DECONTAMINATION AND DECOMMISSIONING

OF

BUILDING C - PHASE II

AT

LYNCHBURG RESEARCH CENTER

LYNCHBURG, VIRGINIA

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1.0 INTRODUCTION

1.1 Statement of the Problem

The Babcock & Wilcox Company (B&W), a wholly owned subsidiary of Mc Dermott International, Inc., holds NRC License SNM-778 (1) to conduct operations involving SNM at its Lynchburg Research Center (LRC) near Lynchburg, Virginia. Under this license, research and development on thoria, urania, and plutonia nuclear fuels were performed in Building C at the LRC.

A corporate decision was made in 1982 to discontinue R&D activities with radioactive materials in Building C. B&W, in ceasing licensed activities in Building C, is complying with a valid license requirement as stated in Appendix F to SNM-778 to provide for decontamination of this building to protect the environment and the general public from exposure to levels of radioactivity in excess of those permissible. Decontamination means the removal or reduction of radioactivity from buildings, walls, floors,and equipment and of radioactively contaminated soil from around and beneath buildings.

A decommissioning plan for Building C was submitted to the NRC for information purposes. (2) Decommissioning means action taken that results in the facility or a portion thereof being released for unrestricted use and termination of control of License SNM-778 for the facility or portion thereof by the NRC and includes the act of decontamination. The decommissioning plan divided work into three phases with a different section of the building being decontaminated in each phase. This report addresses the decontamination performed in Phase II.

1.2 Statement of the Objective

The objective of the decommissioning project is to decontaminate Building C in a responsible and safe manner so as to enable release of the facility for unrestricted use and from licensed control. To assure adequate standards of quality are maintained in achieving this objective, work is performed according to QA Plan NO. 82008L.(3) The decontamination includes the interior and exterior surfaces of Building C and the underlying soil. Table F-1 in Reference 1 establishes numerical limits for surface contamination within the facility. Additional numerical limits for external exposure and soil remaining under Building C are contained in Reference 4. B&W used these limits as minimum goals to achieve during decontamination, but followed the principle of reducing contamination to ALARA levels (As Low As Reasonably Achievable). The objective will be achieved in three sequential phases as described in Reference 2.

1.3 Organization of this Report

This report contains seven sections that describe the decommissioning work performed during Phase II of the Building C pro-

ject. Following this introductory section, a physical description of the site and Building C is provided. Information is provided in Section 3 about the decontamination and decommissioning operations themselves. The fourth section contains descriptions of the survey design and survey procedures used to determine residual radioactivity in and under the building. Sections 5 and 6 provide the results and data interpretation of the surveys. The final section lists the documents referenced in this report.

2.0 IDENTIFICATION OF PREMISES

2.1 Site Description

The Lynchburg Research Center (LRC) is located on the James River about 4 miles east of Lynchburg, Virginia. The site lies within Campbell County and borders on Amherst County. Of the 525 acres at this location, only 13.6 acres are utilized by the LRC. Other major B&W facilities on the site are the Naval Nuclear Fuels Division and the Commercial Nuclear Fuels Plant. Figure 2-1 shows the site property boundary and the locations of the separate facilities on the site.

The LRC is a highly integrated facility built to develop, test, and examine nuclear reactor cores and to develop overall nuclear fuel cycles. The location of Building C is shown in Figure 2-2 relative to the other buildings comprising the LRC

2.2 Building C Physical Description

The existing structure known as Building C is the result of several additions to a small laboratory completed in 1962 (see Fig. 2-3). Building C is a single story building of concrete block construction with outside dimensions of 225 feet by 174 feet at its greatest width. There is a small basement under one of the laboratories. The building contains about 24,000 square feet of laboratory, office, and support space. There were approximately 10,250 square feet in the laboratories which had suitable bench-scale and pilot plant equipment, ventilation, and personnel protection equipment for the handling of radioactive materials. There was sufficient office space to house up to 38 technical, support, and supervisory personnel. The building also contains two vaults formerly used for storage of SNM, a boiler room containing a boiler and a chilled water supply system, and a laundry. There was a large storeroom that served the entire LRC. Finally, the building contains a fan room with associated air stack that serves adjacent Building B as well as Building C.

2.3 Definition of Phase II

Decontamination of Building C will be completed in three phases. Phase I included laboratories on the western end of the building where projects were performed with thorium, plutonium, and uranium solutions and powders. Phase II includes laboratories on the eastern end of the building where projects were performed with plutonium and uranium oxide powders. (External drain lines between Building C and the Liquid Waste Building are included in Phase II.) Phase III includes two laboratories in the center of the building that were used primarily for analytical chemistry projects on plutonium fuels. The Fan Room and Laundry are also included in Phase III. Phase I includes about 10,000 square feet; Phase II, about 6,000 square feet; and Phase III about 8,000 square feet. Figure 2-4 shows the areas included in each phase. No area beyond the walls and roof of Building C

are included in this decommis-sioning project.

Phase II includes former Laboratories 15, 16, and 17, the offices and hallway along the front of the building, and the offices on the other side of the hallway which back up to Laboratories 15 and 16. Also included is the eastern portion of Hallway 23, the hallway connecting Hallway 23 to the front hallway, but not the area that is the main entrance to the building. The interior walls, ceilings, and floors as well as the underlying soil are considered to be included in Phase II.

2.4 History of Operations in Phase II

The original building was constructed in 1962 for bench-scale experiments converting thorium nitrate to thorium oxide. Expansions of this building were added several times in the next few years. A major building expansion was completed in 1968 to permit work on the FFTF Program. This work was con-ducted in gloveboxes installed in Laboratories 15, 16, 17, 19, 20. The FFTF program conducted in these laboratories included fuel preparation, pelletizing and rod loading.

Uranium fuel projects were initiated in laboratories that were vacated at the conclusion of the FFTF Program in 1971. These projects included pelletizing uranium oxide, firing and grinding the pellets, and performing various tests on the finished fuel. A limited amount of beta-gamma contaminated material has been brought into the Phase II area. Samples of beta-gamma materials were occasionally analyzed in Laboratory 19 and the waste was solidified and placed in waste drums for disposal rather than being poured into the Building C drain system. Plutonium fuel projects were primarily conducted during 1968 to 1971, although two small projects were carried out for DOE during 1979 and 1980 in Laboratory 17.

FIGURE 2-1. BABCOCK & WILCOX PROPERTY — MOUNT ATHOS

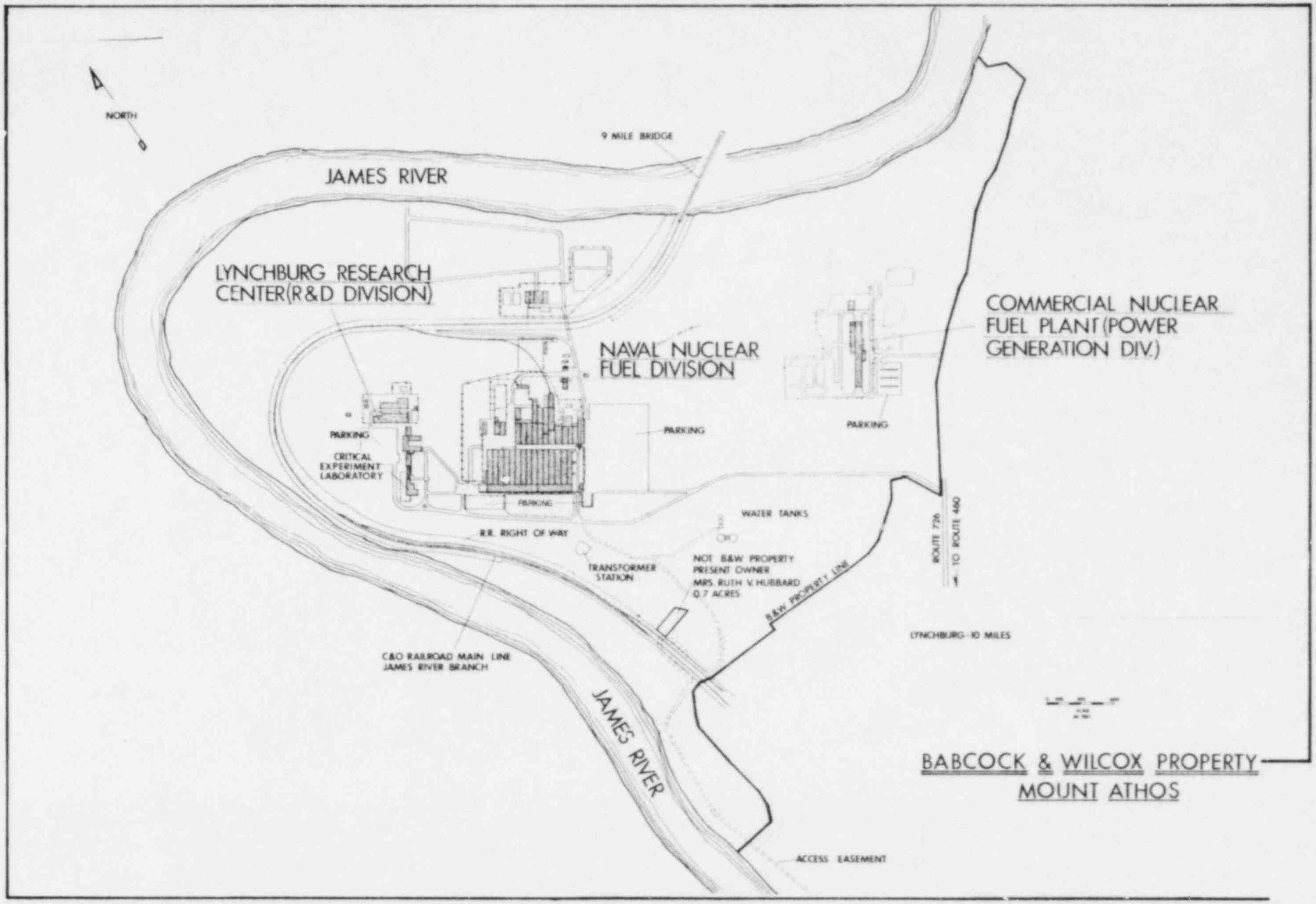


FIGURE 2-2. LYNCHBURG RESEARCH CENTER PLAN OF BUILDINGS

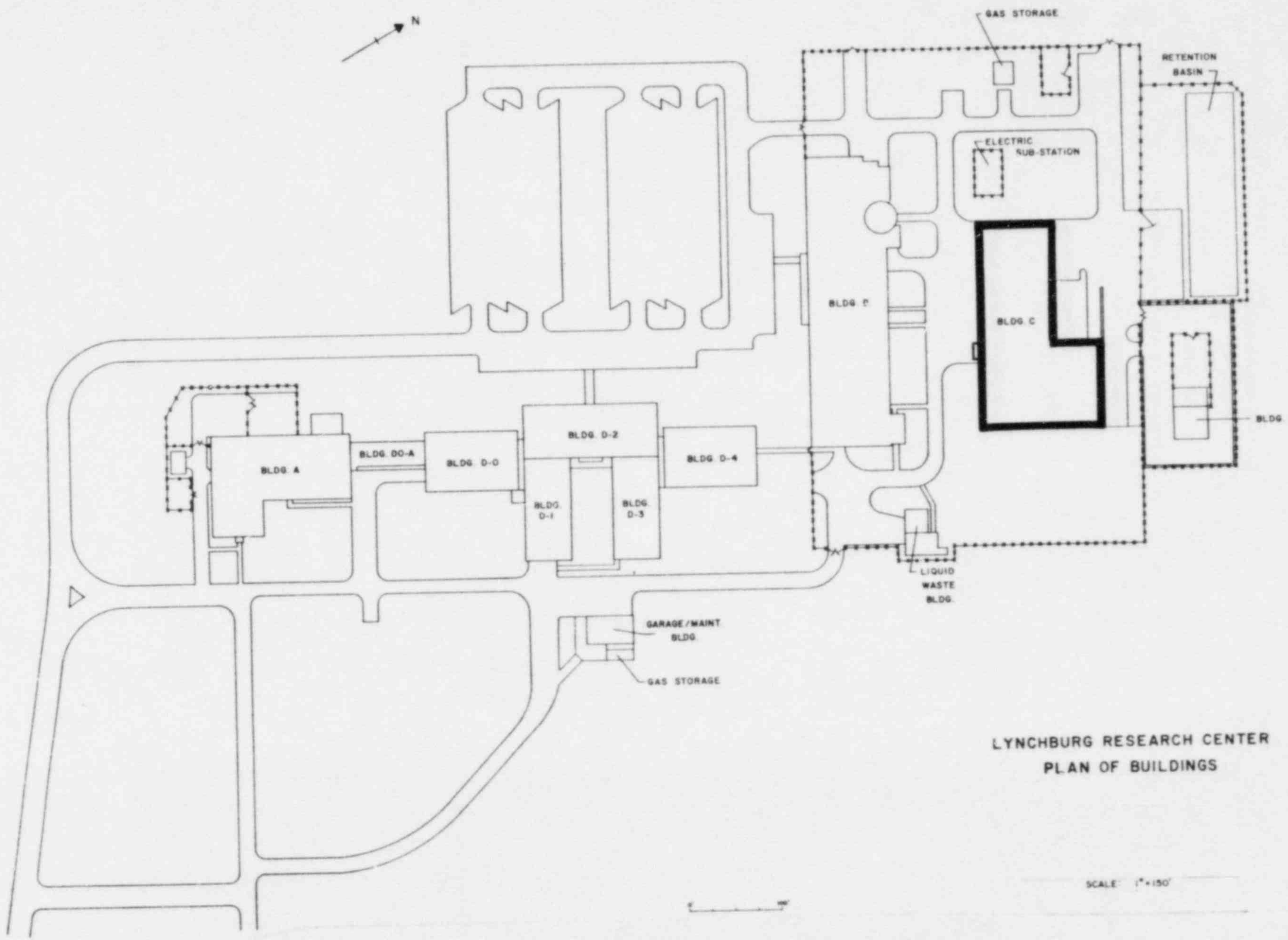


FIGURE 2-3. BUILDING C CONSTRUCTION HISTORY

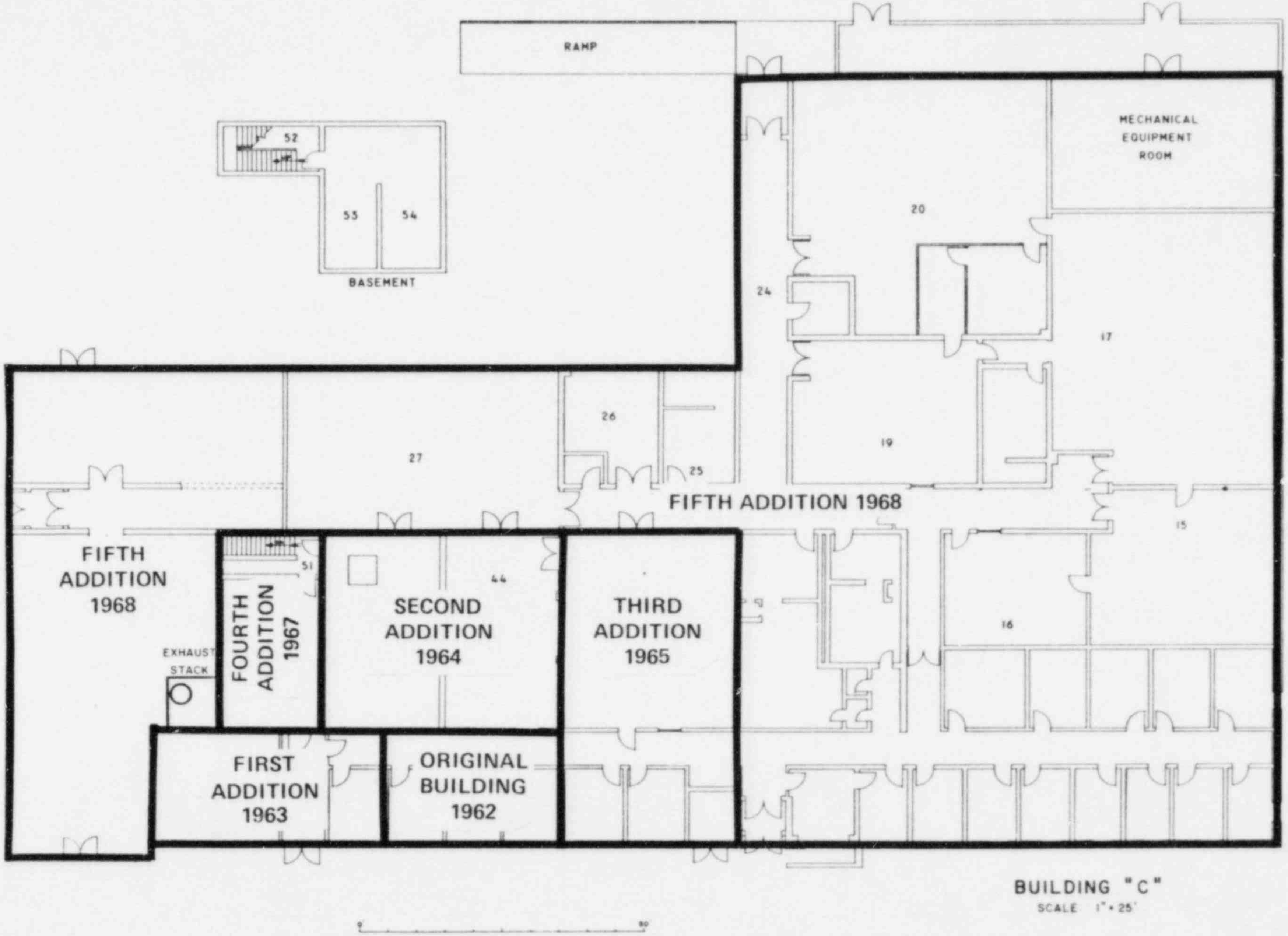
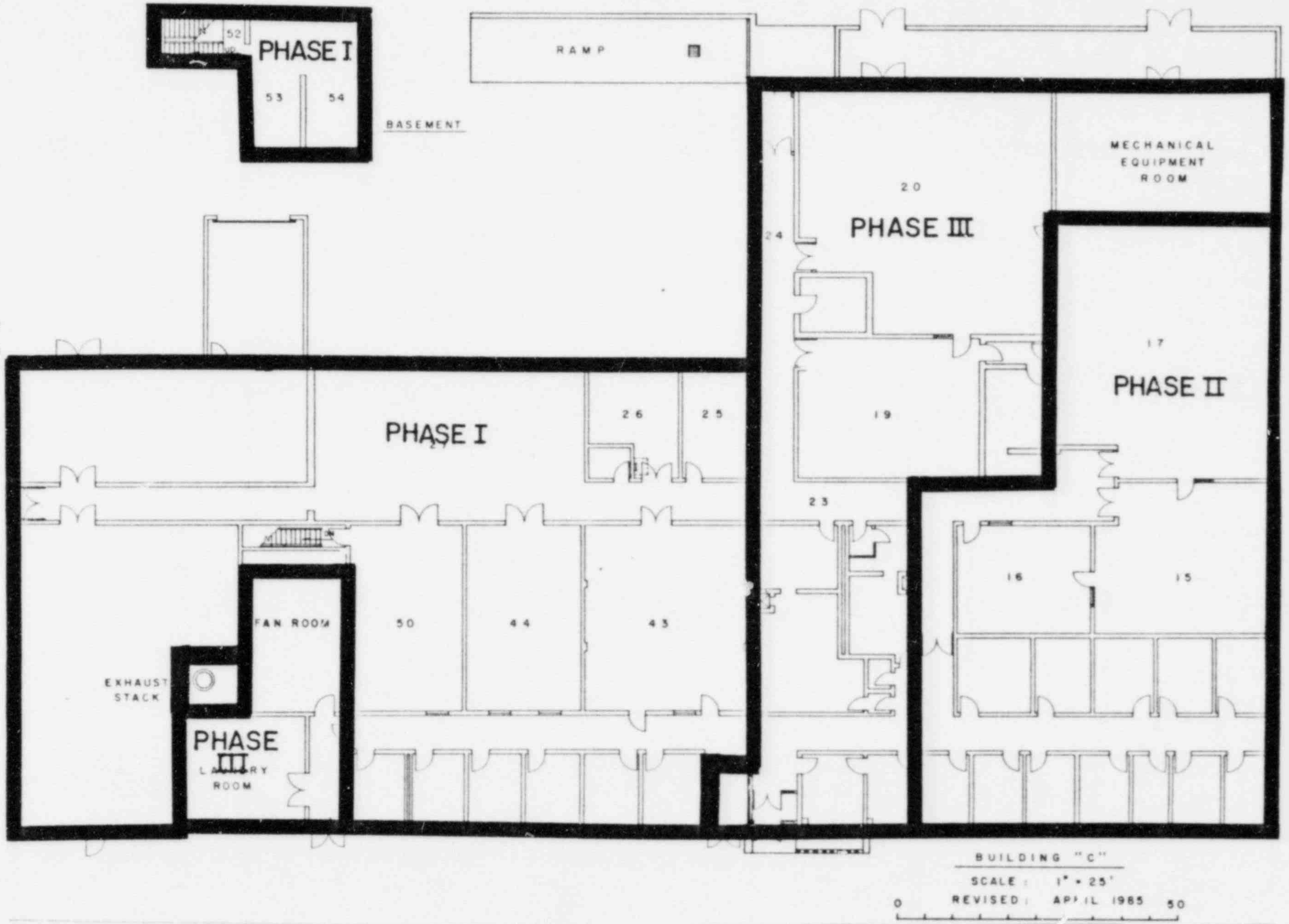


FIGURE 2-4. BUILDING C - FLOOR PLAN WITH PHASE BOUNDARIES



3.0 DECONTAMINATION OPERATIONS

The Phase II area of Building C was used for a range of R&D projects with plutonium, and uranium powders. The general procedure for decontamination operations performed in Phase II consisted of (a) removing all SNM, equipment and supplies, (b) removing service and utility lines that would not be needed during decontamination, (c) decontaminating surfaces in the rooms, (d) removing drain lines, (e) excavating underlying soil, and (f) disposing of contaminated waste. Surveying for radioactivity was conducted during and after decontamination. A successfully decontaminated area was isolated from other areas still being decontaminated in order to prevent recontamination. The decontamination operations were performed by skilled and unskilled laborers, lab technicians, and health physics technicians and professionals trained in approved decontamination procedures and surveying and analytical procedures. The survey equipment and procedures are described in Section 4.0.

3.1 Preparation of Rooms for Decontamination

All accountable SNM was removed from the Phase II area. Equipment and supplies in each laboratory in Phase II were surveyed for contamination prior to removal from Building C. The equipment and supplies were released for unrestricted use if the surface contamination levels were below the limits specified in Table 4-1. If the survey showed contamination at or above permissible limits, the material was decontaminated to meet the limits before removal or was disposed of as contaminated waste. In some cases, equipment was disassembled and contaminated portions were removed and disposed of as contaminated waste.

3.2 Decontamination of Pipe and Duct

Service lines (compressed air, chilled water, vacuum, etc.), electrical conduit, and HVAC (heating, ventilation, and air contioning) ducts were removed if they would have interfered with the comprehensive survey of laboratory surfaces. Paint and coatings were removed from these pipes and ducts. Dismantled, cleaned pipes were surveyed for radioactivity and released as clean scrap if the limits specified in Table 4-1 were met. Pipes that exceeded these limits were disposed of as contaminated waste.

Filters, filter housings, and branch ducts in the box off-gas system serving Phase II were removed. Filters and filter housings in the room off-gas system serving Phase II were removed. The main ducting in Phase III, which serves Phase II, remains in place. Paint and coatings were removed from the ducts and filter housings. Cleaned duct and housings were surveyed for radioactivity and released as clean scrap if the surface activity levels were below the limits specified in Table 4-1. If the survey showed activity above these limits, the materials were disposed of as contaminated waste. The box off-gas and room off-gas headers were surveyed in place. (These headers are suspended

from the ceiling and did not interfere with the survey of room's surfaces.) All filters were disposed of as contaminated waste.

3.3 Decontamination of Room Surfaces

Paint, floor tile, and tile cement were removed from most walls, ceilings, and floors of the laoratories in the Phase II area. Removal was necessary because the walls and ceilings had been repainted and new floor tile had been installed as laboratories were converted to other uses. Potential existed for alpha contamination to be hidden under the new paint and floor tile. The paint was removed to expose either the base surface or the original layer of paint that had been applied prior to introduction of licensed material into a room. Paint was not removed from walls that had been erected after cessation of activities with SNM. (These were primarily walls in the connecting hall.) Paint was not removed from walls in rooms from which SNM had been excluded. (SNM was not handled in the front offices and hallway.) Floor tile and tile cement were removed to expose the concrete floor surface. Paint chips, floor tile and other wastes generated in the surface cleaning processes were placed in 55-gallon waste drums. Samples were obtained from each drum for analysis by gamma spectroscopy. These analyses were used to determine the disposal classification. All drums that contain the decontamination waste have been shipped to an NRC licensed disposal site.

Walls, ceilings, and floors were thoroughly surveyed for alpha radioactivity (the ceilings of the offices were not surveyed.) When contaminated areas were found, walls were decontaminated by removing portions of cinder block and floors were decontaminated by chipping up portions of the concrete floor. These areas were resurveyed and the iterative process of chipping and surveying was continued until release limits were met. These removed materials were disposed of as contaminated waste.

3.4 Drain Line Removal

Hot and cold drain lines were installed under the floor of Building C. A diagram of the hot drain system is shown in Figure 3-1. The floor was removed from above each hot drain line after the bare concrete floor had been surveyed and released. This uncontaminated concrete rubble was disposed of as clean land fill. The soil was removed from above each hot drain line and placed in 55-gallon drums. Samples were obtained from each drum for analysis by gamma spectroscopy. These analyses were used to determine the ultimate disposal of a drum's contents. Drums that satisfy the criteria shown in Table 4-2 are being retained at the LRC for unrestricted disposal after the verification survey has been completed by the NRC. Drums that exceed these criteria have been shipped to an NRC licensed disposal site.

Each hot drain line was cut into sections, removed, and surveyed. If the surface activity was less than the limits

specified in Table 4-1, the pipe was released as clean scrap. Otherwise, the pipe was decontaminated to meet the limits or was disposed of as contaminated waste.

All cold drain lines were surveyed for smearable alpha radioactivity. All cold drain lines that were contaminated were decontaminated or disposed of as contaminated waste. (Experience indicates that pulling a smear cloth through the line is a reliable method to identify radioactivity.)

3.5 Soil Excavation

Samples were taken of the soil lying under the drain line after the pipe was removed. If analyses showed the radioactivity to be below the limits specified in Table 4-2, temporary flooring was installed to isolate the pipe trench. If the activity exceeded these limits, further excavation was performed. Soil removal from a given area was continued until soil samples taken from the surface of the excavation showed the radioactivity to be below the limits listed in Table 4-2. Figure 3-2 shows the location of the excavations. Excavated soil was placed in 55-gallon drums. Samples were obtained from each drum for analysis by gamma spectroscopy. These analyses were used to determine the ultimate disposal of a drum's contents. Drums that satisfy the criteria shown in Table 4-2 are being retained at the LRC for unrestricted disposal after the verification survey has been completed by the NRC. Drums that exceed these criteria have been shipped to an NRC licensed disposal site.

3.6 Waste Disposal

As stated above, Phase II contaminated materials (equipment, pipes, ducts, off-gas filters, filter housings, paint chips, floor tile, concrete chips, soil, etc.) were placed in 55-gallon drums for shipment to a licensed disposal facility in accordance with applicable requirements as described in References 5, 6, and 7. Uncontaminated paint chips, floor tile and cinder blocks were also placed in 55-gallon drums and are being shipped to a licensed disposal facility in accordance with applicable requirements as described in References 5, 6, and 7.

FIGURE 3-1. BUILDING C - PHASE II HOT DRAIN SYSTEM

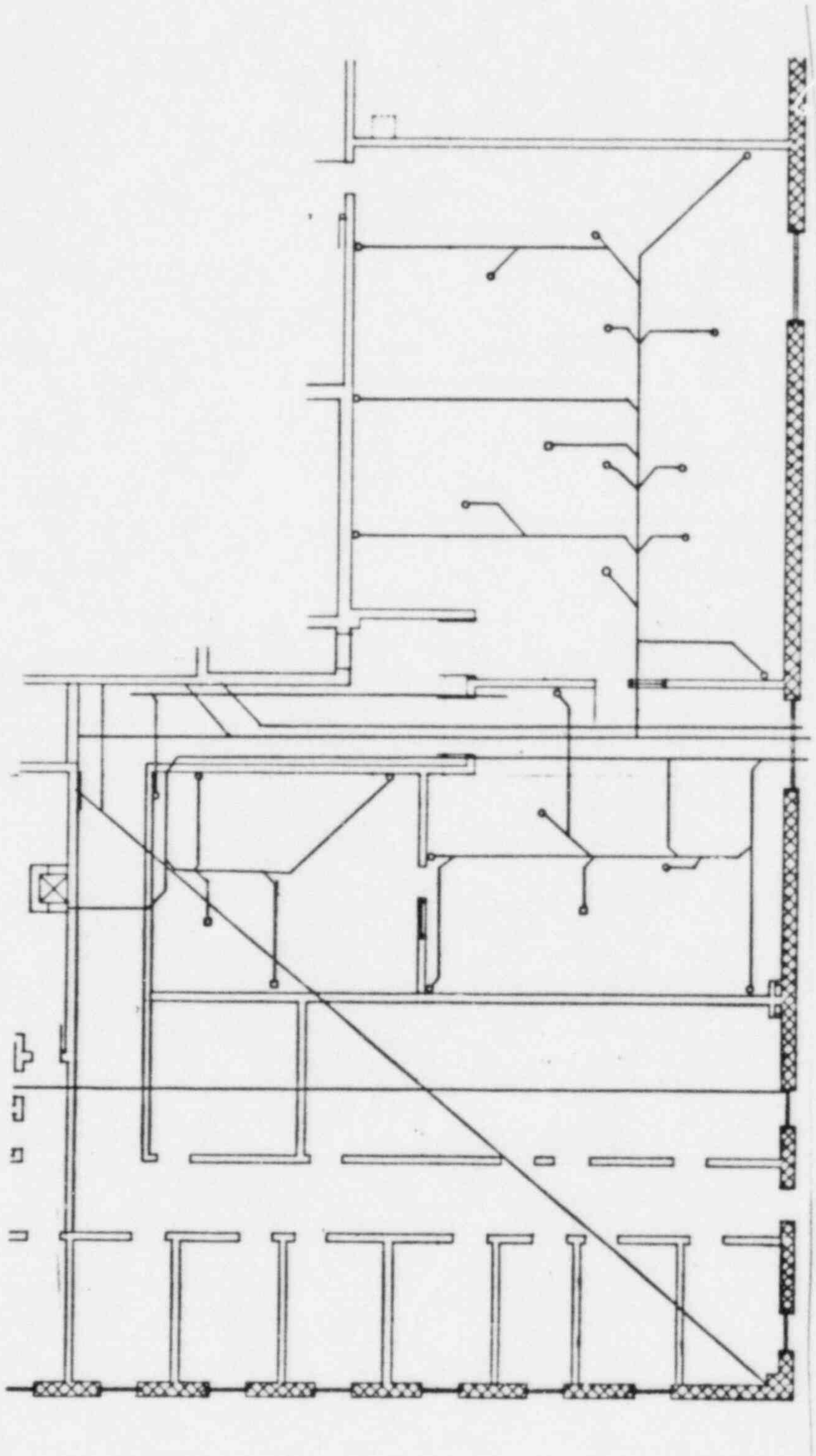
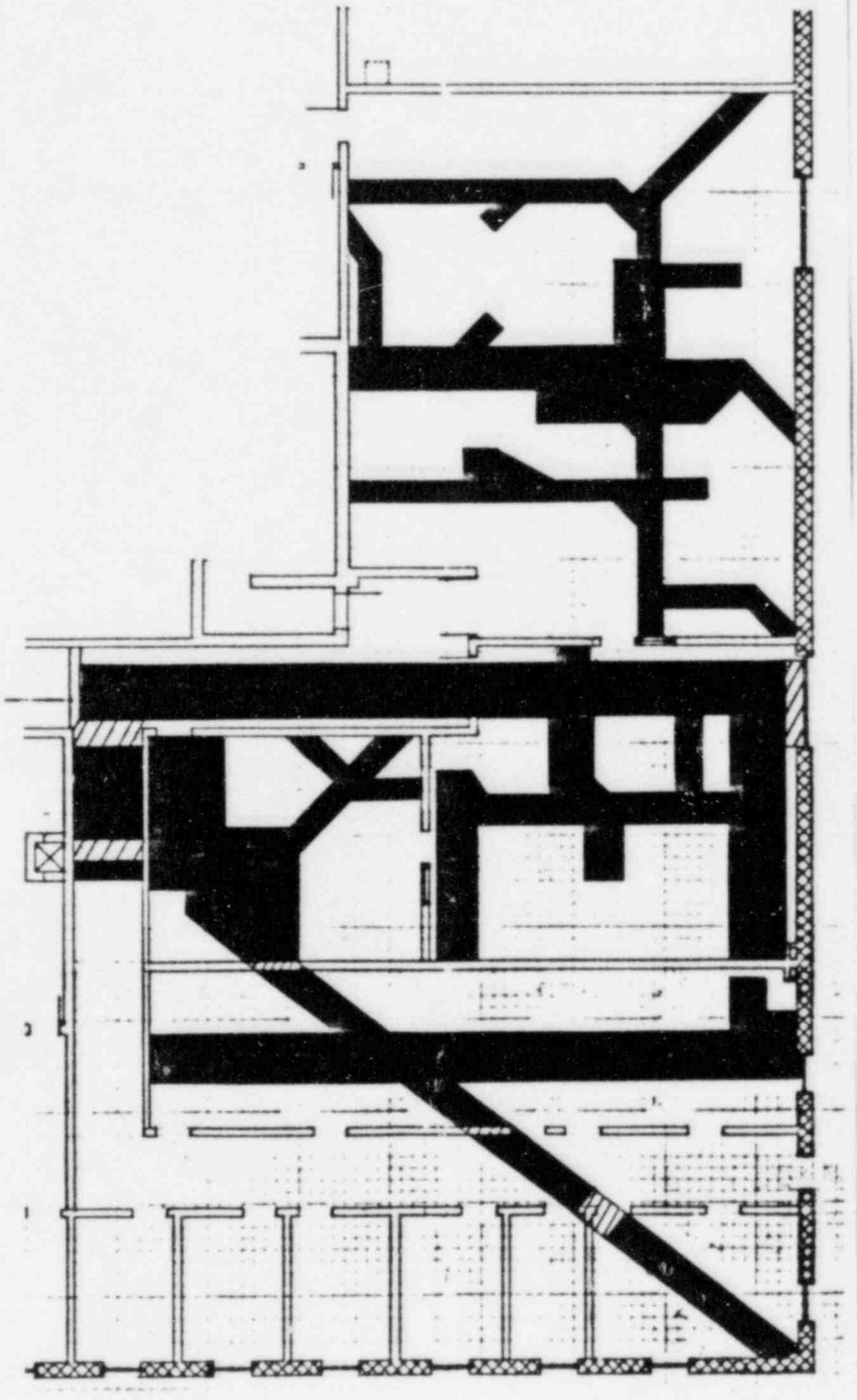


FIGURE 3-2. PHASE II EXCAVATION LOCATIONS



4.0 SURVEY DESIGN AND PROCEDURES

R&D projects performed in Phase II involved the use of plutonium, and uranium. The isotopes of these elements are primarily alpha emitters, but many of their daughters are gamma emitters. The survey plan was based upon inspecting surfaces primarily for alpha contamination and analyzing granular materials (soil, paint chips, etc.) for gamma contamination. Sampling was planned according to NUREG/CR-2082 (8) to assure that no area remained in Phase II that contained radioactivity above release limits established by the NRC. The effect of naturally occurring thorium and uranium at the LRC site was also taken into account during planning and surveying.

4.1 Applicable Release Limits

The release limits applicable to Phase II surfaces were obtained from Table F-1 and Annex C of Reference 1. These limits are reproduced in Table 4-1. The limits for transuranics are the most restrictive in this table and were selected for application to Phase II. These limits can be corrected for local naturally occurring thorium and uranium. From previous background measurement experience within and around the buildings at LRC, it was concluded that the small natural background surface alpha and beta-gamma activity from thorium and uranium and their daughters would not significantly affect the decontamination effort required to achieve the release limits. Therefore, the surface decontamination work for Phase II was based on the conservative use of gross alpha and beta-gamma residual activity to satisfy the surface release limits of Table 4-1 for unrestricted use.

Release limits for Phase II soil are provided in Reference 3 and are listed in Table 4-2. These limits were applied to soil remaining under Building C and to excavated soil. These limits can be corrected for the naturally occurring thorium and uranium. Plans were made to correct the measured analyses for soil samples below the limits, but not to correct measured analyses that were at or above the limit. The correction would have little effect on analyses above the limit and would add confidence that an ALARA condition was achieved. A set of background soil samples was used to obtain data for application to this project. (It was recognized that additional release limits might be needed for Co-60, Cs-137, and U-233. A decision was made to review soil sample analysis data for evidence of these isotopes before requesting limits. The collected data are presented in Section 5.0 and are discussed and evaluated in Section 6.0. There does not appear to be a need for release limits for these three isotopes.)

The release limit for external beta-gamma exposure is given in Reference 2 and is included in Table 4-2. This limit can be corrected for local background activity. It was concluded that the beta-gamma activity from natural thorium and uranium and their daughters would not significantly affect survey results, but external beta-gamma activity from the Hot Cells and Building

J would have to be taken into account. (The Hot Cells are located near the south-west corner of Building B and contain high-level beta-gamma materials. Located toward the north-east behind Building C, Building J is used for storage of high-level beta-gamma waste.) A survey in and around Building C for external beta-gamma activity would be needed to obtain data for application to this project.

4.2 Survey Design

4.2.1 Surface Survey Design

Most of the laboratories in Phase II had been used for experiments with the elements of interest, i.e., plutonium and uranium. Each Phase II laboratory had been cleaned and repainted more than once so there was a possibility that contamination existed beneath the paint and floor tile. Prudence dictated stripping walls, floors, and ceilings to the original surface to expose potential contamination for identification. The surface surveys were designed with these items in mind.

The laboratory surfaces (walls, floors, and ceilings) that had existed during experimental work with plutonium and uranium had to be identified. Materials that could interfere with a comprehensive survey for surface contamination had to be removed. Paint, floor tile, and tile cement had to be removed from these surfaces to expose the original surface. (Paint did not need to be removed from walls that had been erected after cessation of activities with SNM or from walls in areas from which SNM had been excluded.) A rectangular grid was designed for use on walls, floors, and surfaces with each grid block containing slightly less than one square meter. The dimensions of the grid block were determined by the size of the probe to be used for direct alpha survey. An example of a grid configuration is shown in Figure 4-1.

A comprehensive direct alpha survey was planned to include 100% of each grid block and alpha smears were planned to correspond with these grid blocks. This comprehensive method was chosen for the alpha surveys because the history of usage, leaks, and spills of SNM within specific laboratories was uncertain. The direct and indirect (smear) alpha surveys would be conducted immediately after removal of surface coatings to identify areas that would require further decontamination. When the alpha surveys showed acceptable results, other types of surveys would be conducted. Beta smears and direct beta and direct gamma surveys were planned for each of 123 randomly selected floor grid blocks in the Phase II area. This statistical method was chosen for beta-gamma surveys because of the low potential for beta-gamma contamination in Building C. Since the floor was the most likely place to have been contaminated in case of a spill, only floor grid blocks were selected for the beta-gamma surveys.

4.2.2 Gamma Survey Design

Gamma radiation surveys were planned for each of the 123 randomly selected floor grid blocks in the Phase II area. This represents 20% of the floor grid blocks. This statistical method was chosen to establish background levels for comparison with direct gamma surveys taken on the same basis.

4.2.3 Soil Survey Design

Four separate types of soil surveys were foreseen. One would be for soil excavated from under the floor and placed in drums (drummed soil sample). Another would be for soil samples from the face of an excavation (ditch face sample). A third would be to determine the extent of contamination identified by the ditch face samples(core samples). The fourth would be to establish the concentrations of naturally radioactive isotopes in the site's soil (background samples). The same analytical procedure could be used for each type, but sampling methods would differ. Since a large number of samples was expected, gamma analyses were planned based upon known daughters of plutonium, uranium and thorium. A sampling method was planned for excavated soil that would obtain a uniform quantity of soil for analysis as each drum was filled. (This method was also planned for use with other granular materials; e. g., paint chips, concrete chips, and floor tile.) A sampling method was planned to obtain samples from the surface of the ditches that would result in a uniform quantity of soil for analysis from gridded areas of the excavation. Core samples were planned to define contaminated soil boundaries and to obtain samples of background soil at this site.

The sampling plan was based on the assumption that the only source for soil contamination would be the hot drainline system. The only other pathway for contaminants to enter the soil under the building would be through the concrete floor. This type of contamination would be found on and in the floor itself during surface surveys and could be tracked if it did appear. (No evidence was found that contamination penetrated through the concrete into the soil.)

4.3 Survey Instruments

The instruments used for survey and analysis in Phase II are standard models routinely used by the nuclear industry for this type of work. The instruments were calibrated in accordance with applicable LRC Technical Procedures using National Bureau of Standards traceable sources.

4.3.1 Surface Survey Instruments

Each surface survey instrument has a lower limit of detection for the radiation being measured. This is the lowest level of non-zero activity that it can register. These limits are defined in the following sections.

4.3.1.1 Direct Alpha Survey Instruments

Eberline Model PAC-4G or Model PAC-4G-3 Gas Proportional Survey Meters were used for making direct alpha surveys with two different size probes. The probes consisted of either a Model AC-23A 335 sq. cm. Flat Plate Probe or a Model FM-3G 445 sq. cm. Floor Monitor Probe. Calibration was performed according to Technical Procedure LRC-TP-51 using NBS traceable alpha sources. The lower limit of detection for the PAC-4G for alpha detection was 30 cpm/50 sq. cm.

4.3.1.2 Direct Beta Survey Instrument

Separate Eberline PAC-4G instruments similar to those described above were used for making direct beta surveys. Calibration was performed according to Technical Procedure LRC-TP-51 using NBS traceable beta sources. The lower limit of detection for the PAC-4G for beta detection was 300 cpm/50 sq. cm.

4.3.1.3 Alpha and Beta Smear Survey Instruments

Either an NMC Model PC-5 Proportional Counter or an ORT-S-1 Gas Proportional Smear Counter was used to count alpha and beta smears. The former is calibrated using Technical Procedure LRC-TP-162 and the latter using Technical Procedure LRC-TP-190. Calibration was done with NBS traceable alpha and beta sources as appropriate. The background level for the smear counters was 0.1 dpm alpha/ 100 sq. cm. and 300 dpm beta/100 sq. cm.

4.3.1.4 Surface Gamma Survey Instrument

A Geiger-Muller (GM) Survey Meter was used for the surface gamma survey. Instrument calibration was performed according to LRC-TP-50. The lower limit of detection for the GM meter was about 0.05 mR/hr.

4.3.2 Instruments used for Additional Gamma Survey

The Geiger-Muller (GM) Survey Meter described above was used for the gamma surveys one meter abouve the floor surfaces.

A Model RSS-111 Reuter-Stokes Environmental Radiation Monitor was also used to measure gamma radiation one meter above the walking surfaces. These measurements were taken both inside and outside Building C. This monitor was calibrated by the manufacturer with NBS traceable sources. The lower limit of detection for the RSS-111 was 1 μR/hr.

4.3.3 Soil Survey Instrument

A Nuclear Data Corporation high-resolution gamma-ray

spectroscopy system using HPGe detectors was used to nondestructively analyze soil samples. This system is standardized according to Technical Procedure LRC-TP-210.

This spectroscopy system was used to examine a gamma spectrum from about 50 keV to about 2 MeV. Am-241, plutonium, thorium, and uranium concentrations were measured by analysis of gamma-ray energies within this range. The Am-241 concentration was determined directly from it's 59.54 keV peak. The plutonium concentration was calculated by multiplying the Am-241 concentration by an experimetally determined factor. (The Pu-239 concentration was directly measured at 375.02 and 413.69 keV in samples containing nCi/g quantities of Pu-239. These values were compared with Am-241 concentrations in the same samples to develop the factor.) The Th-232 concentration was determined indirectly from it's Pb-212 daughter's 238.60 keV peak. The uranium concentration was determined directly from the 185.72 keV peak for U-235. (A correction was made for the 186.18 keV peak for Ra-226.) Other gamma-ray peaks were evaluated for radionuclides such as Co-60, Cs-137, and U-232 as needed.

4.4 Survey Procedures

A list of the procedures used for this project is provided in Table 4.3. These procedures were prepared in accordance with QA Plan No. 82008L (8).

4.4.1 Surface Surveys

Surface surveys were conducted according to Technical Procedure LRC-TP-183. The major steps in this procedure are summarized below.

(1) Mark the surface with 1 sq. m. grid blocks. Sketch the grid on a data sheet and label each block.

(2) Perform a direct alpha survey with a properly calibrated PAC-4G. Make sequential measurements in a grid block until the entire block has been surveyed. Record the location and count on a log sheet.

(3) Take a random 100 sq. cm. smear in each grid block. Count the smears for alpha activity in a properly calibrated proportional counter. Record the location and count on a data sheet.

(4) In a randomly selected grid block on the floor, conduct a direct gamma survey, a direct beta survey, and a beta smear survey. Using a properly calibrated GM meter, locate the point in the grid block with the maximum gamma level. Perform a direct gamma survey at this point with a properly calibrated G-M meter. Perform a direct beta survey at the maximum gamma point in each block with a properly calibrated PAC-4G meter. Record

the location and maximum gamma, direct gammma, and direct beta counts on a data sheet.

(5) Take a 100 sq. cm. smear at the maximum gamma point in each block. Count the smears for beta activity in a properly calibrated proportional counter. Record the location and count on a data sheet.

4.4.2 Soil Surveys

All soil samples (whether from drums, excavations, or cores) were prepared for analysis using Technical Procedure LRC-TP-208 and were analyzed according to Technical Procedure LRC-TP-210. Each sample was dried, screened, and placed into a container for analysis by gamma spectroscopy. Soil standards were prepared using Technical Procedure LRC-TP-267.

Varying methods were used to obtain soil samples according to their source. These methods are described below. All samples were placed in labelled containers.

Sampling, sample preparation, and sample analysis information and data were recorded on route sheets that followed the sample from the time it was taken through the time it was analyzed.

4.4.2.1 Drummed Soil

Technical Procedure LRC-TP-206 describes three techniques for taking samples of drummed soil. These are all commonly used sampling techniques. (9) These three techniques allow sampling as the drum is filled or after it has been filled.

(1) Six to eight grab samples can be taken as a drum is filled to form a 3 to 4 liter sample. The multiple samples are obtained to create a composite sample representative of the drum's contents.

(2) A 3 to 4 liter sample can be scooped from the entire length of a filled drum as it is laying on its side.

(3) A sampling thief can be used to obtain a 3 to 4 liter sample from a filled drum standing upright.

4.4.2.2 Ditch Face Survey

Technical Procedure LRC-TP-197 describes two techniques for collecting soil samples in excavated areas.

(1) A 3 to 4 liter sample can be scooped from the bottom of a trench (no longer than 20 feet) from which a drainline has just been removed to create a sample representative of the trench.

(2) A 3 to 4 liter sample can be scooped from the surface of a trench to create a sample representative of about 10 square feet.

4.4.2.3 Building C Core Samples

Technical Procedure LRC-TP-207 describes the method for taking exploratory cores in the vicinity of contaminated soil to guide further excavation efforts. A core sampler is used that collects a 4 liter sample per foot of depth.

4.4.2.4 Background Soil Core Samples

Technical Procedure LRC-TP-207 also describes the method of taking background soil cores external to Building C.

TABLE 4-1. ACCEPTABLE SURFACE CONTAMINATION LEVELS

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

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

b As used in this table, 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 Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

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

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

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

TABLE 4.2

BUILDING C SOIL RELEASE LIMITS
AND
BUILDING C EXTERNAL BETA-GAMMA EXPOSURE LIMIT *

Contaminant	Maximum Acceptable Limit For Unrestricted Use **
Natural Thorium (Th-232 + Th-228) with daughters present and in equilibrium	10 pCi/g soil ***
Natural Uranium (U-238 + U-234) with daughters present and in equilibrium	10 pCi/g soil
Depleted Uranium or Natural Uranium that has been separated from its daughters, soluble or insoluble	35 pCi/g soil
Enriched Uranium Soluble or insoluble	30 pCi/g soil
Plutonium (Y) or (W) compounds	25 pCi/g soil
Americium-241 (W) compounds	30 pCi/g soil
External Beta-Gamma Exposure Rate	10 μR/hr

* These limits are above background levels.

** The individual soil limits given in this table apply to each element if it exists by itself. When they occur as a mixture, the sum of the ratios of the elemental concentrations versus their limits must be less than 1. Thus, for Phase II,

$$(Am\text{-}241/30) + (Pu/25) + (Th\text{-}232/5) + (U/30) < 1$$

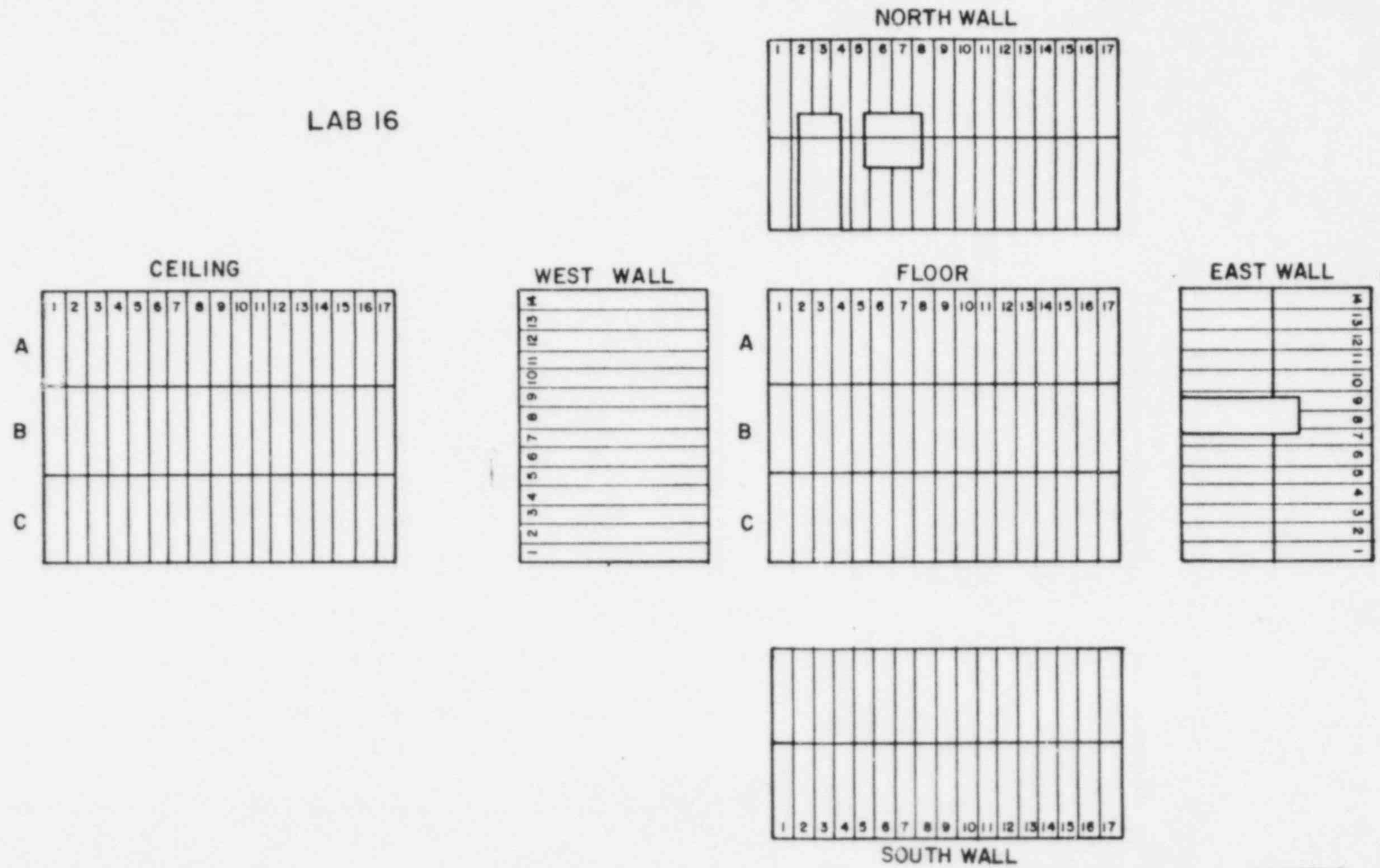
*** A limit of 5 pCi Th-232/g soil has been adopted for this project.

TABLE 4.3

LRC TECHNICAL PROCEDURES
USED FOR
BUILDING C DECOMMISSIONING OPERATIONS

LRC-TP-50	CALIBRATION PROCEDURE FOR EBERLINE G-M COUNTER
LRC-TP-51	CALIBRATION PROCEDURE FOR PAC-4G GAS PROPORTIONAL COUNTER
LRC-TP-95	RESPIRATORY PROTECTION PROGRAM
LRC-TP-162	CALIBRATION AND OPERATING PROCEDURE FOR NMC PC-5 PROPORTIONAL COUNTER
LRC-TP-183	SURVEY OF DECONTAMINATED LABORATORY AND OFFICES IN BUILDING C FOR FIXED AND SMEARABLE CONTAMINATION
LRC-TP-190	CALIBRATION PROCEDURE FOR BUILDING C PROPORTIONAL SMEAR COUNTER
LRC-TP-197	BUILDING C SOIL SAMPLING PROCEDURE
LRC-TP-206	PLUTONIUM DECONTAMINATION PROJECT DRUM SAMPLING PROCEDURE
LRC-TP-207	BUILDING C SOIL CORE SAMPLING PROCEDURE
LRC-TP-208	PREPARATION OF SOIL SAMPLES
LRC-TP-210	ANALYSIS OF RADIONUCLIDES IN SOIL BY GAMMA RAY SPECTROSCOPY
LRC-TP-236	OPERATING INSTRUCTIONS FOR USE OF 3M BRAND WHITECAP HELMET MODEL W-5005
LRC-TP-237	PREPARATION OF WASTE SHIPMENTS TO THE U. S. ECOLOGY SITE IN WASHINGTON
LRC-TP-267	PREPARATION OF SOIL STANDARDS

FIGURE 4-1. TYPICAL SURFACE GRID ARRANGEMENT



5.0 PHASE II SURVEY RESULTS

Building C was used primarily for R&D projects with thorium, plutonium, and uranium. Since these are all alpha emitters and only limited information was available about specific usage in the laboratories, comprehensive surveys for direct and smearable alpha contamination were conducted on the surfaces of the Phase II area in Building C. Only limited amounts of beta-gamma materials had ever entered Building C, so beta-gamma surveys were conducted on a limited number of randomly selected floor grid blocks. A survey was performed to establish gamma radiation levels due to sources external to Building C. The data for these surveys and analyses are described below. All data are contained in the Building C Decommissioning files.

5.1 Surface Surveys

5.1.1 Initial Surface Surveys

Each laboratory (or former use area) was cleaned (SNM and equipment were removed, non-essential service pipe and duct were removed, and paint and floor tile were stripped) and an initial survey was performed to determine direct and smearable alpha radiation levels on the room's surfaces. Offices and other clean areas were surveyed on floors and walls (not ceilings) without removing paint and floor tile. Tables 5-1 through 5-3 provide summaries of these initial surface survey results.

The lower limit of detection for the direct alpha survey was 30 dpm/100 sq. cm. As Table 5-1 shows, 3,661 of the 3,688 grids or 99.3% were at this level and the other 27 grids or .7% were below or met the release limit of 100 dpm/100 sq. cm. About 75% of these 27 grids were on the floors with the other 25% on the walls. No contamination was found on the ceilings. None of the grids exceeded the release limit for direct alpha radiation. The highest reading was on the wall of one of the laboratories. Using the ALARA concept, additional decontamination was performed on the 27 grids that were above the lower limit of detection.

Table 5-2 summarizes the 47,460 direct alpha readings that were obtained during the initial surface survey. More than 99.8% or 47,384 of these readings were at the lower limit of detection and 75 or about .2% were below 300 dpm/100 sq. cm. Only one reading or less than .1% was above 300 dpm/100 sq. cm. with the highest reading being 600 dpm/100 sq. cm.

No smearable alpha radioactivity above 12 dpm/100 sq. cm. was detected. The background reading for the smear counter was 0.1 dpm/100 sq. cm. As shown in Table 5-3, 3,231 of the 4,397 smears or 73% were at this level. Of the remainder, 965 or 22% were between 0.1 and 5 dpm/100 sq. cm. and the remaining 5% or 201 readings were between 6 and 12 dpm/100 sq. cm.

5.1.2 Release Surface Surveys

Decontamination was performed in those areas identified in the original alpha survey as being above the limit of detection. Some areas were more difficult to decontaminate than others. Removal of 1/16 to 1/4 inch of the concrete surface was adequate in most areas. Tables 5-4 and 5-5 provide summaries of the release survey results.

Table 5-4 gives a summary of the release direct alpha surface survey data. The data show that all grid blocks are below the release criterion of an average value of 100 dpm/100 sq. cm. with no grid block exceeding an average of 50 dpm/100 sq. cm. About 78% of the grids averaging over 30 dpm/100 sq. cm. were on the floor. The data are summarized in Table 5-5 and have no single reading exceeding 65 dpm/100 sq. cm. Over 99.3% of the grid blocks and over 99.8% of the individual readings were at the lower limit of detection of 30 dpm/100 sq. cm.

In the course of data reduction, the raw direct alpha survey data were summarized in terms of range, mean, standard deviation, variance, and other simple statistics as needed for estimating population parameters. Normal distribution statistics were used as all sample sizes were greater than 100. Sample means were used as the least biased estimate of the unknown population mean. Confidence limits were set up on the sample mean to assess the significance or degree of confidence that can be placed on such a value. As shown in Table 5-6 (which summarizes the data from Tables 5-4 and 5-5), we can be 99.7% confident (three standard deviations) that the population mean lies between 30.09 and 30.01 dpm/100 sq. cm. in the case of the grids and between 30.09 and 30.01 dpm/100 sq. cm. in the case of the individual readings. The 99.7% confidence limit is based on the formula

$$UCL = x(mean) + (z)(\sigma)/\sqrt{N}$$

$$LCL = x(mean) - (z)(\sigma)/\sqrt{N}$$

where $z = 3.0$

UCL = Upper Confidence Limit

LCL = Lower Confidence Limit

The data obtained during the original alpha smear survey and shown in Table 5-3 are being used for the release alpha smear survey. Precautions were taken during decontamination to prevent the spread of contaminated dust and routine large area smears have shown no trace of smearable alpha activity in the Phase II portion of Building C. No grid had smearable alpha activity greater than 60 percent of the allowable limit of 20 dpm/100 sq.cm. The alpha smear survey data were statistically

analyzed in the same manner as the direct alpha survey data. Table 5-6 contains these results.

Surveys for direct beta, smearable beta, and gamma activity were made in randomly selected floor grid blocks. The results are shown in Table 5-7. A survey for gamma radiation was performed in each of 123 floor grids out of a total of 666 in Phase II. A gamma radiation reading was taken 1 meter from the floor and another reading was taken less than 1 cm from the floor at the same spot. Both readings were nearly equal in all 123 cases indicating no residual gamma contamination was present. (All 246 readings were between 0.02 and 0.07 mR/hr. This is the lower limit of detection for the GM meter.) Surveys were performed for direct beta and smearable beta activity at the same 123 locations. As shown in Table 5-7, the beta activity averaged 521 cpm (2000 dpm/100 sq. cm.), well below the limit of 5,000 dpm/100 sq. cm. for fixed beta activity. No reading for smearable beta activity was greater than 310 dpm/100 sq. cm. The 123 readings were all about 300 dpm/100 sq. cm. which is the background level for the beta smear instrument.)

5.1.3 Gamma Radiation Survey

A survey was conducted in and around Phase II to measure the ambient gamma radiation levels. Figure 5-1 shows the results of this survey. The data show that the Hot Cells in Building B and the high-level waste stored in Building J are the external sources that, in addition to terrestial and cosmic radiation, establish the background gamma radiation inside Phase II of Building C. The data also support the gamma survey data shown in Table 5-7.

5.2 Release Soil Survey

Samples were taken from drums of soil excavated from under Building C (drummed soil samples) and samples were taken from the face of ditches in the excavations (ditch face soil samples). Samples of site background soil were also taken (background soil samples). The data are presented in Tables 5-8 through 5-11 for each type of material. These data are discussed below.

5.2.1 Background Soil Survey

Core samples were taken at each foot of depth from three holes 15 feet deep and from 31 holes 2 feet deep to provide 107 samples of background soil. These samples were analyzed for Am-241, Th-232, Pu, and U. The results for all 107 samples are summarized in Table 5-8. The results for Am-241 and plutonium represent the lower limits of detection for gamma analyses, no Am-241 or Pu activity was found in the background soil samples. The values given in Table 5-9 for uranium and thorium have been used to correct ditch face and drummed soil samples for local naturally occurring concentrations of these elements.

5.2.2 Ditch Face Release Survey

The data are summarized in Table 5-10 for the ditch face survey. The results for Am-241 and plutonium represent 5 samples in which Am-241 was detected and 80 samples where Am-241 was reported at the lower limit of detection. The analyses for thorium and uranium indicate only background concentrations for these two elements remain in the excavation under Phase II and identify the relatively uniform concentration of these elements throughout the region. The calculation of the unity factor was performed with only the Am-241 and Pu values.

To address the possibility of potential U-233 contamination in the drummed soil samples, a series of Bateman decay chain calculations were performed to identify a nuclide that would provide a sensitive indication of U-233 concentration in soil. This nuclide is Pb-212 that is a daughter of the U-232 that is present in the U-233 as a contaminant. A review of the data from the ditch face samples showed that none had Pb-212 activity above that expected from the naturally occurring Th-232 parent. (Th-232 also produces Pb-212 as well as U-232.) These results indicate no contamination from U-233.

The continued ingrowth of Am-241 was recognized and evaluated for its effect upon activity levels in the future.

5.2.3 Drummed Soil Survey

The data are summarized in Table 5-11 for the drummed soil release survey. There are 605 drums of soil that meet release limits. The results for Am-241 and plutonium represent 36 samples in which Am-241 was detected and 536 samples where Am-241 was reported at the lower limit of detection. The analyses for thorium and uranium indicate primarily background concentraions for these two elements are contained in the releasable drums. The background concentrations for thorium and uranium have been deducted for the calculation of the unity factor for the releasable drums.

The data from analyses of the drummed soil samples was reviewed for Pb-212 content to address the possibility of potential U-233 contamination. These data showed that no drums had Pb-212 activity above that expected from the naturally occurring Th-232 parent. A previous statistical evaluation of both the Pb-212 and Ac-228 activities had indicated that, when the Pb-212 activity was above that expected from the naturally occuring Th-232, the samples had equal concentrations of these isotopes. (Th-232 produces Ac-228 and Pb-212 daughters. These two daughters will be in secular equilibrium in geologic soil. Thus, if their concentrations are found to be equal, a conclusion may be drawn that the Pb-212 originated from Th-232 rather than from U-232 which can also be a parent.) These results indicate no contamination from U-233.

The drummed soil drum samples data were reviewed for the presence of Co-60 and Cs-137 contamination. None of the release samples indicated concentrations above the experimental background.

The continued ingrowth of Am-241 was recognized and evaluated for its effect upon activity levels in the future.

There were 9 drums of soil that did not meet release limits. The results for Am-241 and plutonium represented 4 samples in which Am-241 was detected. The analyses for thorium and uranium indicated some contamination from these two elements was present in the soil in these drums. The background concentrations for thorium and uranium have not been deducted for the calculation of the unity factor for these drums. All 9 drums have been shipped to a commercial radwaste burial site for disposal.

5.2.4 Soil Survey Data Analysis

The data used to prepare Tables 5-8, 5-10, and 5-11 have been summarized statistically and are presented in Table 5-12. Examination of Table 5-12 shows that the mean of the ditch face soil samples is less than the 99.7% upper confidence level of the background soil samples for Am-241, plutonium, Th-232, and uranium. Therefore, we have 99.7% confidence that the concentrations of any of these substances in the ditch face samples do not statistically exceed their concentrations in the background soil samples. The same statement is made for the drummed soil samples.

TABLE 5-1

SUMMARY OF AVERAGE ORIGINAL DIRECT ALPHA SURVEY RESULTS

Location	Direct Alpha Survey Results Number of Grids			Total Number of Grids
	30	30-100	>100	
	(average dpm/100 sq. cm.)			
Front Offices 1-5	268			268
Front Offices 6-7	108			108
Front Office 8	78			78
Front Office 9	78			78
Front Office 10	78			78
Front Office 11	78			78
Front Office 12	78			78
Lab 15	836	5		841
Lab 16	287	11		298
Lab 17	1087	11		1098
Hallway 23	471			471
Front Hall	471			471
Total	3661	27		3688

TABLE 5-2

SUMMARY OF MAXIMUM ORIGINAL DIRECT ALPHA SURVEY RESULTS

Location	Direct Alpha Survey Results Number of Readings			Total Number of Readings
	30	30-300	>300	
	(average dpm/100 sq. cm.)			
Front Offices 1-5	3480			3480
Front Offices 6-7	1308			1308
Front Office 8	948			948
Front Office 9	948			948
Front Office 10	948			948
Front Office 11	948			948
Front Office 12	948			948
Lab 15	8116	7	1	8124
Lab 16	4608	20		4628
Lab 17	15208	48		15256
Hallway 23	6682			6682
Front Hall	2542			2542
Total	47384	75	1	47460

TABLE 5-3

SUMMARY OF ORIGINAL ALPHA SMEAR SURVEY RESULTS

Location	Alpha Smear Survey Results Number of Grids			Total Number of Grids
	0.1	0.1-5	5-12	
	(dpm/100 sq. cm.)			
Front Offices 1-5	249	49	8	306
Front Offices 6-7	75	26	7	108
Front Office 8	61	14	3	78
Front Office 9	63	12	3	78
Front Office 10	61	12	5	78
Front Office 11	50	24	4	78
Front Office 12	57	12	9	78
Lab 15	710	177	31	918
Lab 16	293	82	9	384
Lab 17	1046	418	105	1569
Hallway 23	386	107	15	508
Front Hall	180	32	2	214
Total	3231	965	201	4397

TABLE 5-4

SUMMARY OF AVERAGE RELEASE DIRECT ALPHA SURVEY RESULTS

Location	Direct Alpha Survey Results Number of Grids			Total Number of Grids
	30	30-100	>100	
	(average dpm/100 sq. cm.)			
Front Offices 1-5	268			268
Front Offices 6-7	108			108
Front Office 8	78			78
Front Office 9	78			78
Front Office 10	78			78
Front Office 11	78			78
Front Office 12	78			78
Lab 15	838	3		841
Lab 16	287	11		298
Lab 17	1089	9		1098
Hallway 23	471			471
Front Hall	471			471
Total	3665	23		3688

TABLE 5-5

SUMMARY OF MAXIMUM RELEASE DIRECT ALPHA SURVEY RESULTS

Location	Direct Alpha Survey Results Number of Readings			Total Number of Readings
	30	30-300	>300	
	(maximum dpm/100 sq. cm.)			
Front Offices 1-5	3480			3480
Front Offices 6-7	1308			1308
Front Office 8	948			948
Front Office 9	948			948
Front Office 10	948			948
Front Office 11	948			948
Front Office 12	948			948
Lab 15	8818	6		8824
Lab 16	4608	20		4628
Lab 17	15222	34		15256
Hallway 23	6682			6682
Front Hall	2542			2542
Total	47400	60		47260

TABLE 5-6

ALPHA SURVEY RESULTS
dpm/100 sq. cm.

	Direct Alpha Surveys By Grid	Direct Alpha Surveys By Reading	Alpha Smear Surveys By Grid
Sample Size	3688	47,460	4,397
Mean	30.05	30.05	1.03
Standard Deviation	0.82	2.90	1.72
Error on Mean	0.01	0.01	0.03
99.7% UCL	30.09	30.09	1.11
99.7% LCL	30.01	30.01	0.95

TABLE 5-7

SUMMARY OF RELEASE DIRECT BETA AND GAMMA AND SMEARABLE BETA SURVEY RESULTS FOR 123 FLOOR GRID BLOCKS IN PHASE II

Direct Gamma Survey Results µR/hr. Average Value	Direct Beta Survey Results cpm Average Value	Smearable Beta Survey Results dpm/100 sq. cm. Average Value	Decision
37	521	275	Accept

Direct Gamma Survey Results µR/hr. Maximum Value	Direct Beta Survey Results cpm Maximum Value	Smearable Beta Survey Results dpm/100 sq. cm. Maximum Value	Decision
65	1000	308	Accept

TABLE 5-8

ANALYSES OF BACKGROUND SOIL SAMPLES

Number of Samples	Activity, pCi/gram							
	Am-241*		Plutonium*		Th-232		Uranium	
	Avg	Max	Avg	Max	Avg	Max	Avg	Max
107**	0.33	0.54	1.43	2.33	1.28	2.12	1.40	2.51

* The values shown for Am-241 and plutonium represent minimum detectable levels; i. e., they do not actually indicate the presence of americium or plutonium, but indicate an upper limit for the values if they were present.

** Of the 107 samples, 45 represent three 15 foot cores and 62 represent one foot and two foot samples from 31 locations.

TABLE 5-9

ACCEPTANCE LIMITS FOR THE BACKGROUND SOIL ACTIVITIES*

Activity, pCi/gram					
Bi-214	Pb-214	U-235	Ac-228	Pb-212	Tl-208
1.0280	1.079	0.2053	1.738	1.760	1.478

* Details of the calculations for acceptance limits are given in reference 11.

TABLE 5-10

ANALYSES OF DITCH FACE SOIL SAMPLES

Number of Samples	Activity, pCi/gram								Unity Factor	
	Am-241*		Plutonium*		Th-232		Uranium			
	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
85*	0.35	0.77	1.52	3.32	1.24	1.56	1.41	2.17	0.07	0.16

* Of the 85 values represented for Am-241 and plutonium in this table, 80 are minimum detectable concentrations; i. e., they do not actually indicate the presence of americium or plutonium, but indicate an upper limit for the values if they were present.

TABLE 5-11

ANALYSES OF DRUMMED SOIL SAMPLES

Number of Samples	Activity, pCi/gram								Unity Factor	
	Am-241		Plutonium		Th-232		Uranium			
	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
605*	0.34	1.73	1.48	7.48	1.31	3.49	1.47	3.59	0.07	0.45
9	0.77	1.73	3.34	7.48	3.66	9.05	2.75	5.33	0.98	2.26

* Of the 605 values represented for Am-241 and plutonium in this category, 569 are minimum detectable concentrations; i. e., they do not actually indicate the presence of americium or plutonium, but indicate an upper limit for the values if they were present.

TABLE 5-12
SOIL SAMPLES ANALYSIS RESULTS

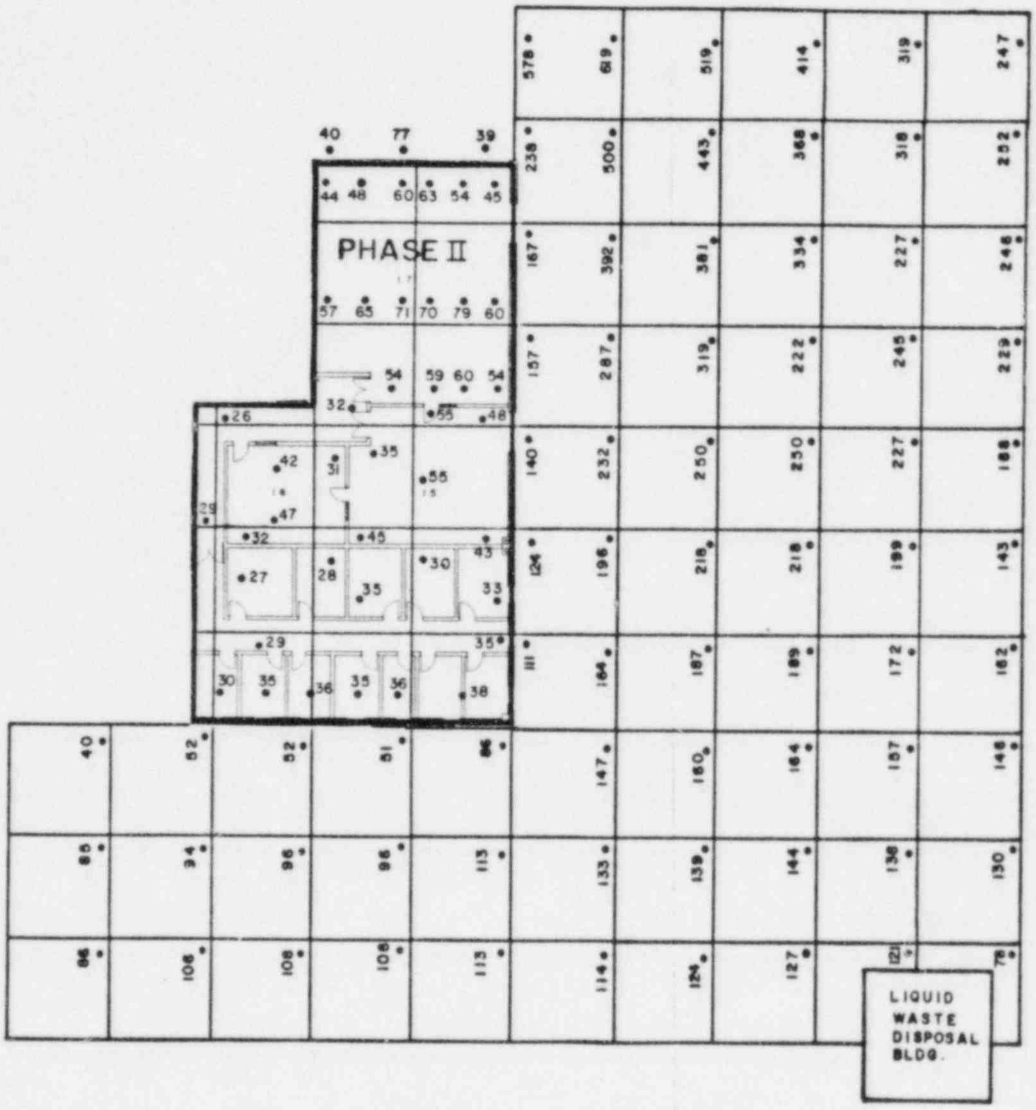
	Am-241 Activity, pCi/g		
	Background	Ditch Face	Drummed Soil
Sample Size	107	85	605
Mean	0.33	0.35	0.34
Standard Deviation	0.14	0.10	0.12
Error of Mean	0.01	0.01	0.01
99.7% UCL	0.37	0.38	0.36
99.7% LCL	0.30	0.32	0.33

	Plutonium Activity, pCi/g		
	Background	Ditch Face	Drummed Soil
Sample Size	107	85	605
Mean	1.43	1.52	1.48
Standard Deviation	0.69	0.43	0.54
Error of Mean	0.06	0.05	0.02
99.7% UCL	1.60	1.66	1.55
99.7% LCL	1.26	1.38	1.42

	Th-232 Activity, pCi/g		
	Background	Ditch Face	Drummed Soil
Sample Size	107	85	605
Mean	1.28	1.24	1.31
Standard Deviation	0.27	0.13	0.15
Error of Mean	0.03	0.01	0.01
99.7% UCL	1.35	1.28	1.33
99.7% LCL	1.21	1.20	1.29

	Uranium Activity, pCi/g		
	Background	Ditch Face	Drummed Soil
Sample Size	107	85	605
Mean	1.40	1.44	1.47
Standard Deviation	0.33	0.27	0.29
Error of Mean	0.03	0.03	0.01
99.7% UCL	1.47	1.50	1.50
99.7% LCL	1.32	1.33	1.43

FIGURE 5-1. GAMMA RADIATION SURVEY, μR/HOUR



6.0 SURVEY INTERPRETATION

An extensive decontamination program was conducted throughout Phase II of Building C. Based on the survey results shown in Section 5.0, Phase II meets or surpassess all applicable release limits and can be released for unrestricted use pending approval by the NRC.

Comprehensive surveys were performed on the room's surfaces to measure direct and smearable alpha radioactivity. A statistical survey was performed for beta-gamma radioactivity. Fixed alpha contamination was the primary surface contamination found in Phase II with most of the readings (99%) being at the lower limit of detection. Americium, plutonium, thorium, and uranium from nuclear fuels R&D were the only contaminants found in the soil under Phase II of Building C. Excavation of soil under the drains continued until samples from the faces and bottoms of the ditches demonstrated release limits had been met with most of the samples (99%) being at background concentrations. A total of 614 55-gallon drums of soil were excavated. The 9 drums of contaminated soil were shipped to a licensed commercial radwaste burial site for disposal. The remaining 605 drums of soil are being retained at the LRC until approved for release.

The scope of the decontamination project and the procedures, equipment, and analyses applied give strong assurance that the measured values of residual radioactivity are representative of Phase II and all release limits have been met. Thus, the decontamination and decommissioning project for Phase II has been successfully completed. Therefore, upon the concurrence of the NRC, Phase II will be released for unrestricted use.

7.0 REFERENCES

1. Docket No. 070-00824, NRC Materials License SNM-778, as renewed, Expires July 31, 1985.

2. Memo, A.F. Olsen, B&W, to W.T. Crow, NRC, "Decommissioning Plan for the Lynchburg Research Center's Building C", March 28, 1983.

3. LRC Building C Decommissioning Project QA Program, Work Plan for Plutonium Decontamination, Revision No. 0, LRC Order No. 8604, LRC QA No. 82008L. May 12, 1982.

4. Memo, W.T. Crow, NRC to A.F. Olsen, B&W, "Standard Review Plan for Termination of Special Nuclear Material Licenses" with Appendix I, March 15, 1983.

5. D.A. Edling and J.F. Griffin, "Certification of ERDA Contractors' Packaging with Respect to Compliance with DOT Specification 7A Performance Requirements, Phase II Summary Report", MLM-2228, June 12, 1975.

6. Department of Transportation Hazardous Materials Regulations, Title 49 CFR Part 178.118, Specification 17H; steel drums.

7. NRC Materials License No. 16-19204-01, Ammendment No. 4, Expires November 30, 1985 and State of Washington Radioactive Materials License WN-1019-2, Expires November 30, 1985.

8. NUREG/CR-2082, "Monitoring for Compliance with Decommissioning Termination Survey Criteria" with Appendices I through VII, June 1981.

9. Arthur F. Taggart, "Handbook of Mineral Dressing, Ores and Industrial Minerals", John Wiley & Sons, Inc. 1927.

10. Memo, A. F. Olsen, B&W, to W. T. Crow, NRC, "Soil Decontamination Plan", October 12, 1981.

11. Memo, N. Soltys, B&W, to R. L. Bennett, B&W, "Bldg 'C' decommissioning", January 10, 1985.

DOCKET NO. 70-824

CONTROL NO. 26200

DATE OF DOC. 12/13/85

DATE RCVD. 12/18/85

FCUF ✓ PDR ✓

FCAF ___ LPDR ✓

WM ___ I&E REF. ✓

WMUR ___ SAFEGUARDS ✓

FCTC ___ OTHER ___

DESCRIPTION:

Building C Decommissioning, Phase II

12/20/85 INITIAL CEC