HMM ASSOCIATES, INC.

U.S. NRC LICENSE NUMBER 20-20795-01

TERMINATION SURVEY REPORT

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1.0 INTRODUCTION

HMM License Number 20-20795-01 allows the receipt, possession and storage of prepackaged radioactive waste, in accordance with license application dated December 19, 1984 and letters dated March 14,1985 and September 25, 1985. Since HMM has reached an agreement with ADCO Services, Inc. concerning purchase of our low level waste brokerage service, HMM wishes to terminate their existing license.

Licensed Material packaged in 30 and 55 gallon drums was stored in a designated area of a warehouse located at 5 Bryant Street in Woburn, Mass. Equipment which was used in handling drums included a scale, a drum hoist, 2 drum trucks, and 2 drum ramps. Other material stored in the warehouse for sale to customers included empty drums, absorbant, and drum liners, all of which were stored in assigned designated areas (see Figure 1-1).

A termination survey was performed on July 27, 1987. The results show that the warehouse area and truck used to transport material are free from radioactive contamination and are in accordance with NRC criteria for license termination and release for unrestricted use.

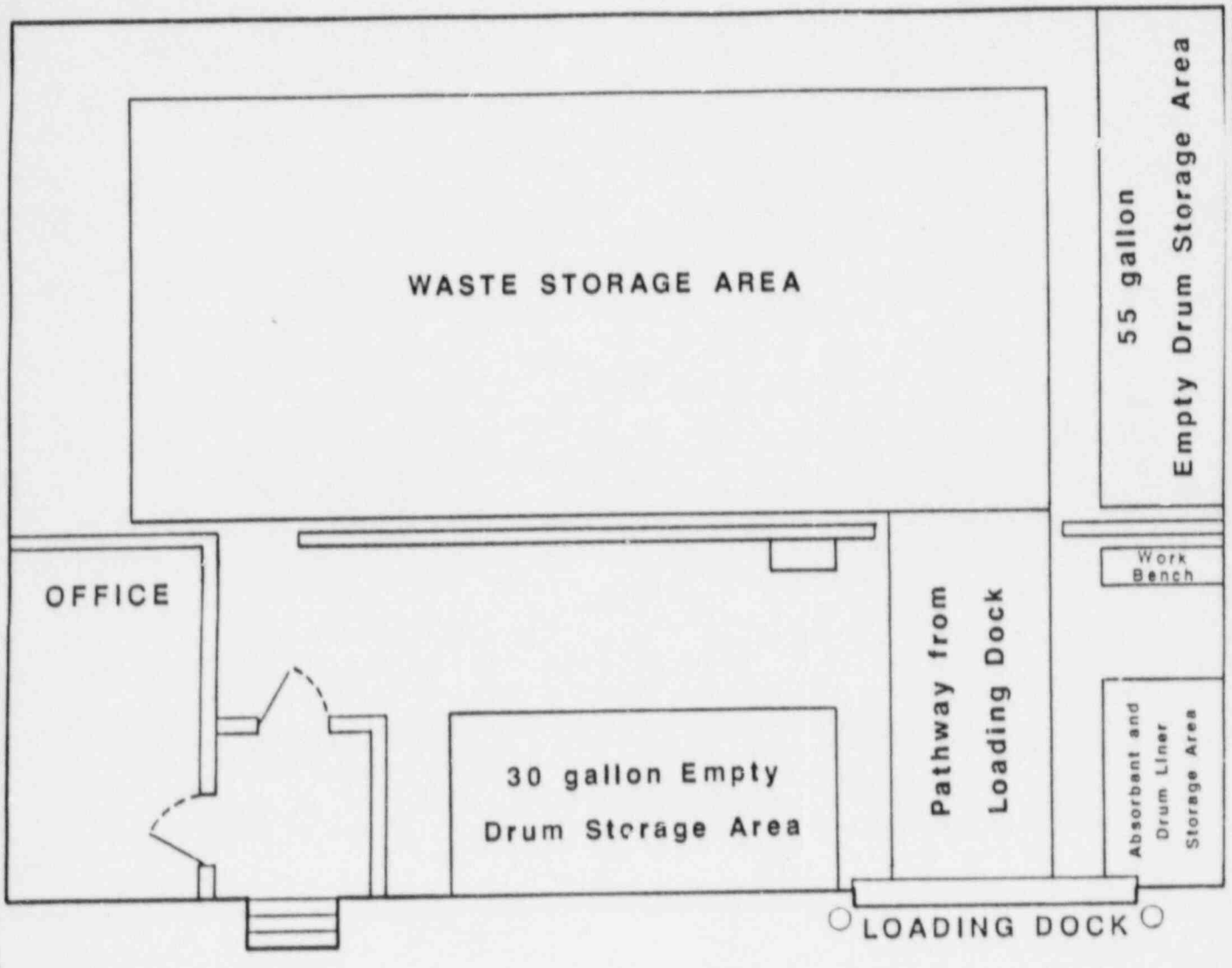

Figure 1-1 License# 20-20795-01-Restricted Area

HMM ASSOCIATES, INC.

2.0 SURVEY AND ANALYTICAL TECHNIQUES

General

The radiological assessment of the warehouse facility involved instrument surveys to measure the radiation levels and smear samples for removable contamination.

The waste storage area, pathway from the loading dock, and 18' truck were surveyed in their entirety. For purposes of this assessment, the floor of these areas was gridded into reference squares 100 cm on a side as indicated on Figures 2-1 and 2-2. Tnis provides reference squares of $1m^2$ area each. Although these locations were the only areas contacting with waste drums, other areas shown on Figure 2-1 were surveyed selectively to ensure the entire area was free of contamination. The equipment used in drum handling including the scale, drum hoist, drum trucks and drum ramps were also surveyed in their entirety.

It should be noted that only floor areas and equipment coming in contact with the drums needed to be fully surveyed. This is due to the fact that the license authorized handling of only prepackaged radioactive waste. There was no opening or repackaging of waste in the facility,hence no threat of airborne contamination. The only potential contamination to be found would be on the floor or on equipment contacting the drums. Additionally, the routine procedures followed in conduct of the operation included a requirement for documented smear samples of each waste drum prior to pickup by HMM, and prior to shipment to the waste disposal site. The cleanliness of the drums in this regard further reduces the possibility of any contamination in the warehouse or truck areas.

Direct Radiation Measurements

A Ludlum Model 3 survey meter with a Pancake probe was used to conduct the direct radiological surveys. The instrument was calibrated for exposure and surface contamination measurements as indicated in Appendix 2.

For the waste storage area, pathway, and truck, a minimum of one recorded measurement for each square meter of floor area wa[illegible]en. This recorded measurement was indicative of the highest reading [illegible]ed over each square

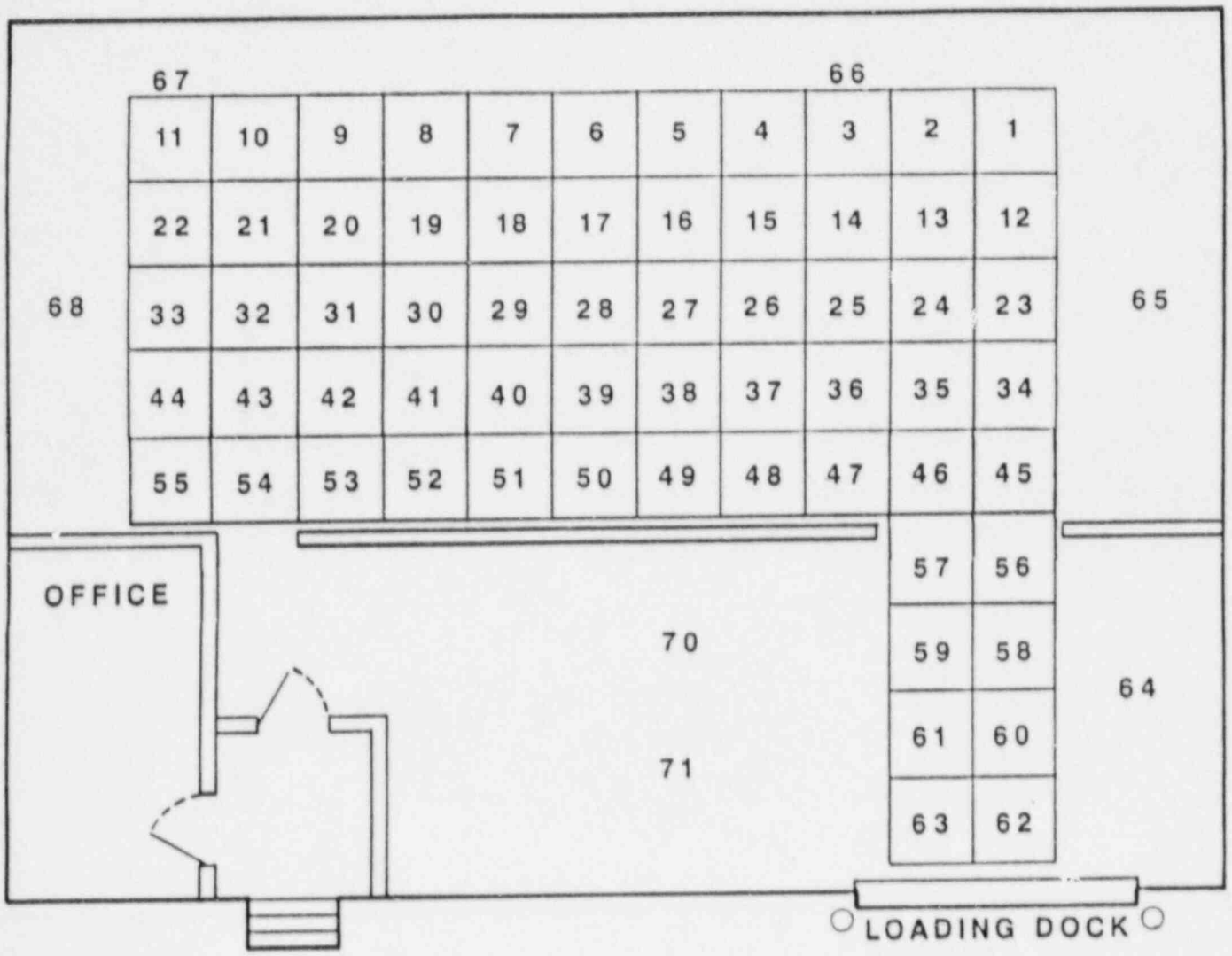

Figure 2-1 Waste Storage Area

Pathway-Survey Grid Map and General Surveys

HMM ASSOCIATES, INC.

1	2	3
4	5	6
7	8	9
10	11	12
13	14	15
16	17	18

Figure 2-2 18' Truck Survey Grid Map

meter area. Due to the lower probability of contamination, statistical sampling of other warehouse areas was conducted, with a minimum of one recorded measurement for each ten square meters of surface area. The data collection sheets for direct radiation measurements are included as Appendix 3.

Smear Surveys

Dry smears were taken at representative locations within the facility, with 4.25 cm diameter filter papers (Whatman #1). The smear sample was obtained by applying moderate pressure with the tips of the first two fingers to the back of the filter paper and wiping the surface over an area of approximately 100 cm^2. One smear sample was taken for each square meter of floor area in the waste storage, pathway and truck areas. Again statistical sampling of other warehouse areas was conducted with a minimum of one smear sample taken for every ten square meters of surface area.

Smear samples were analyzed by Bolton and Galanek Health Physics Consultants, Boston, Massachusetts, via alph/beta/gamma internal proportional counting, as well as liquid scintillation counting (for detection of low energy betas from tritium). A copy of their printed results is included in Appendix 4.

3.0 ANALYSIS OF SURVEY RESULTS

General

Low energy x-ray, gamma, and beta-gamma exposures and total surface contamination levels were measured with the Ludlum Model 3 GM instrument. The exposure rate measurements are reported in net mrem/hr after subtracting the instrument background of .03 mrem/hr. Surface contamination levels are reported in net dpm/100cm^2, after normalizing the surface area to 100cm^2, and correcting for instrument efficiency (see Appendix 1).

Smear samples for removable contamination levels were counted for both alpha and beta-gamma activity, and the results provided in net dpm/100cm^2 (see Appendix 4).

Table 3-1 presents the summary of results of the termination survey. The locations where these measurements were recorded are shown in Figures 2-1 and 2-2, or are listed directly on the table.

The instrument survey data and the smear results were reviewed with respect to both the ANSI Standard N13.12, "Control of Radioactive Surface Contamination of Facilities to be Released for Uncontrolled Use", and the NRC's "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-product, Source, or Special Nuclear Material" (July, 1982). These references can be found in Appendix 5 of this report.

Instrument and Smear Surveys

As seen from the survey results in Table 3-1, no contamination was detected in any of the areas of the warehouse or truck, or on any equipment used. This was expected given the precautions taken during routine conduct of operations (i.e., requirement for survey of all drums prior to pickup and prior to shipment to a disposal site.)

TABLE 3-1

HMM RADIATION SURVEY RESULTS

DATE: 7/27/87

Location	Ambient Radiation Levels		Contamination Levels		
	Beta-Gamma (mrem/hr)	Gamma (mrem/hr)	Total Fixed Plus Removable Beta-Gamma (dpm/100cm^2)	Alpha Removable (dpm/100cm^2)	Beta-Gamma Removable (dpm/100cm^2)
Waste Storage Area/Pathway Floor Ref. #					
1	Bkg	Bkg	Bkg	< 1	< 10
2	Bkg	Bkg	Bkg	< 1	< 10
3	Bkg	Bkg	Bkg	< 1	< 10
4	Bkg	Bkg	Bkg	< 1	< 10
5	Bkg	Bkg	Bkg	< 1	< 10
6	Bkg	Bkg	Bkg	< 1	< 10
7	Bkg	Bkg	Bkg	< 1	< 10
8	Bkg	Bkg	Bkg	< 1	< 10
9	Bkg	Bkg	Bkg	< 1	< 10
10	Bkg	Bkg	Bkg	< 1	< 10
11	Bkg	Bkg	Bkg	< 1	< 10
12	Bkg	Bkg	Bkg	< 1	< 10
13	Bkg	Bkg	Bkg	< 1	< 10
14	Bkg	Bkg	Bkg	< 1	< 10
15	Bkg	Bkg	Bkg	< 1	< 10
16	Bkg	Bkg	Bkg	< 1	< 10

TABLE 3-1 (Continued)

HMM RADIATION SURVEY RESULTS

DATE: 7/27/87

Location	Ambient Radiation Levels		Contamination Levels		
	Beta-Gamma (mrem/hr)	Gamma (mrem/hr)	Total Fixed Plus Removable Beta-Gamma (dpm/100cm^2)	Alpha Removable (dpm/100cm^2)	Beta-Gamma Removable (dpm/100cm^2)
Waste Storage Area/Pathway Floor Ref. #					
17	Bkg	Bkg	Bkg	< 1	< 10
18	Bkg	Bkg	Bkg	< 1	< 10
19	Bkg	Bkg	Bkg	< 1	< 10
20	Bkg	Bkg	Bkg	< 1	< 10
21	Bkg	Bkg	Bkg	< 1	< 10
22	Bkg	Bkg	Bkg	< 1	< 10
23	Bkg	Bkg	Bkg	< 1	< 10
24	Bkg	Bkg	Bkg	< 1	< 10
25	Bkg	Bkg	Bkg	< 1	< 10
26	Bkg	Bkg	Bkg	< 1	< 10
27	Bkg	Bkg	Bkg	< 1	< 10
28	Bkg	Bkg	Bkg	< 1	< 10
29	Bkg	Bkg	Bkg	< 1	< 10
30	Bkg	Bkg	Bkg	< 1	< 10
31	Bkg	Bkg	Bkg	< 1	< 10
32	Bkg	Bkg	Bkg	< 1	< 10

TABLE 3-1 (Continued)

HMM RADIATION SURVEY RESULTS

DATE: 7/27/87

Location	Ambient Radiation Levels		Contamination Levels		
	Beta-Gamma (mrem/hr)	Gamma (mrem/hr)	Total Fixed Plus Removable Beta-Gamma (dpm/100cm^2)	Alpha Removable (dpm/100cm^2)	Beta-Gamma Removable (dpm/100cm^2)
Waste Storage Area/Pathway Floor Ref. #					
33	Bkg	Bkg	Bkg	< 1	< 10
34	Bkg	Bkg	Bkg	< 1	< 10
35	Bkg	Bkg	Bkg	< 1	< 10
36	Bkg	Bkg	Bkg	< 1	< 10
37	Bkg	Bkg	Bkg	< 1	< 10
38	Bkg	Bkg	Bkg	< 1	< 10
39	Bkg	Bkg	Bkg	< 1	< 10
40	Bkg	Bkg	Bkg	< 1	< 10
41	Bkg	Bkg	Bkg	< 1	< 10
42	Bkg	Bkg	Bkg	< 1	< 10
43	Bkg	Bkg	Bkg	< 1	< 10
44	Bkg	Bkg	Bkg	< 1	< 10
45	Bkg	Bkg	Bkg	< 1	< 10
46	Bkg	Bkg	Bkg	< 1	< 10
47	Bkg	Bkg	Bkg	< 1	< 10

TABLE 3-1 (Continued)

HMM RADIATION SURVEY RESULTS

DATE: 7/27/87

Location	Ambient Radiation Levels		Contamination Levels		
	Beta-Gamma (mrem/hr)	Gamma (mrem/hr)	Total Fixed Plus Removable Beta-Gamma (dpm/100cm^2)	Alpha Removable (dpm/100cm^2)	Beta-Gamma Removable (dpm/100cm^2)
Waste Storage Area/Pathway Floor Ref. #					
48	Bkg	Bkg	Bkg	< 1	< 10
49	Bkg	Bkg	Bkg	< 1	< 10
50	Bkg	Bkg	Bkg	< 1	< 10
51	Bkg	Bkg	Bkg	< 1	< 10
52	Bkg	Bkg	Bkg	< 1	< 10
53	Bkg	Bkg	Bkg	< 1	< 10
54	Bkg	Bkg	Bkg	< 1	< 10
55	Bkg	Bkg	Bkg	< 1	< 10
56	Bkg	Bkg	Bkg	< 1	< 10
57	Bkg	Bkg	Bkg	< 1	< 10
58	Bkg	Bkg	Bkg	< 1	< 10
59	Bkg	Bkg	Bkg	< 1	< 10
60	Bkg	Bkg	Bkg	< 1	< 10
61	Bkg	Bkg	Bkg	< 1	< 10
62	Bkg	Bkg	Bkg	< 1	< 10
63	Bkg	Bkg	Bkg	< 1	< 10

TABLE 3-1 (Continued)

HMM RADIATION SURVEY RESULTS

DATE: 7/27/87

Location	Ambient Radiation Levels		Contamination Levels		
	Beta-Gamma (mrem/hr)	Gamma (mrem/hr)	Total Fixed Plus Removable Beta-Gamma (dpm/100cm^2)	Alpha Removable (dpm/100cm^2)	Beta-Gamma Removable (dpm/100cm^2)
General Area Floor Ref. No.					
64	Bkg	Bkg	Bkg	< 1	< 10
65	Bkg	Bkg	Bkg	< 1	< 10
66	Bkg	Bkg	Bkg	< 1	< 10
67	Bkg	Bkg	Bkg	< 1	< 10
68	Bkg	Bkg	Bkg	< 1	< 10
69	Bkg	Bkg	Bkg	< 1	< 10
70	Bkg	Bkg	Bkg	< 1	< 10
71	Bkg	Bkg	Bkg	< 1	< 10
18' Truck Floor Ref. No.					
T-1	Bkg	Bkg	Bkg	< 1	< 10
T-2	Bkg	Bkg	Bkg	< 1	< 10
T-3	Bkg	Bkg	Bkg	< 1	< 10
T-4	Bkg	Bkg	Bkg	< 1	< 10
T-5	Bkg	Bkg	Bkg	< 1	< 10
T-6	Bkg	Bkg	Bkg	< 1	< 10
T-7	Bkg	Bkg	Bkg	< 1	< 10
T-8	Bkg	Bkg	Bkg	< 1	< 10

TABLE 3-1 (Continued)

HMM RADIATION SURVEY RESULTS

DATE: 7/27/87

Location	Ambient Radiation Levels		Contamination Levels		
	Beta-Gamma (mrem/hr)	Gamma (mrem/hr)	Total Fixed Plus Removable Beta-Gamma (dpm/100cm^2)	Alpha Removable (dpm/100cm^2)	Beta-Gamma Removable (dpm/100cm^2)
18' Truck Floor Ref. No.					
T-9	Bkg	Bkg	Bkg	< 1	< 10
T-10	Bkg	Bkg	Bkg	< 1	< 10
T-11	Bkg	Bkg	Bkg	< 1	< 10
T-12	Bkg	Bkg	Bkg	< 1	< 10
T-13	Bkg	Bkg	Bkg	< 1	< 10
T-14	Bkg	Bkg	Bkg	< 1	< 10
T-15	Bkg	Bkg	Bkg	< 1	< 10
T-16	Bkg	Bkg	Bkg	< 1	< 10
T-17	Bkg	Bkg	Bkg	< 1	< 10
T-18	Bkg	Bkg	Bkg	< 1	< 10
Warehouse Equipment					
Scale					
S-1	Bkg	Bkg	Bkg	< 1	< 10
S-2	Bkg	Bkg	Bkg	< 1	< 10
Large Ramp					
LR-1	Bkg	Bkg	Bkg	< 1	< 10
LR-2	Bkg	Bkg	Bkg	< 1	< 10

TABLE 3-1 (Continued)

HMM RADIATION SURVEY RESULTS

DATE: 7/27/87

Location	Ambient Radiation Levels		Contamination Levels		
	Beta-Gamma (mrem/hr)	Gamma (mrem/hr)	Total Fixed Plus Removable Beta-Gamma (dpm/100cm^2)	Alpha Removable (dpm/100cm^2)	Beta-Gamma Removable (dpm/100cm^2)
Large Ramp (Cont'd)					
LR-3	Bkg	Bkg	Bkg	< 1	< 10
LR-4	Bkg	Bkg	Bkg	< 1	< 10
Small Ramp					
SR-1	Bkg	Bkg	Bkg	< 1	< 10
SR-2	Bkg	Bkg	Bkg	< 1	< 10
Drum Truck 1					
DT1-1	Bkg	Bkg	Bkg	< 1	< 10
DT1-2	Bkg	Bkg	Bkg	< 1	< 10
Drum Truck 2					
DT2-1	Bkg	Bkg	Bkg	< 1	< 10
DT2-2	Bkg	Bkg	Bkg	< 1	< 10
Drum Hoist					
DH-1	Bkg	Bkg	Bkg	< 1	< 10
DH-2	Bkg	Bkg	Bkg	< 1	< 10

TABLE 3-1 (Continued)

HMM RADIATION SURVEY RESULTS

DATE: 7/27/87

Location	Ambient Radiation Levels		Contamination Levels		
	Beta-Gamma (mrem/hr)	Gamma (mrem/hr)	Total Fixed Plus Removable Beta-Gamma (dpm/100cm^2)	Alpha Removable (dpm/100cm^2)	Beta-Gamma Removable (dpm/100cm^2)
Pallet Truck					
PT-1	Bkg	Bkg	Bkg	< 1	< 10
PT-2	Bkg	Bkg	Bkg	< 1	< 10

APPENDICES

APPENDIX 1

Conversion Factors

APPENDIX 1

Conversion Factors

The factors used to convert Ludlum 3 instrument readings to units of dpm/100cm^2 are as follows:

To 100cm^2 - 6.25
cpm per dpm - 0.17

To convert to 100cm^2, the actual probe area of 16cm^2 is divided into 100, the result being 6.25.

The efficiency value of 0.17 cpm per dpm is determined from the calibration certificate which is included as Appendix 2.

MDA

The MDA of the Ludlum 3 is determined as follows:

C_n = Minimum detectable net count = $2Z\ (\ C_b\ )^{1/2}$

Where Z = Zalpha = Zbeta = 1.96 (95% confidence level)

C_b = 100 cpm background

$C_n = 2(1.96)(100)^{1/2}$
$C_n = 39.2$ cpm
$MDA = C_n/E$

Where E = Efficiency = .17 cpm/dpm

MDA = 39.2/.173 = 227 dpm

APPENDIX 2

Calibration Certificate

NUCLEAR INSTRUMENT CO.

Reg. No. 7743

Calibration Certificate

Customer HMM Associates
Instrument Model 3
Serial No. 12605

Probe Type 44-9
Serial No. PR-9792
Calibration Date 5-14-87

Calibration source(s)	Radium 226 A	Radium 226 B	Radium 226 C	Cesium 137 D	Cesium 137 E
Quantity	25.02 mg.	4.98 mg.	1.03 mg.	130 curies	100 mCi.
Mfgs. No.	11880	1582	1-738	Model 69	28-5
NBS Traceable No.	TPX 33822	11005	11005	C-396	30214
Date	8-20-70	11-5-75	9-22-77	9-14-68	10-8-79

Calculated Exposure Rate	Meter Reading *	Range Maximum	Calibration Source(s)
15	30	200 MR/hr **	E
		— R/hr	
10	18		
5	9.8	20 MR/hr	E
2	4.0	— R/hr	
1	2		
.5	1	2 MR/hr	E
.2	.41	— R/hr	
.05	.14		
.02	.07	.2 MR/hr	E
		— R/hr	
		MR/hr	☐
		R/hr	

Integrate Calculated Dose

Beta Shield Open ☐ Closed ☐
Detector center axis parallel ☑ perpendicular ☐ to radiation field
Electronic Alignment ☐ Temperature _____ °C Barometric Pressure _____ mm(Hg) Elevation _____
Instrument check source: Scale: _____ Reading: _____
Remarks: * Meter readings are recorded minus background.
* 44-9 Probe is usable to only 15 M-r/hr. ON x100 range due to GM Tube characteristics.

This instrument has been calibrated using procedures recommended by the N.R.C. U.S. Nuclear Regulatory Commission U.S.N.R.C. License No. 20-16972-01

Calibrated by Carl J Bonari

65 Grove Street – P.O.Box 178 – Rockland, MA. 02370 – Tel. Area Code 617 · 878-6878

REG.NO. 7743

NUCLEAR INSTRUMENT CO.
ROCKLAND, MASSACHUSETTS

CALIBRATION CERTIFICATE

Customer HMM Associates Probe Type 44-9

Instrument Model 3 Serial No. PR-9792

Serial No. 12605 Calibration Date 5-14-87

Calibration Source	Sr-90		
Quantity	.0212 uCi		
Mfgs, No.	NES-261 Lot #261031180A		
NBS Traceable No.	SRM-4234-15		
Date	August 1975		
Activity	78,000 DPM.	5-15-87	Date

Calibration:

Sr-90 on window contact = _____ CPM
Efficiency = _____ %

Sr-90 on grid contact = 25,000 CPM.
Efficiency = 32 %

Sr-90 on even plane with probe end = 22,000 CPM.
Efficiency = 28 %

Background, unshielded = 70 CPM.

High voltage set at 900 Volts

Electronic pulse calibration X

Comments:

Sr-90 @ 1cm distance from probe face= 13,500 CPM
Efficiency = 17.3%

Calibrated by Carl J. Bossari U.S.NRC Licence No. 20-16972-01

65 Grove Street – P.O.Box 178 - Rockland, MA. 02370 – Tel. Area Code 617 · 878-6878

APPENDIX 3

Direct Radiation Measurement

Data Collection Sheets

HMM RADIATION SURVEY

Survey By: Joe Lischinsky/M. Vigliani Date: 7/27/87

Counter Number: 12605 Time: 0900 a.m.

SURVEY LOCATION	Ambient Radiation		Fixed Contamination
	Net Beta-Gamma mrem/hr	Net Gamma mR/hr	Net Beta-Gamma cpm
Floor #1	Bkg	Bkg	Bkg
Floor #2	Bkg	Bkg	Bkg
Floor #3	Bkg	Bkg	Bkg
Floor #4	Bkg	Bkg	Bkg
Floor #5	Bkg	Bkg	Bkg
Floor #6	Bkg	Bkg	Bkg
Floor #7	Bkg	Bkg	Bkg
Floor #8	Bkg	Bkg	Bkg
Floor #9	Bkg	Bkg	Bkg
Floor #10	Bkg	0.04	Bkg
Floor #11	Bkg	0.04	Bkg
Floor #12	Bkg	Bkg	Bkg
Floor #13	Bkg	Bkg	Bkg
Floor #14	Bkg	Bkg	Bkg
Floor #15	Bkg	Bkg	Bkg
GUIDE: UNRESTRICTED AREA			

Bkg = 0.04 mrem/hr

100 cpm

HMM RADIATION SURVEY

Survey By: Joe Lischinsky/M. Vigliani Date: 7/27/87

Counter Number: 12605 Time: 0900 a.m.

SURVEY LOCATION	Ambient Radiation		Fixed Contamination
	Net Beta-Gamma mrem/hr	Net Gamma mR/hr	Net Beta-Gamma cpm
Floor #16	Bkg	Bkg	Bkg
Floor #17	Bkg	Bkg	Bkg
Floor #18	Bkg	Bkg	Bkg
Floor #19	Bkg	0.01	Bkg
Floor #20	Bkg	Bkg	Bkg
Floor #21	Bkg	Bkg	Bkg
Floor #22	Bkg	Bkg	Bkg
Floor #23	Bkg	Bkg	Bkg
Floor #24	Bkg	Bkg	Bkg
Floor #25	Bkg	Bkg	Bkg
Floor #26	Bkg	Bkg	Bkg
Floor #27	Bkg	Bkg	Bkg
Floor #28	Bkg	Bkg	Bkg
Floor #29	Bkg	Bkg	Bkg
Floor #30	Bkg	Bkg	Bkg
GUIDE: UNRESTRICTED AREA			

HMM RADIATION SURVEY

Survey By: Joe Lischinsky/M. Vigliani Date: 7/27/87

Counter Number: 12605 Time: 0900 a.m.

SURVEY LOCATION	Ambient Radiation		Fixed Contamination
	Net Beta-Gamma mrem/hr	Net Gamma mR/hr	Net Beta-Gamma cpm
Floor #31	Bkg	Bkg	Bkg
Floor #32	Bkg	Bkg	Bkg
Floor #33	Bkg	Bkg	Bkg
Floor #34	Bkg	Bkg	Bkg
Floor #35	Bkg	Bkg	Bkg
Floor #36	Bkg	Bkg	Bkg
Floor #37	Bkg	Bkg	Bkg
Floor #38	Bkg	Bkg	Bkg
Floor #39	Bkg	Bkg	Bkg
Floor #40	Bkg	Bkg	Bkg
Floor #41	Bkg	Bkg	Bkg
Floor #42	Bkg	Bkg	Bkg
Floor #43	Bkg	Bkg	Bkg
Floor #44	Bkg	Bkg	Bkg
Floor #45	Bkg	Bkg	Bkg
GUIDE: UNRESTRICTED AREA			

HMM RADIATION SURVEY

Survey By: Joe Lischinsky/M. Vigliani Date: 7/27/87

Counter Number: 12605 Time: 0900 a.m.

SURVEY LOCATION	Ambient Radiation		Fixed Contamination
	Net Beta-Gamma mrem/hr	Net Gamma mR/hr	Net Beta-Gamma cpm
Floor #46	Bkg	Bkg	Bkg
Floor #47	Bkg	Bkg	Bkg
Floor #48	Bkg	Bkg	Bkg
Floor #49	Bkg	Bkg	Bkg
Floor #50	Bkg	Bkg	Bkg
Floor #51	Bkg	Bkg	Bkg
Floor #52	Bkg	Bkg	Bkg
Floor #53	Bkg	Bkg	Bkg
Floor #54	Bkg	Bkg	Bkg
Floor #55	Bkg	Bkg	Bkg
Floor #56	Bkg	Bkg	Bkg
Floor #57	Bkg	Bkg	Bkg
Floor #58	Bkg	Bkg	Bkg
Floor #59	Bkg	Bkg	Bkg
Floor #60	Bkg	Bkg	Bkg
GUIDE: UNRESTRICTED AREA			

HMM RADIATION SURVEY

Survey By: Joe Lischinsky/M. Vigliani Date: 7/27/87

Counter Number: 12605 Time: 0900 a.m.

SURVEY LOCATION	Ambient Radiation		Fixed Contamination
	Net Beta-Gamma mrem/hr	Net Gamma mR/hr	Net Beta-Gamma cpm
Floor #61	Bkg	Bkg	Bkg
Floor #62	Bkg	Bkg	Bkg
Floor #63	Bkg	Bkg	Bkg
Floor #64	Bkg	Bkg	Bkg
Floor #65	Bkg	Bkg	Bkg
Floor #66	Bkg	Bkg	Bkg
Floor #67	Bkg	Bkg	Bkg
Floor #68	Bkg	Bkg	Bkg
Floor #69	Bkg	Bkg	Bkg
Floor #70	Bkg	Bkg	Bkg
Floor #71	Bkg	Bkg	Bkg
GUIDE: UNRESTRICTED AREA			

HMM RADIATION SURVEY

Survey By: Joe Lischinsky/M. Vigliani Date: 7/27/87

Counter Number: 12605 Time: 0900 a.m.

SURVEY LOCATION	Ambient Radiation		Fixed Contamination
	Net Beta-Gamma mrem/hr	Net Gamma mR/hr	Net Beta-Gamma cpm
18' Truck	Bkg	Bkg	Bkg
T-1	Bkg	Bkg	Bkg
T-2	Bkg	Bkg	Bkg
T-3	Bkg	Bkg	Bkg
T-4	Bkg	Bkg	Bkg
T-5	Bkg	Bkg	Bkg
T-6	Bkg	Bkg	Bkg
T-7	Bkg	Bkg	Bkg
T-8	Bkg	Bkg	Bkg
T-9	Bkg	Bkg	Bkg
T-10	Bkg	Bkg	Bkg
T-11	Bkg	Bkg	Bkg
T-12	Bkg	Bkg	Bkg
T-13	Bkg	Bkg	Bkg
T-14	Bkg	Bkg	Bkg
GUIDE: UNRESTRICTED AREA			

HMM RADIATION SURVEY

Survey By: Joe Lischinsky/M. Vigliani Date: 7/27/87

Counter Number: 12605 Time: 0900 a.m.

SURVEY LOCATION	Ambient Radiation		Fixed Contamination
	Net Beta-Gamma mrem/hr	Net Gamma mR/hr	Net Beta-Gamma cpm
18' Truck			
T-15	Bkg	Bkg	Bkg
T-16	Bkg	Bkg	Bkg
T-17	Bkg	Bkg	Bkg
T-18	Bkg	Bkg	Bkg
Scale			
S-1	Bkg	Bkg	Bkg
S-2	Bkg	Bkg	Bkg
Large Ramp			
LR-1	Bkg	Bkg	Bkg
LR-2	Bkg	Bkg	Bkg
Small Ramp			
SR-1	Bkg	Bkg	Bkg
SR-2	Bkg	Bkg	Bkg
GUIDE: UNRESTRICTED AREA			

HMM RADIATION SURVEY

Survey By: Joe Lischinsky/M. Vigliani Date: 7/27/87

Counter Number: 12605 Time: 0900 a.m.

SURVEY LOCATION	Ambient Radiation		Fixed Contamination
	Net Beta-Gamma mrem/hr	Net Gamma mR/hr	Net Beta-Gamma cpm
Drum Truck 1			
DT1-1	Bkg	Bkg	Bkg
DT1-2	Bkg	Bkg	Bkg
Drum Truck 2			
DT2-1	Bkg	Bkg	Bkg
DT2-2			
Drum Hoist			
DH-1	Bkg	Bkg	Bkg
DH-2			
Pallet Truck			
PT-1	Bkg	Bkg	Bkg
PT-2			
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APPENDIX 4

Bolton and Galanek

Smear Analysis Results

SMEAR IDENTIFICATION

The smear numbering indicated in the following analyses documentation depicts smears taken from locations as follows:

Smear Numbers	Location
1 through 63	Waste Storage Area/Pathway Floor Grid
64 through 71	General Area of Warehouse
T-1 through T-18	Truck Floor Grid
S-1 through S-2	Scale Surface
LR-1 through LR-4	Large Ramp Surface
SR-1 through SR-2	Small Ramp Surface
DT1-1 through DT1-2	Dump Truck #1 Surface
DT2-1 through DT2-2	Dump Truck #2 Surface
DH-1 through DH-2	Drum Hoist
PT-1 through PT-2	Pallet Truck

BOLTON & GALANEK, INC.
Consultants · Radiochemistry & Health Physics
P.O. Box 366 M.I.T. Branch
Boston, MA 02139
Tel. (617) 253-2180

July 31, 1987

HMM Associates
336 Baker Avenue
Concord, MA 01742

Attention: Mr. Mario Vigliani

The following are the results from the analysis of the wipe test samples submitted to this laboratory:

Sample #	Alpha results (dpm/100cm^2)	Beta results (dpm/100 cm^2)	Tritium results (dpm/100 cm^2)
1	<1.0	<10.0	<10.0
2	<1.0	<10.0	<10.0
3	<1.0	<10.0	<10.0
4	<1.0	<10.0	<10.0
5	<1.0	<10.0	<10.0
6	<1.0	<10.0	<10.0
7	<1.0	<10.0	<10.0
8	<1.0	<10.0	<10.0
9	<1.0	<10.0	<10.0
10	<1.0	<10.0	<10.0
11	<1.0	<10.0	<10.0
12	<1.0	<10.0	<10.0
13	<1.0	<10.0	<10.0
14	<1.0	<10.0	<10.0
15	<1.0	<10.0	<10.0
16	<1.0	<10.0	<10.0
17	<1.0	<10.0	<10.0
18	<1.0	<10.0	<10.0
19	<1.0	<10.0	<10.0
20	<1.0	<10.0	<10.0
21	<1.0	<10.0	<10.0
22	<1.0	<10.0	<10.0
23	<1.0	<10.0	<10.0
24	<1.0	<10.0	<10.0
25	<1.0	<10.0	<10.0
26	<1.0	<10.0	<10.0
27	<1.0	<10.0	<10.0
28	<1.0	<10.0	<10.0
29	<1.0	<10.0	<10.0
30	<1.0	<10.0	<10.0
31	<1.0	<10.0	<10.0
32	<1.0	<10.0	<10.0
33	<1.0	<10.0	<10.0
34	<1.0	<10.0	<10.0
35	<1.0	<10.0	<10.0

Sample #	Alpha results (dpm/100cm^2)	Beta results (dpm/100 cm^2)	Tritium results (dpm/100 cm^2)
36	<1.0	<10.0	<10.0
37	<1.0	<10.0	<10.0
38	<1.0	<10.0	<10.0
39	<1.0	<10.0	<10.0
40	<1.0	<10.0	<10.0
41	<1.0	<10.0	<10.0
42	<1.0	<10.0	<10.0
43	<1.0	<10.0	<10.0
44	<1.0	<10.0	<10.0
45	<1.0	<10.0	<10.0
46	<1.0	<10.0	<10.0
47	<1.0	<10.0	<10.0
48	<1.0	<10.0	<10.0
49	<1.0	<10.0	<10.0
50	<1.0	<10.0	<10.0
51	<1.0	<10.0	<10.0
52	<1.0	<10.0	<10.0
53	<1.0	<10.0	<10.0
54	<1.0	<10.0	<10.0
55	<1.0	<10.0	<10.0
56	<1.0	<10.0	<10.0
57	<1.0	<10.0	<10.0
58	<1.0	<10.0	<10.0
59	<1.0	<10.0	<10.0
60	<1.0	<10.0	<10.0
61	<1.0	<10.0	<10.0
62	<1.0	<10.0	<10.0
63	<1.0	<10.0	<10.0
64	<1.0	<10.0	<10.0
65	<1.0	<10.0	<10.0
66	<1.0	<10.0	<10.0
67	<1.0	<10.0	<10.0
68	<1.0	<10.0	<10.0
69	<1.0	<10.0	<10.0
70	<1.0	<10.0	<10.0
71	<1.0	<10.0	<10.0
S1	<1.0	<10.0	<10.0
S2	<1.0	<10.0	<10.0
LR-1	<1.0	<10.0	<10.0
LR-2	<1.0	<10.0	<10.0
LR-3	<1.0	<10.0	<10.0
LR-4	<1.0	<10.0	<10.0
SR-1	<1.0	<10.0	<10.0
SR-1	<1.0	<10.0	<10.0

Sample #	Alpha results (dpm/100cm^2)	Beta results (dpm/100 cm^2)	Tritium results (dpm/100 cm^2)
DT1-1	<1.0	<10.0	<10.0
DT1-2	<1.0	<10.0	<10.0
DT2-1	<1.0	<10.0	<10.0
DT2-2	<1.0	<10.0	<10.0
DH-1	<1.0	<10.0	<10.0
DH-2	<1.0	<10.0	<10.0
PT-1	<1.0	<10.0	<10.0
PT-2	<1.0	<10.0	<10.0
T-1	<1.0	<10.0	<10.0
T-2	<1.0	<10.0	<10.0
T-3	<1.0	<10.0	<10.0
T-4	<1.0	<10.0	<10.0
T-5	<1.0	<10.0	<10.0
T-6	<1.0	<10.0	<10.0
T-7	<1.0	<10.0	<10.0
T-8	<1.0	<10.0	<10.0
T-9	<1.0	<10.0	<10.0
T-10	<1.0	<10.0	<10.0
T-11	<1.0	<10.0	<10.0
T-12	<1.0	<10.0	<10.0
T-13	<1.0	<10.0	<10.0
T-14	<1.0	<10.0	<10.0
T-15	<1.0	<10.0	<10.0
T-16	<1.0	<10.0	<10.0
T-17	<1.0	<10.0	<10.0
T-18	<1.0	<10.0	<10.0

There were a total of 105 wipe test samples. There was no detectable radioactivity on any of the wipes. The wipes were analysed for gross alpha and gross beta activity in a Canberra Model 2404 Alpha/Beta/Gamma proportional counter that is calibrated with NBS traceable standards. The tritium analysis was performed in a Packard Model 300A liquid scintillation counter that is also calibrated with NBS traceable standards.

If you have any questions concerning these results, please do not hesitate to call me.

Mitchell S. Galanek
Health Physicist
NRC License # 20-13302-01

APPENDIX 5

Pertinent Radiological Regulations,

Standards, and Guidelines

I. EXCERPTS FROM

DRAFT AMERICAN NATIONAL STANDARD

N13.12

Control of Radioactive Surface Contamination
on Materials, Equipment, and Facilities to be
Released for Uncontrolled Use

Where potentially contaminated surfaces are not accessible for measurement (as in some pipes, drains, and ductwork), such property shall not be released pursuant to this standard, but shall be made the subject of case-by-case evaluation.

Property shall not be released for uncontrolled use unless measurements show the total and removable contamination levels to be no greater than the values in Table 1 or Table 2. (The values in Table 2 are easier to apply when the contaminants cannot be individually identified.)

Coatings used to cover the contamination shall not be considered a solution to the contamination problem. That is, the monitoring techniques shall be sufficient to determine, and such determination shall be made, that the total amount of contamination present on and under any coating does not exceed the Table 1 or Table 2 values before release.

TABLE 1

SURFACE CONTAMINATION LIMITS*

Contaminants			Limit (Activity) (dis/min-100 cm^2)+	
Group	Description	Nuclides (Note 1)	Removable	Total (Fixed plus Removable)
1	Nuclides for which the nonoccupational MPC (Note 2) is 2 x 10^{-13} Ci/m^3 or less or for which the nonoccupational MPC (Note 4) is 2 x 10^{-7} Ci/m^3 or less	^{227}Ac $^{241,242m,243}Am$ $^{249,250,251,252}Cf$ $^{243,244,245,246,247,248}Cm$ $^{125,129}I$ ^{237}Np ^{231}Pa ^{210}Pb $^{238,239,240,242,244}Pu$ $^{226,228}Ra$ $^{228,230}Th$	20	Nondetectable (Note 3)
2	Those nuclides not in Group 1 for which the nonoccupational MPC (Note 2) is 1 x 10^{-12} Ci/m^3 or less for which the nonoccupational MPC (Note 4) is 1 x 10^{-6} Ci/m^3 or less	^{254}Es ^{256}Fm $^{126,131,133}I$ ^{210}Po ^{223}Ra ^{90}Sr ^{232}Th ^{232}U	200	2000 α Nondetectable β,γ (Note 5)
3	Those nuclides not in Group 1 or Group 2		1000	5000

SURFACE CONTAMINATION LIMITS

* The levels may be averaged over one square meter provided the maximum activity in any area of 100 cm^2 is less than three times the limit value. For purposes of averaging with regard to isolated spots of activity, any square meter of surface shall be considered to be contaminated above the limit L, applicable to 100 cm^2, if (1) from measurements of a representative number n of sections it is determined that $1/n \Sigma n S_i \geq L$, where S_i is the dis/min-100 cm^2 determined from measurement of section i; or (2) it is determined that the activity of all isolated spots or particles in any area less than 100 cm^2 exceeds 3 L.

\+ Disintegrations per minute per square decimeter.

NOTES:

(1) Values presented here are obtained from the Code of Federal Regulations, Title 10, Part 20, April 30, 1975. The most limiting of all given MPC values (for example, soluble versus insoluble) are to be used. In the event of the occurrence of mixtures of radionuclides, the fraction contributed by each constituent of its own limit shall be determined and the sum of the fraction shall be less than 1.

(2) Maximum permissible concentration in air applicable to continuous exposure of members of the public as published by or derived from an authoritative source such as the National Committee on Radiation Protection and Measurements (NCRP), the International Commission on Radiological Protection (ICRP), or the Nuclear Regulatory Commission (NRC). From the Code of Federal Regulations, Title 10, Part 20, Appendix B, Table 2, Column 1.

(3) The instrument utilized for this measurement shall be calibrated to measure at least 100 pCi of any Group 1 contaminants uniformly spread over 100 cm^2.

(4) Maximum permissible concentration in water applicable to members of the public.

(5) The instrument utilized for this measurement shall be calibrated to measure at least 1 nCi of any Group 2 beta or gamma contaminants uniformly spread over an area equivalent to the sensitive area of the detector. Direct survey for unconditional release should be performed in areas where the background is $\leq$ 100 counts per minute. When the survey must be performed in a background exceeding 100 counts per minute, it may be necessary to use the indirect survey method to provide the additional sensitivity required.

TABLE 2

ALTERNATE SURFACE CONTAMINATION LIMITS

(All Alpha Emitters, except U_{nat} and Th_{nat}, Considered as a Group)*

Contamination Contingencies	Limit (Activity) (dis/min-100 cm^2)+ Removable	Total (Fixed Plus Removable
If the contaminant cannot be identified; or if alpha emitters other than U_{nat} (Note 1) and Th_{nat} are present; or if the beta emitters comprise ^{227}Ac or ^{228}Ra.	20	Nondetectable (Note 2)
If it is known that all alpha emitters are generated from U_{nat} (Note 1) and Th_{nat}; and if beta emitters are present that, while not identified, do not include ^{227}Ac, ^{125}I, ^{226}Ra, and ^{228}Ra.	200	2000 α Nondetectable β,γ (Note 3)
If it is known that alpha emitters are generated only from U_{nat} (Note 1) and Th_{nat} in equilibrium with its decay products; and if the beta emitters, while not identified, do not include ^{227}Ac, ^{125}I, ^{129}I, ^{90}Sr, ^{223}Ra, ^{228}Ra, ^{126}I, ^{131}I and ^{133}I.	1000	5000

ALTERNATE SURFACE CONTAMINATION LIMITS

* The levels may be averaged over one square meter provided the maximum activity in any area of 100 cm^2 is less than three times the limit value. For purposes of averaging with regard to isolated spots of activity, any square meter of surface shall be considered to be contaminated above the limit L, applicable to 100 cm^2, if (1) from measurements of a representative number n of sections it is determined that $1/n \sum n S_i \geq L$, where S_i is the dis/min-100 cm^2 determined from measurement of section i; or (2) it is determined that the activity of all isolated spots or particles in any area less than 100 cm^2 exceeds 3 L.

\+ Disintegrations per minute per square decimeter.

NOTES:

(1) U_{nat} and decay products.

(2) The instrument utilized for this measurement shall be calibrated to measure at least 100 pCi of any Group 1 contaminants uniformly spread over 100 cm^2.

(3) The instrument utilized for this measurement shall be calibrated to measure at least 1 nCi of any Group 2 beta or gamma contaminants uniformly spread over an area equivalent to the sensitive area of the detector. Direct survey for unconditional release should be performed in areas where the background is $\leq$ 100 counts per minute. When the survey must be performed in a background exceeding 100 counts per minute, it may be necessary to use the indirect survey method to provide the additional sensitivity required.

II. U.S. NUCLEAR REGULATORY COMMISSION,
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY
WASHINGTON, D.C.
July, 1982

Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-Product, Source, or Special Nuclear Material

(These have been retyped for purposes of this report.)

The instructions in this guide, in conjunction with Table 1, specify the radioactivity and radiation exposure rate limits which should be used in accomplishing the decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table 1 do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control will be considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 1 prior to applying the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or duct work shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or duct work. Surfaces of premises, equipment, or

scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such request that:

   a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

   b. Provide a detailed health and safety analysis which reflects the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table 1. A copy of the survey report shall be filed with the Division of Fuel Cycle and Material Safety, USNRC, Washington, DC 20555, and also the Director of the Regional Office of the Office of Inspection and Enforcement, USNRC, having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

   a. Identify the premises.

   b. Show that reasonable effort has been made to eliminate residual contamination.

c. Describe the scope of the survey and general procedures followed.

d. State the findings of the survey in units specified in the instruction.

Following review of the report, NRC will consider visiting the facilities to confirm the survey.

TABLE 3

ACCEPTABLE SURFACE CONTAMINATION LIMITS

NUCLIDES[a]	AVERAGE[bcf]	MAXIMUM[bdf]	REMOVABLE[bef]
U-nat, ^{235}U, ^{238}U and associated decay products	5000 dis/min-100 cm^2 α	15,000 dis/min-100 cm^2 α	1000 dis/min-100 cm^2 α
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100 dis/min-100 cm^2	300 dis/min-100 cm^2	20 dis/min-100 cm^2
Th-nat, ^{232}Th ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	1000 dis/min-100 cm^2	3,000 dis/min-100 cm^2	200 dis/min-100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and others noted above.	5000 dis/min-100 cm^2 $\beta\gamma$	15,000 dis/min-100 cm^2 $\beta\gamma$	1000 dis/min-100 cm^2 $\beta\gamma$

TABLE 3 (Continued)

ACCEPTABLE SURFACE CONTAMINATION LEVELS

a Where surface contamination by both alpha and beta-gamma emitting nuclides exists, the limits established for alpha and beta-gamma emitting nuclides should apply independently.

b As used in this table, dis/min (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

c Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

d The maximum contamination level applies to an area of not more than 100 cm^2.

e The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

f The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h at 1 cm and 1.0 mrad/h at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.