ornl

ORNL/RASA-94/2

OAK RIDGE NATIONAL LABORATORY

MARTIN MARIETTA

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

> M. E. Murray K. S. Brown

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; prices available from (615) 576-8401, FTS 626-8401.

Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

HEALTH SCIENCES RESEARCH DIVISION

Environmental Restoration and Waste Management Non-Defense Programs (Activity No. EX 20 20 01 0; ADS317AEX)

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

M. E. Murray and K. S. Brown

Date Issued - July 1994

Investigation Team

R. D. Foley-Measurement Applications and Development Manager
W. D. Cottrell - FUSRAP Project Director
M. E. Murray - Survey Team Leader

Survey Team Members

R. A. Mathis D. D. McKinney D. A. Rose P. F. Tiner

Work performed by the MEASUREMENT APPLICATIONS AND DEVELOPMENT GROUP

Prepared by the
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6285
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
U. S. DEPARTMENT OF ENERGY
under contract DE-AC05-84OR21400

CONTENTS

LIST OF TABLES	V
ACKNOWLEDGMENTS	vii
ABSTRACT	ix
INTRODUCTION	1
SURVEY METHODS	1
SURVEY RESULTS	2
ORNL INDEPENDENT VERIFICATION SURVEY RESULTS	2
CONCLUSIONS	3
REFERENCES	3

		 The Company of the Co	"

LIST OF TABLES

1	Applicable guidelines for protection against radiation	5
2	Grid locations containing contamination levels above DOE guidelines at the Old Betatron Building, Granite City, Illinois	6
3	Results of analysis of smears from the Old Betatron Building, Granite City, Illinois	7
4	Results of detailed characterization at random locations at the Old Betatron Building, Granite City, Illinois	8
5	Post-remedial action survey results at the Old Betatron Building, Granite City, Illinois	10

The second secon	MARK TO SERVICE SHEET AND THE SECOND	AAAA TA'AAAA AAAA AAAA AAAA AAAA AAAA A	The second designation of the second designa	and a fabric to provide a recommendation of the second of	nanar sa - Ald

ACKNOWLEDGMENTS

This project was sponsored by the Office of Environmental Restoration, U.S. Department of Energy, under contract DE-AC05-84OR21400 with Martin Marietta Energy Systems, Inc. The authors wish to acknowledge the contributions of W. D. Cottrell, V. P. Patania, D. A. Roberts, and J. Lovegrove of the Measurement Applications and Development Group, Oak Ridge National Laboratory, for participation in the analyses, editing, graphics, and reporting of data for this survey.

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.

			, Contraction and
	-		

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-89/10¹, 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 levels¹ were marked for further

^{*}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 cm². 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 cm² (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 cm². 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 cm², 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.

REFERENCES

- 1. W. D. Cottrell and R. F. Carrier, Results of the Radiological Survey at the Granite City Steel Facility, Granite City, Illinois, ORNL/RASA-89/10, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., July 1990.
- 2. T. E. Myrick, B. A. Berven, W. D. Cottrell, W. A. Goldsmith, and F. F. Haywood, Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program, ORNL/TM-8600, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., April 1987.

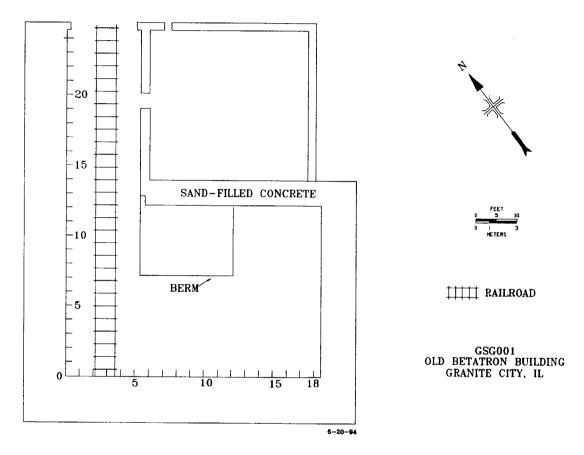


Fig. 1. Ground-level floor plan of the Old Betatron Building, Granite City, Illinois.

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 Average Removable	15,000 dpm/100 cm ² 5,000 dpm/100 cm ² 1,000 dpm/100 cm ²

^aDOE 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	Sample location		Directly measured radiation levels		
North	East	Alpha ^a (dpm/100 cm ²)	Beta/gamma (dpm/100 cm²)	Smear numberb	
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< td=""><td>12480</td><td>13</td></mda<>	12480	13	
11.00	18.20	<mda< td=""><td>7710</td><td>23</td></mda<>	7710	23	
11.25	15.30	28	4230	26	
12.30	4.00	<mda< td=""><td>6420</td><td>11</td></mda<>	6420	11	
12.70	4.10	<mda< td=""><td>6150</td><td>12</td></mda<>	6150	12	
13.20	4.15	<mda< td=""><td>7620</td><td>10</td></mda<>	7620	10	
14.60	3.80	<mda< td=""><td>9930</td><td>8</td></mda<>	9930	8	
14.90	3.80	<mda< td=""><td>7770</td><td>7</td></mda<>	7770	7	
15.10	3.80	35	30240	6	
15.30	3.80	<mda< td=""><td>6840</td><td>4</td></mda<>	6840	4	
15.50	3.80	<mda< td=""><td>6270</td><td>5</td></mda<>	6270	5	
16.00	3.90	<mda< td=""><td>5970</td><td>3</td></mda<>	5970	3	
16.40	0.30	<mda< td=""><td>7620</td><td>9</td></mda<>	7620	9	
16.50	3.10	<mda< td=""><td>24540</td><td>1</td></mda<>	24540	1	
16.95	3.10	<mda< td=""><td>10710</td><td>2</td></mda<>	10710	2	

^aMDA = 50 dpm/100 cm². Some alpha levels were below the MDA but above the critical decision level, indicating a measurable amount of alpha radiation above the instrument background. ^bSee Table 3 for analytical results.

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

number (dpm/100 cm²)			Granite C	ity, Illinois	.	
2		Alpha level ^a (dpm/100 cm ²)	level		Alpha level (dpm/100 cm ²)	Beta/gamma level (dpm/100 cm ²)
2	1	<mda< td=""><td><mda< td=""><td>41</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>41</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	41	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
3				42	3	<mda< td=""></mda<>
4 <mda< td=""> <m< td=""><td></td><td><mda< td=""><td><mda< td=""><td>43</td><td>5</td><td><mda< td=""></mda<></td></mda<></td></mda<></td></m<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>		<mda< td=""><td><mda< td=""><td>43</td><td>5</td><td><mda< td=""></mda<></td></mda<></td></mda<>	<mda< td=""><td>43</td><td>5</td><td><mda< td=""></mda<></td></mda<>	43	5	<mda< td=""></mda<>
6		<mda< td=""><td><mda< td=""><td>44</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>44</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	44	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
7 <mda< td=""> <mda< td=""> 47 <mda< td=""> <mda< td=""> 8 <mda< td=""> <mda< td=""> 48 <mda< td=""> <mda< td=""> 9 <mda< td=""> <mda< td=""> 49 3 <mda< td=""> 10 <mda< td=""> <mda< td=""> 50 8 <mda< td=""> 11 <mda< td=""> <mda< td=""> 50 8 <mda< td=""> 11 <mda< td=""> <mda< td=""> 50 8 <mda< td=""> 11 <mda< td=""> <mda< td=""> 50 8 <mda< td=""> 11 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 12 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 12 <mda< td=""> <mda< td=""></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	5	<mda< td=""><td><mda< td=""><td>45</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>45</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	45	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
8	6	<mda< td=""><td><mda< td=""><td>46</td><td>3</td><td><mda< td=""></mda<></td></mda<></td></mda<>	<mda< td=""><td>46</td><td>3</td><td><mda< td=""></mda<></td></mda<>	46	3	<mda< td=""></mda<>
9	7	<mda< td=""><td><mda< td=""><td>47</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>47</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	47	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
10 <mda< td=""> <mda< td=""> 50 8 <mda< td=""> 11 <mda< td=""> <mda< td=""> 51 <mda< td=""> <mda< td=""> 12 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 12 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 13 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 15 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 16 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 16 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 16 <mda< td=""> <mda< td=""><td>8</td><td><mda< td=""><td><mda< td=""><td>48</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<></td></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	8	<mda< td=""><td><mda< td=""><td>48</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>48</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	48	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
11		<mda< td=""><td><mda< td=""><td>49</td><td>3</td><td><mda< td=""></mda<></td></mda<></td></mda<>	<mda< td=""><td>49</td><td>3</td><td><mda< td=""></mda<></td></mda<>	49	3	<mda< td=""></mda<>
12	10	<mda< td=""><td><mda< td=""><td>50</td><td>8</td><td><mda< td=""></mda<></td></mda<></td></mda<>	<mda< td=""><td>50</td><td>8</td><td><mda< td=""></mda<></td></mda<>	50	8	<mda< td=""></mda<>
13	11	<mda< td=""><td><mda< td=""><td>51</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>51</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	51	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
14	12	<mda< td=""><td><mda< td=""><td>52</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>52</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	52	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
15 < MDA	13	<mda< td=""><td><mda< td=""><td>53</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>53</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	53	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
16 <mda< td=""> <mda< td=""> 56 3 <mda< td=""> 17 13 <mda< td=""> 57 <mda< td=""> <mda< td=""> 18 <mda< td=""> <mda< td=""> 58 <mda< td=""> <mda< td=""> 19 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 20 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 21 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 21 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 22 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 22 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 23 5 <mda< td=""> <mda< td=""></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	14	<mda< td=""><td><mda< td=""><td>54</td><td>3</td><td><mda< td=""></mda<></td></mda<></td></mda<>	<mda< td=""><td>54</td><td>3</td><td><mda< td=""></mda<></td></mda<>	54	3	<mda< td=""></mda<>
17 13	15	<mda< td=""><td><mda< td=""><td>55</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>55</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	55	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
18 <mda< td=""> <mda< td=""> 58 <mda< td=""> <mda< td=""> 19 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 20 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 21 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 21 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 22 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 22 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 23 5 <mda< td=""> <</mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	16	<mda< td=""><td><mda< td=""><td>56</td><td>3</td><td><mda< td=""></mda<></td></mda<></td></mda<>	<mda< td=""><td>56</td><td>3</td><td><mda< td=""></mda<></td></mda<>	56	3	<mda< td=""></mda<>
19 <mda< td=""> <mda< td=""> 59 <mda< td=""> <mda< td=""> 20 <mda< td=""> <mda< td=""> 60 <mda< td=""> <mda< td=""> 21 <mda< td=""> <mda< td=""> 61 5 <mda< td=""> 21 <mda< td=""> <mda< td=""> 61 5 <mda< td=""> 22 <mda< td=""> <mda< td=""> 62 <mda< td=""> <mda< td=""> <mda< td=""> 22 <mda< td=""> <mda< td=""> 62 <mda< td=""> <mda< td=""> <mda< td=""> 23 5 <mda< td=""> 63 <mda< td=""> <mda< td=""> <mda< td=""> 24 <mda< td=""> <mda< td=""> 63 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 25 3 <mda< td=""> 64 15 <mda< td=""> <mda< t<="" td=""><td>17</td><td>13</td><td><mda< td=""><td>57</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	17	13	<mda< td=""><td>57</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	57	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
20 <mda< td=""> <mda< td=""> 60 <mda< td=""> <mda< td=""> 21 <mda< td=""> <mda< td=""> 61 5 <mda< td=""> 22 <mda< td=""> <mda< td=""> 62 <mda< td=""> <mda< td=""> 22 <mda< td=""> <mda< td=""> 62 <mda< td=""> <mda< td=""> 23 5 <mda< td=""> 63 <mda< td=""> <mda< td=""> 24 <mda< td=""> <mda< td=""> 63 <mda< td=""> <mda< td=""> 25 3 <mda< td=""> 64 15 <mda< td=""> 25 3 <mda< td=""> 65 5 <mda< td=""> 26 15 <mda< td=""> 66 <mda< td=""> <mda< td=""> 27 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 28 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 29 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 30 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 31 <mda< td=""> <mda< td=""></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	18	<mda< td=""><td><mda< td=""><td>58</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>58</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	58	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
21 <mda< td=""> <mda< td=""> 61 5 <mda< td=""> 22 <mda< td=""> <mda< td=""> 62 <mda< td=""> <mda< td=""> 23 5 <mda< td=""> 63 <mda< td=""> <mda< td=""> 24 <mda< td=""> <mda< td=""> 64 15 <mda< td=""> 25 3 <mda< td=""> 65 5 <mda< td=""> 26 15 <mda< td=""> 66 <mda< td=""> <mda< td=""> 27 <mda< td=""> <mda< td=""> 67 <mda< td=""> <mda< td=""> 28 <mda< td=""> <mda< td=""> 67 <mda< td=""> <mda< td=""> 29 <mda< td=""> <mda< td=""> 68 <mda< td=""> <mda< td=""> 30 <mda< td=""> <mda< td=""> 69 5 <mda< td=""> 30 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 31 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 31 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 33 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 34 3 <mda< td=""> <mda< td=""> <mda< td=""> 35 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	19	<mda< td=""><td><mda< td=""><td>59</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>59</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	59	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
22 <mda< td=""> <mda< td=""> 62 <mda< td=""> <mda< td=""> 23 5 <mda< td=""> 63 <mda< td=""> <mda< td=""> 24 <mda< td=""> <mda< td=""> 64 15 <mda< td=""> 25 3 <mda< td=""> 65 5 <mda< td=""> 26 15 <mda< td=""> 66 <mda< td=""> <mda< td=""> 27 <mda< td=""> <mda< td=""> 67 <mda< td=""> <mda< td=""> 28 <mda< td=""> <mda< td=""> 68 <mda< td=""> <mda< td=""> 28 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 30 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 30 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 31 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 31 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 32 3 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 33 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> <mda< td="" td<=""><td>20</td><td><mda< td=""><td><mda< td=""><td>60</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<></td></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	20	<mda< td=""><td><mda< td=""><td>60</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>60</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	60	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
23	21	<mda< td=""><td><mda< td=""><td>61</td><td>5</td><td></td></mda<></td></mda<>	<mda< td=""><td>61</td><td>5</td><td></td></mda<>	61	5	
24 <mda< td=""> <mda< td=""> 64 15 <mda< td=""> 25 3 <mda< td=""> 65 5 <mda< td=""> 26 15 <mda< td=""> 66 <mda< td=""> <mda< td=""> 27 <mda< td=""> <mda< td=""> 67 <mda< td=""> <mda< td=""> 28 <mda< td=""> <mda< td=""> 68 <mda< td=""> <mda< td=""> 29 <mda< td=""> <mda< td=""> 69 5 <mda< td=""> 30 <mda< td=""> <mda< td=""> 70 <mda< td=""> <mda< td=""> 31 <mda< td=""> <mda< td=""> 71 <mda< td=""> <mda< td=""> 31 <mda< td=""> <mda< td=""> 71 <mda< td=""> <mda< td=""> 32 3 <mda< td=""> 72 <mda< td=""> <mda< td=""> 33 <mda< td=""> <mda< td=""> 73 <mda< td=""> <mda< td=""> 34 3 <mda< td=""> 74 5 <mda< td=""> 35 <mda< td=""> <mda< td=""> 75 8 <mda< td=""> 36 5 <mda< td=""> 76 <mda< td=""> <mda< td=""> 37 <mda< td=""> <mda< td=""> 77 <mda< td=""> <mda< td=""> 38</mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	22	<mda< td=""><td><mda< td=""><td>62</td><td><mda< td=""><td></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>62</td><td><mda< td=""><td></td></mda<></td></mda<>	62	<mda< td=""><td></td></mda<>	
25	23	5	<mda< td=""><td>63</td><td></td><td></td></mda<>	63		
26 15 <mda< td=""> 66 <mda< td=""> <mda< td=""> 27 <mda< td=""> <mda< td=""> 67 <mda< td=""> <mda< td=""> 28 <mda< td=""> <mda< td=""> 68 <mda< td=""> <mda< td=""> 29 <mda< td=""> <mda< td=""> 69 5 <mda< td=""> 30 <mda< td=""> <mda< td=""> 70 <mda< td=""> <mda< td=""> 31 <mda< td=""> <mda< td=""> 71 <mda< td=""> <mda< td=""> 32 3 <mda< td=""> 72 <mda< td=""> <mda< td=""> 33 <mda< td=""> <mda< td=""> 73 <mda< td=""> <mda< td=""> 34 3 <mda< td=""> 74 5 <mda< td=""> 35 <mda< td=""> <mda< td=""> 75 8 <mda< td=""> 36 5 <mda< td=""> 76 <mda< td=""> <mda< td=""> 37 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""> 38 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	24	<mda< td=""><td><mda< td=""><td>11</td><td></td><td></td></mda<></td></mda<>	<mda< td=""><td>11</td><td></td><td></td></mda<>	11		
27 <mda< td=""> <mda< td=""> 67 <mda< td=""> <mda< td=""> 28 <mda< td=""> <mda< td=""> 68 <mda< td=""> <mda< td=""> 29 <mda< td=""> <mda< td=""> 69 5 <mda< td=""> 30 <mda< td=""> <mda< td=""> 70 <mda< td=""> <mda< td=""> 31 <mda< td=""> <mda< td=""> 71 <mda< td=""> <mda< td=""> 32 3 <mda< td=""> 72 <mda< td=""> <mda< td=""> 33 <mda< td=""> <mda< td=""> 73 <mda< td=""> <mda< td=""> 34 3 <mda< td=""> 74 5 <mda< td=""> 35 <mda< td=""> <mda< td=""> 75 8 <mda< td=""> 36 5 <mda< td=""> 76 <mda< td=""> <mda< td=""> 37 <mda< td=""> <mda< td=""> 77 <mda< td=""> <mda< td=""> 38 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	25	3	<mda< td=""><td>65</td><td></td><td></td></mda<>	65		
28	26	15	<mda< td=""><td>66</td><td><mda< td=""><td></td></mda<></td></mda<>	66	<mda< td=""><td></td></mda<>	
29 < MDA	27	<mda< td=""><td><mda< td=""><td>67</td><td><mda< td=""><td></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>67</td><td><mda< td=""><td></td></mda<></td></mda<>	67	<mda< td=""><td></td></mda<>	
30 <mda< td=""> <mda< td=""> 70 <mda< td=""> <mda< td=""> 31 <mda< td=""> <mda< td=""> 71 <mda< td=""> <mda< td=""> 32 3 <mda< td=""> 72 <mda< td=""> <mda< td=""> 33 <mda< td=""> <mda< td=""> 73 <mda< td=""> <mda< td=""> 34 3 <mda< td=""> 74 5 <mda< td=""> 35 <mda< td=""> <mda< td=""> 75 8 <mda< td=""> 36 5 <mda< td=""> 76 <mda< td=""> <mda< td=""> 37 <mda< td=""> <mda< td=""> 77 <mda< td=""> <mda< td=""> 38 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	28	<mda< td=""><td><mda< td=""><td>68</td><td><mda< td=""><td></td></mda<></td></mda<></td></mda<>	<mda< td=""><td>68</td><td><mda< td=""><td></td></mda<></td></mda<>	68	<mda< td=""><td></td></mda<>	
31 <mda< td=""> <mda< td=""> 71 <mda< td=""> <mda< td=""> 32 3 <mda< td=""> 72 <mda< td=""> <mda< td=""> 33 <mda< td=""> <mda< td=""> 73 <mda< td=""> <mda< td=""> 34 3 <mda< td=""> 74 5 <mda< td=""> 35 <mda< td=""> <mda< td=""> 75 8 <mda< td=""> 36 5 <mda< td=""> 76 <mda< td=""> <mda< td=""> 37 <mda< td=""> <mda< td=""> 77 <mda< td=""> <mda< td=""> 38 <mda< td=""> <mda< td=""> <mda< td=""> <mda< td=""></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<></mda<>	29	<mda< td=""><td><mda< td=""><td>69</td><td></td><td></td></mda<></td></mda<>	<mda< td=""><td>69</td><td></td><td></td></mda<>	69		
32	30	<mda< td=""><td><mda< td=""><td>70</td><td></td><td></td></mda<></td></mda<>	<mda< td=""><td>70</td><td></td><td></td></mda<>	70		
33	31	<mda< td=""><td><mda< td=""><td>71</td><td></td><td></td></mda<></td></mda<>	<mda< td=""><td>71</td><td></td><td></td></mda<>	71		
34 3 <mda 35="" 5="" 74="" <mda="" <mda<="" td=""><td>32</td><td>3</td><td><mda< td=""><td>72</td><td><mda< td=""><td></td></mda<></td></mda<></td></mda>	32	3	<mda< td=""><td>72</td><td><mda< td=""><td></td></mda<></td></mda<>	72	<mda< td=""><td></td></mda<>	
35	33	<mda< td=""><td><mda< td=""><td>11</td><td></td><td></td></mda<></td></mda<>	<mda< td=""><td>11</td><td></td><td></td></mda<>	11		
36 5 <mda 76="" <mda="" <mda<br="">37 <mda 77="" <mda="" <mda<br="">38 <mda 78="" <mda="" <mda<="" td=""><td>34</td><td>3</td><td><mda< td=""><td>Li .</td><td></td><td></td></mda<></td></mda></mda></mda>	34	3	<mda< td=""><td>Li .</td><td></td><td></td></mda<>	Li .		
37	35	<mda< td=""><td><mda< td=""><td>III.</td><td></td><td></td></mda<></td></mda<>	<mda< td=""><td>III.</td><td></td><td></td></mda<>	III.		
38 <mda 78="" <mda="" <mda<="" td=""><td>36</td><td>5</td><td><mda< td=""><td>11</td><td></td><td></td></mda<></td></mda>	36	5	<mda< td=""><td>11</td><td></td><td></td></mda<>	11		
	37	<mda< td=""><td><mda< td=""><td>77</td><td></td><td></td></mda<></td></mda<>	<mda< td=""><td>77</td><td></td><td></td></mda<>	77		
20 2 ANDA 70 ANDA ANDA	38	<mda< td=""><td><mda< td=""><td></td><td></td><td></td></mda<></td></mda<>	<mda< td=""><td></td><td></td><td></td></mda<>			
39 3 MDA 19 MDA MDA	39	3	<mda< td=""><td>79</td><td><mda< td=""><td><mda< td=""></mda<></td></mda<></td></mda<>	79	<mda< td=""><td><mda< td=""></mda<></td></mda<>	<mda< td=""></mda<>
40 <mda <mda<="" td=""><td>40</td><td><mda< td=""><td><mda< td=""><td></td><td></td><td></td></mda<></td></mda<></td></mda>	40	<mda< td=""><td><mda< td=""><td></td><td></td><td></td></mda<></td></mda<>	<mda< td=""><td></td><td></td><td></td></mda<>			

^aMDA = 10 dpm/100 cm². Some alpha levels were below the MDA but above the critical decision level, indicating a measurable amount of alpha radiation above the instrument background. ^bMDA = 120 dpm/100 cm².

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

Sample	location	Directly measure	d radiation levels	
North	East	Alpha ^a (dpm/100 cm²)	Beta/gamma ^b (dpm/100 cm ²)	Smear number ^c
0.00	4.00	<mda< td=""><td>1020</td><td>28</td></mda<>	1020	28
0.00	8.00	<mda< td=""><td><mda< td=""><td>29</td></mda<></td></mda<>	<mda< td=""><td>29</td></mda<>	29
0.00	14.00	<mda< td=""><td><mda< td=""><td>30</td></mda<></td></mda<>	<mda< td=""><td>30</td></mda<>	30
1.00	6.00	<mda< td=""><td><mda< td=""><td>31</td></mda<></td></mda<>	<mda< td=""><td>31</td></mda<>	31
1.00	10.00	<mda< td=""><td><mda< td=""><td>32</td></mda<></td></mda<>	<mda< td=""><td>32</td></mda<>	32
1.00	17.00	<mda< td=""><td><mda< td=""><td>33</td></mda<></td></mda<>	<mda< td=""><td>33</td></mda<>	33
2.00	2.00	<mda< td=""><td>600</td><td>27</td></mda<>	600	27
2.00	4.00	<mda< td=""><td><mda< td=""><td>34</td></mda<></td></mda<>	<mda< td=""><td>34</td></mda<>	34
2.00	11.00	21	<mda< td=""><td>35</td></mda<>	35
3.00	3.00	<mda< td=""><td><mda< td=""><td>36</td></mda<></td></mda<>	<mda< td=""><td>36</td></mda<>	36
3.00	7.00	35	<mda< td=""><td>37</td></mda<>	37
3.00	9.00	<mda< td=""><td><mda< td=""><td>38</td></mda<></td></mda<>	<mda< td=""><td>38</td></mda<>	38
4.00	12.00	<mda< td=""><td>840</td><td>39</td></mda<>	840	39
4.00	15.00	<mda< td=""><td><mda< td=""><td>40</td></mda<></td></mda<>	<mda< td=""><td>40</td></mda<>	40
5.00	6.00	<mda< td=""><td>540</td><td>41</td></mda<>	540	41
6.00	7.00	<mda< td=""><td><mda< td=""><td>42</td></mda<></td></mda<>	<mda< td=""><td>42</td></mda<>	42
6.00	10.00	<mda< td=""><td><mda< td=""><td>43</td></mda<></td></mda<>	<mda< td=""><td>43</td></mda<>	43
7.00	8.00	<mda< td=""><td><mda< td=""><td>44</td></mda<></td></mda<>	<mda< td=""><td>44</td></mda<>	44
7.00	13.00	35	<mda< td=""><td>45</td></mda<>	45
7.00	17.00	<mda< td=""><td>720</td><td>46</td></mda<>	720	46
8.00	1.00	<mda< td=""><td>540</td><td>47</td></mda<>	540	47
9.00	5.00	<mda< td=""><td><mda< td=""><td>48</td></mda<></td></mda<>	<mda< td=""><td>48</td></mda<>	48
9.00	14.00	<mda< td=""><td>750</td><td>49</td></mda<>	750	49
10.00	17.00	42	1200	50
11.00	1.00	<mda< td=""><td>1230</td><td>51</td></mda<>	1230	51
14.00	5.00	28	<mda< td=""><td>52</td></mda<>	52
18.00	3.00	<mda< td=""><td>1080</td><td>53</td></mda<>	1080	53
20.00	1.00	<mda< td=""><td><mda< td=""><td>54</td></mda<></td></mda<>	<mda< td=""><td>54</td></mda<>	54

Table 4 (continued)

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

 $^{^{}a}MDA = 50 \text{ dpm}/100 \text{ cm}^{2}$. Some alpha levels were below the MDA but above the critical decision level, indicating a measurable amount of alpha radiation above the instrument background. $^{b}MDA = 500 \text{ dpm}/100 \text{ cm}^{2}$.

^cSee 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	78 0	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< td=""><td>74</td></mda<>	74
16.00	0.00	720	65
16.00	2.00	930	67
16.00	3.00	1020	66

^aMDA = 500 dpm/100 cm². ^bSee Table 3 for analytical results.

INTERNAL DISTRIBUTION

1.	B. A. Berven	17.	R. E. Rodriguez
2-4.	K. J. Brown	18.	R. E. Swaja
5.	R. F. Carrier	19.	M. S. Uziel
6.	W. D. Cottrell	20.	J. K. Williams
7.	R. D. Foley	21-22.	Laboratory Records
8.	R. O. Hultgren		Laboratory Records – RC
9.	C. A. Johnson		Central Research Library
10-14.	M. E. Murray	25.	ORNL Technical Lib., Y-12
15.	P. T. Owen	26.	ORNL Patent Section
16.	D. A. Roberts	27-32.	MAD Records Center

EXTERNAL DISTRIBUTION

- 33. W. L. Beck, Oak Ridge Associated Universities, E/SH Division, Environmental Survey and Site Assessment Program, P.O. Box 117, Oak Ridge, TN 37831-0117
- 34. P. Doolittle, Booz-Allen & Hamilton, Inc., 4330 East-West Highway, Bethesda, MD 20814
- 35. J. J. Fiore, Director, Office of Eastern Area Programs, Office of Environmental Restoration, U.S. Department of Energy, 4th Floor, 656 Quince Orchard Rd., Gaithersburg, MD 20878
- 36-41. R. R. Harbert, Bechtel National, Inc., FUSRAP Department, Oak Ridge Corporate Center, 151 Lafayette Drive, P.O. Box 350, Oak Ridge, TN 37831-0350
- 42-44. J. King, Science Applications International Corp., P.O. Box 2501, 301 Laboratory Road, Oak Ridge, TN 37831
 - 45. L. K. Price, Director, Former Sites Restoration Division, Oak Ridge Field Office, U.S. Department of Energy, P.O. Box 2001, Oak Ridge, TN 37831-8723
 - 46. J. W. Wagoner II, Director, Division of Off-Site Programs, Office of Eastern Area Programs, Office of Environmental Restoration, U.S. Department of Energy, 4th Floor, 656 Quince Orchard Rd., Gaithersburg, MD 20878
- 47-51. W. A. Williams, Designation and Certification Manager, Division of Off-Site Programs, Office of Eastern Area Programs, Office of Environmental Restoration, U.S. Department of Energy, 4th Floor, 656 Quince Orchard Rd., Gaithersburg, MD 20878
- 52-53. Office of Scientific and Technical Information, U.S. Department of Energy, P.O. Box 62, Oak Ridge, TN 37831