

NORTH CAROLINA STATE UNIVERSITY

SCHOOL OF ENGINEERING

DEPARTMENT OF NUCLEAR ENGINEERING
NUCLEAR REACTOR PROGRAM
Box 5636 Zip 27650

March 16, 1983

Mr. William Peery
Materials and RAD Protection Section
Division of Engineering & Technical Inspection
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, GA 30303

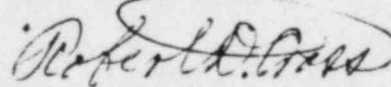
Dear Mr. Peery:

Enclosed is a copy of our final survey of the R-3 Bay after removing the R-3 reactor biological shield. These swipes were taken of the walls below the track of the overhead crane, the floor, all horizontal surfaces on the walls, the trenches relating to the reactor, and the fuel storage pit. All swipes were "clean"; i.e., the DPM (β - γ) count was less than 85. These swipes were taken of individual areas of less than 10' square since the smaller size better fitted the octagon walls of the Bay.

Per our conversation relative to the area above the crane track vs the area below, I conclude the area above the crane track would not show any greater deviation of radiological cleanliness than did the area below the crane. Hence, it is not necessary to swipe the surfaces above the crane track.

A copy of this letter and enclosure has been sent to Mr. Peter Erickson in Washington.

Very truly yours,



Robert D. Cross
Reactor Health Physicist

RDC:lpe

Enclosure:
R-3 Demolition Final Survey

R-3 DEMOLITION FINAL SURVEY

Page: Final 1:

Items 1 thru 20: Storage holes in walls.

Items 21 thru 32: Relate to equipment associated with the Gamma Facility

Pages: Final 2 thru 6:

Items 1 thru 191: Swipes of R-3 Bay walls and pipes on these walls.

NOTE: R-3 Bay is octagonal in shape. See Drawings 1 thru 4. Side A has 4 windows. Each side was divided into thirds both horizontal and vertical, about 8' squares. The vertical wall, each side, is Number 1, 2, 3 ... from left to right. Hence, for Side A, the numbering is: 1A, 2A, 3A, 4A, etc. The horizontal pipes on each side, each vertical section are numbered consecutively from 1 up, floor to crane track. Hence for Side 1A, the pipes are 1AH1, 1AH2,, 4AH5, 4AH6,, 7AH7, 7AH8 This system is followed throughout the Bay walls.

Page: Final 6:

Items 192 thru 210: These swipes were taken on horizontal surfaces under Wall Source Storage Holes 1 thru 20, under beam catcher holes in the walls; on shelves attached to the wall, and the sink.

Page: Final 7:

Items 211 thru 236: Swipes of the R-3 Bay Floor exclusive of the trenches and biological shield area.

Page: Final 8 & 9 - See Drawing #5:

Items 1 thru 70: Swipes of the trenches associated with the R-3 reactor and the base of the biological shield.

Page: Final 9 & 10 - See Drawing #5:

Items 71 thru 98: Swipes of holes in fuel storage pit.

Page: Final 11 - See Drawing #6:

Items 1 thru 14: Swipes of floor from platform within R-3 to Loading Dock outside of building.

All swipes indicated above were not greater than 85 DPM for beta-gamma contamination and 0 DPM for alpha. On this basis, it is suggested that all surfaces above (over) the track of the overhead crane are, likewise, "clean".

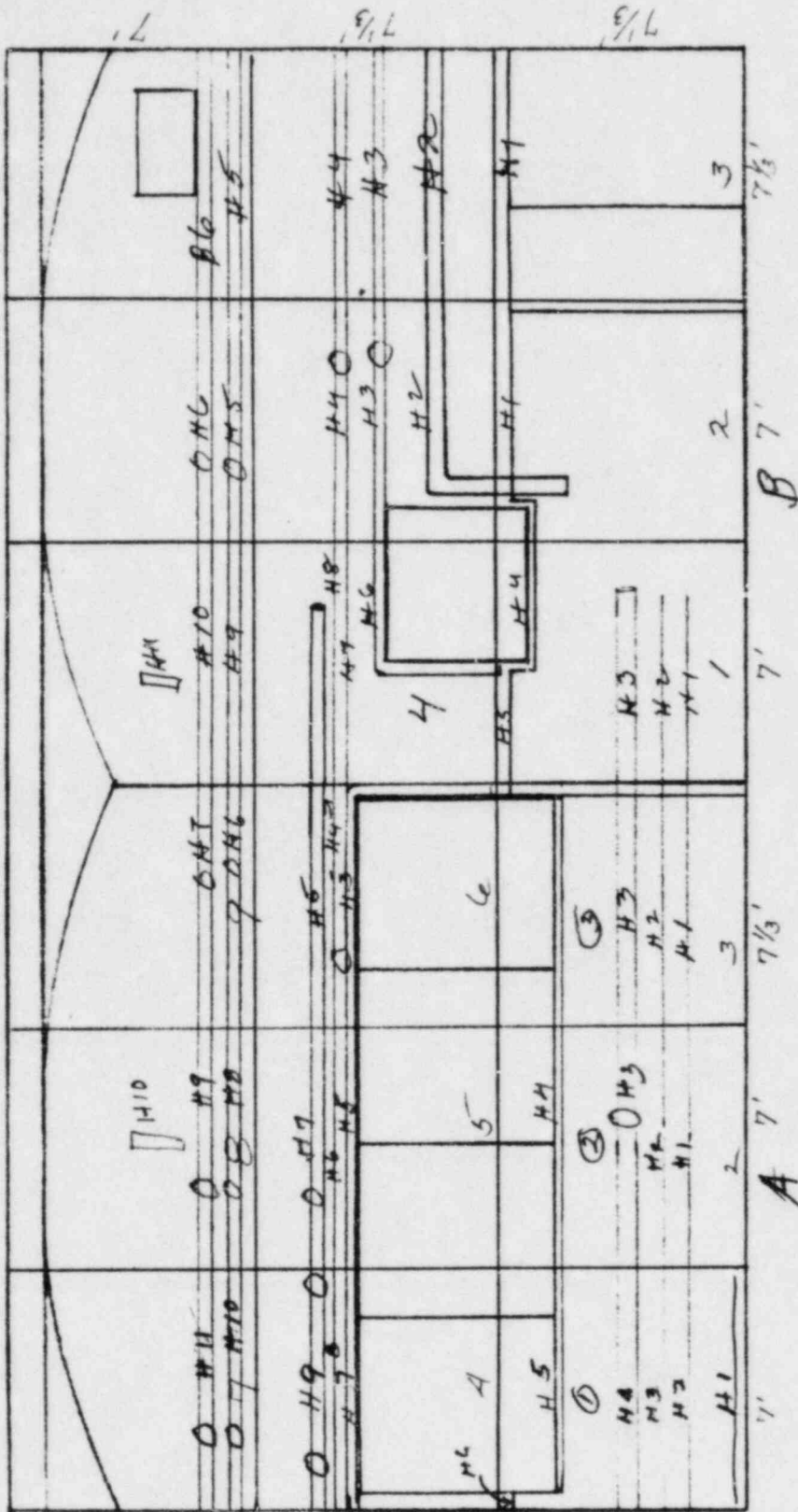
Drawing Nos 1, 2, 3 & 4 relate to Swipes No 1 thru 191.

Vertical Surfaces

1A, 2A, 3A,

Horizontal Surfaces

1A, 1B, 2, 3, ---



SCALE 3/16" = 1'0"

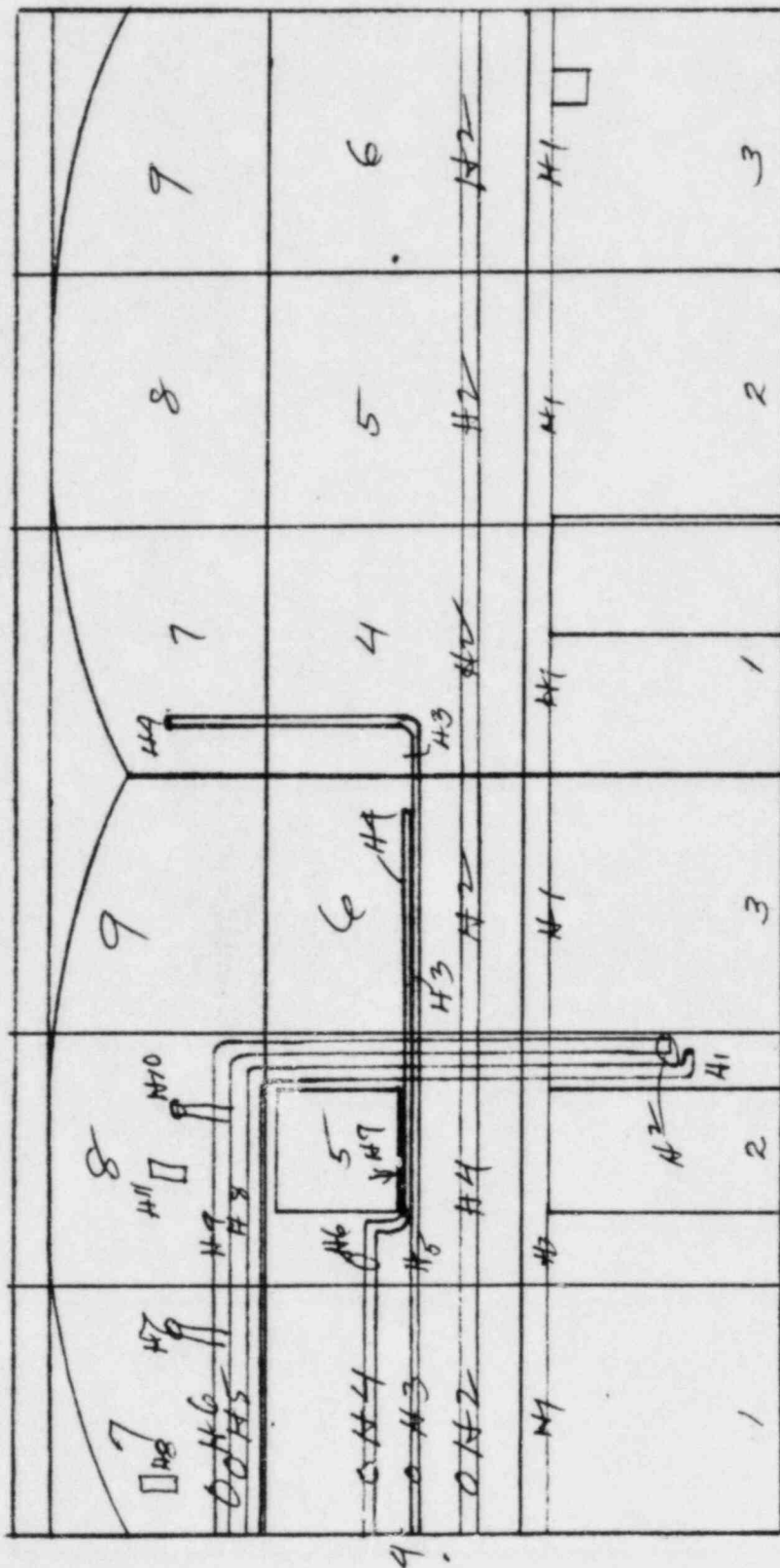
TITLE R-3 ROOM WALLS

DATE 1-31-83

DRAWING NUMBER 1

DRAWN BY V. STOTT

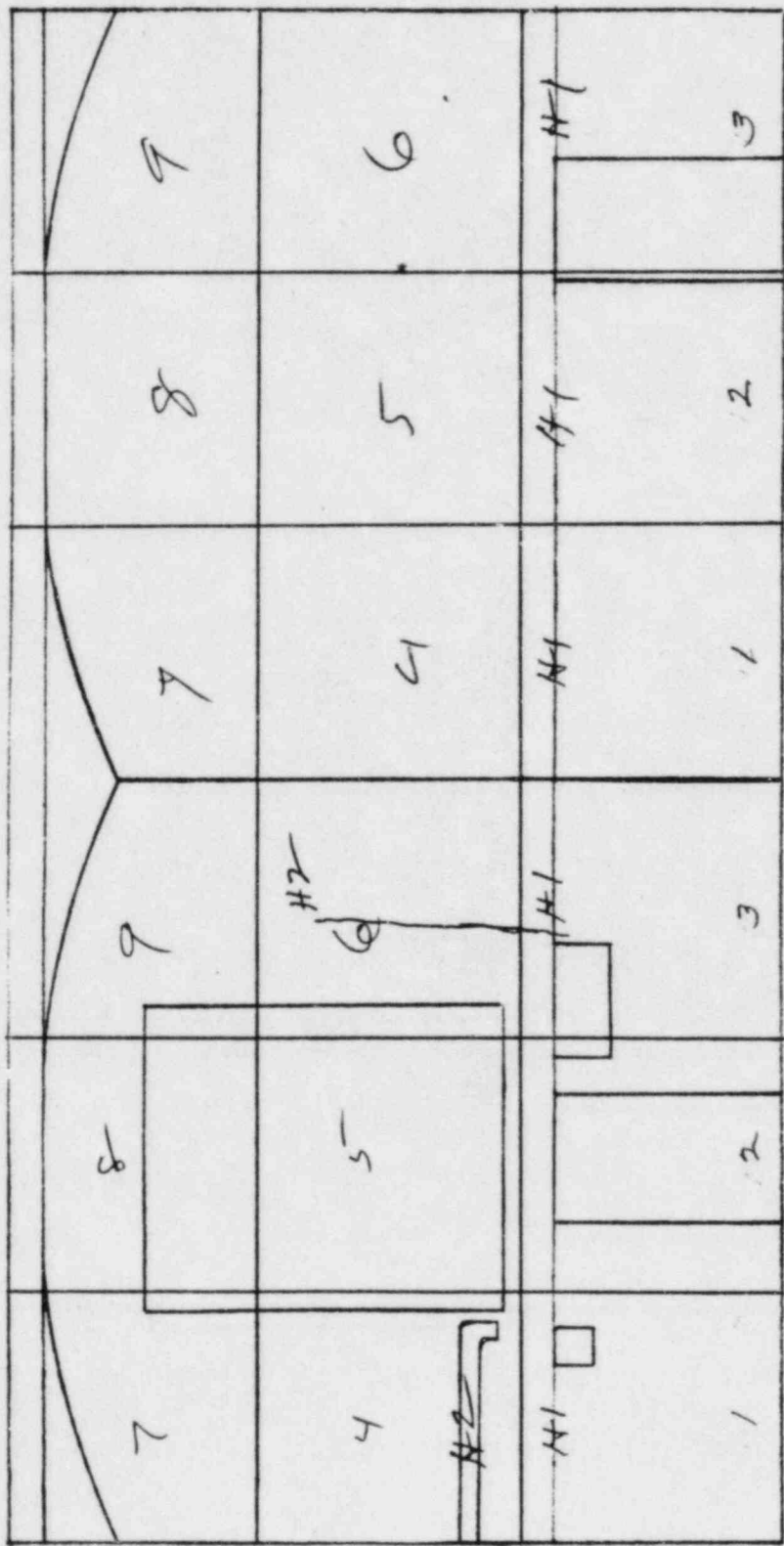
APPROVED BY



D

C

SCALE 3/16" = 1'-0"	DRAWN BY V. STOTT
APPROVED BY	
TITLE R-3 ROOM WALLS	
DATE 1-31-83	DRAWING NUMBER 2



E

F

SCALE 3/16" = 1'-0"	DRAWN BY V. SLOTT
APPROVED BY	
TITLE R-3 ROOM WALLS	
DATE 1-31-83	DRAWING NUMBER 3

Swipe Log

Swipe No.	Location	Gross Counts	GCPM	Bkgd. α or β	NCPM	Eff. α or β	DPM
2-28-83	$\beta_{BKG} = 50 \text{ cpm}$ $\beta_{EFF} = .6010$ $\alpha_{BKG} = .1$ $\alpha_{EFF} = .3327$						
1	STORAGE HOLES IN	45	45	50	—	.6010	—
2	WALLS (SWIPE NO. AND	56	56		6		10
3	HOLE NO. ARE SAME)	54	54		4		7
4		38	38		—		—
5		45	45		—		—
6		60	60		10		17
7		44	44		—		—
8		50	50		—		—
9		52	52		2		3
10		46	46		—		—
11		61	61		11		18
12		43	43		—		—
13		63	63		13		21
14		60	60		10		17
15		52	52		2		3
16		58	58		8		13
17		49	49		—		—
18		46	46		—		—
19		43	43		—		—
20		59	59		9		15

TAKEN BY: R. CROSS
COUNTED BY: M. BURRIS

2-28-83							
21	R3 MOTOR & PUMP	76	76	50	26	.6010	43
22	" PIPING INLET	55	55		5		8
23	" OLD PUMP	54	54		4		7
24	INLET FILTER	54	54		4		7
25	PIPING INLET FILT. TO DEMIN.	55	55		5		8
26	DEMIN. TOP	55	55		5		8
27	" SIDES	57	57		7		11
28	" SIDES	56	56		6		10
29	DEMIN. PIPING TO FILTER	51	51		1		2
30	OUTLET FILTER	48	48		—		—
31	OUTLET PIPING	53	53		3		5
32	DEMIN. STAND METER	58	58		8		13

TAKEN BY R. CROSS
COUNTED BY M. BURRIS

Items 21-32 inclusive are related to the Gamma Facility.

R.D.Z.

Swipe Log

Swipe No.	Location	Gross Counts	GCPM	Bkgd. α or β	NCPM	Eff. α or β	DPM
1	1A	43	43	51	—	.6097	—
2	1A H1	59	59	51	8	.6097	13.12
3	1A H2	54	54	51	3	.6097	4.9
4	1A H3	56	56	51	5	.6097	8
5	1A H4	55	55	51	4	.6097	6
6	1A H5	52	52	51	1	.6097	2
7	1A H6	57	57	51	6	.6097	9
8	4A	55	55	51	4	.6097	6
9	H7	56	56	51	5	.6097	8
10	H8	43	43	51	—	.6097	—
11	H9	51	51	51	—	.6097	—
12	A7	61	61	51	10	.6097	16
13	H10	68	68	51	17	.6097	28
14	H11	62	62	51	11	.6097	18
15	A2	47	47	51	—	.6097	—
16	H1	54	54		3		5
17	H2	63	63		12		20
18	H3	55	55		4		6
19	H4	55	55		4		6
20	A5	65	65		14		23
21	H5	68	68		17		28
22	H6	45	45		—		—
23	H7	58	58		7		11
24	A8	75	75		24		39
25	H8	62	62		11		18
26	H9	57	57		6		10
27	H10	60	60		9		15
28	A3	61	61		10		16
29	H1	58	58		7		11
30	H2	65	65		14		23
31	A6	59	59		8		13
32	H3	59	59		8		13
33	H4	65	65		14		23
34	H5	59	59		8		13
35	A9	75	75		24		39
36	H6	65	65		14		23
37	H7	63	63		12		20
38	B1	52	52		1		2
39	H1	52	52		1		2
40	H2	58	58		7		11
41	H3	53	53		2		3
42	B4	64	64		13		21
43	H6	55	55		4		6
44	B1	53	53		2		3
45	H5	75	75		24		39
46	H7	65	65		14		23
47	H8	59	59		8		13
48	B4	77	77		21		33

Swipe Log

Swipe No.	Location	Gross Counts	GCPM	Bkgd. α or β	NCPM	Eff. α or β	DPM
				51		.6097	
49	H9	64	64		13		21
50	H10	60	60		9		15
51	B4 H11	61	61		10		16
52	B2	65	65		14		23
53	H1	66	66		15		25
54	B5	65	65		14		23
55	H2	56	56		5		8
56	H3	63	63		12		20
57	H4	52	52		1		1
58	B8	45	45		—		—
59	H5	42	42		—		—
60	H6	65	65		14		23
61	B3	69	69		18		29
62	H1	58	58		7		11
63	B6	49	49		—		—
64	H2	63	63		12		20
65	H3	71	71		20		33
66	H4	60	60		9		15
67	B9	54	54	51	3	.6097	5
68	H5	60	60		9		15
69	H6	55	55		4		6
70	C1	63	63		12		20
71	H1	60	60		9		15
72	C4	73	73		22		36
73	H2	63	63		12		20
74	H3	54	54		3		5
75	H4	60	60		9		15
76	C7	50	50		—		—
77	H5	60	60		9		15
78	H6	54	54		3		5
79	H7	70	70		19		31
80	H8	58	58		7		11
81	C2	44	44		—		—
82	H1	55	55		4		6
83	H2	50	50		—		—
84	H3	56	56		5		8
85	C5	54	54	51	3	.6097	5
86	H4	63	63		12		20
87	H5	62	62		11		18
88	H6	71	71		20		33
89	H7	66	66		15		25
90	C8	64	64		13		21
91	H8	69	69		18		29
92	H9	63	63		12		20
93	H10	55	55		4		6
94	H11	69	69		18		29
95	C3	54	54		3		5

Swipe Log

Swipe No.	Location	Gross Counts	GCPM	Bkgd. α or β	NCPM	Eff. α or β	DPM
96	C3 H1	49	49	51	—	.6097	—
97	C6	59	59	↓	8	↓	13
98	H2	63	63	↓	12	↓	20
99	H3	54	54	↓	3	↓	5
100	H4	69	69	↓	18	↓	29
101	C9	65	65	↓	14	↓	23
102	D1	58	58	↓	7	↓	11
103	H1	68	68	↓	17	↓	28
104	D4	63	63	↓	12	↓	20
105	H2	54	54	↓	3	↓	5
106	H3	51	51	51	—	.6092	—
3/2/83 107	D7	65	65	60	5	.6072	8
108	H4	58	58	↓	—	↓	—
109	D2	54	54	↓	—	↓	—
110	H1	51	51	↓	—	↓	—
111	D5	50	50	↓	—	↓	—
112	H2	57	57	↓	—	↓	—
113	D8	52	52	↓	—	↓	—
114	D3	56	56	↓	—	↓	—
115	H1	67	67	↓	7	↓	12
116	D6	68	68	60	8	.6092	13
117	H2	50	50	↓	—	↓	—
118	D9	71	71	↓	11	.6072	18
119	E1	56	56	↓	0	↓	—
120	H1	53	53	↓	0	↓	—
121	SNK	52	52	↓	0	↓	—
122	E4	64	64	↓	4	↓	7
123	H2	59	59	↓	0	↓	—
124	E7	60	60	↓	0	↓	—
125	E2	59	59	↓	0	↓	—
126	E5	58	58	60	0	.6092	—
127	E8	57	57	↓	0	↓	—
128	E3	66	66	↓	0	↓	—
129	H1	57	57	↓	0	↓	—
130	E6	54	54	↓	0	↓	—
131	H2	49	49	↓	0	↓	—
132	E9	57	57	↓	0	↓	—
133	F1	60	60	↓	0	↓	—
134	H1	60	60	↓	0	↓	—
135	F4	58	58	↓	0	↓	—
136	F7	64	64	60	4	.6092	7

3/2/83

Swipe Log

Swipe No.	Location	Gross Counts	GCPM	Bkgd. α or β	NCPM	Eff. α or β	DPM
137	F2	58	58	60	0	.6092	—
138	H1	55	55	↓	0	.6092	—
139	F5	60	60	↓	0	↓	—
140	F8	52	52	↓	0	↓	—
141	F3	74	74	↓	14	↓	23
142	H1	62	62	↓	2	↓	3
143	F6	51	51	↓	0	↓	—
144	F9	61	61	↓	1	↓	2
145	G1	73	73	↓	13	↓	21
146	H1	60	60	↓	0	↓	—
147	G4	55	55	60	0	.6092	—
148	H2	58	58	↓	0	↓	—
149	G7	63	63	↓	3	↓	5
150	G2	61	61	↓	1	↓	2
151	G3	65	65	↓	5	↓	8
152	G2 H1	59	59	↓	0	↓	—
153	G5 H2	65	65	↓	5	↓	8
154	H3	58	58	↓	0	↓	—
155	H1	78	78	↓	18	↓	30
156	G8	64	64	↓	14	↓	23
157	G3	54	54	60	—	.6092	—
158	H1	49	49	↓	—	↓	—
159	G6	52	52	↓	—	↓	—
160	H2	58	58	↓	—	↓	—
161	H3	50	50	↓	—	↓	—
162	G9	57	57	↓	—	↓	—
163	H1	55	55	↓	—	↓	—
164	H1	70	70	↓	10	↓	16
165	H4	72	72	↓	12	↓	20
166	H2	67	67	60	7	.6092	12

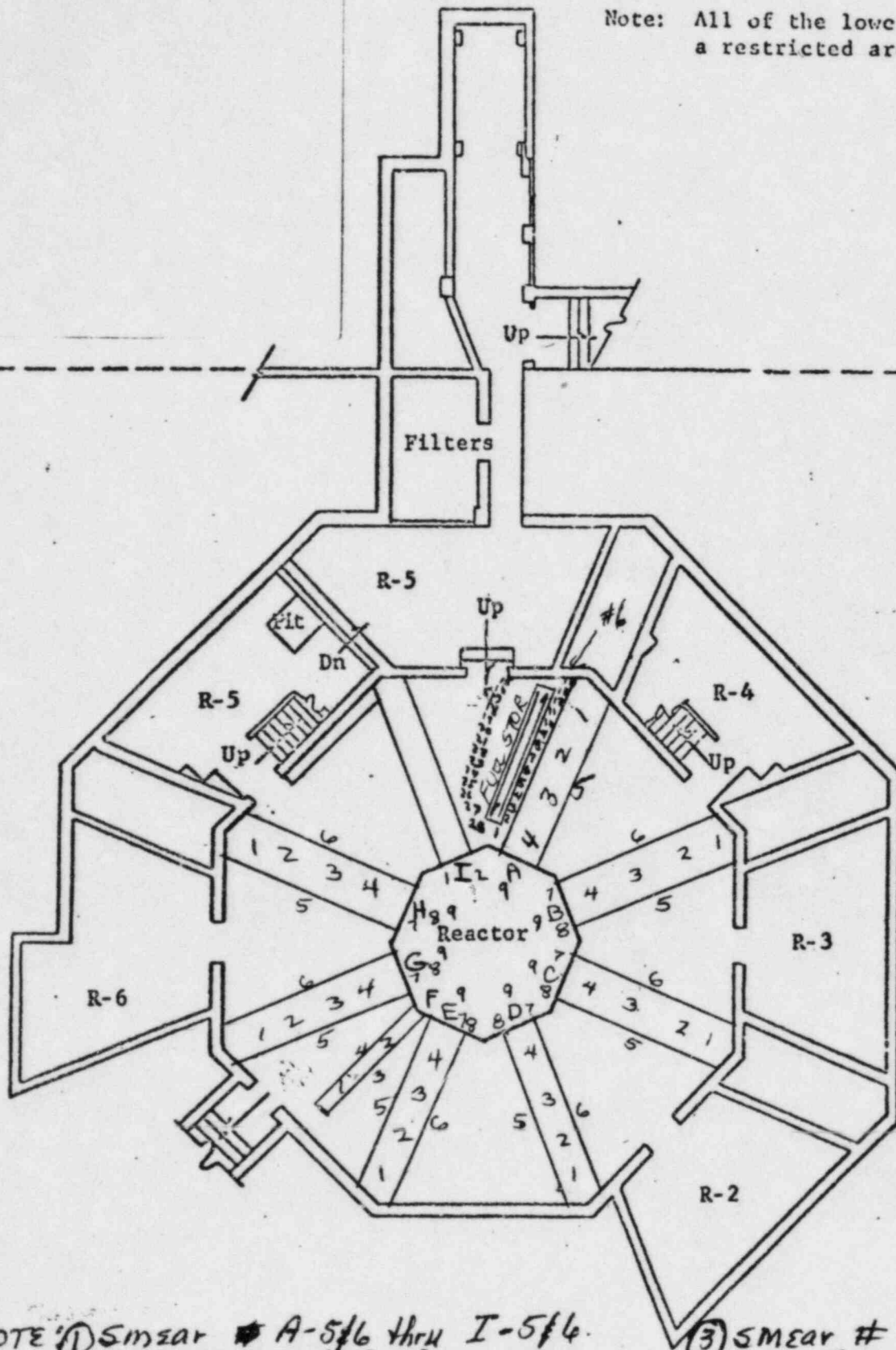
Swipe Log

Swipe No.	Location	Gross Counts	GCPM	Bkgd. a or B	NCPM	Eff. a or B	DPM
167	H4 H3	63	63	60	3	.6072	5
168	H7	54	54		1		1
169	H2	48	48		1		1
170	H1	59	59		1		1
171	H5	62	62		2		3
172	H2	71	71		11		18
173	H3	54	54		1		1
174	H8	61	61		7		2
175	H3	63	63		3		5
176	H1	49	49		1		1
177	H2	63	63	60	3	.6072	5
178	H3	60	60		0		1
179	H4	49	49		1		1
180	H6	47	47		1		1
181	H5	64	64		4		7
182	H6	71	71		11		18
183	H7	59	59		1		1
184	H8	75	75		15		25
185	H9	60	60		0		1
186	H10	58	58		1		1
187	H11	54	54	60	1	.6072	1
188	H9	59	59		1		1
189	H12	52	52		1		1
190	H13	63	63		3		5
191	H14	59	59		1		1
				BT 60		.6072	
(3-2-83)	192	LEDGE - STOR. HOOD 1-2	54	54		1	1
	193	SITE FBY DOOR B205	72	72		12	20
	194	INST. STAIRS B205	65	65		5	8
	195	LEDGE UNDER HOLES 3-4	50	50		1	1
	196	LEDGE UNDER HOLES 5-6	61	61		1	2
	197	" BOAM CATCHER D	52	52		1	1
	198	" UNDER HOLES 7-8	49	49		1	1
	199	" " " 9-10	53	53		1	1
	200	BOAM CATCHER F LEDGE	55	55		1	1
	201	LEDGE HOLES UNDER 11-12	53	53		1	1
	202	" " " 13-14	68	68		8	13
	203	LEDGE BOAM CATCHER G	63	63		3	5
	204	" HOLES UNDER 15-16	58	58		0	1
	205	" " " 17-18	67	67		7	12
	206	LEDGE BOAM CATCHER H	53	53		0	0
	207	" HOLES UNDER 19-20	68	68		8	0
	208	" BOAM CATCHER D	56	56		0	1
	209	" " " B	54	54		0	1
	210	" " " C	54	54		0	1

Swipe Log

Swipe No.	Location	Gross Counts	GCPM	Bkgd. a or B	NCPM	Eff. a or B	DPM
3-2-83				60		.6072	
211	R3 FLOOR	62	62		2		3
212		73	73		13		21
213		60	60		0		1
214		55	55		0		1
215		63	63		3		5
216		51	51		0		1
217		64	64		4		6
218		59	59		0		1
219		67	67		7		12
220		56	56		0		1
221		60	60		0		1
222		61	61		1		2
223		64	64		4		7
224		68	68		8		13
225		55	55		0		1
226		59	59	60	0	.6072	1
227		51	51		0		1
228		71	71		11		18
229		61	61		1		2
230		66	66		6		10
231		53	53		0		1
232		55	55		0		1
233		45	45		0		1
234		48	48		0		1
235		65	65		5		8
236	RPG SCANS	64	64		4		7

Note: All of the lower level is a restricted area



NOTE: ① Smear # A-5/6 thru I-5/6 ARE VERTICAL Surfaces OF Trench walls.

② Smear # 7's are VERTICAL Surfaces
8's are Horizontal Surfaces

③ Smear # 9's ARE From Reactor pad.

Drawing #5

Swipe Log

Swipe No.	Location		Gross Counts	GCPM	Bkgd. α or β	NCPM	Eff. α or β	DPM
1	A	1	65	65	59	6	.5653	11
2		2	59	59		0		1
3		3	72	72		13		23
4		4	56	56		0		1
5		5	54	54		0		1
6		6	51	51		0		1
7		7	50	50		0		1
8		8	69	69		16		18
9	B	1	56	56		0		1
10		2	56	56		0		1
11		3	47	47		0		1
12		4	61	61		2		4
13		5	58	58		0		1
14		6	45	45		0		1
15		7	66	66		7		12
16		8	48	48		0		1
17	C	1	66	66		7		12
18		2	69	69		10		18
19		3	68	68		9		16
20		4	60	60		1		2
21		5	71	71		12		2
22		6	51	51		0		1
23		7	56	56		0		1
24		8	60	60		2		2
25	D	1	61	61		2		4
26		2	50	50		0		1
27		3	52	52		0		1
28		4	58	58		0		1
29		5	59	59		0		1
30		6	59	59		0		1
31		7	59	59		0		1
32		8	58	58		0		1
33	E	1	50	50	59	0	.5653	1

Pages 8 & 9, Nos 1-70:

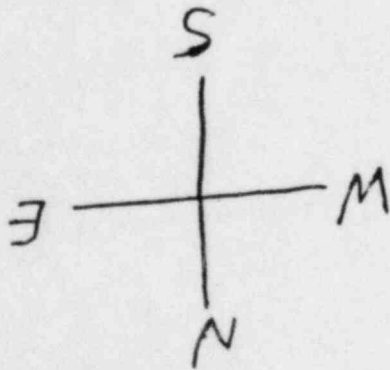
These swipes were taken in the Trenches radiating from and around the R-3 reactor. Eight (8) were taken in each Trench, except for Trench F where 4 were taken. See drawing No. 5.

Swipe Log

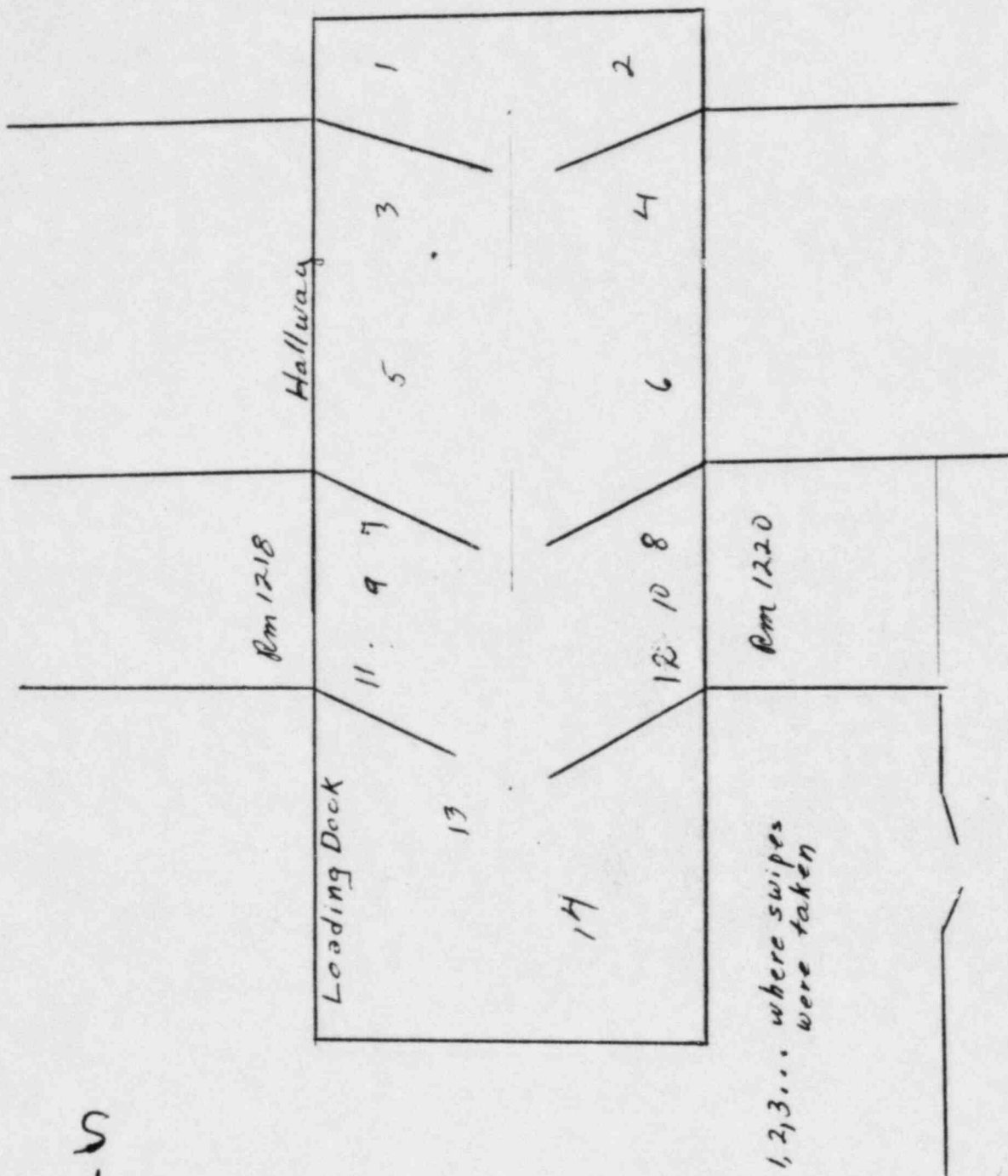
Swipe No.	Location	Gross Counts	GCPM	Bkgd. α or β	NCPM	Eff. α or β	DPM
34	E 2	57	57	59	00	.5653	1
35	3	49	49		00		1
36	4	45	45		00		1
37	5	56	56		00		1
38	6	42	42		00		1
39	7	54	54		00		1
40	8	60	60		00		2
41	F 1	50	50		20		1
42	2	61	61		20		4
43	3	70	70		20		19
44	4	64	64		20		9
45	G 1	73	73		20		25
46	2	64	64		20		9
47	3	74	74		20		26
48	4	66	66		20		12
49	5	42	42		20		1
50	6	61	61		20		4
51	7	63	63		20		7
52	8	56	56		20		1
53	H 1	58	58		20		1
54	2	60	60		20		2
55	3	61	61		20		4
56	4	55	55		20		1
57	5	78	78		20		34
58	6	49	49		20		1
59	7	55	55		20		1
60	8	49	49		20		1
61	I 1	65	65		20		1
62	2	52	52	59	20	.5994	1
63	A 9	47	47		20		1
64	B 9	55	55		20		1
65	C 9	49	49		20		1
66	D 9	69	69		20		17
67	E 9	62	62		20		5
68	G 9	53	53		20		1
69	H 9	66	66		20		12
70	I 9	45	45		20		1
71	A1 FUEL STORAGE HOLES	59	59		20		1
72	H 2 (RT. TO LEFT)	71	71		20		20
73	H 3 (75	75		20		27
74	4	59	59		20		1
75	5	60	60	59	20	.5994	2

Swipe Log

Swipe No.	Location	Gross Counts	GCPM	Bkgd. α or β	NCPM	Eff. α or β	DPM
76	FUEL STORAGE	57	57	59	0	.5994	1
77		61	61		2		3
78	Holes.	54	54		0		1
79	ROC	54	54		0		1
80		47	47		0		1
81		63	63		4		7
82		64	64		5		0
83		71	71		12		2
84		47	47		0		1
85		47	47		0		1
86		57	57		0		1
87		49	49		0		1
88		67	67		8		5
89		108	108		49		8
90		62	62		3		5
91		69	68		9		15
92		58	58		0		1
93		46	46		0		1
94		71	71		12		2
95		50	50		0		1
96		52	52		0		1
97		51	51		0		1
98		57	57		0		1
99				59		.5994	



Platform
in R-3
at leve
Loading
Dock



Swipe Log

Swipe No.	Location	Gross Counts	GCPM	Bkgd. α or β	NCPM	Eff. α or β	DPM
1	EAST Side R-3 bay Loading Platform	52	52	55	0	.6418	0
2.	WEST Side of R-3 Loading platform	59	59	55	4		6
3.	EAST Side of hallway between Loading dock & R-3 Platform S. to north	60	60	55	5		8
4.	W. Side of hallway S. to North	59	59	55	4		6
5.	E. " of hallway S to north	55	55	55	0		0
6.	W. Side of hallway S to north	47	47	55	0		0
7.	E. Side of hallway S to north	44	44	55	0		0
8.	W. Side of hallway S to north	51	51	55	0		0
9.	E. Side of hallway S to north	55	55	55	0		0
10.	W. Side of hallway S to N	57	57	55	2		3
11.	E Side of hallway S to N	58	58	55	3		5
12.	W. Side of hallway S to N	46	46	55	0		0
13.	Center to East Side of Loading dock	57	57	55	2		3
14.	Center to West side of Loading dock	52	52	55	0		0

DRAWING NO. 7

The general radiation survey of the R-3 Bay and the base under the R-3 reactor biological shield is shown in Drawing No. 7. These dose rate readings were taken at one meter from the reference plane. Outside of the small octagon (reactor base) the reference plane was the Bay floor; while inside the reactor base, the plane was 6 inches lower. See Section A-A, Drawing No. 8, point B.

The larger rectangle (Drawing No. 7) within the reactor base represents the area from which concrete under the reactor core thermal column was removed to comply with the demolition criteria. See Drawing No. 8 and Section A-A.

The dose rate readings, Drawing No. 7, meet the demolition criteria of $5 \mu\text{R/hr}$ above background ($20 \mu\text{R/hr}$) at one meter from the surface at all points outside of the large rectangle. Dose rates within the large rectangle are shown in Drawing No. 8.

DRAWING NO. 8

The dose rate readings shown on Drawing No. 8 were at a one meter distance from the respective surfaces; not the reference planes of Drawing No. 7. The area under the R-3 core is described by the dose rates of 28, 28, and $27 \mu\text{R/hr}$.

An iron plate, $58'' \times 51'' \times 1''$, was placed over this apparent "hot" spot area and the dose rate remeasured. The iron reduced the dose rate to $21\text{--}22 \mu\text{R/hr}$, approximately background elsewhere in the R-3 Bay. The identified isotope in concrete is Eu-152. The sum of energies from Eu-152 is approximately 6.1 Mev. At this energy, the HVL of Fe is $1.14''$ and that of concrete is $4.35''$. Hence, 3.82 inches of concrete would be the equivalent of the one inch of iron used above. Theoretically, more concrete would reduce the dose rate further. However, a practical limit is reached, namely, background. Upon termination of our R-63 license, the area occupied by the R-3 reactor will be covered by concrete to the level of the Bay floor. Thus, 18 inches of concrete will cover the apparent "hot" spot. This amount of concrete is the equivalent of 4.71 inches of iron. The dose rate at one meter above the Bay floor reference plane, with 18 inches of concrete in place, will yield a dose rate equal to the general background in the Bay, namely, $20 \mu\text{R/hr}$. After finishing the Bay floor as indicated, an individual standing over the apparent "hot" spot for one year would not receive a greater dose than he would in a

like time elsewhere in the R-3 Bay.

Several points adjacent to Bay side A appear to exceed the criteria. Our Gamma Facility, containing Co-60 (approximately 10,000 Ci) and Cs-137 (approximately 75,000 Ci), under a minimum of eight (8) feet of water, remains in the bay. These points reflect the impact of these isotopes.

Radiation Survey of R-3 Bay After
Demolition of Shield

Ludlum Micro R Meter, Model 19.

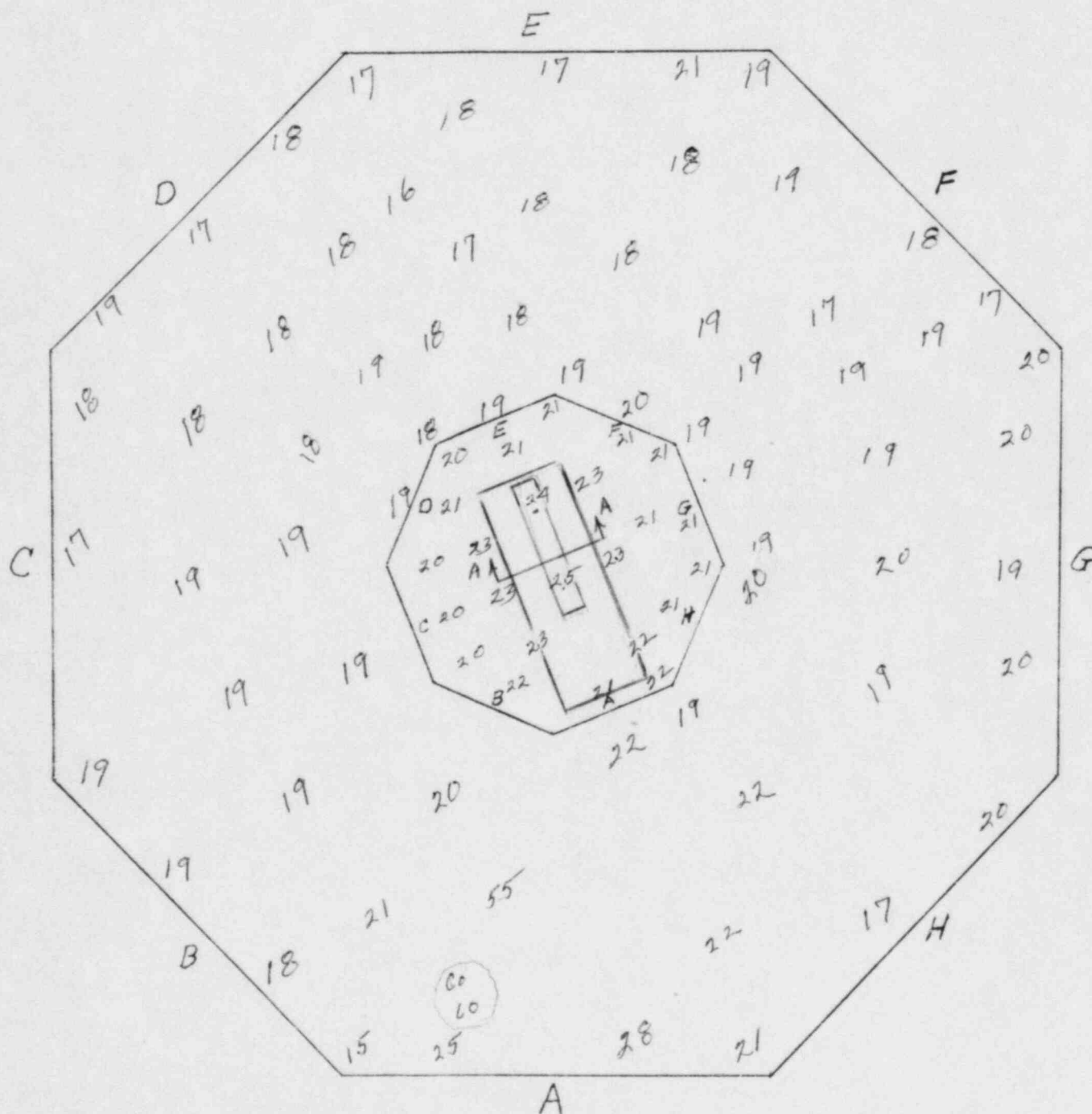
All measurements with meter on meter
stick in contact with surface.

Reactor base represented by octagon in the
center.

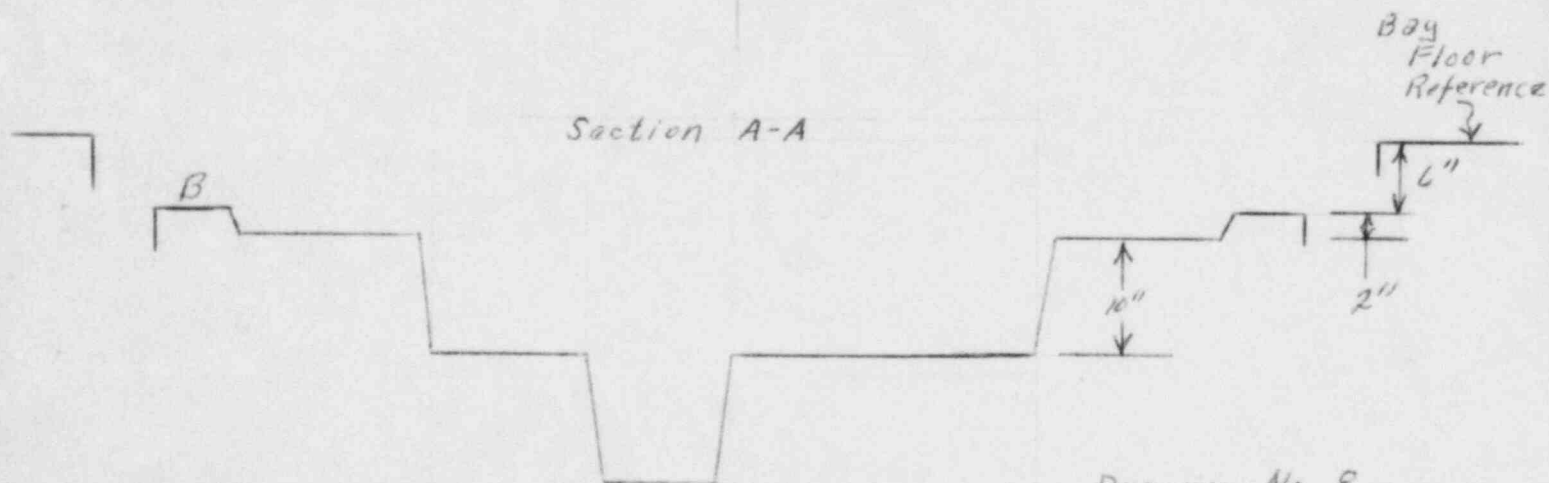
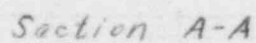
All readings in $\mu\text{R/hr.}$

Gamma Facility near Bay Face A.

Surveyors: R. D. Cross/T. L. Brackin



Meter: Ludlum Micro-R Meter



Drawing No. 8