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DOE Contract No. DE-AC05-91OR21949
Code: 7330/WBS: 106

SEP 17 1993

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Oak Ridge Operations Office
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Oak Ridge, TN 37831-8723

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Former Sites Restoration Division

Subject: Granite City - Post-Remedial Action Report - Publication

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If you have any questions, please call me at 576-1710.

Sincerely,

G. L. Palau
Project Manager - FUSRAP

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Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-91OR21949

Post-Remedial Action Report for the Remedial Action at the Granite City Site

Granite City, Illinois

September 1993

Printed on recycled/recyclable paper.

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DOE/OR/21949-371

POST-REMEDIAL ACTION REPORT

FOR THE

REMEDIAL ACTION AT THE GRANITE CITY SITE

GRANITE CITY, ILLINOIS

SEPTEMBER 1993

Prepared for

United States Department of Energy

Oak Ridge Operations Office

Under Contract No. DE-AC05-91OR21949

By

Bechtel National, Inc.

Oak Ridge, Tennessee

Bechtel Job No. 14501

108597

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ACRONYMS

AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
BNI	Bechtel National, Inc.
DOE	Department of Energy
FUSRAP	Formerly Utilized Sites Remedial Action Program
HEPA	high-efficiency particulate air
IVC	independent verification contractor
LLRW	low-level radioactive waste
NSC	National Steel Corporation
ORNL	Oak Ridge National Laboratory
PMC	project management contractor
RSS	radiological support subcontractor

UNITS OF MEASURE

cm	centimeter
cpm	counts per minute
dpm	disintegrations per minute
ft	foot
in.	inch
g	gram
gal	gallon
h	hour
L	liter
lb	pound
m	meter
μCi	microcurie
μR	microroentgen
ml	milliliter
mrad	millirad
mrem	millirem
pCi	picocurie
ppm	parts per million

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1.0 INTRODUCTION

1.1 BACKGROUND

This report describes and documents the expedited remedial action and subsequent radiological surveys performed at the Betatron Building, Granite City South Plant Facility, 1417 State Street, Granite City, Illinois (Figure 1-1), from June 7 to 11, 1993.

Decontamination activities and post-decontamination surveys at the Granite City site were performed as part of the Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). In 1974 the United States Congress authorized the Atomic Energy Commission (AEC), a predecessor agency to DOE, to institute FUSRAP. The objective of FUSRAP, now managed by DOE, is to identify and clean up or otherwise control sites where residual radioactive contamination (exceeding current guidelines) remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy.

Bechtel National, Inc. (BNI) is the project management contractor (PMC) for FUSRAP. Oak Ridge National Laboratory (ORNL), the FUSRAP independent verification contractor (IVC), performed designation, characterization, and verification surveys and will issue an independent report of its post-remedial action verification survey results.

1.2 HISTORY

In the late 1950s and early 1960s, uranium-238 ingots were x-rayed for AEC in the Betatron Building to detect metallurgical flaws. X-ray services were provided by General Steel Castings Corporation under purchase orders from Mallinckrodt Chemical Works, a prime AEC contractor. Purchase orders were issued by Mallinckrodt from 1958 to 1966 on an "as required" basis.

In 1989 ORNL conducted radiological surveys on behalf of DOE to determine current radiological conditions in and around the Betatron Building. Survey results indicated that only a limited area of this storage building was contaminated above current guidelines. AEC-related activities at the site had caused some residual radioactive contamination (in excess of DOE guidelines) on an industrial vacuum cleaner, in the vacuum cleaner contents,

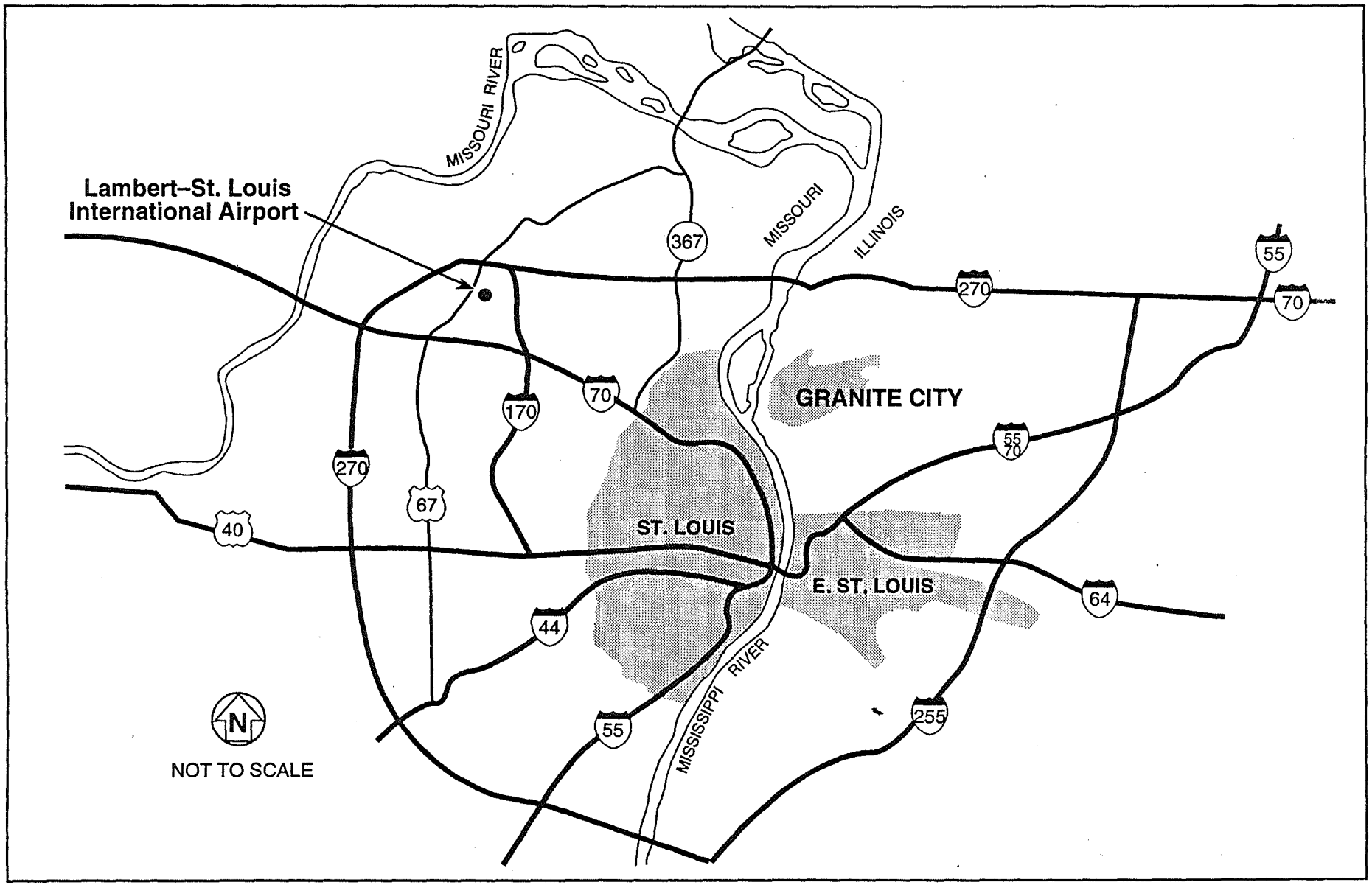

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Figure 1-1
Location of Granite City, Illinois

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on some of the building surfaces in the immediate vicinity of the vacuum cleaner, and in a few localized spots on the ground-level floor. However, most of the building, its roof, and surrounding grounds were generally free of residual contamination resulting from AEC activities. The contaminants of concern were uranium and its daughter products. No records were found to indicate that any cleanup activities were performed at the conclusion of the AEC contract work (ORNL 1990).

In 1991 a second betatron building (called the New Betatron Building) was also surveyed by ORNL at the request of DOE. New information indicated that the New Betatron Building may also have been used to examine uranium ingots. The survey results showed no residual uranium-238 attributable to former AEC-supported operations at this site (ORNL 1992); therefore, no remedial action was performed in this building.

1.3 SITE DESCRIPTION

Granite City, Illinois, is northeast and across the Mississippi River from St. Louis, Missouri (Figure 1-1). The current owner of the Betatron Building is the National Steel Corporation (NSC). The building is constructed of metal and concrete. A railroad track enters from the north end of the building, through a high bay area, into a large, open room at the south end of the building, called the betatron room (Figure 1-2). The walls around the betatron room and the bay area are 3 m (10 ft) thick. The walls are constructed of concrete slabs, built as two separate walls with sand between the walls. Two Allis-Chalmers betatron particle accelerators, used to x-ray the ingots, remained in the room against the south wall at the time of the designation surveys. NSC has now removed the betatron accelerators from the building, and recently has stored transformers in this room. The remaining northeast quarter of the building is subdivided into offices and utility rooms, with a second floor over these rooms (Figure 1-3) (ORNL 1990).

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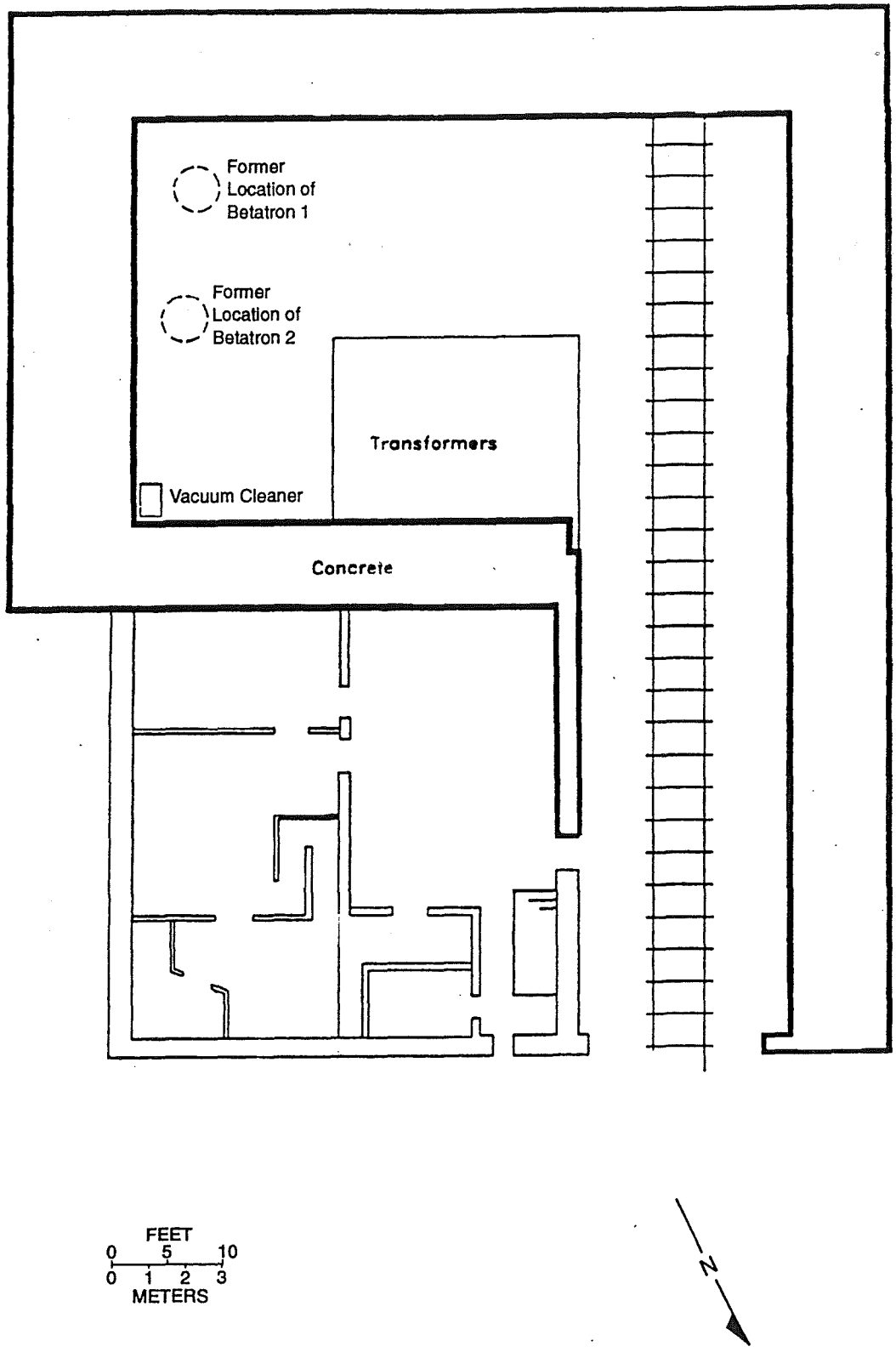

Figure 1-2
Floor Plan—First Floor of the Betatron Building

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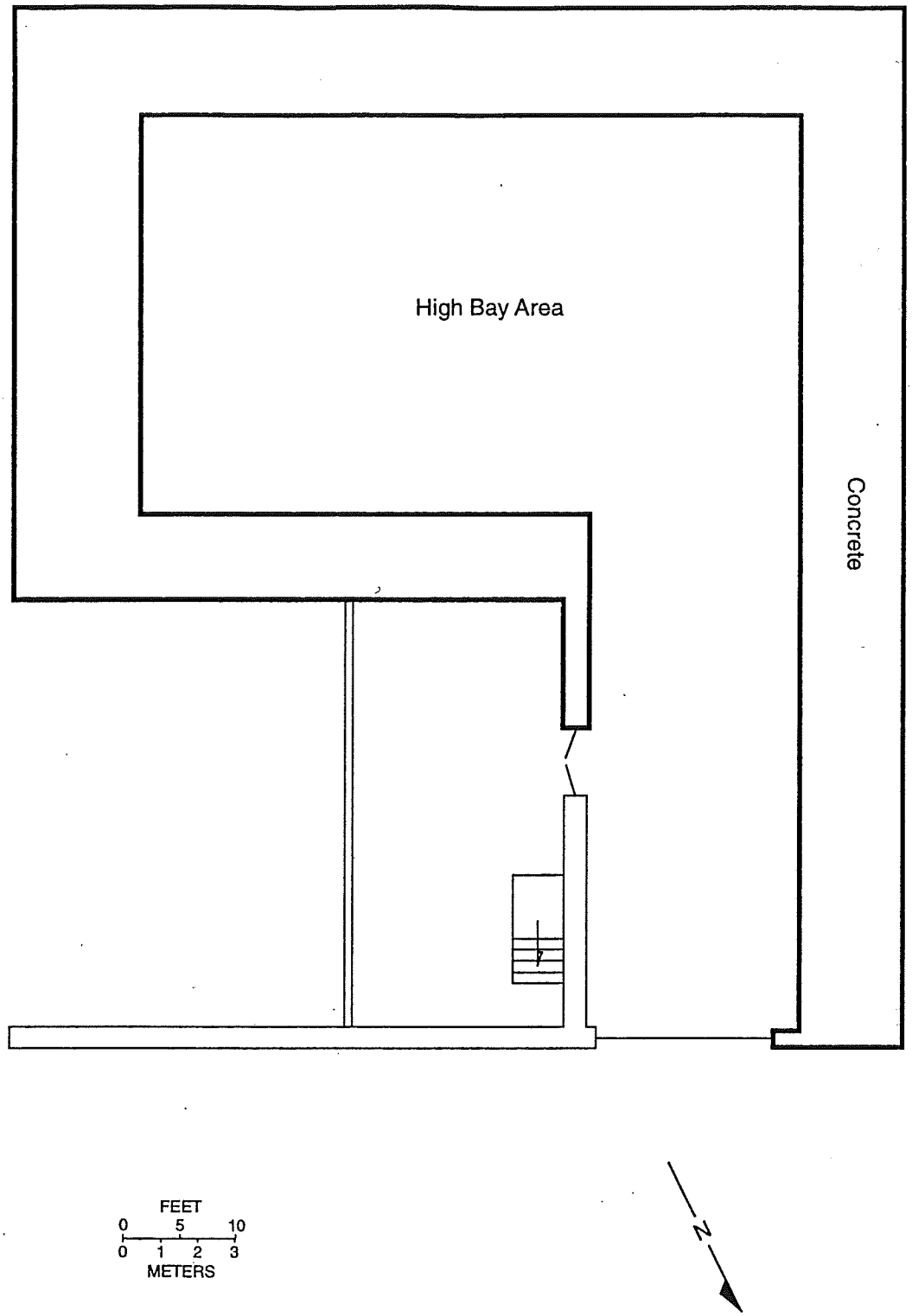

Figure 1-3
Floor Plan—Second Floor of the Betatron Building

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2.0 REMEDIAL ACTION GUIDELINES

Because the source of contamination in the building was from the handling and examination of uranium ingots for AEC, and the contamination was surficial, the residual contamination guidelines in DOE Order 5400.5, Radiation Protection of the Public and Environment, were applicable. These guidelines are summarized in Table 2-1.

According to DOE Order 5400.5, the relevant remedial action guidelines for alpha activity resulting from residual uranium on structural surfaces at the Granite City site are 5,000 dpm/100 cm^2 average and 15,000 dpm/100 cm^2 maximum for fixed (nontransferable) alpha activity, and 1,000 dpm/100 cm^2 for transferable alpha activity. The relevant remedial action guidelines for beta-gamma activity are also summarized in Table 2-1.

Gamma radiation exposure rates in the northeast corner of the betatron room were 90 μR/h on contact with the industrial vacuum cleaner and 40 μR/h on the floor beneath it. The beta-gamma dose rate near the industrial vacuum cleaner was 0.2 mrad/h. Transferable alpha and beta-gamma measurements were below the DOE guideline of 1,000 dpm/100 cm^2. Concentrations of uranium-238 were 3,300 and 4,000 pCi/g in samples from the floor beside the contaminated vacuum cleaner and from the cleaner itself, respectively. In three other locations pCi/g (the damper in a vent above the vacuum cleaner and at locations S4 and S6), uranium-238 values were above 35 pCi/g.

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TABLE 2-1
SUMMARY OF RESIDUAL CONTAMINATION GUIDELINES FOR STRUCTURES

BASIC DOSE LIMITS

The basic limit for the annual radiation dose received by an individual member of the general public is 100 mrem/yr.

STRUCTURE GUIDELINES

Airborne Radon Decay Products

Generic guidelines for concentrations of airborne radon decay products shall apply to existing occupied or habitable structures on private property that has no radiological restrictions on its use; structures that will be demolished or buried are excluded. The applicable generic guideline (40 CFR 192) is: In any occupied or habitable building, the objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL.[a] In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL. Remedial actions are not required in order to comply with this guideline when there is reasonable assurance that residual radioactive materials are not the cause.

External Gamma Radiation

The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restrictions on its use shall not exceed the background level by more than 20 μR/h.

Indoor/Outdoor Structure Surface Contamination

Radionuclide[c]	Allowable Surface Residual Contamination[b] (dpm/100 cm^2) Average[d,e]	Maximum[e,f]	Removable[e,g]
Transuranics, Ra-226, Ra-228, Th-230, Th-228 Pa-231, Ac-227, I-125, I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224 U-232, I-126, I-131, I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000 β - γ	15,000 β - γ	1,000 β - γ

[a]A working level (WL) is any combination of short-lived radon decay products in 1 liter of air that will result in the ultimate emission of 1.3 x 10^5 MeV of potential alpha energy.

[b]As used in this table, dpm (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]Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

[d]Measurements of average contamination should not be averaged over more than 1 m^2. For objects of less surface area, the average shall be derived for each such object.

[e]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

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

[g]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 measuring the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. The numbers in this column are maximum amounts.

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3.0 REMEDIAL ACTION

This section describes the expedited remedial action conducted at the Betatron Building and specifically addresses:

- coordination among DOE, BNI, and ORNL,
- decontamination activities, and
- contamination control and waste management.

3.1 COORDINATION

Coordination among DOE, BNI, and ORNL was critical to the timely and efficient decontamination of the building. Coordination was discussed during a meeting between representatives of BNI and ORNL on March 24, 1993, and points of agreement were summarized in a letter plan from BNI (BNI 1993a) and acknowledged by ORNL (ORNL 1993). The letter plan was developed in accordance with applicable verification protocols (DOE 1990).

Because the radioactive contamination was contained in the interior of the building and in limited amounts, DOE recommended that the remediation follow the expedited protocol. Under the expedited protocol, ORNL acted as both the characterization contractor and the verification contractor. Appropriate environmental documentation was prepared, including a categorical exclusion as required under the National Environmental Policy Act and a modified preliminary assessment/site inspection. To designate the areas of contamination, ORNL performed walkover surveys on the surface of the first floor, the railroad bay, and the betatron room using a floor monitor to directly measure alpha and beta-gamma radiation. These surveys excluded the office area, which had been previously characterized and was found to meet the release criteria for residual radioactive contamination (ORNL 1990).

BNI and NSC supported ORNL's characterization surveys. NSC moved pallets, building debris, and drums to provide access to the first floor for the survey. ORNL supplied generator power for the lighting. NSC removed the betatron accelerators from the building, and they remained outside of the building while remedial action was completed.

The betatrons were surveyed during the designation survey and met release guidelines for residual radioactive contamination. BNI provided scaffolding and lighting for the survey areas.

BNI performed decontamination concurrently with IVC characterization activities. Remedial action continued until concentrations were as low as reasonably achievable (ALARA). The BNI site superintendent notified the IVC when decontamination was complete and provided the IVC access to post-remedial action survey results as they became available. ORNL performed final independent verification surveys of the remediated areas and verified based on direct reading measurements that decontamination was completed. ORNL and BNI demobilized on June 10 and 11, respectively.

3.2 DECONTAMINATION ACTIVITIES

Various decontamination techniques were used at the Granite City site (see Table 3-1). Decontamination activities focused first on areas designated in the site designation report (ORNL 1990) and then on additional areas that were found to contain concentrations exceeding guidelines, according to characterization surveys conducted during remedial action activities. Designated areas and items were an industrial vacuum cleaner and its contents, building surfaces in the immediate vicinity of the vacuum cleaner, and a few localized spots on the first floor (Figure 3-1). Decontamination activities were documented daily by the BNI site superintendent.

Decontamination included packaging the contaminated vacuum cleaner and its contents in a 55-gal galvanized steel drum and then vacuuming the floor where the vacuum cleaner had been stored, using a high-efficiency particulate air-(HEPA-) filtered exhaust vacuum cleaner. The area of contamination on the floor was approximately 10 m^2 (107 ft^2). In areas where contamination remained after vacuuming, an alconox/water mixture and stiff-bristled brush were used to further decontaminate. Washing and light abrasive techniques were found to be generally effective; however, two locations [approximately 0.1 m^2 (1 ft^2)] required scabbling, a more aggressive destructive technique, to reduce the contamination. The areas were scabbled to depths not greater than 0.6 cm (0.25 in.). Post-remedial action surveys showed no contamination on the walls in this area.

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Table 3-1

Decontamination Techniques Used at the Granite City Site

Technique	Description
HEPA vacuuming	High-efficiency particulate air- (HEPA-) filtered vacuum cleaners were used to remove loose contamination.
Hand wiping/light abrasion	Small areas and structural surfaces that were either inaccessible or resistant to HEPA vacuuming were wiped with a dry cloth or a cloth wetted with a detergent solution to remove loose surface contamination. Contamination that was resistant to simple wiping was brushed with a wire brush.
Scabbling	This destructive technique uses an impact hammer-drill with a rotary hone.
Chipping	This destructive technique uses an impact hammer-drill with a chisel bit.

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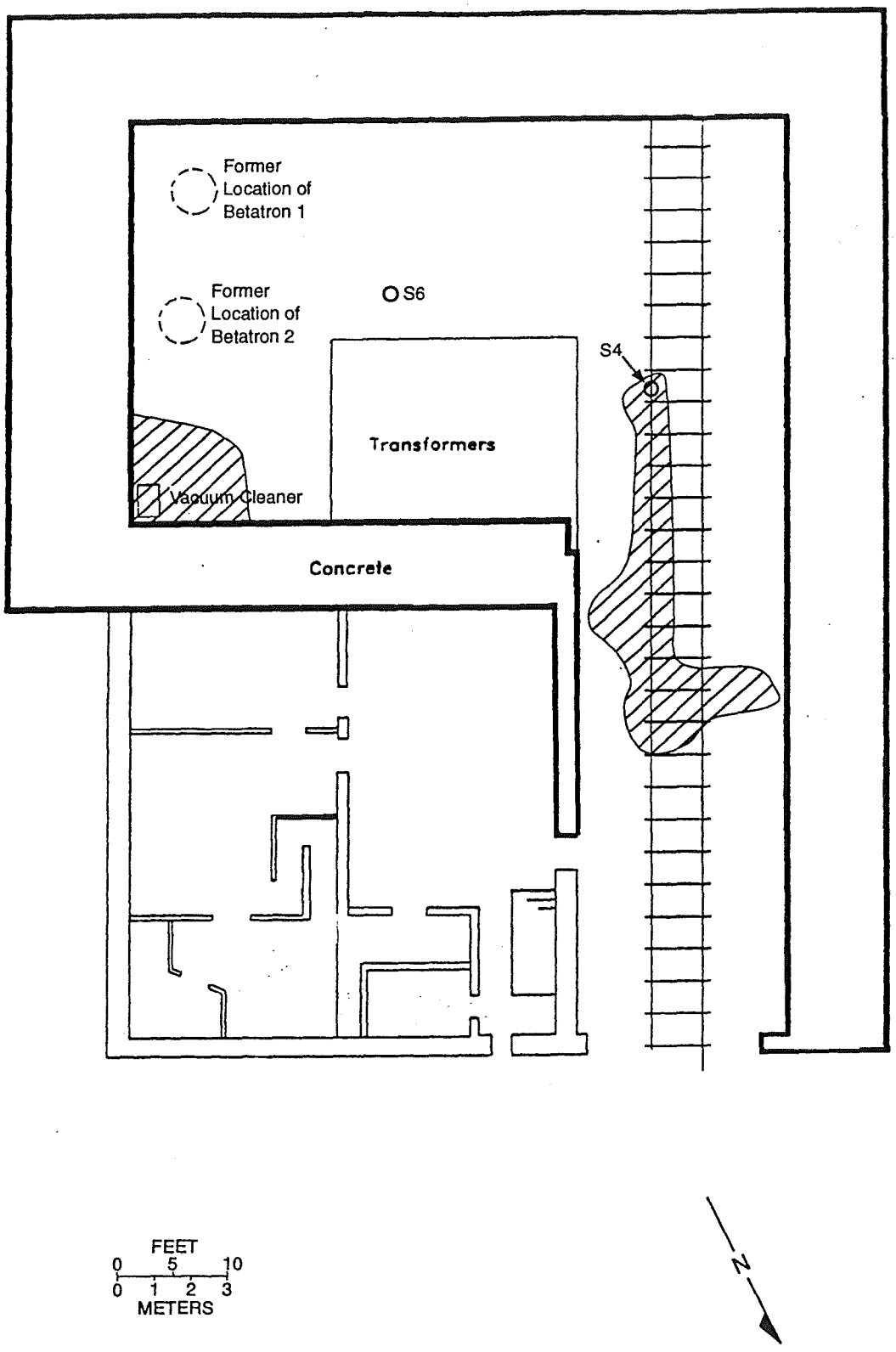

Figure 3-1
Areas of Contamination at the Granite City Site

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A ventilation duct above the industrial vacuum cleaner was previously designated by ORNL as requiring decontamination. The contaminated portion of the duct was the damper unit [0.6 by 0.6 by 1 m (2 by 2 by 3 ft)]. The damper unit was removed and compacted to reduce its volume for waste disposal packaging.

Two floor locations [S4 and S6 (Figure 3-1)] were previously designated, (ORNL 1990). No contamination was detected during remedial action at location S6. Location S4 was along the railroad tracks. The surfaces around the railroad tracks were asphalt, with indentions in the asphalt 3 to 5 cm (1 to 2 in.) deep and 3 to 8 cm (1 to 3 in.) wide along the inside of each track. Soil that had accumulated in these indentions was removed and packaged for disposal. Afterwards, a characterization survey of the area indicated several spots of contamination about 7 m (23 ft) south of location S4. ORNL designated these areas (Figure 3-1) at the time of remediation. Chipping, a destructive technique using a hammer drill with a chisel bit, was used to remove the contamination. Chipping depths were no greater than 2 cm (0.79 in.).

3.3 CONTAMINATION CONTROL AND WASTE MANAGEMENT

This section describes controls implemented at the Granite City site during remedial action to prevent spread of contamination and to minimize exposure to workers and the public. Several instructions and plans were applicable to the remedial action. The field crew performed training and planning activities in accordance with applicable work controlling documents before field activities began.

Because the decontamination activities involved potential exposure to contaminated material, all work was performed under hazardous work permits. Hazardous work permits, issued by the site safety and health officer, specified required personal protective equipment and provided specific health and safety instructions for various tasks. In general, work in contaminated areas required gloves, hard hats, safety glasses, and sturdy work boots.

Access to the building and work areas was controlled by postings and signs. Restricted work areas were set up around the industrial vacuum cleaner and the duct work. A heavy plastic sheet was placed on the floor before the industrial vacuum cleaner and ductwork were packaged; the plastic was subsequently packaged for disposal. HEPA-filtered vacuum

cleaners were used for dust control during chipping and scabbling. The vacuum cleaners were emptied over the plastic sheet. Face shields were worn during wet washing, chipping, and scabbling. All equipment was surveyed and decontaminated before leaving the site.

Air particulate samples were collected from the roll-up door on the northeast end of the building and from the industrial vacuum area. Also, representative members of the field crew wore breathing-zone air samplers to collect air samples in the remedial action area. Samples were analyzed for airborne concentrations of total uranium; activity detected in these samples ranged from 1.9E-14 to 8.3E-13 μCi/ml. Detected concentrations of uranium-238 were below occupational exposure guidelines (DOE Order 5480.11, Radiation Protection for Occupational Workers) and below derived concentration guides for the general public (DOE Order 5400.5) [2E-11 and 2E-12 μCi/ml, respectively]. Thermoluminescent dosimeters were also worn by the field crew to measure exposure to penetrating (beta/gamma) radiation. As the results are obtained, they will be reviewed. Based on the gamma radiation exposure rates measured, acceptable readings are expected.

Water was required onsite for possible personal decontamination and equipment decontamination; however, the use and amount of water was minimized. Flushing with large amounts of water was avoided. Water used for decontamination was collected using absorbent towels or wet vacuuming techniques.

Waste was packaged in four 55-gal drums (Table 3-2). The soil from the railroad tracks and the HEPA vacuum contents were packaged in two of the four drums. Standing water was absorbed. The remaining two drums contained the industrial vacuum cleaner, dismantled ductwork, plastic sheeting, and personal protective equipment used during remediation.

The contents of only the two drums containing the railroad dirt were sampled for waste disposal purposes. Representative sample aliquots were collected in 0.5-L plastic containers for gamma spectroscopy and in 0/5-L amber glass containers for polychlorinated biphenyl analyses. Gamma spectroscopy analysis was requested for uranium-238, radium-226, thorium-232, and thorium-230. The drums were sampled before adding absorbent material.

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Table 3-2

Drum Inventory at the Granite City Site

Drum Identification Number	Contents	Type Waste	Container Weight (lbs)
CD01851	Soil	LLRW[a]	750
CD01852	Vacuum cleaner	LLRW	125
CD01853	Duct metal, personal protective clothing	LLRW	90
CD01854	Dirt, plastic sheeting, vacuum filter	LLRW	400

[a]LLRW - low-level radioactive waste.

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Analytical results show Arochlor-1254, a polychlorinated biphenyl at 21 ppm in the soil collected (the analytical result was qualified by the laboratory as an estimated value because the matrix spike was too dilute for the Arochlor-1254 to be detected, and the spike recovery, therefore, could not be measured). Isotopic analysis results for uranium-238 was 4.2 pCi/g, for radium-226 was 1.7 pCi/g, for thorium-232 was 0.95 pCi/g, and for thorium-230 was 1.26 pCi/g (BNI 1993b).

The two remaining drums containing the contaminated industrial vacuum cleaner, ductwork, and personal protective equipment were not sampled for waste disposal purposes. The highest contaminant concentration reported in the designation report (ORNL 1990) for all of the material in the two drums will be used for waste disposal purposes.

The drums were placed in temporary storage on pallets just inside the Betatron Building to await final disposal. The drums were sealed, banded, and labeled. The drum labels indicate the drum contents, the waste generator, and the origin of the material. NSC provides security for the area.

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4.0 POST-REMEDIAL ACTION MEASUREMENTS

4.1 EXTERIOR AREAS

Because no outside areas were designated or remediated, no post-remedial action samples were collected outside the building.

4.2 INTERIOR AREAS

Following decontamination, the radiological support subcontractor (RSS) performed post-remedial action surveys to determine the completeness of the removal action and to document that no residual radioactive contamination above DOE guidelines remains at the site and that the site can be released without radiological restrictions.

4.2.1 Background Measurements

Before performing post-remedial action surveys, the RSS obtained site-specific background measurements from remote background locations in the general vicinity of the site. The locations for background measurements were chosen so that they would be representative of the general area of the site and were mutually agreeable to BNI and ORNL (Figure 4-1). BNI took background measurements with a pressurized ionization chamber and provided the results to ORNL. The three background gamma radiation exposure rates ranged from 6.6 to 8.2 μR/h (BNI 1993b).

Alpha and beta-gamma background measurements were taken daily. For alpha background measurements, the source was removed from the instrument for the reading. Beta-gamma measurements were taken from a source holder with the source removed. Alpha background measurements ranged from 1.0 to 2.0 cpm for the AC-3 instrument and 0.32 cpm for the SAC-4 instrument. Beta-gamma background measurements ranged from 22.0 to 24.0 cpm for the HP-210 instrument (BNI 1993b).

4.2.2 Surveys

The RSS performed a gamma radiation exposure survey at 1 m (3 ft) from the ground surface at six locations in the building to ensure that exposure rates were reduced to

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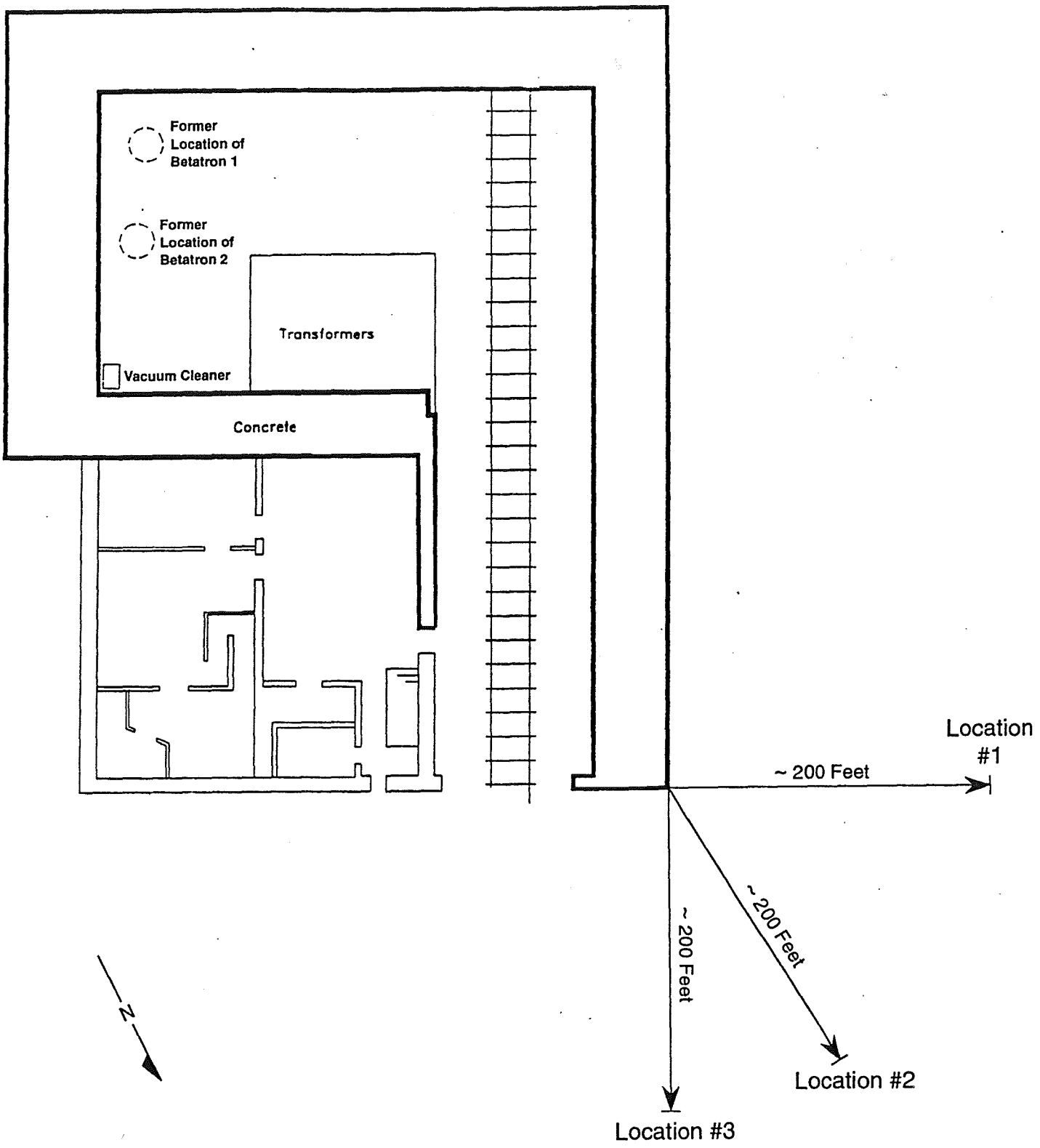

Figure 4-1
Locations of Background Measurements Taken at the Granite City Site

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acceptable levels. The measured exposure rates ranged from 8.2 to 9.0 μR/h, including background. These rates are well below DOE exposure rate criteria, 20 μR/h above background, for habitable structures and buildings (BNI 1993b).

A 1-m^2 (3-ft^2) grid was established over the remediated areas for fixed-point and transferable survey measurements. The starting point for the grid was measured from the north and east walls to enable re-creation of the grid, if necessary, at some time in the future. Fixed-point measurements were taken and transferable contamination samples were collected at the corners and in the center of each block. Areas not meeting DOE guidelines were marked for further decontamination and were subsequently resurveyed.

Two general areas were surveyed for direct and transferable contamination (Figure 3-1):

- In the S4 area along the railroad tracks, direct surface contamination ranged from 23 to 54 dpm/100 cm^2 for alpha and from 624 to 4,935 dpm/100 cm^2 for beta-gamma; all measurements were below the guideline of 5,000 dpm/100 cm^2 for average direct surface contamination. Transferable contamination concentrations ranged from 3 to 7 dpm/100 cm^2 for alpha and from 50 to 102 dpm/100 cm^2 for beta-gamma; all measurements were below the guideline of 1,000 dpm/100 cm^2 (BNI 1993b).

- In the area where the industrial vacuum cleaner had been located, direct measurements ranged from 15 to 223 dpm/100 cm^2 for alpha and from 416 to 3,270 dpm/100 cm^2 for beta-gamma. Transferable contamination concentrations ranged from 3 to 16 dpm/100 cm^2 for alpha and from 50 to 106 dpm/100 cm^2 for beta-gamma (BNI 1993b).

4.2.3 Sampling

No residue remained following vacuuming; therefore, sampling was not required.

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5.0 POST-REMEDIAL ACTION STATUS

Post-remedial action survey results indicate that the decontamination of the Betatron Building was effective and that residual contamination at the site is now below DOE release criteria as specified in DOE Order 5400.5. The waste is stored just inside the Betatron Building and will be disposed of as low-level radioactive waste. BNI continues to pursue the final disposal of the waste at a licensed disposal facility.

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GLOSSARY

Alpha - See **Radiation.**

Background radiation - Background radiation refers to naturally occurring radiation emitted from either cosmic (e.g., from the sun) or terrestrial (e.g., from the earth) sources. Exposure to this type of radiation is unavoidable, and its level varies greatly depending on the geographic location. For example, because of naturally occurring radiation alone, New Jersey typically receives 100 mrem/yr, Colorado receives about 300 mrem/yr, and some areas in South America receive up to 7,000 mrem/yr. Naturally occurring terrestrial radionuclides include uranium, radium, potassium, and thorium (see **Radionuclide**). The dose levels do not include the concentrations of naturally occurring radon inside buildings.

Beta-gamma - See **Radiation.**

Centimeter - A centimeter (cm) is a metric unit of measurement for length; 1 inch is equal to 2.54 cm; 1 foot is equal to approximately 30 cm.

Contamination - Contamination is used generally to mean a concentration of one or more radioactive materials that exceeds naturally occurring levels. Contamination may or may not exceed the DOE cleanup guidelines.

Curie - The curie, symbolized by Ci, is the unit for quantity of radioactivity. It is the quantity of radioactive material in which 3.7×10^{10} atoms are transformed per second, or disintegrate per second. For health physics, as well as for many other purposes, the curie is a very large amount of activity. For convenience, sub-multiples of the curie, as listed below, are therefore used: 1 microcurie (μCi) = .000001 Ci (E-6 Ci), and
1 picocurie (pCi) = .000000000001 Ci (E-12 Ci).

Disintegrations per minute - Disintegrations per minute (dpm) is the measurement indicating the amount of radiation being released from a substance per minute. See **Curie.**

Exposure rate - Exposure rate is the rate at which radiation imparts energy to the air. Exposure is typically measured in microroentgens (μR), and exposure rate is typically expressed as μR/h. The dose to the whole body can be approximated by multiplying the exposure rate by the number of hours of exposure. For example, if an individual were

exposed to gamma radiation at a rate of 20 μR/h for 168 h/week (continuous exposure) for 52 weeks/year, the whole-body dose on an annual basis would be 170 mrem (1 mrem = 1,000 μR).

Gamma - See **Radiation.**

Gram - A gram (g) is a metric unit of weight. There are 454 g in 1 pound and 28 g in 1 ounce.

Meter - A meter (m) is a metric unit of length; 1 m is equal to approximately 39 inches.

Microroentgen - A microroentgen (μR) is a unit used to measure radiation exposure. For further information, see **Exposure rate.**

Picocurie - See **Curie.**

Radiation - There are three primary types of radiation: alpha, beta, and gamma. Alpha radiation travels less than an inch in air before it stops and cannot penetrate the outer layers of human skin. Alpha radiation is of concern only if it is ingested or inhaled into the body. Beta radiation can penetrate the outer layers of skin but cannot reach the internal organs. Gamma radiation, the most penetrating type, can usually reach the internal organs.

Radionuclide - Radioactive elements are also referred to as radionuclides. For example, uranium-235 is a radionuclide, uranium-238 is another, thorium-232 is another, and so on.

Remedial action - Remedial action is a general term used to mean "cleanup of contamination that exceeds DOE guidelines." It refers to any action required so that a property can be certified as being in compliance with guidelines and can therefore be released for future use. In practice, this may require removing grass and soil, cutting trees, and removing asphalt. Remedial action also includes restoring remediated properties to their original conditions insofar as possible.

Uranium - Uranium is a naturally occurring radioactive element. The principal use of uranium when refined is for the production of fuel for nuclear reactors. Uranium in its natural form is not suitable for use as a fuel source.