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MASTER

COMPARISON OF HAND EXPOSURE DATA WITH FILM

BADGE METER RESULTS

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Facsimile Price \$ 1.10

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I. Introduction - Purpose of Study

This preliminary investigation was undertaken to study and compare the skin and penetrating doses measured by the ORNL Hand Exposure Meter (film ring) with like doses recorded by the UCNC Film Badge Meter. Ratios of comparable dose evaluations are of interest currently because of the increase in Laboratory programs involving low energy exposures with the enhanced importance of hand exposures.

II. Investigative Procedure

The group selected for study consisted of 44 radiation survey personnel routinely involved in exposure monitoring and evaluation duties throughout the Laboratory. Although not necessarily in strict proportion to exposed employees, it was considered that this group would provide a suitable sample of the diverse types of exposure energies and radiation problems typically encountered.

This group of participating radiation survey personnel wore hand exposure meters daily for a period of six months covering two complete quarters—January 1 through March 31, 1962, and April 1 through June 30, 1962. The hand exposure meters were processed on a weekly cycle and the component interpreted exposure results were accumulated in totals for each quarter. These data, together with the corresponding results for the individual's film badge meter, are listed in Tables 1 and 2.

III. Evaluation of Results

Ratios of the interpreted dose results of these two film monitoring devices were calculated for each individual. These ratios were then grouped for the total of 87 observations and the results are presented as histograms in Figures 1 and 2.

Figure 1 presents the resulting ratio groupings for ratios of the skin dose interpretation and Figure 2 presents the results for the penetrating dose values obtained. A not unexpected finding was the considerable scatter in values for this ratio, including a small number of cases in which it exceeded 8.5. This is interpreted as reflecting the relative proximity of the hands to the exposure sources encountered. The average ratio values, calculated from exposure totals for the 87 cases, are 2.2 as the average ratio of skin doses evaluated by hand meters compared to film badge and 2.0 for the average ratio of penetrating doses. However, it is felt that the spread of ratios as presented in Figures 1 and 2 is more significant than such average values. It may be noted in passing that on an annual basis the hand exposure permitted may be 15 times the whole body exposure and for a given quarter the ratio may be 8.3.

IV. Conclusions

Radiation survey personnel are concerned with all Laboratory operations where significant quantities of radioactive materials are involved. This fact allows the information as presented here to represent a cross section sample of hand exposures vs whole body exposures that may be expected during routine Laboratory operations.

It is concluded that the ratio of hand to whole body exposures typically shown is sufficiently variable to warrant prudent and careful use of hand exposure meters. In particular, this monitoring should be employed for work involving low energy and short range emitters as well as operations conducted over a barricade shield when it may be reasonably expected that a person may receive in one monitoring quarter a dose to the hands in excess of 2500 mrem.

Table 1

1st Qtr. 1962 - January 1 through March 31

Observation	Hand Meter Exposure Information		Film Badge Meter (Whole Body Exposure)	
	*D _S (Mrem)	**D _C (Mrem)	D _S (Mrem)	D _C (Mrem)
1	470	260	100	50
2	150	40	120	70
3	430	230	10	10
4	480	260	70	20
5	1040	940	460	380
6	310	120	130	60
7	420	210	160	160
8	890	825	600	500
9	580	390	550	320
10	220	190	80	50
11	80	40	50	20
12	280	130	80	50
13	740	340	340	140
14	260	80	100	30
15	600	180	190	90
16	3570	1210	2315	540
17	310	150	160	60
18	360	240	440	240
19	540	235	530	260
20	420	90	240	90
21	1550	770	810	520
22	170	80	160	130
23	1370	1170	600	520
24	670	470	160	160
25	1960	1660	1590	1360
26	870	590	220	220
27	970	770	530	350
28	1840	1240	230	180
29	1190	990	510	460
30	1560	1200	370	290
31	1070	840	300	200
32	1490	1240	520	420
33	2080	1330	470	410
34	485	200	120	90
35	710	310	330	280
36	490	260	370	280
37	680	340	470	370
38	390	160	320	220
39	425	190	190	130
40	730	280	410	270
41	580	200	160	120
42	320	90	310	180
43	570	210	570	340
44	840	510	430	300
Totals	35160	21260	16895	10830

* - Dose to the Skin of the Whole Body (Low Penetrating Radiation).

** - Dose to Other Critical Organs or Total Body (Penetrating Radiation).

Table 2

2nd Qtr. 1962 - April 1 through June 30

Observation	Hand Meter Exposure Information		Film Badge Meter (Whole Body Exposure)	
	D _B (Mrem)	D _C (Mrem)	D _B (Mrem)	D _C (Mrem)
1	320	140	50	30
2	380	190	60	30
3	400	300	30	20
4	190	90	30	20
5	390	130	100	70
6	190	130	70	40
7	200	120	30	10
8	600	380	520	320
9	680	340	480	230
10	490	170	10	0
11	200	100	90	50
12	460	210	210	130
13	1400	310	540	140
14	860	300	290	90
15	950	340	270	170
16	4280	1860	2670	720
17	400	140	130	80
18	990	310	620	220
19	1950	820	1100	350
20	360	150	100	50
21	2650	1300	1270	720
22	610	310	130	80
23	1700	1250	450	450
24	1140	880	320	220
25	2005	850	1050	700
26	790	440	170	140
27	1200	800	350	300
28	1100	760	160	110
29	780	660	220	220
30	1140	1020	300	230
31	3360	1430	450	250
32	610	320	470	370
33	1040	400	350	280
34	310	130	270	190
35	570	200	630	530
36	960	570	470	320
37	780	610	310	280
38	580	360	510	310
39	1220	520	450	230
40	510	220	270	170
41	570	300	300	150
42	290	140	260	160
43	600	300	560	380
Totals	40205	20500	17120	9560

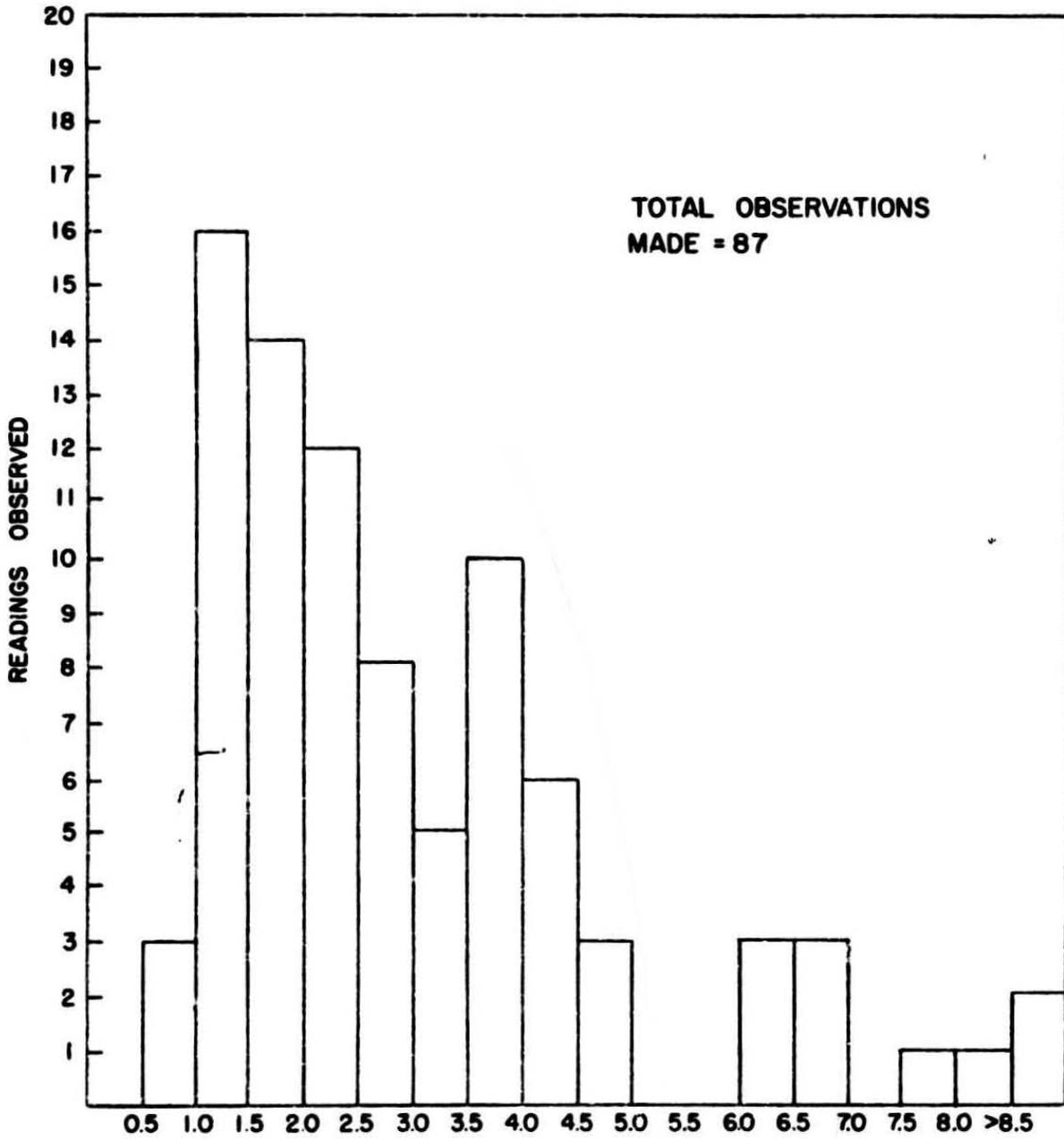


FIGURE-1 DOSE RATIO $\frac{\text{HAND EXPOSURE METER}}{\text{FILM BADGE METER}}$ (D_s)

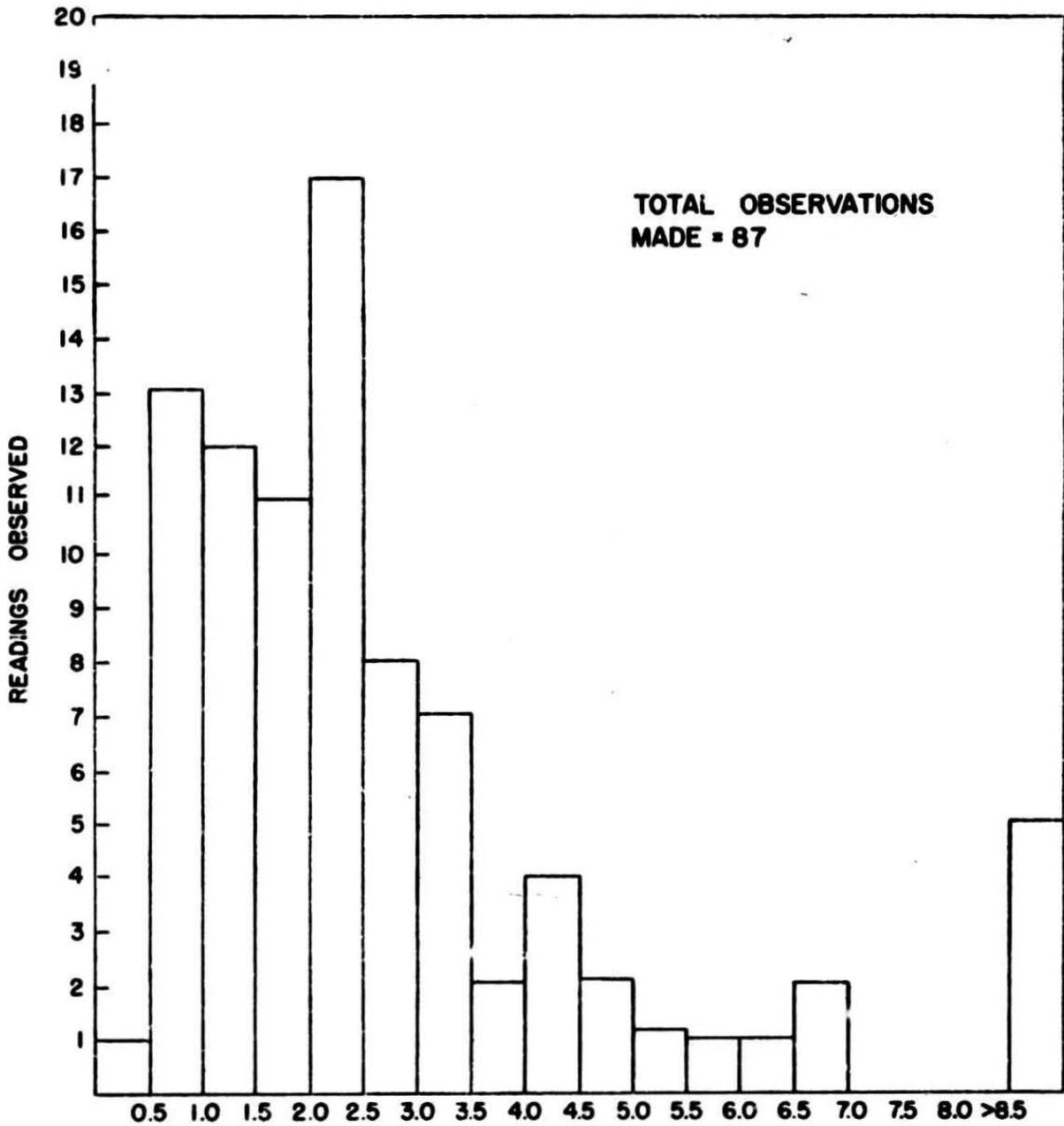


FIGURE-2 DOSE RATIO $\frac{\text{HAND EXPOSURE METER}}{\text{FILM BADGE METER}} (D_c)$

END