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Results of the Independent Verification Survey at the Old Betatron Building, Granite City, Illinois (GSG001)

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MANAGED BY
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ABSTRACT

A team from the Measurement Applications and Development Group, Oak Ridge National Laboratory (ORNL), conducted an independent verification of the radiological condition of the Old Betatron Building, Granite City, Illinois, at the request of the Department of Energy in June of 1993. The building is owned by the National Steel Corporation. The contamination present resulted from the handling of uranium slabs of metal during the time the betatron facility was used to x-ray the slabs for metallurgical defects. The designation survey did not characterize the entire floor space because of obstructing equipment and debris. Therefore, prior to remediation by Bechtel National, Incorporated (BNI), a thorough characterization of the floor was conducted, and the results were immediately conveyed to on-site staff of BNI. An independent verification assessment was also performed after the cleanup activities were performed under the direction of BNI. The process of characterization, remediation, and verification was accomplished within a five-day period.

Based on results of the independent verification assessment, the Old Betatron Building was determined to meet the DOE radiological guidelines for unrestricted use.

Results of the Independent Verification Survey at the Old Betatron Building, Granite City, Illinois (GSG001)*

INTRODUCTION

During the late 1950s and early 1960s, the General Steel Casting Corporation x-rayed uranium ingots for the Atomic Energy Commission (AEC) under purchase orders issued by Mallinckrodt Chemical Company. The facility used for this purpose is located at 1417 State Street (Parcel No. 301-001, Deed/Plat Book 19-24-14, Page 22-1, Madison County, Illinois) in southwest Granite City, Illinois, northeast of St. Louis, Missouri. Although purchase orders dated July 14, 1961, and others subsequent to that time are available, actual periods of operation are unknown. The facility was probably used on an as-needed basis.

Beginning June 7, 1993, a team from the Measurement Applications and Development Group, Oak Ridge National Laboratory (ORNL), conducted an independent verification of the radiological condition of the Old Betatron Building owned by the National Steel Corporation, at the request of the Department of Energy. The contamination present resulted from the handling of uranium slabs of metal during the time the betatron facility was being used to x-ray the slabs for metallurgical defects. The designation survey, reported in ORNL/RASA-89/10[1], did not characterize the entire floor space because of equipment and debris that could not be moved at the time. Therefore, prior to the remediation by Bechtel National, Incorporated (BNI), a thorough characterization of the floor was conducted and the results were immediately conveyed to BNI staff on-site. The independent verification assessment was performed by ORNL after the cleanup activities were performed under the direction of BNI. The process of characterization, remediation, and verification was accomplished within a five-day period.

Areas of known radioactive contamination were remediated by BNI while the characterization of the floor surface was in progress. The two known areas of radioactive contamination included a vacuum cleaner and a small section of ventilation duct.

SURVEY METHODS

A description of the typical survey methods and instrumentation providing guidance for the survey is given in *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*, ORNL/TM-8600 (April 1987).[2]

The floor was characterized by marking it off in a one-meter grid (see Fig. 1) and completely scanning it for beta activity using large-area floor monitors and GM "pancake" detectors. Areas of radioactivity above background levels[1] were marked for further

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*The survey was performed by members of the Measurement Applications and Development Group of the Health Sciences Research Division at Oak Ridge National Laboratory under DOE contract DE-AC05-84OR21400.

characterization. All spots/areas with elevated activity were extensively characterized by determining the alpha and beta/gamma activity in dpm/100 cm^2. Smear samples were taken to determine the transferability of the activity. In addition, 31 of the 260 grid blocks were randomly selected and extensively characterized in the same manner as the elevated areas.

SURVEY RESULTS

Initially, spots in 12 grid blocks were determined to be above DOE guidelines (shown in Table 1) of 5000 dpm/100 cm^2 (see Table 2), or marginally close enough to merit remediation. Two additional grid blocks were found to have contaminated spots in areas thought to be free of contamination. Table 2 gives the grid location of each contaminated spot. The contamination could best be described as spotty, with a maximum of 30,000 dpm/100 cm^2. Results of smear sample analysis (see Table 3) show the contamination was predominately fixed. The maximum alpha activity detected on a smear was 15 dpm/100 cm^2, and no beta activity was detected above the minimum detectable activity.

The radiological survey results of the 31 randomly selected grid blocks are shown in Table 4. Results from the direct radiation measurement and the smear sample analysis were provided to the BNI on-site staff immediately after review by the ORNL project manager.

ORNL INDEPENDENT VERIFICATION SURVEY RESULTS

ORNL provided an independent verification of the radiological condition of remediated areas immediately after notification by BNI. Remediated areas were either cleaned to levels indistinguishable from background levels of radiation, as was usually the case, or cleaned to within DOE guidelines for surface contamination, even if detectable radiation above background remained. Table 5 contains the final verification survey data for all grid blocks where remediation occurred.

A few areas required multiple attempts at contamination removal/verification for two reasons. First, as the "hottest" spots were removed, less contaminated spots could be more readily identified. Secondly, different instruments and conversion factors among the contractors caused minor discrepancies. In each case, a mutual understanding between the contractors allowed for a quick turnaround in the overall process. The ALARA principle also influenced the decision to clean several spots to significantly less than DOE guidelines.

REVIEW OF BNI VERIFICATION SURVEY RESULTS

As a part of the Independent Verification Contractor (IVC) responsibilities, the verification survey results of the remediation contractor were reviewed. The verification survey results were transmitted by BNI to ORNL on July 14, 1993. The data package included:

- Air Particulate Sample Reporting Log
- Gamma Exposure Rate Survey of Background and Betatron Room, Report No. 10693005
- Direct and Transferable Contamination Survey of Betatron Room (with maps), Report No(s). 10693002, 10693002-T, 10693003, 10693003-T

The verification survey results were reviewed for thoroughness and compliance with DOE requirements. The direct radiation measurements were also compared to the ORNL measurements conducted at the same locations. The results provided to ORNL appear to be thorough and accurate.

CONCLUSIONS

Based on the independent verification radiological survey by ORNL, and the review of the verification survey measurements by BNI, the Old Betatron Building meets the DOE guidelines for unrestricted use.

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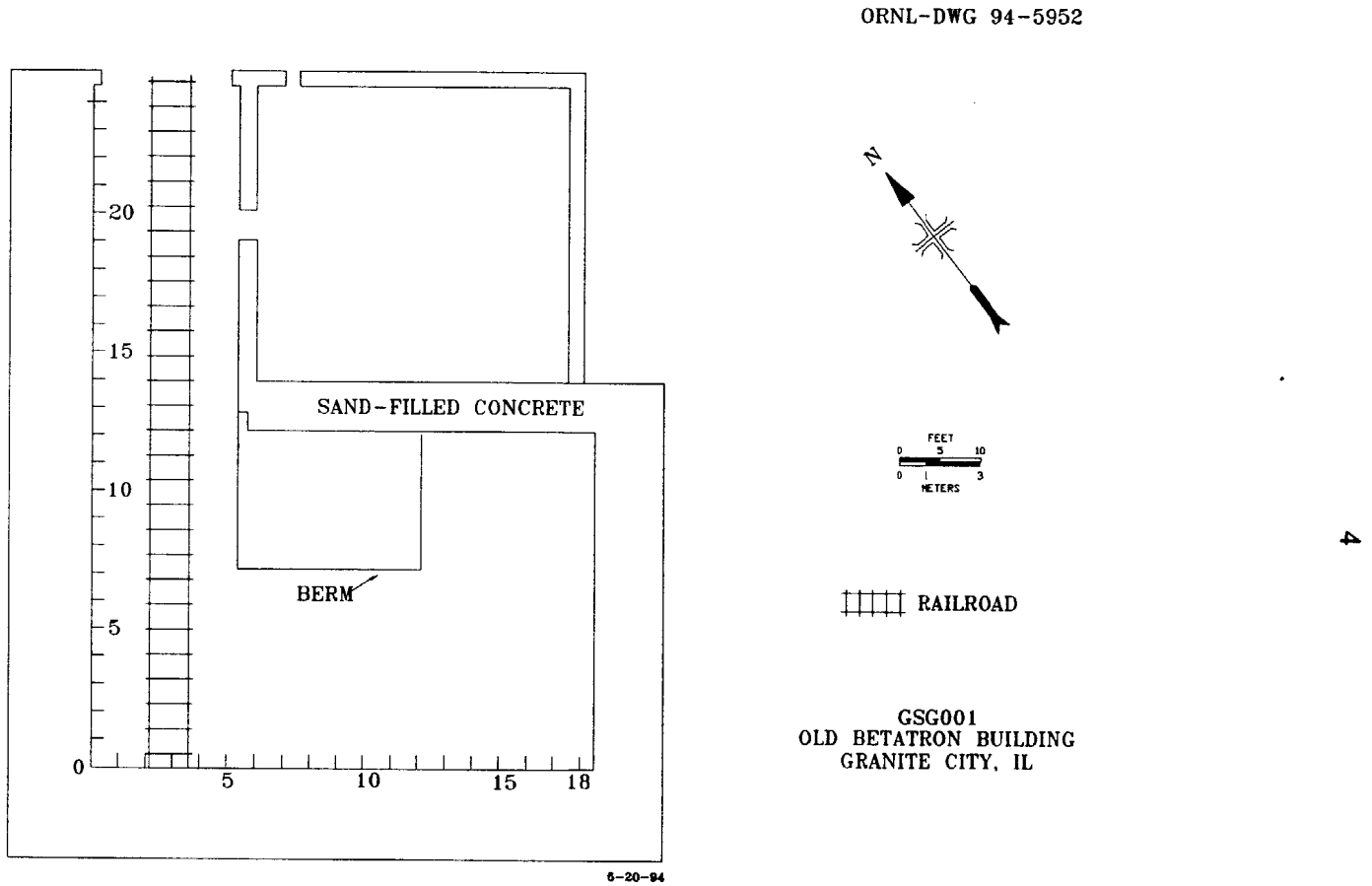

Fig. 1. Ground-level floor plan of the Old Betatron Building, Granite City, Illinois.

Table 1. Applicable guidelines for protection against radiation
(Limits for uncontrolled areas)

Mode of exposure	Exposure conditions	Guideline value
Total residual surface contamination[a]	^{238}U, ^{235}U, U-natural (alpha emitters)	
	Maximum	15,000 dpm/100 cm^2
	Average	5,000 dpm/100 cm^2
	Removable	1,000 dpm/100 cm^2

[a]DOE surface contamination guidelines are consistent with *NRC Guidelines for Decontamination at Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-Product, Source, or Special Nuclear Material*, May 1987.

Sources: Adapted from U.S. Department of Energy, DOE Order 5400.5, April 1990, and U.S. Department of Energy, *Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites*, Rev. 2, March 1987; and U. S. Department of Energy Radiological Control Manual, DOE N 5480.6 (DOE/EH-256T), June 1992.

Table 2. Grid locations containing contamination levels above DOE guidelines at the Old Betatron Building, Granite City, Illinois

Sample location		Directly measured radiation levels		Smear number[b]
North	East	Alpha[a] (dpm/100 cm^2)	Beta/gamma (dpm/100 cm^2)	
8.70	16.35	77	6000	16
8.80	16.10	511	10680	15
8.80	16.75	161	6120	17
8.90	16.75	161	7200	18
9.50	17.55	231	5880	19
9.50	17.80	266	5880	25
9.60	3.90	28	6120	14
10.00	17.55	455	6120	20
10.25	16.35	280	7500	22
10.40	16.15	224	17970	21
10.60	4.00	<MDA	12480	13
11.00	18.20	<MDA	7710	23
11.25	15.30	28	4230	26
12.30	4.00	<MDA	6420	11
12.70	4.10	<MDA	6150	12
13.20	4.15	<MDA	7620	10
14.60	3.80	<MDA	9930	8
14.90	3.80	<MDA	7770	7
15.10	3.80	35	30240	6
15.30	3.80	<MDA	6840	4
15.50	3.80	<MDA	6270	5
16.00	3.90	<MDA	5970	3
16.40	0.30	<MDA	7620	9
16.50	3.10	<MDA	24540	1
16.95	3.10	<MDA	10710	2

[a]MDA = 50 dpm/100 cm^2. Some alpha levels were below the MDA but above the critical decision level, indicating a measurable amount of alpha radiation above the instrument background.
[b]See Table 3 for analytical results.

Table 3. Results of analysis of smears from the Old Betatron Building, Granite City, Illinois

Smear number	Alpha level[a] (dpm/100 cm^2)	Beta/gamma[b] level (dpm/100 cm^2)	Smear number	Alpha level (dpm/100 cm^2)	Beta/gamma level (dpm/100 cm^2)
1	<MDA	<MDA	41	<MDA	<MDA
2	<MDA	<MDA	42	3	<MDA
3	<MDA	<MDA	43	5	<MDA
4	<MDA	<MDA	44	<MDA	<MDA
5	<MDA	<MDA	45	<MDA	<MDA
6	<MDA	<MDA	46	3	<MDA
7	<MDA	<MDA	47	<MDA	<MDA
8	<MDA	<MDA	48	<MDA	<MDA
9	<MDA	<MDA	49	3	<MDA
10	<MDA	<MDA	50	8	<MDA
11	<MDA	<MDA	51	<MDA	<MDA
12	<MDA	<MDA	52	<MDA	<MDA
13	<MDA	<MDA	53	<MDA	<MDA
14	<MDA	<MDA	54	3	<MDA
15	<MDA	<MDA	55	<MDA	<MDA
16	<MDA	<MDA	56	3	<MDA
17	13	<MDA	57	<MDA	<MDA
18	<MDA	<MDA	58	<MDA	<MDA
19	<MDA	<MDA	59	<MDA	<MDA
20	<MDA	<MDA	60	<MDA	<MDA
21	<MDA	<MDA	61	5	<MDA
22	<MDA	<MDA	62	<MDA	<MDA
23	5	<MDA	63	<MDA	<MDA
24	<MDA	<MDA	64	15	<MDA
25	3	<MDA	65	5	<MDA
26	15	<MDA	66	<MDA	<MDA
27	<MDA	<MDA	67	<MDA	<MDA
28	<MDA	<MDA	68	<MDA	<MDA
29	<MDA	<MDA	69	5	<MDA
30	<MDA	<MDA	70	<MDA	<MDA
31	<MDA	<MDA	71	<MDA	<MDA
32	3	<MDA	72	<MDA	<MDA
33	<MDA	<MDA	73	<MDA	<MDA
34	3	<MDA	74	5	<MDA
35	<MDA	<MDA	75	8	<MDA
36	5	<MDA	76	<MDA	<MDA
37	<MDA	<MDA	77	<MDA	<MDA
38	<MDA	<MDA	78	<MDA	<MDA
39	3	<MDA	79	<MDA	<MDA
40	<MDA	<MDA			

[a]MDA = 10 dpm/100 cm^2. Some alpha levels were below the MDA but above the critical decision level, indicating a measurable amount of alpha radiation above the instrument background.
[b]MDA = 120 dpm/100 cm^2.

Table 4. Results of detailed characterization at random locations at the Old Betatron Building, Granite City, Illinois

Sample location		Directly measured radiation levels		Smear number[c]
North	East	Alpha[a] (dpm/100 cm^2)	Beta/gamma[b] (dpm/100 cm^2)	
0.00	4.00	<MDA	1020	28
0.00	8.00	<MDA	<MDA	29
0.00	14.00	<MDA	<MDA	30
1.00	6.00	<MDA	<MDA	31
1.00	10.00	<MDA	<MDA	32
1.00	17.00	<MDA	<MDA	33
2.00	2.00	<MDA	600	27
2.00	4.00	<MDA	<MDA	34
2.00	11.00	21	<MDA	35
3.00	3.00	<MDA	<MDA	36
3.00	7.00	35	<MDA	37
3.00	9.00	<MDA	<MDA	38
4.00	12.00	<MDA	840	39
4.00	15.00	<MDA	<MDA	40
5.00	6.00	<MDA	540	41
6.00	7.00	<MDA	<MDA	42
6.00	10.00	<MDA	<MDA	43
7.00	8.00	<MDA	<MDA	44
7.00	13.00	35	<MDA	45
7.00	17.00	<MDA	720	46
8.00	1.00	<MDA	540	47
9.00	5.00	<MDA	<MDA	48
9.00	14.00	<MDA	750	49
10.00	17.00	42	1200	50
11.00	1.00	<MDA	1230	51
14.00	5.00	28	<MDA	52
18.00	3.00	<MDA	1080	53
20.00	1.00	<MDA	<MDA	54

Table 4 (continued)

Sample location		Directly measured radiation levels		Smear number[c]
North	East	Alpha[a] (dpm/100 cm^2)	Beta/gamma[b] (dpm/100 cm^2)	
21.00	3.00	<MDA	780	55
21.00	5.00	<MDA	<MDA	56
22.00	4.00	<MDA	570	57

[a]MDA = 50 dpm/100 cm^2. Some alpha levels were below the MDA but above the critical decision level, indicating a measurable amount of alpha radiation above the instrument background.

[b]MDA = 500 dpm/100 cm^2.

[c]See Table 3 for analytical results.

Table 5. Post-remedial action survey results at the Old Betatron Building, Granite City, Illinois

North	East	Average direct beta radiation levels[a] (dpm/100 cm^2)	Smear number[b]
8.00	15.00	1110	64
8.00	16.00	780	63
9.00	3.00	900	69
9.00	4.00	840	68
9.00	17.00	1140	62
10.00	3.00	600	76
10.00	4.00	780	70
10.00	16.00	990	59
10.00	17.00	1290	58
11.00	15.00	930	60
11.00	18.00	1830	61
12.00	3.00	900	71
12.00	4.00	1200	72
13.00	4.00	780	75
14.00	3.00	660	79
14.00	4.00	600	77
15.00	2.00	1200	73
15.00	3.00	1200	78
15.00	4.00	<MDA	74
16.00	0.00	720	65
16.00	2.00	930	67
16.00	3.00	1020	66

[a]MDA = 500 dpm/100 cm^2.
[b]See Table 3 for analytical results.

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