the reporting level for the quarterly doses in 1961.

LIST OF PUBLISHED AE-REPORTS

1—50. (See the back cover earlier reports.)

51. Activation analysis of aluminium. By D. Brune. 1961. 8 p. Sw. cr. 6:—.
52. Thermo-technical data for D₂O. By E. Axblom. 1961. 14 p. Sw. cr. 6:—.
53. Neutron damage in steels containing small amounts of boron. By H. P. Myers. 1961. 23 p. Sw. cr. 6:—.
54. A chemical eight group separation method for routine use in gamma spectrometric analysis. I. Ion exchange experiments. By K. Samsahl. 1961. 13 p. Sw. cr. 6:—.
55. The Swedish zero power reactor R0. By Olof Landergård, Kaj Cavallin and Georg Jonsson. 1961. 31 p. Sw. cr. 6:—.
56. A chemical eight group separation method for routine use in gamma spectrometric analysis. II. Detailed analytical schema. By K. Samsahl. 18 p. 1961. Sw. cr. 6:—.
57. Heterogeneous two-group diffusion theory for a finite cylindrical reactor. By Alf Jonsson and Göran Näslund. 1961. 20 p. Sw. cr. 6:—.
58. Q-values for (n, p) and (n, α) reactions. By J. Konijn. 1961. 29 p. Sw. cr. 6:—.
59. Studies of the effective total and resonance absorption cross section for zircaloy 2 and zirconium. By E. Hellstrand, G. Lindahl and G. Lundgren. 1961. 26 p. Sw. cr. 6:—.
60. Determination of elements in normal and leukemic human whole blood by neutron activation analysis. By D. Brune, B. Frykberg, K. Samsahl and P. O. Wester. 1961. 16 p. Sw. cr. 6:—.
61. Comparative and absolute measurements of 11 inorganic constituents of 38 human tooth samples with gamma-ray spectrometry. By K. Samsahl and R. Söremark. 19 p. 1961. Sw. cr. 6:—.
62. A Monte Carlo sampling technique for multi-phonon processes. By Thure Högberg. 10 p. 1961. Sw. cr. 6:—.
63. Numerical integration of the transport equation for infinite homogeneous media. By Rune Håkansson. 1962. 15 p. Sw. cr. 6:—.
64. Modified Sucksmith balances for ferromagnetic and paramagnetic measurements. By N. Lundquist and H. P. Myers. 1962. 9 p. Sw. cr. 6:—.
65. Irradiation effects in strain aged pressure vessel steel. By M. Grounes and H. P. Myers. 1962. 8 p. Sw. cr. 6:—.
66. Critical and exponential experiments on 19-rod clusters (R3-fuel) in heavy water. By R. Persson, C-E. Wikdahl and Z. Zadworski. 1962. 34 p. Sw. cr. 6:—.
67. On the calibration and accuracy of the Guinier camera for the determination of interplanar spacings. By M. Möller. 1962. 21 p. Sw. cr. 6:—.
68. Quantitative determination of pole figures with a texture goniometer by the reflection method. By M. Möller. 1962. 16 p. Sw. cr. 6:—.
69. An experimental study of pressure gradients for flow of boiling water in a vertical round duct, Part I. By K. M. Becker, G. Hernborg and M. Bode. 1962. 46 p. Sw. cr. 6:—.
70. An experimental study of pressure gradients for flow of boiling water in a vertical round duct, Part II. By K. M. Becker, G. Hernborg and M. Bode. 1962. 32 p. Sw. cr. 6:—.
71. The space-, time- and energy-distribution of neutrons from a pulsed plane source. By A. Claesson. 1962. 16 p. Sw. cr. 6:—.
72. One-group perturbation theory applied to substitution measurements with void. By R. Persson. 1962. 21 p. Sw. cr. 6:—.
73. Conversion factors. By A. Amnerntson and S-E. Larsson. 1962. 15 p. Sw. cr. 10:—.
74. Burnout conditions for flow of boiling water in vertical rod clusters. By Kurt M. Becker. 1962. 44 p. Sw. cr. 6:—.
75. Two-group current-equivalent parameters for control rod cells. Autocode programme CRCC. By O. Norinder and K. Nyman. 1962. 18 p. Sw. cr. 6:—.
76. On the electronic structure of MnB. By N. Lundquist. 1962. 16 p. Sw. cr. 6:—.
77. The resonance absorption of uranium metal and oxide. By E. Hellstrand and G. Lundgren. 1962. 17 p. Sw. cr. 6:—.
78. Half-life measurements of ⁴He, ¹⁶N, ¹⁹O, ²⁰F, ²⁸Al, ⁷⁷Se and ¹¹⁰Ag. By J. Konijn and S. Malmkog. 1962. 34 p. Sw. cr. 6:—.
79. Progress report for period ending December 1961. Department for Reactor Physics. 1962. 53 p. Sw. cr. 6:—.
80. Investigation of the 800 keV peak in the gamma spectrum of Swedish Laplanders. By I. O. Andersson, I. Nilsson and K. Eckerstig. 1962. 8 p. Sw. cr. 6:—.
81. The resonance integral of niobium. By E. Hellstrand and G. Lundgren. 1962. 14 p. Sw. cr. 6:—.
82. Some chemical group separations of radioactive trace elements. By K. Samsahl. 1962. 18 p. Sw. cr. 6:—.
83. Void measurement by the (γ , n) reactions. By S. Z. Rouhani. 1962. 17 p. Sw. cr. 6:—.
84. Investigation of the pulse height distribution of boron trifluoride proportional counters. By I. O. Andersson and S. Malmkog. 1962. 16 p. Sw. cr. 6:—.
85. An experimental study of pressure gradients for flow of boiling water in vertical round ducts. (Part 3). By K. M. Becker, G. Hernborg and M. Bode. 1962. 29 p. Sw. cr. 6:—.
86. An experimental study of pressure gradients for flow of boiling water in vertical round ducts. (Part 4). By K. M. Becker, G. Hernborg and M. Bode. 1962. 19 p. Sw. cr. 6:—.
87. Measurements of burnout conditions for flow of boiling water in vertical round ducts. By K. M. Becker. 1962. 38 p. Sw. cr. 6:—.
88. Cross sections for neutron inelastic scattering and (n, 2n) processes. By M. Leimdörfer, E. Bock and L. Arkeryd. 1962. 225 p. Sw. cr. 10:—.
89. On the solution of the neutron transport equation. By S. Depken. 1962. 43 p. Sw. cr. 6:—.
90. Swedish studies on irradiation effects in structural materials. By M. Grounes and H. P. Myers. 1962. 11 p. Sw. cr. 6:—.
91. The energy variation of the sensitivity of a polyethylene moderated BF₃ proportional counter. By R. Fräki, M. Leimdörfer and S. Malmkog. 1962. 12. Sw. cr. 6:—.
92. The backscattering of gamma radiation from plane concrete walls. By M. Leimdörfer. 1962. 20 p. Sw. cr. 6:—.
93. The backscattering of gamma radiation from spherical concrete walls. By M. Leimdörfer. 1962. 16 p. Sw. cr. 6:—.
94. Multiple scattering of gamma radiation in a spherical concrete wall room. By m. Leimdörfer. 1962. 18 p. Sw. cr. 6:—.
95. The paramagnetism of Mn dissolved in α and β brasses. By H. P. Myers and R. Westin. 1962. 13 p. Sw. cr. 6:—.
96. Isomorphic substitutions of calcium by strontium in calcium hydroxy-apatite. By H. Christensen. 1962. 9 p. Sw. cr. 6:—.
97. A fast time-to-pulse height converter. By O. Aspelund. 1962. 21 p. Sw. cr. 6:—.
98. Neutron streaming in D₂O pipes. By J. Braun and K. Randén. 1962. 41 p. Sw. cr. 6:—.
99. The effective resonance integral of thorium oxide rods. By J. Weitman. 1962. 41 p. Sw. cr. 6:—.
100. Measurements of burnout conditions for flow of boiling water in vertical annuli. By K. M. Becker and G. Hernborg. 1962. 41 p. Sw. cr. 6:—.
101. Solid angle computations for a circular radiator and a circular detector. By J. Konijn and B. Tollander. 1963. 6 p. Sw. cr. 8:—.
102. A selective neutron detector in the keV region utilizing the ¹⁹F(n, γ)²⁰F reaction. By J. Konijn. 1963. 21 p. Sw. cr. 8:—.
103. Anion-exchange studies of radioactive trace elements in sulphuric acid solutions. By K. Samsahl. 1963. 12 p. Sw. cr. 8:—.
104. Problems in pressure vessel design and manufacture. By O. Hellström and R. Nilson. 1963. 44 p. Sw. cr. 8:—.
105. Flame photometric determination of lithium contents down to 10⁻³ ppm in water samples. By G. Jönsson. 1963. 9 p. Sw. cr. 8:—.
106. Measurements of void fractions for flow of boiling heavy water in a vertical round duct. By S. Z. Rouhani and K. M. Becker. 1963. 2nd rev. ed. 32 p. Sw. cr. 8:—.
107. Measurements of convective heat transfer from a horizontal cylinder rotating in a pool of water. K. M. Becker. 1963. 20 p. Sw. cr. 8:—.
108. Two-group analysis of xenon stability in slab geometry by modal expansion. O. Norinder. 1963. 50 p. Sw. cr. 8:—.
109. The properties of CaSO₄/Mn thermoluminescence dosimeters. B. Bjärngård. 1963. 27 p. Sw. cr. 8:—.
110. Semianalytical and seminumerical calculations of optimum material distributions. By C. I. G. Andersson. 1963. 26 p. Sw. cr. 8:—.
111. The paramagnetism of small amounts of Mn dissolved in Cu-Al and Cu-Ge alloys. By H. P. Myers and R. Westin. 1963. 7 p. Sw. cr. 8:—.
112. Determination of the absolute disintegration rate of Cs¹³⁷-sources by the tracer method. S. Hellström and D. Brune. 1963. 17 p. Sw. cr. 8:—.
113. An analysis of burnout conditions for flow of boiling water in vertical round ducts. By K. M. Becker and P. Persson. 1963. 28 p. Sw. cr. 8:—.
114. Measurements of burnout conditions for flow of boiling water in vertical round ducts (Part 2). By K. M. Becker, et al. 1963. 29 p. Sw. cr. 8:—.
115. Cross section measurements of the ⁵⁸Ni(n, p)⁵⁸Co and ²⁹Si(n, α)²⁶Mg reactions in the energy range 2.2 to 3.8 MeV. By J. Konijn and A. Lauber. 1963. 30 p. Sw. cr. 8:—.
116. Calculations of total and differential solid angles for a proton recoil solid state detector. By J. Konijn, A. Lauber and B. Tollander. 1963. 31 p. Sw. cr. 8:—.
117. Neutron cross sections for aluminium. By L. Forsberg. 1963. 32 p. Sw. cr. 8:—.
118. Measurements of small exposures of gamma radiation with CaSO₄/Mn radiothermoluminescence. By B. Bjärngård. 1963. 18 p. Sw. cr. 8:—.
119. Measurement of gamma radioactivity in a group of control subjects from the Stockholm area during 1959—1963. By I. O. Andersson, I. Nilsson and Eckerstig. 1963. 19 p. Sw. cr. 8:—.
120. The thermox process. By O. Tjälldin. 1963. 38 p. Sw. cr. 8:—.
121. The transistor as low level switch. By A. Lydén. 1963. 47 p. Sw. cr. 8:—.
122. The planning of a small pilot plant for development work on aqueous reprocessing of nuclear fuels. By T. U. Sjöborg, E. Haeflner and Hultgren. 1963. 20 p. Sw. cr. 8:—.
123. The neutron spectrum in a uranium tube. By E. Johansson, E. Jonsson, M. Lindberg and J. Mednis. 1963. 36 p. Sw. cr. 8:—.
124. Simultaneous determination of 30 trace elements in cancerous and non-cancerous human tissue samples with gamma-ray spectrometry. K. Samsahl, D. Brune and P. O. Wester. 1963. 23 p. Sw. cr. 8:—.
125. Measurement of the slowing-down and thermalization time of neutrons in water. By E. Möller and N. G. Sjöström. 1963. 42 p. Sw. cr. 8:—.
126. Report on the personnel dosimetry at AB Atomenergi during 1962. By K-A. Edvardsson and S. Hagsgård. 1963.

Förteckning över publicerade AES-rapporter

1. Analys medelst gamma-spektrometri. Av D. Brune. 1961. 10 s. Kr 6:—.
2. Bestrålningssförändringar och neutronanströf i reaktortrycktankar — några synpunkter. Av M. Grounes. 1962. 33 s. Kr 6:—.
3. Studium av sträckgränsen i mjukt stål. G. Östberg, R. Attermo. 1963. 17 s. Kr 6:—.
4. Teknisk upphandling inom reaktorområdet. Erik Jonson. 1963. 64 s. Kr 8:—.

Additional copies available at the library of AB Atomenergi, Studsvik, Nyköping, Sweden. Transport microcards of the reports are obtainable through the International Documentation Center, Tumba, Sweden.