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October 15, 1952

LAUNDERED PROTECTIVE CLOTHING SURVEY

Introduction

It is considered appropriate occasionally to make independent checks on the effectiveness of the plant laundry in removing radioactive contamination from plant-issue protective clothing. Previous surveys have offered constructive criticism resulting in improved handling of high level and soft beta contaminated clothing and incorporation in new designs of ventilating and air sampling recommendations.

Recurrently the adequacy of laundry reject limits is questioned, and only recently an accurate, special study resulted in relaxed limits for Metal Preparation area clothing. A current question concerns the advisability of determining the reject level on the beta-gamma monitor more frequently than once a day.

Personnel in facilities where contamination is present have complained that bath towels, which can become contaminated in various ways and, after laundering, be used as dish towels in the lunch rooms, are not monitored by the laundry before re-issue. Another complaint is that the work load at the laundry has been increased at the expense of safety and shoddy workmanship.

This survey was undertaken to obtain current data pertinent to these problems, of sufficient scope to be statistically significant.

Conclusions

Contamination survey of laundered protective clothing returned to the operating facilities for re-use has shown that 99.2% of the clothing is not contaminated with radioactive material. Radiation exposure of personnel who wear clothing still contaminated after laundering is insignificant in comparison to the permissible limits for occupational exposure. Present laundry practices appear satisfactory to prevent significant exposure from laundered protective clothing.

Discussion

As shown in the attached table of survey results, a statistically large sample of each kind of laundered protective clothing was taken from the re-issue bins in buildings where the contamination is representative of one or more of the several types encountered.

The clothing was surveyed with instruments appropriate to the type of contamination: the Poppy for alpha contamination, with results in disintegrations per minute (d/m); the other instruments for beta and gamma contamination, reported in counts per minute (c/m).

Out of 3930 articles of protective clothing surveyed, only 31 articles were found to be contaminated. The maximum levels of contamination detected were 2000 d/m and 8000 c/m (4 mrep/hr). Statistical analysis of the survey shows that only 0.8% of the articles surveyed were contaminated above the detectable limits of 500 d/m alpha and/or 100 c/m beta-gamma. Even if this survey of about 4000 articles were repeated 100 times, there is only one chance that the average percent of articles found contaminated would exceed 2.2% and only five chances that it would exceed 1.9%

There are currently about 120,000 canvas articles of protective clothing worn per month (rubber articles are omitted here because of effective shielding at low contamination levels). If there are as few as 2000 people who wear protective clothing at Hanford Works, and if it is assumed that four articles are worn per person per day, and that there are 30 wearing days per month, then on the average each person would wear a contaminated article four times in 1000 work days, or only once a year. If the maximum contamination found in this survey were in contact with each person's skin for the eight hours of that day, he would receive a total of 32 mrep exposure, which is only a small fraction of the permissible weekly exposure, and is insignificant in regard to long term occupational exposure.

Included in the study were surveys of plant-issue bath towels, which are not considered as protective clothing, and which if used so as to become contaminated, are supposed to be destroyed and not laundered for re-issue. Out of 320 towels checked, not one was found contaminated.

The protective clothing survey was performed by F. A. Perkins, and the statistical frequency was calculated by G. E. Pilcher.

H. V. Clukey

RADIOLOGICAL SCIENCES DEPARTMENT

HV CLUKEY:VB

STATISTICAL ANALYSIS

TYPE OF CLOTHING	P % CONTAMINATED	N NO. SURVEYED	P x N	P^2 x N
Coveralls	1.4	798	1117.2	1564.08
Lab. Coats	0	202	-	-
Shoe Covers	0.5	1773	886.5	443.25
Hoods	0	75	-	-
Canvas Boots	1.0	184	184.	184.
Caps	0	106	-	-
Canvas Gloves	1.5	196	294.	441.
Rubber Overshoes	1.8	271	487.8	878.04
Rubberized Gloves	0.6	161	96.6	57.96
Gauntlet Gloves	0	88	-	-
British Boots	1.3	76	98.8	128.44
TOTAL		3930	3164.9	3696.77

Average % Contaminated: $3164.9/3930 = 0.805\%$

Variance: $\frac{3696.77 - (3164.9)(0.805)}{3930} = 0.2924$

Standard Deviation: $0.2924^{\frac{1}{2}} = 0.541$

95% Probability Level: $0.805 + (0.541)(1.960) = 1.9\%$

99% Probability Level: $0.805 + (0.541)(2.575) = 2.2\%$

NOTE: This statistical analysis assumes no significant difference in the manner of being laundered of the various kinds of clothing from the various buildings. This includes the fact that the permissible limit for re-issue of laundered 303 Area clothing, which is double the beta-gamma release limit for other areas, resulted in no more contaminated articles being found than the five which are possible within the 95% probability level.

		233	234-S	222-S	202-S	105-F	108-F	3706	3707 for 303 AREA	TOTALS
TOWELS	Contaminated	0	0	0	0			0	0	0
	Surveyed	22	52	46	125			40	35	320
BRITISH BOOTS	Contaminated					(1) 740c/m				(1)
	Surveyed					76				76
RUBBER GAUNT. GLOVES	Contaminated					0				0
	Surveyed					88				88
RUBBER CANVAS GLOVES	Contaminated					(1) 1200c/m				(1)
	Surveyed					131	30 (0)			161
RUBBER OVER-SHOES	Contaminated				(5) 400c/m 550c/m 700c/m 740c/m 750c/m	(3)				(5)
	Surveyed				169	92	10 (0)			271
CANVAS GLOVES	Contaminated				(1) 540c/m	(2) 840c/m 900c/m				(3)
	Surveyed				100	96				196
CAPS	Contaminated	0			0					0
	Surveyed	12			95					196
CANVAS BOOTS	Contaminated				(1) 9000c/m	(1) 3100c/m				(2)
	Surveyed	30 (0)			55	99				184
HOODS	Contaminated	0	0		0					0
	Surveyed	22	18		35					75
SHOE COVERS	Contaminated		10cd/m 500d/m	5000c/m						
	Surveyed	400 (0)	530 (2)	528 (1)	100 (0)	58 (0)		97 (5) 400c/m 540c/m 600c/m 660c/m 800c/m		(8)
LAB. COATS	Contaminated	0	0	0				0		0
	Surveyed	45	60	38				45		202
COVER-ALLS	Contaminated	(2) 500d/m 500d/m	(1) 2000d/m	(1) 3200c/m		(1) 2200c/m		(2) 500d/m 800c/m	(4) 600c/m 680c/m 800c/m 960c/m	(11)
	Surveyed	55	100	42	87 (0)	56	62 (0)	91	275	796
SURVEY INSTRUMENT USED		Poppy	Poppy	Poppy TGM	Poppy TGM	VGM Zeuto	Poppy TGM	Poppy EGM	EGM	
BUILDING NUMBERS		233	234-S	222-S	202-S	105-F	108-F	3706	3707 for 303 AREA	

END

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10 / 16 / 90