DL-020397_01

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

Mail Stop 926A
February 3, 1997

United States Nuclear Regulatory Commission
Region II
101 Marietta Street, N. W., Suite 2900
Atlanta, GA 30323-0199

Attn: Jay L. Henson
Materials License Reviewer
Division of Nuclear Material Safety

License No. 45-15923-01
Expiration Date: November 30, 2000

Dear Mr. Henson:

Enclosed you will find two copies of Mr. Michael Terpilak's, CHP, final survey report of rooms 107A, 203, 204, 205, 209, and 210 of the Solid State Physics Building of the U.S. Geological Survey, in Reston, VA. This is in response to your request of July 9, 1996 requesting additional information about our final survey report of Feb. 26, 1996 (Reference: 296696; 030-10034). This report should address items 1 and 3 of your letter. We have chosen not to release room 107B for unrestricted use at this time. It will remain in use as a radiation laboratory. This report was prepared at our request for the purpose of determining if those rooms may be released for unrestricted use. Based upon Mr. Terpilak's findings we believe those rooms meet the guidelines for release for unrestricted access and request that those rooms be released for unrestricted access. The release of these rooms does not terminate licensed activities in the Solid State Physics Building of the U.S. Geological Survey.

If you have any questions concerning this matter please call me at (703) 648-6189 or Dr. Charles W. Naeser at (703) 648-6964.

Sincerely,

Gregory A. Wandless

Gregory Wandless
Radiation Safety Officer

cc: Curt Larsen, MS 953
Gary Kramer, MS 246
Wayne Martin, MS 953
RSO Files

Physics Building

FINAL REPORT

RADIOLOGICAL SAFETY ASSESSMENT

FOR

UNITED STATES DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

RESTON, VIRGINIA 22092

TASK ORDER NO. 1434-HQ-97-SA-00304

DECEMBER 31, 1996

PREPARED BY:

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PREPARED FOR:

U.S. DEPARTMENT OF INTERIOR

U.S. GEOLOGICAL SURVEY

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I. EXECUTIVE SUMMARY AND ACTION ITEMS

A radiological safety assessment of the United States Department of Interior, U.S. Geological Survey (USGS) Physics Building was conducted on December 4 and 5, 1996 by Michael S. Terpilak, Certified Health Physicist.

This structure is a two-story laboratory and storage complex that is presently vacant except for a core drilling component of the USGS. The building is presently being considered to be renovated and converted into office space for recently acquired personnel.

The radiological safety assessment included a radiological survey utilizing portable radiation detection survey instruments. In addition, a total 456 swipe samples were conducted at six laboratories located in the Physics Building on the campus of the USGS National Center located at Reston, Virginia.

The following laboratories were surveyed:

- Laboratory - Room 203 - Sample Preparation
- Laboratory - Room 204 - Chemistry Lab
- Laboratory - Room 205 - Sample Storage Area
- Laboratory - Room 209 - Counting Room and Weighing Room
- Laboratory - Room 210 - Counting Room.
- Office - Room 107A - Radiation Safety Office

All rooms were designated as unaffected areas as specified in section 4.0 of NUREG/CR-5849 "Manual for Conducting Radiological Surveys in Support of Licence Termination," June 1992.

The findings and results of all samples (instrument and swipe surveys) indicated that all six laboratories were free of fixed and removable contamination and qualify for release for UNRESTRICTED USE in accordance with the current U.S. Nuclear Regulatory Commission (NRC) guidelines, April 1993.

II. INTRODUCTION

This radiological assessment was requested by Laura Schwarting, Contract Officers Technical Representative (COTR), United States Geological Survey (USGS). This radiological assessment was also conducted at the request of Mr. Greg Wandless, Radiation Safety Officer (RSO) of the USGS National Center. The date of request was November 13, 1996 and the Task Order number is USGS - 1434-HQ-97-SA-0034. The Radiological Safety Assessment was performed by Michael S. Terpilak, Certified Health Physicist, on December 4 and 5, 1996.

The objective of this report is to present the findings and results of the radiation survey and to indicate whether the laboratories surveyed qualify for release for UNRESTRICTED USE in accordance with current U.S. NRC guidelines April, 1993 and NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination," June 1992.

III. BACKGROUND

The U.S. Department of the Interior, U.S. Geological Survey (USGS) currently holds an NRC License (License Number - 45-15923-01 as amended through amendment 28) to operate the following facilities: (Appendix A)

- U.S. Geological Survey National Center
  12201 Sunrise Valley Drive
  Physics Building Laboratories
  Reston, Virginia 22092

- U.S. Geological Survey
  Stephenson Center
  Suite 129
  729 Gracern Road
  Columbia, South Carolina 29210

The current license expired on November 30, 1995. In accordance with 10 CFR 30.37, to ensure that the operating license did not expire, the USGS submitted the renewal application on November 27, 1995 and renewed July 29, 1996 with an expiration date of November 30, 2000.

The Nuclear Regulatory Commission (NRC) has established Technical and Financial Regulations for decommissioning Licensed Nuclear Facilities (53 CFR 24018, June 27, 1988). The regulations address decommissioning planning, needs, timing, funding methods, and environmental review requirements for Public and Private Facilities having licenses under 10

CFR parts 30, 40, 50, 70 and 72. The intent of the regulations is to ensure that the decommissioning of all Licensed facilities will be accomplished in a safe and timely manner and that licensees will provide adequate funds to cover all costs associated with decommissioning. The rule defines "Decommissioning" as the following: To safely remove nuclear facilities from service and reduce residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license.

As noted in Part 30.35.f.4, government licensees may elect to submit a statement of intent containing an amount based on the possession limit of the license and indicating that funds will be obtained when decommissioning actually occurs. Part 30.35.c.2 states that if the licensee chooses to submit a certificate of financial assurance (statement of intent) at this time, a decommissioning funding plan and cost estimate shall be included in the licensee's next application for license renewal.

The regulations specify that a facility licensee either must set aside money for decommissioning activities or must provide a guarantee through a third party that funds will be available. The funds set aside or guaranteed are determined by a decommissioning funding plan (DFP) which the licensee provides.

Specific requirements are stated in 10 CFR 30.35, "Financial Assurance and Recordkeeping for Decommissioning." 10 CFR 30.35.f.4 state that in the case of Federal, State, or local government of licensees, a statement of intent containing a cost estimate--or a value fixed by the regulation and determined by the type of facility--is acceptable. **The regulations do not explicitly address the need for a DFP for all Federal, State, or Local government licensees. However, other NRC documents indicate the need for a DFP before the issuance of a new license or the renewal of an existing license.**

Specific details of what the NRC considers an acceptable DFP are documented in NUREG-1336, "Interim Guidance on the Standard Format and Content of Financial Mechanisms Required for Decommissioning Under 10 CFR Parts 30, 40, and 70," and subsequent Regulatory Guide (Reg Guide) 3.66 published in June 1990. Also, NUREG-1337, "Interim Guidance on the Standard Review Plan for the Review of Financial Assurance Mechanisms for Decommissioning Under 10 CFR Parts 30, 40, and 70," serves as an outline and checklist for NRC staff reviewers. Reg Guide 3.65, "Standard Format and Content of Decommissioning Plan for Licensees under 10 CFR Parts 30, 40, and 70," outlines the overall decommissioning plan requirements showing the relationship of the DFP to the decommissioning process.

In addition, the following radiological surveys were conducted by the contractor for the Licensee prior to the release of Laboratories and rooms for unrestricted use.

- Establishing Background Levels
- Scanning Survey Using Portable Radiation Instruments
- Removable Surface Contamination Measurements

- Laboratory Analysis and Measurement of Smear (Filter Paper) Samples

In accordance with section 4.2.2 Establishing Reference Grid Systems, since unaffected areas do not require gridding for the purpose of establishing measurement or sampling locations, the specific laboratory survey locations (instrument and smear) were marked, identified by white adhesive tabs and the laboratories were locked and secured to deny and prohibit areas pending the NRC review of this Radiological Safety Assessment report.

On February 16, 1996 an initial preliminary Radiological Safety Assessment report was submitted to the NRC of a survey conducted of these same six laboratories and rooms in the Physics Building on the campus of the USGS National Center located at Reston, Virginia. This survey was conducted on January 22, 23 and 24, 1996 and a total of 228 swipe samples and portable radiation instrument surveys were taken.

IV. EVALUATION METHODS

The radiological assessment was conducted by Michael S. Terpilak, Certified Health Physicist, in a manner similar to typical radiation surveys of licensees by the Nuclear Regulatory Commission (NRC).

These surveys were accomplished and performed in accordance with and as specified in the Nuclear Regulatory Commission (NRC), NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination," Draft Report for Comment, June, 1992 as described and specified in section 4.2 and in addition to 10 CFRs Part 30 (Appendix B).

ESTABLISHING BACKGROUND LEVELS

Background was determined by conducting survey measurements and/or sampling at locations on the site, which are unaffected by-site operations, i.e., preferable locations for interior background determinations all within on-site buildings of similar constructions, or even Physics Building location that has had no previous history of licensed operations, i.e., use of radioactive materials. Surveys conducted with portable radiation instruments as well as smear surveys were duplicated in laboratories and/or office space similar in dimensions and construction as the laboratories that are presently using licensed materials (i.e., laboratories using radioactive materials). Background surveys radiation instrument surveys were in the range of 0.020 mR/hr and 15-20 μR/hr and random smear samples were nondetectable, i.e., Minimum Detectable Activity (MDA).

Based on previous historical records, interviews with personnel, present licence inventory and possession license limits and conditions as well as current and present documented monthly Laboratory Contamination Surveys it was determined in accordance with Section 4.2 Designing the Survey, NUREG/CR-5849 that the six laboratories to be surveyed were classified as unaffected areas that are not expected to contain residual radioactivity, based on a knowledge of site history and previous survey information.

Since it can be readily shown from previous records, inventories, possession limits and many surveys that alpha radioactive material has never been used at this facility, it is recommended that only Beta-Gamma (β-γ) assessment be performed at this time.

SCANNING SURVEYS USING PORTABLE RADIATION INSTRUMENTS

These measurements typically consist of surface scanning (moving the detector at a consistent speed and distance near the surface) and measuring levels of direct radiation (surface activity and exposure rate) at representative points (Appendix D).

Before conducting any fixed measurements, surfaces are scanned to identify the presence of elevated direct radiation which might indicate residual gross activity or hot-spots. Scans are conducted for all radiations potentially present, based on the operational history. The scanning detector is kept as close as possible to the surface and moved cross the surface at a slow speed. Nominally, the distance between the detector and the surface is maintained at less than two centimeters. For particulate radiations (beta) which may have very limited ranges, the scan speed should not exceed 1 detector width per second; this speed should be reduced to as low as 1/3 detector width per second for those situations when relatively low count rates may be indicative of residual activity exceeding guideline values. For gamma radiation the scanning speed may be greater; the probe is typically moved in a serpentine pattern while advancing at a speed of about 0.5 m per second.

For optimum detection sensitivity, changes in the instrument response are monitored via the audible output (use of headphones is recommended), rather than by observing fluctuations in the analog meter reading. This use of an audible signal negates concern for the time constant related to the meter response. Locations of direct radiation, discernable above the ambient level (typically 2 to 3 times the ambient count rate), are marked on facility maps and identified for further measurements and/or sampling.

A complete radiological assessment included a radiation survey utilizing a Radiological Instrumentation as identified and specified in section 5 Radiological Instrumentation of NUREG/CR5489 (Appendix C).

- Beta-Gamma (β-γ) Field Survey Instrumentation

The following instruments were utilized in the survey.

- Ludlum Model #2 survey meter serial #88228 with a pancake type halogen quenched Geiger-Muller (G-M) Probe Model #44-9 Serial #010560 with a 1.7 ± 0.3 mg/cm^2 mica end window and active area of 15 cm^2.

- Ludlum Model #3 survey meter serial #22331 with an end window halogen quenched Geiger-Muller (G-M) Probe Model #44-7 Serial #PRO5338 with a 1.7 ± 0.3 mg/cm^2 mica end window and active area of 6 cm^2.

- Gamma Field Survey Instrumentation

The following instrument was utilized in the survey.

- Victoreen Model 450P Pressurized Ion Chamber Survey Meter with a high sensitivity Micro-R measurements of exposures and exposure rates. Serial #1618.

The appropriate calibration certificates for the above instruments are enclosed (Appendix G).

The Beta-Gamma (β-γ) field survey instrumentation, i.e., the surface scanning (moving the detectors at a consistent speed and distance near the surface of each area approximately 1 cm) was conducted at 456 surface locations in the six laboratories and reported in mR/hr (Appendix C).

The gamma (γ) field survey instruments were conducted at approximately 1 meter from the 456 surface locations in the six laboratories and reported in mR/hr. In addition another reading was reported in μR/hr at 1 meter (Appendix C). The radiological surveys were conducted consistent and in compliance with 10 CFR 30 and NUREG/CR 5849. In addition a total of 456 swipe samples were conducted in the six laboratories, located in the Physics Building, Main Campus, Reston, Virginia. **All laboratories were classified as an UNAFFECTED AREAS, i.e., these areas were not expected to contain residual radioactivity, based on a knowledge of site history and previous survey information.**

The following laboratories were surveyed and measures taken are listed in Table 1.0.

TABLE 1.0
Laboratories Surveyed in Physics Building

Laboratory	Square Feet	Square Meters	Swipes	Radiation Readings		
				mR/hr at 1cm	mR/hr at 1 meter	µR/hr at 1 meter
Room 203 Sample Preparation	180	17.0	76	0.020	0.020	15.0
Room 204 Chemistry Lab	440	41.0	103	0.020	0.020	15.0
Room 205 Storage Area	48	4.5	16	0.020	0.020	15.0
Room 209 Counting Room	600	56.0	73	0.020	0.020	15.0
Room 209 Weighing Room	72	7.0	17	0.020	0.020	15.0
Room 210 Counting Room	660	61.0	132	0.020	0.020	15.0
Room 107A Radiation Safety Office	154	14.0	39	0.020	0.020	15.0

V. RADIONUCLIDE USAGE IN LABORATORIES

The only radionuclides used in this laboratory space were as follows:

- Tritium (Hydrogen-3)
- Carbon-14
- Sodium-22
- Scandium-46
- Iron-59
- Cobalt-60

Attached for your information is Table 2.0 that identifies the specific characteristics of these radionuclides.

Radioactive material used and processed in these laboratories consisted of minerals irradiated at the USGS TRIGA Reactor Facility in Denver Colorado. The construction of the Solid State Physics Building was completed in January, 1974, occupied in February, 1974. The radioactive material used and a description of research activities for each laboratory is described below.

Room 107A--Radiation Safety Office

Originally Room 107 was a single room used as a storage area for electronic equipment. No licensed material was used in this room until approximately 1985. A portion of Room 107 was converted to a wet chemistry lab used by the Instrumental Neutron Activation Analysis (INNA) group for doing radiochemical separation on activated rock materials. Construction was begun around 1981 and completed in 1984. It is about this time that the INAA project was directed to move from the National Center to the Physics Building. With the chemistry labs on the second floor, Rooms 203 and 204, and there was no need for the INAA project was to occupy Room 107B. Room 107A continued as a storage area when it was vacated and occupied as the Radiation Safety Officers office. Room 107A was used by the RSO to solidify liquid active waste, composed of Uranium washings, from various sources and ^{14}C waste generated by Water Resources Division.

Room 203

Room 203 was used to prepare U counting standards by diluted natural U bearing ore with powdered dunites.

Room 204

Room 204 was a general chemistry laboratory for work on non-active material and for experiments utilizing 3H and 22Na.

Room 205

Room 205 was used as a dark room and storage for chemicals. No active material was in this room prior to 1985.

Room 209

Room 209 was used for experiments using 22Na.

Room 210

Used as a counting faculty for natural uranium ores and counting of standards prepared in room 204. Solutions of 222Ra for radon analysis standards were stored here but never opened or used.

The Instrumental Neutron Activation Analysis (INAA) project moved into the Solid State Physics Building in the summer of 1985. Prior to occupation all material from these rooms was moved to storage, to room 104 or accompanied a relocating USGS employee to the licensed faculty at the Denver Federal Center in Denver, CO. A survey of 209 and 210 was performed on

November 27 1984 and is presently on file in the Radiation Safety Office.

The project performed trace element analysis of geological samples using the techniques of gamma-ray spectrometry of neutron activated samples. Samples of approximately 0.5 grams were sealed into 2/5 dram polyvials and sealed into a 2-dram polyvial. These were shipped to the TRIGA reactor at the U.S.Geological Survey facility in Denver, CO for neutron activation. The activated samples were returned to the Reston faculty where the inner sealed via was removed and placed into a clean 2-dram polyvial ~~count~~ for gamma-ray counting. Gamma-ray data was acquired over a period of 1-2 months.

In October, 1995 the INAA project was terminated. All backlogged samples had been completed and all samples were transferred to 55-gallon drums in the "Hot-Rock Shed" and were disposed of a Low-Level Radioactive Waste (LLRW) through normal radioactive waste proceedings and a LLRW broker for ultimate disposal and burial at a licensed facility.

Room 203--Sample Preparation

Room 203 was used to prepare the irradiated samples for counting. This done by cutting open the 2-dram outer vial and removing the inner 2/5-dram and placing it into a clean 2-dram vial. These operations were done entirely in a hood. Through the normal sequence of events the activated powder was always contained inside the 2/5-dram vial. Infrequently the inner vial would rupture and leak some of the activated sample into the 2-dram vial. The sample was generally recovered by opening the outer 2-dram vial in the hood over weighing paper and then transferred to a new 2/5-dram vial which was then sealed and placed in 2-dram vial for counting. This room was also used by the current RSO (Gregory Wandless) to solidify liquids containing small amounts of 14C received from Water Resources Division 14C lab.

Room 204--Chemistry Laboratory

Room 204 was used as a general wet chemistry laboratory. The only radioactive material in this room was confined to storage of contaminated trash, used TRIGA tubes, polyvials etc. This material was stored in 55-gal drums until full and was then transferred to the "Hot Rock Shed" to await pick-up for disposal.

Room 205-- Storage Area

Room 205 was used to store the 2-dram polyvials containing the activated samples (as described above) until the counting for each sample was complete. After this they were transferred to a 55-gal drum for disposal.

Room 209--Counting Room and Weighing Room

Room 209 was used to weigh nonactive samples for analysis. On several occasion new detectors were tested and calibrated in this room using sealed 60Co and 137Cs sources and the counting

of samples with very low levels of activity. Those samples were encapsulated as described above in polyvials.

Room 210--Counting Room

Room 210 was the main counting room for INAA project. Samples as described above were counted on High purity Germanium detectors to acquire gamma-ray spectra which were used to determine the trace element content. Samples in the process of counting were also stored here and were transform to Room 205 upon completion.

Based on the above use of this laboratories, it was designated as an unaffected area as defined in NUREG/CR-5849 and as such section 4.23 Selecting Measurement Sampling Locations for Structure Surveys states that scans of unaffected areas should cover a minimum of to 10% of the floor and lower wall surface area. Since there was no reason to suspect residual activity exceeding 25% of the guidelin. alue on these surfaces, a minimum of 30 measurement locations each, on vertical and horizontal surfaces where radioactive materials would likely accumulate (air exhaust rents and horizontal surfaces where dust would settle was selected). At least 30 randomly selected measurement locations or average measurement of 1 per 50 m^2 of building surface area, whichever is greater, for total and removable activity, should be performed for each survey unit.

TABLE 2.0

CHARACTERISTICS OF RADIONUCLIDES USED IN LABORATORIES

Radionuclide	Radiation	Energy	Half-Life
• Hydrogen-3 (Tritium)	Beta$^-$	18.60 keV Max. 5.680 keV Avg. (100%)	12.26 years
• Carbon-14	Beta$^-$	156.48 keV Max. 49.470 keV Avg. (100%)	5730 years
• Sodium-22	Beta$^+$ Positron Gamma (γ) k x-ray Augeo-K	545.5 keV Max. 215.5 keV Avg. (89.8%) k x-ray 0.84 keV (0.12%) 1.274 MeV (99.9%) 0.84 keV (0.12%) 0.82 keV (9.2%)	2.62 years
• Scandium-46	Beta$^-$ Gamma (γ)	0.357 MeV (Max.) 1.120 MeV (100%) 0.889 MeV (100%) Ti - x-ray	84 days

Radionuclide	Radiation	Energy	Half-Life
• Iron-59	Beta⁻		45 days
	B-1	130.8 keV Max. (1.27%) 35.8 keV Avg.	
	B-2	273.4 keV Max. 80.8 ke V Avg. (45.6%)	
	B-3	465.8 keV Max. 149.3 keV Avg. (52.8%)	
	B-4	1.565 MeV Max. 635.8 keV Avg. (0.18%)	
	Gamma (γ)		
	γ-1	190 keV (3%)	
	γ-2	1.10 MeV (56%)	
	γ-3	1.29 MeV (44%)	
	γ-4	143 keV (1%)	
• Cobalt-60	Beta⁻		5.27 years
	Beta⁻	318.0 keV Max. (99%) 95.80 keV Avg. (99%)	
	Gamma (γ)	1.173 MeV (100%) 1.332 MeV (100%)	

In addition, all irradiated samples were in solid state, no radioactive liquids or gases were involved, and all irradiated samples were sealed, no unsealed radioactive material or sources were used in these laboratories. The estimated activity of the radioactive materials never exceeded microcurie quantities.

VI. RADIATION SURVEYS

The radiation surveys conducted by portable radiation detection instruments in each of the six laboratories did not indicate any fixed contamination on all the surfaces surveys. A total of 456 surfaces, areas and locations were surveyed in the six laboratories and all instruments surveys indicated no radiation levels above natural background. Therefore, an indication of no fixed contamination was identified.

As a result of these instrument surveys since there was no fixed contamination identified, there was no need to express results in fixed contamination in dpm/100 cm^2. The specific radionuclides in question have energies similar to the calibration energies of the radiation instruments used for the surveys. In addition, the scanning and survey technique was demonstrated to have a detection sensitivity for the radionuclide or radiations of interest at ≤ 25% of the guideline level.

In addition, all swipe surveys in these laboratories were determined to be Minimum Detectable Activity (MDA), i.e., zero Disintegrations per Minute (DPM) which indicates that there was no removable and/or loose surface contamination identified.

REMOVABLE SURFACE CONTAMINATION MEASUREMENTS

A total of 456 wipe areas and 456 Beta-Gamma and 912 Gamma instrument measurements were conducted in this six laboratories Table 1.0.

Swipe samples were conducted over a surface are of 100 cm^2 within a 1 m^2 area of each laboratory.

The 456 swipe samples were analyzed for the following:

- Gross BETA - Gas Flow Proportional Counter
- GAMMA Spectroscopy - Sodium Iodide (NAI) Detector

LABORATORY ANALYSIS AND MEASUREMENT OF SMEAR (FILTER PAPER) SAMPLES

In any samples were identified with radioactive contamination, then these samples were analyzed for specific radioactivity (i.e., isotopic analysis). The results of the swipe sample analysis are enclosed (Appendix E).

VII. ANALYSIS AND COMPARISON OF RADIATION SURVEY RESULTS TO U.S. NUCLEAR REGULATORY COMMISSION (NRC) GUIDELINES

The USNRC guidance document entitled "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Material," April 1993 states that depending on the specific radionuclides identified acceptable surface contamination levels shall be followed.

Therefore, based on three radionuclides identified in these two laboratories the category Beta-Gamma emitters was selected as the criteria for analysis and comparison with the radiation survey results (instrument and swipes).

The Beta-Gamma emitter nuclide category for acceptable surface contamination levels are as follows:

- Average - 5,000 dpm Bγ/100 cm^2
- Maximum - 15,000 dpm Bγ/100 cm^2
- Removable - 1,000 dpm Bγ/100 cm^2

In addition, 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.

Swipe surveys at each laboratory indicted that samples were nondetectable, i.e., Minimum Detectable Activity (MDA), the results were significantly below the average, maximum and removable acceptable surface contamination levels.

Subsequently the radiation instrument surveys of each laboratory indicated levels in the range of 0.020 mR/hr and 15-20 μR/hr which indicate natural background radiation and were significantly below the average and maximum radiation levels associated with surface contamination resulting from then beta-gamma emitters.

VIII. BRIEF SUMMARY OF STANDARDS AND CRITERIA

The U.S. Nuclear Regulatory Commission (NRC), Division of Fuel Cycle, Medical, Academic and Commercial Use Safety, Washington, D.C., has published a technical document entitled "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source of Special Nuclear Material," dated April 1993. The document delineates specific instructions concerning instrument and swipe surveys and Table 1, specifically states "Acceptable Surface Contamination Levels" that shall be used for decontamination of facilities and equipment prior to release for unrestricted use (Appendix F).

IX. RESULTS AND CONCLUSIONS

Based on the results of the radiological safety assessment, i.e., the radiation instrument and swipe survey, the following laboratories located in the Physics Building United States Geological Survey (USGS) National Center can be released for unrestricted use:

- Laboratory - Room 203 - Sample Preparation
- Laboratory - Room 204 - Chemistry Laboratory
- Laboratory - Room 205 - Storage Area
- Laboratory - Room 209 - Courting Room and Weighing Room
- Laboratory - Room 210 - Counting Room
- Office - Room 107A - Radiation Safety Office

X. REFERENCES

Title 10 Code of Federal Regulations, Part 20, Standards for Protection Against Radiation, January 1993. Federal Register Vol. 56, No. 98, Tuesday, May 2, 1991, pp. 23360-23474 (Includes revisions to Parts 2, 19, 20, 30, 31, 32, 34, 35, 39, 40, 50, 61, and 70).

Title 10 Code of Federal Regulations, Part 30, Rules of General Applicability to Domestic Licensing of Byproduct Material, January 1, 1993.

Title 10 Code of Federal Regulations, Part 33, Specific Domestic Licenses of Broad Scope for Byproduct Materials January 1, 1993.

Title 10 Code of Federal Regulations, Part 71, Packaging and Transportation of Radioactive Materials, January 1993.

Title 49 Code of Federal Regulation, Parts 100 to 177, Transportation, October 1, 1992.

Regulatory Guide 3.66, Standard Format and Content of Financial Assurance Mechanisms Required for Decommissioning under 10 CFR Parts 30, 40, 70, and 72, June 1990.

Regulatory Guide 7.10, Establishing Quality Assurance Programs for Packaging Used in the Transport of Radioactive Material, Rev. 1, June 1986.

Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data, Rev. 1, June 1992.

Regulatory Guide 8.9, Acceptable Concepts, Models, Equations and Assumptions for a Bioassay Program, Rev. 1, July 1993.

Regulatory Guide, 8.10, Operating Philosophy for Maintaining Occupational Radiation Exposure as Low as Reasonably Achievable, Rev. 1, May 1977.

Regulatory Guide 8.18, Information Relevant to Ensuring that Occupational Radiation Exposures at Medical Institutions Will Be As Low As Reasonably Achievable, Rev. 1, October 1982.

Regulatory Guide 8.23, Radiation Safety Surveys at Medical Institutions, Rev. 1, January 1981.

Regulatory Guide 8.25, Air Sampling in the Workplace, 1992.

Regulatory Guide 8.33, Quality Management Program, October 1991.

Regulatory Guide 8.34, Monitoring Criteria and Methods to Calculate Occupational Radiation Doses, July 1992.

Regulatory Guide 8.36, Radiation Dose to the Embryo/Fetus, July 1992.

Regulatory Guide 8.37, ALARA Levels for Effluents from Materials Facilities, July 1993.

APPENDIX A

UNITED STATES GEOLOGICAL SURVEY

RADIOACTIVE MATERIALS LICENSE

NUMBER--45-15923-01

JULY 29, 1996

APPENDIX B

UNITED STATES

NUCLEAR REGULATORY COMMISSION

NUREG/CR - 5489

MANUAL FOR CONDUCTING

RADIOLOGICAL SURVEYS IN SUPPORT OF

LICENSE TERMINATION

JUNE, 1992

NUREG/CR-5849
ORAU-92/C57

Manual for Conducting Radiological Surveys in Support of License Termination

Draft Report for Comment

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4.0 Planning and Designing the Final Status Survey

The purpose of the final status survey is to demonstrate that the release criteria established by the NRC have been met. Demonstrating that this has been achieved requires collection of data for determining surface activity levels, direct exposure rates, and radionuclide concentrations in soil. In addition, supplemental information, such as radionuclide concentrations in ground water and total site inventory of radioactive material, may be required by the NRC. The data should be accurate and reliable and should be adequate to satisfy other conditions and considerations which the NRC may impose. A well-documented, statistically based survey plan will be the basis for meeting these objectives.

The survey plan should describe the survey design in detail. The plan should include:

- A list of the types, numbers, and locations of measurements and samples to be obtained;
- Information on the equipment and techniques to be used for measuring, sampling, and analyzing data;
- The methods to be used to interpret and evaluate the survey data; and,
- Quality control procedures for ensuring the validity of the data.

This section discusses considerations for developing such a plan, including quality control procedures, and site information required to plan and design the survey. This section also describes how to select measurement/sampling locations and to determine the sampling frequency that will be required to assure the statistical significance of the data. A general flow chart for a radiological survey supporting license termination is provided in Figure 4-6; detailed flow charts for various activities related to the survey process are provided in Section 6.0. Appendix B provides a sample survey plan for a hypothetical reference fuel fabrication facility.

4.1 General Considerations for Survey Planning

4.1.1 Quality Assurance

Because the purpose of the final status survey is to demonstrate that a facility meets the established release criteria, the survey should be performed in a manner that assures the results are accurate and that uncertainties have been adequately considered. An effective QA program will define the data quality objectives of the survey and thereby determine, to a significant extent, the survey design. This program will operate in all stages of the survey through final validation of the data and the interpretation of the results.

The consensus nuclear industry standard for quality assurance is ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities (ANSI 1989). The NRC has also issued guidance for an acceptable QA program in Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Program -- Effluent Streams and the Environment (NRC 1979). A quality assurance program, consistent with the information contained in these documents, should be developed.

Surveys should be performed by trained individuals who are following standard, written procedures, and are using properly calibrated instruments which are sensitive to the suspected contaminant. The custody of samples should be tracked from collection to analysis. Data should be recorded in an orderly and verifiable way and reviewed for accuracy and consistency. Every step of the decommissioning process, from training personnel to calculating and interpreting the data, should be documented in a way that lends itself to audit. These requirements are achieved through a formal program of quality assurance. Failure to follow such requirements may limit the usefulness of portions of the survey data.

QA Plans

The decommissioning plan should include a written QA plan that describes the organizational structure under which the decommissioning efforts -- and particularly the final status survey -- will be conducted. Functional and administrative responsibilities and interfaces of key individuals should be clearly delineated. Education, experience, and any other requirements for each key position should be specified. The size and complexity of the organizational structure will be determined by the magnitude of the decommissioning action.

QA Coordination

One individual should be designated as the QA officer or QA coordinator. This individual should not be involved in survey activities that generate data and should report directly to the project manager. The QA officer/coordinator should be responsible for ensuring that all QA objectives of the survey are met, should review selected field and analytical data to ensure adherence to procedures, and should approve the quality of data before it us used to test hypotheses regarding attainment of cleanup standards. Specifically, this individual:

- Serves as the focal point for survey QA activities and ensures that they are conducted in accordance with established policies and procedures
- Oversees survey activities by conducting internal audits and/or surveillance.

Documentation Requirements

All aspects of the survey should be documented in detail. For certain field or laboratory activities, consensus or industry-wide procedures, such as those developed by the Environmental Protection Agency (EPA), American Society of Testing and Materials (ASTM), DOE's Environmental Measurements Laboratory (EML), or other such organizations may be either adopted in whole or adapted to meet the requirements of the specific decommissioning action. These procedures become part of the administrative record of the survey. The procedures should be approved by the individual responsible for the decommissioning project and the effective date of the procedure should be indicated. Changes or exceptions to established procedures are likely to be required; and these also should be properly documented, signed, and dated.

Training/Certification of Survey Staff

All personnel conducting the surveys should receive training to qualify in the procedures being performed. The extent of training and qualifications should be commensurate with the education, experience, and proficiency of the individual and the scope, complexity, and nature of the activity. Training should be designed to achieve initial proficiency and to maintain that proficiency at least over the course of the decommissioning process. Records of training, including testing to demonstrate qualification, should be maintained.

Equipment Maintenance and Calibration

Measuring equipment should be maintained, calibrated, and tested to assure the validity of the survey data. Further, the procedures, responsibilities, and schedules for calibrating and testing equipment should be documented.

Proper maintenance of equipment varies, but maintenance information and use limitations should be provided in the vendor documentation. All measurement

and analytical equipment should be tested and calibrated before initial use and should be recalibrated if maintenance or modifications could invalidate earlier calibrations. Field and laboratory equipment should be calibrated based on standards traceable to the National Institute of Standards and Technology (NIST). In those cases where NIST-traceable standards are not available, standards of an industry-recognized organization (for example, the New Brunswick Laboratory for various uranium standards) may be used. Minimum frequencies for calibrating equipment should be established and documented.

Measuring equipment should be tested at least once each day the equipment is used. Test results should be recorded in tabular or graphic form and compared to predetermined, acceptable performance ranges. Equipment that does not conform to the performance criteria should be immediately removed from service until the deficiencies can be resolved.

Data Management

A consistent method of data generation, handling, computations, evaluation, and reporting should be developed and documented as part of the survey plan. In general, information and data should be recorded in bound logs or on standardized field and laboratory record forms. Analytical data should not be obliterated by erasing or the use of whiteout. Incorrect entries should be corrected by striking a single line across the entry and entering new data. The correction or change should be initialed and dated by the person making the entry.

A system of data review and validation is important to ensure consistency, thoroughness, and acceptability. This begins with regular (daily or weekly) reviews of calculations based on field data; and reviews of final reports by survey and laboratory supervisors, QA officials, and project managers. All reviews should be signed and dated. Any questionable or invalid data should be identified in project records and in the survey report. Active records should remain under direct control of a designated individual during report preparation; inactive records should be protected from loss or destruction by storage in access-controlled areas or files and in facilities with fire protection. It is also recommended that copies (microfilm, computer disc, photostats, etc.) of critical data be produced and stored at a separate location.

Sample Chain-of-Custody

One of the most important aspects of sample management is to ensure that the integrity of the sample is maintained; that is, that there is an accurate record of sample collection, transport, analysis, and disposal. This ensures that samples are neither lost nor tampered with and that the sample analyzed in the laboratory is actually and verifiably the sample taken from a specific location in the field.

Sample custody should be assigned to one individual at a time. This will prevent confusion of responsibility. Custody is maintained when (1) the sample is under direct surveillance by the assigned individual, (2) the sample is maintained in a tamper-free container, or (3) the sample is within a controlled-access facility.

A chain-of-custody record (a standard form) should be initiated by the individual collecting or overseeing the collection of samples. A copy of this form should accompany the samples throughout transportation and analyses; and any break in custody or evidence of tampering should be documented.

Audits

Periodic audits should be performed to verify that survey activities comply with established procedures and other aspects of the QA plan and to evaluate the overall effectiveness of the QA program. The audits should be conducted in accordance with written guidelines or checklists, and should be performed by individuals not actively participating in the activities being audited. Audit results are reported to responsible management in writing, and actions to resolve identified deficiencies should be tracked and appropriately documented.

4.1.2 Health and Safety

Consistent with the approach for any operation, decommissioning activities should be planned and monitored to assure the health and safety of the worker and other personnel, both on- and off-site, are adequately protected.

Contamination control and radiation control support surveys are conducted for protection of personnel performing decontamination activities. These surveys are operational in nature, as opposed to determining the radiological status of a facility, and are typically conducted as part of a licensee's ongoing radiation protection program. However, at the stage of determining the final status of the site, residual radioactivity is expected to be below the guideline values for unrestricted release; therefore, the final status survey should not require radiation protection controls.

The primary health and safety concerns during a final survey are the common potential industrial hazards typically found at a construction site. These include exposed electrical circuitry, excavations, enclosed work spaces, sharp objects or

surfaces, falling objects, tripping hazards, and working at heights. The survey plan should incorporate requirements and procedures for eliminating, avoiding, or minimizing these potential safety hazards.

4.1.3 Physical Characteristics of Site

The physical characteristics of the site will have a significant impact on the complexity, schedule, and cost of a survey. These characteristics include the number and size of buildings, type of building construction, building condition, total area of grounds, topography, and ground cover.

Building Interiors

Building design and condition will have a marked influence on the survey efforts. The time required to conduct a survey of building interior surface is essentially directly proportional to the total surface area. For this reason the degree of survey coverage is decreased as the potential for residual activity decreases.

Building construction features such as ceiling height and incorporation of ducts, piping, and certain other services into the construction will determine the ease of accessibility of various surfaces. Scaffolding, cranes, manlifts, or ladders may be necessary to reach some surfaces. Accessing some locations may actually require dismantling portions of the building. If the building is constructed of porous materials, such as wood or concrete, and the surface was not sealed, contamination may have found its way into the walls, floors, and other surfaces. It may be necessary to obtain cores for laboratory analysis. Another common difficulty is the presence of contamination beneath tile or other floor coverings. This occurs because the covering placed over contaminated surfaces or the joints in tile were not sealed to prevent penetration. It has been the practice in some facilities to "fix" contamination (particularly alpha emitters) by painting over the surface of the contaminated area. All this should be addressed in surveys.

The condition of surfaces after decontamination may affect the survey process. Removing contamination that has penetrated a surface usually involves removing the surface as well. As a result, the floors and walls of decontaminated facilities are frequently badly scarred or broken up and are often very uneven. Such surfaces are more difficult to survey, because it is not possible to maintain a fixed distance between the detector and the surface and pitted or porous surfaces may significantly attenuate radiations — particularly alpha and low-energy beta particles. Use of monitoring equipment on wheels is precluded by rough surfaces, and such surfaces also pose an increased risk of damage to fragile detector probe faces.

The presence of furnishings and equipment will restrict access to building surfaces and add additional items which the survey should address. Equipment that was used directly for processes or activities involving radioactive materials will likely have been removed; however, in cases where such equipment remains, relatively

inaccessible surfaces may require evaluation. It may also become necessary to remove or relocate certain furnishings such as lab benches and hoods, to obtain access to potentially contaminated floors and walls.

Piping, drains, sewers, sumps, tanks and other components of liquid handling systems present special difficulties because of the inaccessibility of interior surfaces. Process information, operating history, and preliminary monitoring at available access points will assist in evaluating the extent of sampling and measurements that will be required. Evaluation of inaccessible surfaces is addressed in Sections 6.4.3 - 6.4.5

Expansion joints, stress cracks, and penetrations into floors and walls for piping, conduit, anchor bolts, etc. are potential sites for accumulation of contamination and pathways for migration into subfloor soil and hollow wall spaces. Wall/floor interfaces are also likely locations for residual contamination. Coring, drilling, or other such methods may be necessary to gain access for survey.

Building Exteriors

Exterior building surfaces will typically have a low potential for residual contamination; however, there are several locations which should be surveyed. If there were roof exhausts or the facility is in proximity to the air effluent discharge points, the possibility of roof contamination should be considered. Because roofs are periodically resurfaced, contaminants may have been trapped in roofing material, and samples of this material may have to be obtained. Wall penetrations for process equipment, piping, and exhaust ventilation are potential locations for exterior contamination. Roof drainage points such as driplines along overhangs, downspouts, and gutters are also important survey locations. Window ledges and outside exits (doors, doorways, landings, stairways, etc.) from former contamination control areas are also building exterior surfaces which should be addressed.

Grounds

Depending upon site processes and operating history, the radiological survey may include varying portions of the land areas. At a minimum, those areas immediately adjacent to facilities where radioactive materials were handled should be surveyed. Other potentially contaminated open land or paved areas to be considered include equipment, product, waste, and raw material storage areas; liquid waste collection lagoons; areas downwind (based on predominant wind directions on an average annual basis, if possible) of stack release points; surface drainage pathways; and roadways that may have been used for transport of radioactive or contaminated materials.

Buried piping and underground tanks, spills, and septic leach fields which may have received contaminated liquids are locations of possible contamination that

will require sampling of subsurface soil. Information regarding soil type (e.g. clay, sand, etc.) may provide insight into the retention or migration characteristics of specific radionuclides. The need for special sampling by coring or split-spoon equipment, usually by a commercial firm, should be anticipated.

Disposition of on-site, low-level waste burials, authorized under AEC/NRC regulations, will require a decision by the NRC following review of the licensee's decommissioning plan. If radioactive waste has been removed, surveys of excavations will be necessary before backfilling. If such material is to be left in place, the NRC may request subsurface sampling around the burial site perimeter to assess the potential for future migration.

If ground cover should be removed or if there are other obstacles that limit access by either survey personnel or by any needed special equipment (electromagnetic scanners and subsurface sampling rigs) the time and expense of making land areas accessible should be considered. In addition, precautionary procedures should be developed to prevent spreading surface contamination during ground cover removal and/or the use of heavy equipment.

4.2 Designing the Survey

4.2.1 Classification of Areas by Contamination Potential

All areas of the site will not have the same potential for residual contamination and therefore do not require the same level of survey coverage to achieve an acceptable level of confidence that the site satisfies the established release criteria. By designing the survey such that areas with higher potential for contamination receive a higher degree of survey effort, the process will be both effective and efficient.

Two classifications of areas are used in this Manual; these are termed **affected** and **unaffected** areas. These classifications are defined as follows:

- **affected areas:** Areas that have potential radioactive contamination (based on plant operating history) or known radioactive contamination (based on past or preliminary radiological surveillance). This would normally include areas where radioactive materials were used and stored, where records indicate spills or other unusual occurrences that could have resulted in spread of contamination, and where radioactive materials were buried. Areas immediately surrounding or adjacent to locations where radioactive materials were used or stored, spilled, or buried are included in this classification because of the potential for inadvertent spread of contamination.

- **unaffected areas:** All areas not classified as affected. These areas are not expected to contain residual radioactivity, based on a knowledge of site history and previous survey information.

Segregation of the site into these two classifications should be justified by the licensee in the decommissioning plan (in those cases where a decommissioning plan is required to be submitted) and in the final survey report. It should be emphasized that review and concurrence by the NRC of the classification of areas is to the advantage of the licensee at the early stages of planning the survey. It should also be recognized that as the final survey progresses, the area classification may require changing, based on additional data.

4.2.2 Establishing Reference Grid Systems

Grid systems are established at the site to:

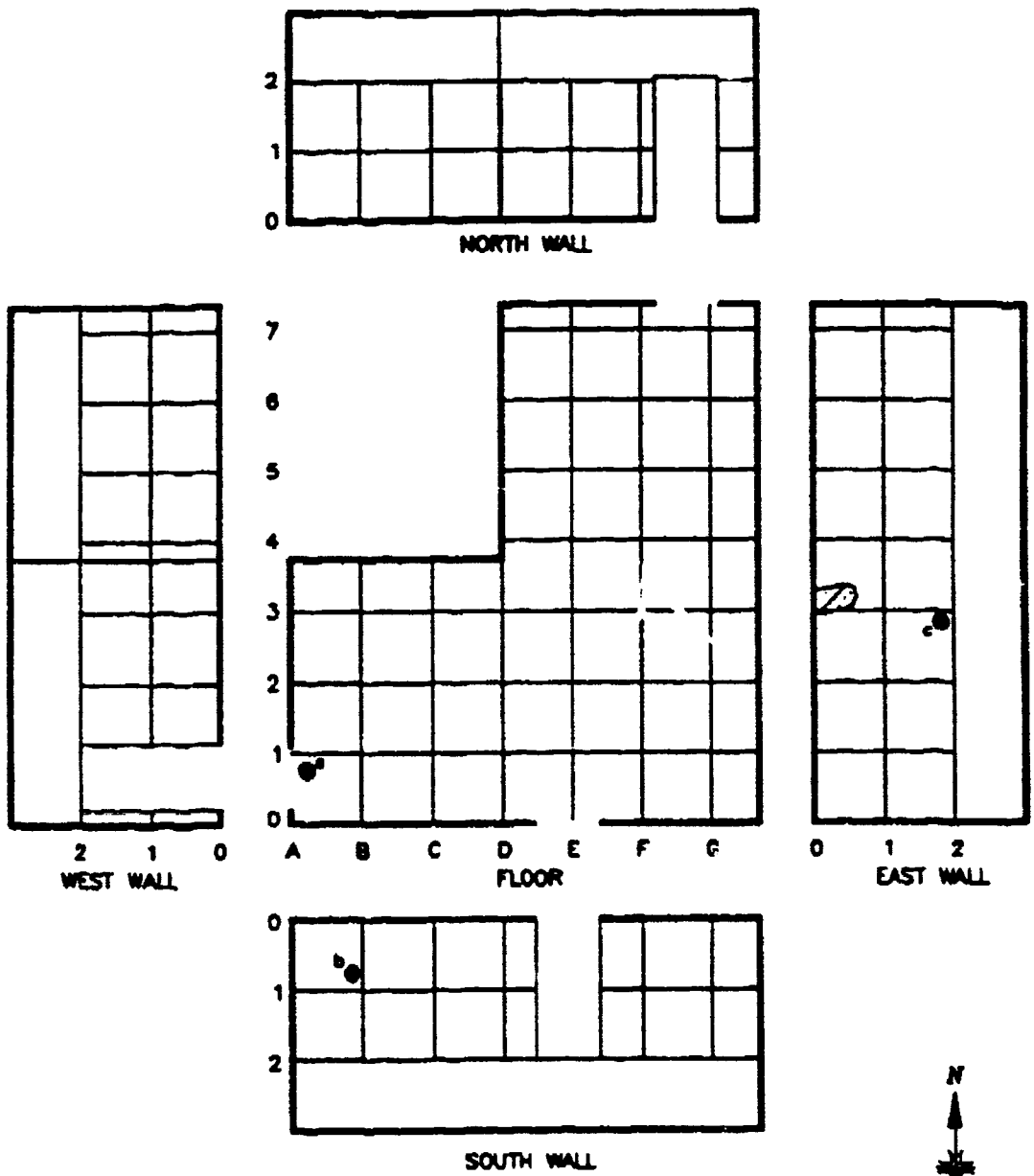
- Facilitate systematic selection of measuring/sampling

- Provide a mechanism for referencing a measurement/sample back to a specific location so that the same survey point can be relocated, and

- Provide a convenient means for determining average activity levels.

A grid consists of a system of intersecting lines, referenced to a fixed site location or bench mark. Typically, the grid lines are arranged in a perpendicular pattern, dividing the survey location into squares or blocks of equal area; however, other types of patterns (triangular, rectangular, hexagonal) have been used for survey reference purposes.

Grid patterns on horizontal surfaces are usually identified numerically on one axis and alphabetically on the other axis or in distances in different compass directions from the grid origin. Examples of building interior and land area grids are shown in Figures 4-1 and 4-2, respectively. Grids on vertical surfaces include a third designator, indicating position relative to floor or ground level. Figure 4-1 provides examples of designating grid locations in three dimensions.



EXAMPLE OF
GRID POINT DESIGNATION

POINT	GRID DESIGNATION
a	A+0.2, 0.8
b	A+0.8, 0, 0.8
c	G+0.6, 2.9, 1.9

FIGURE 4-1: Example of a Grid System Used for Building Interior Survey

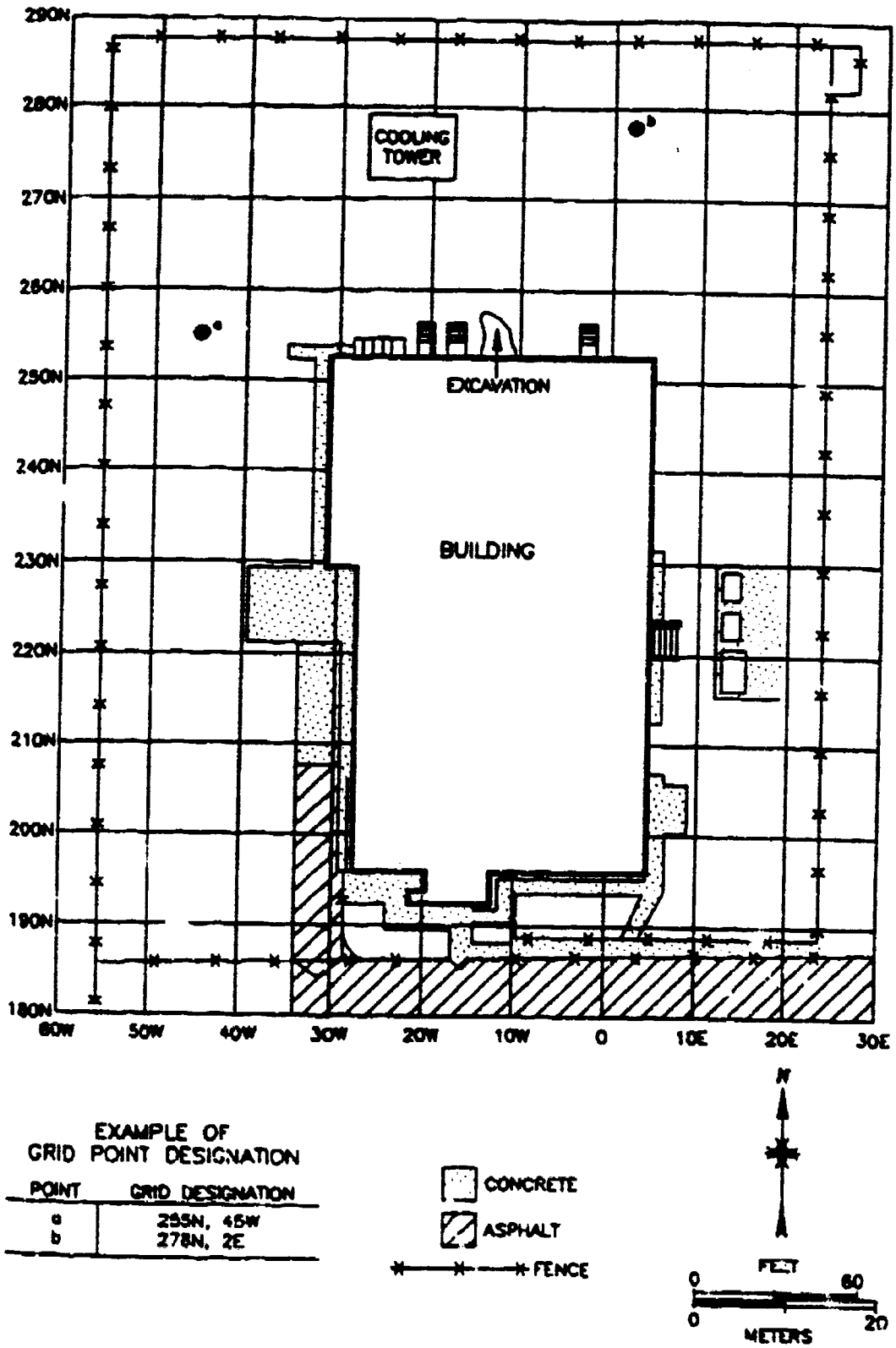


FIGURE 4-2: Example of Grid System for Survey of Site Grounds

For surveys of structures the basic grid system for affected areas is 1 m. Gridding may be limited to the floor and lower (up to 2 m height) walls, unless there is also a potential for upper wall and ceiling area contamination. Survey locations are referenced to the grid system; surveys of ungridded surfaces are referenced to the floor grid (if one exists) or to prominent building features.

Grounds and open land areas classified as affected areas are gridded at 10 meter intervals.

Unaffected areas do not require gridding for the purposes of establishing measurement or sampling locations; however, grids systems of larger spacing, e.g. 5 to 10 m for large structural surfaces and 20 to 50 m for land areas, may be helpful to the licensee by facilitating the referencing of survey locations in those areas to a common site reference system.

The grids described above are intended primarily for reference purposes and do not necessarily dictate the spacing of survey measurements or sampling. Closer spaced survey locations may be required to demonstrate that average and *elevated area* guideline values are met to the required level of confidence. Larger spacing may be acceptable, based on the capabilities of survey techniques. Considerations for determining measurement/sampling spacing are provided in Sections 4.2.3 and 8.5.

To facilitate survey design and assure that the number of survey data points from an area is sufficient to enable statistical evaluation, the area may be divided into survey "units" which have common history or other characteristics or are naturally distinguishable from other portions of the site. Such survey units may combine contiguous rooms or land areas having the same potential contamination classification. The size of a survey unit should be chosen to assure that the total number of data points and/or the spacing (frequency) of measurement/sampling satisfy the requirements of Section 4.2.3. The maximum survey unit size for building surface areas classified as affected, limited to 100 m^2. A survey unit cannot include both affected and unaffected areas.

4.2.3 Selecting Measurement/Sampling Locations

It is not possible to perform measurements or conduct sampling at the theoretically infinite number of locations on a site. Instead, a survey should have as its objective the collection of quality radiological data from sufficient representative site locations, such that a statistically sound conclusion regarding the radiological status of the entire site can be developed. Meeting this objective requires a statistically based plan for selecting measurement and sampling locations.

Experience has indicated that residual contamination on a former radioactive material site is typically concentrated in a relatively small portion of the site. The pattern is asymmetrical, with much of the activity often located in small isolated hot-spots. If the licensee's cleanup efforts have been effective, however, essentially all locations will have residual activity below the guideline levels, and many areas will contain levels in the range of natural background and/or below the measurement sensitivities of the survey and analytical procedures. After cleanup, the pattern of residual activity will therefore likely approximate a normal distribution; the approach to survey design described below assumes such a distribution. If, based on site operating history or the results of preliminary surveys, there is reason to believe there may be unusual localized contamination patterns, the licensee should supplement the survey with samples from randomly selected points in the area of suspect localized contamination.

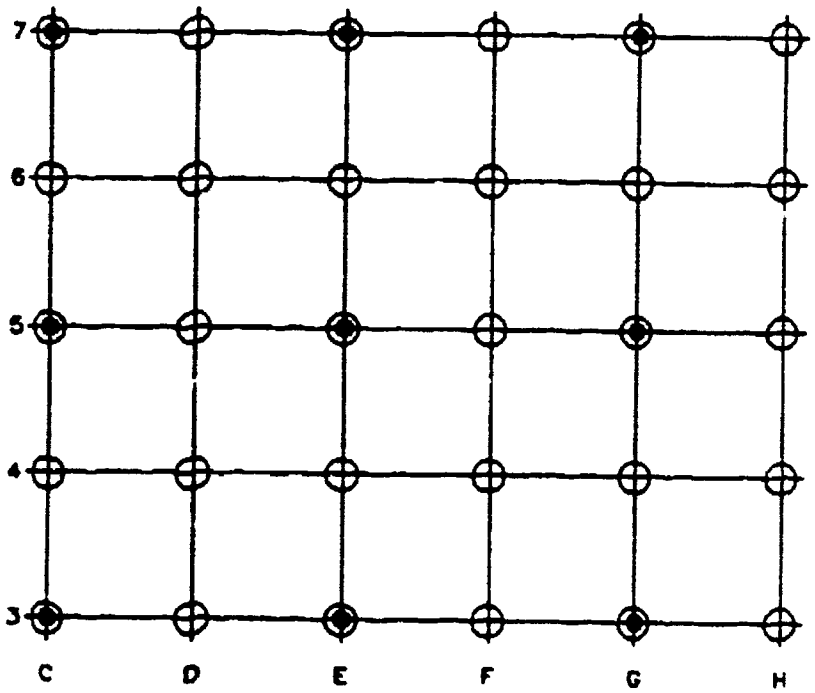
Structure Surveys

Affected Areas

At a minimum, the floors and lower walls of affected areas should receive 100% coverage during the final status survey. The coverage provided for upper walls and ceilings will be dependent upon the contamination potential for these surfaces. The survey measurements for surface activity will consist of a combination of surface scans, direct measurements, and measurements of removable activity. Procedures for performing these measurements are described in Section 6.4

Scans of 100% of affected area floor and lower wall surfaces are performed for all radiations which may be emitted from the radionuclides of interest. Locations of areas of elevated activity are identified and direct measurements are performed to define their extent and activity levels. Residual activity which exceeds 3 times the guideline value results in external radiation in excess of 2 times the guideline value above background at 1 m from the surface, or results in an average activity above the guideline value in any contiguous 1 m^2 area (refer to Section 8.5.2 for averaging procedures) should be remediated until these conditions are satisfied.

Once all identified elevated areas are evaluated and cleaned up as necessary, systematic measurements of surface activity are performed. If the scanning technique has been demonstrated to have a detection sensitivity for the radionuclide or radiations of interest at $\leq$ 25% of the guideline level, systematic measurements are performed at a spacing of 2 m or less to provide at least 30 data point locations. A recommended approach is to obtain data from grid line intersections (see Figure 4-3) or grid block centers. If the detection sensitivity of the scanning technique is not $\leq$ 25% of the guideline value, systematic measurements are performed at 1 m intervals.



● MEASUREMENT LOCATIONS IF SCANNING TECHNIQUE IS CAPABLE TO DETECTING ≤ 25% OF GUIDELINE LEVEL

○ MEASUREMENT LOCATIONS IF SCANNING TECHNIQUE IS NOT CAPABLE TO DETECTING ≤ 25% OF GUIDELINE LEVEL

FIGURE 4-3: Standard Measurement/Sampling Pattern For Systematic Grid Survey of Structure Surfaces

The number of data points required to demonstrate that the confidence level of the survey satisfies the 95% objective for a survey unit, is a function of the average and variance of the data. Following the procedures in Sections 8.5 and 8.6, the need for any additional measurements is determined; if additional measurements are required, they should be obtained at approximately evenly-spaced intervals throughout the survey unit.

Upper walls, ceilings, and other overhead surfaces which are suspected of having residual activity at greater than 25% of the guideline value, based on operating history and previous surveys, are surveyed in the same manner as floors and lower walls. If there is no reason to suspect residual activity exceeding 25% of the guideline value on these surfaces, a minimum of 30 measurement locations each, on vertical and horizontal surfaces where radioactive material would likely accumulate, (air exhaust vents and horizontal surfaces where dust would settle) is selected. To assure a reasonable coverage of these surfaces, an average of at least 1 measurement location per 20 m^2 of surface area should be selected. At each location a scan of the immediate area is performed to identify the presence of any elevated activity levels, followed by the measurement. If scans or measurements indicate residual activity exceeding 25% of the guideline, the area is considered potentially contaminated and the surface exhibiting such levels should be surveyed in the same manner as floors and lower walls of affected areas.

If gamma emitting radionuclides are among the potential contaminants, exposure rate measurements at 1 m from floor and lower wall surfaces are performed at a frequency of 1 systematic measurement per every 4 m^2. If potential contaminants did not include gamma emitters, exposure rate measurements should be performed at a minimum spacing of 1 measurement per 10 m^2.

Unaffected Areas

Scans of unaffected surfaces should cover a minimum of 10% of the floor and lower wall surface area. At least 30 randomly selected measurement locations or an average measurement of 1 per 50 m^2 of building surface area, whichever is greater, for total and removable activity, should be performed for each survey unit. These locations should include all building surfaces. Identification of activity levels in excess of 25% of the guideline, either by scans or measurements, will require reclassification of the area to the "affected" category. Testing of the data relative to the confidence level objective is performed in the same manner as for affected areas and any additional measurement locations required should be selected randomly. Exposure rate measurements at 1 m from the floor are performed at each location of surface activity measurement.

Open Land Surveys

Affected Areas

As with structure surfaces, 100% coverage of affected open land areas (paved surfaces and soil) is necessary. Scanning is performed to identify locations of elevated activity levels. Areas of suspected elevated activity, identified in this manner, are evaluated by sampling and analyses to determine their activity level and area 1 extent, and results are compared with criteria (see Sections 2.2 and 8.5); cleanup is performed, as required, and scanning repeated. After scanning has indicated the guidelines and conditions have been satisfied, systematic soil sampling of each affected area grid block is performed at locations equidistant between the center and each of the four grid block corners (see Figure 4-4). If scanning is not capable of detecting surface areas with activity levels $\leq$ 75% of the guideline values for the radionuclides of interest, additional sampling will be required to provide an acceptable level of confidence that locations of elevated activity have been identified. An EPA procedure (EPA 1989) recommends a triangular grid with a sampling interval of 5 m on a side (enclosed area of approximately 10.8 m^2) for a 95% assurance that elevated areas in excess of 10 m^2 surface area are identified. By beginning with the standard systematic pattern and including additional sampling points, located along the 10 m grid lines, at block corners and centers, and midway between grid block corners (Figure 4-5), a triangular sampling pattern with spacing of 5 m or less (enclosed area of approximately 6.3 m^2) is obtained.

Paved surfaces are surveyed in the same manner as described above for structure surfaces.

For both soil sampling and paved surface measurements, a minimum of 30 data locations should be used. Data for each of these surface types are tested relative to the guideline value and the confidence level objective, and additional systematic sampling/measurement locations that may be required are obtained at approximately uniformly spaced intervals throughout the survey unit.

Exposure rates are measured at 1 m above the surface on the pattern shown in Figure 4-4.

Unaffected Areas

Unaffected open land area should be uniformly scanned for radiations from the radionuclides of interest. Spacing intervals between scanning paths should be such that a minimum of 10% of the surface is scanned. Soil sampling is performed at a minimum of 30 randomly selected locations. Surface activity measurements on paved areas are also performed at 30 randomly selected locations. Identification of hot-spots or individual locations with activity levels

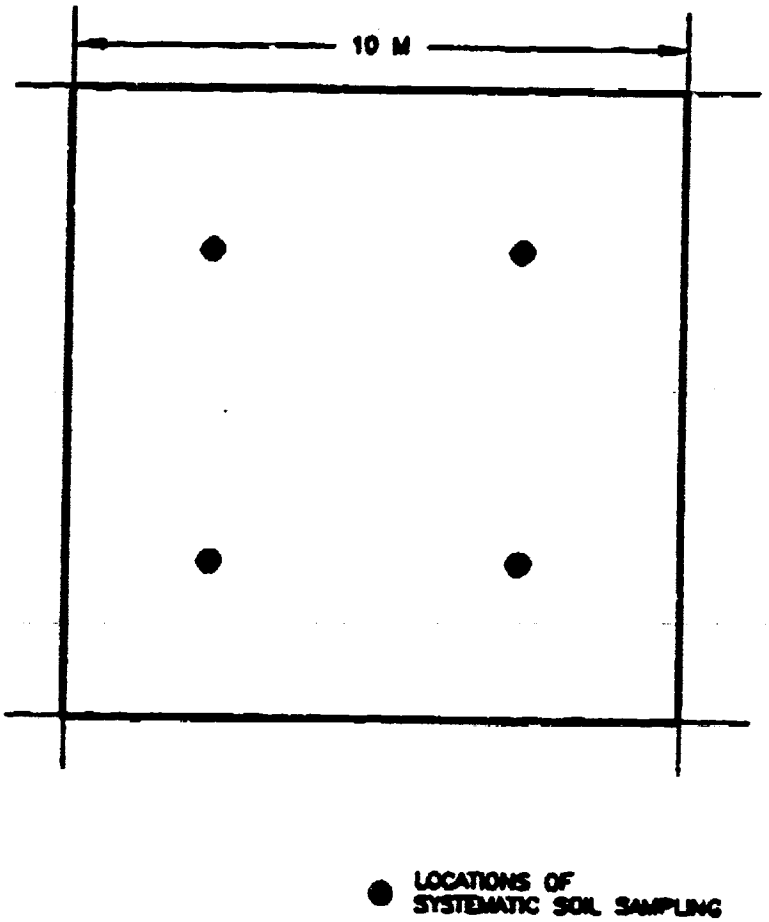


FIGURE 4-4: Standard Sampling Pattern for Systematic Grid Survey of Soil

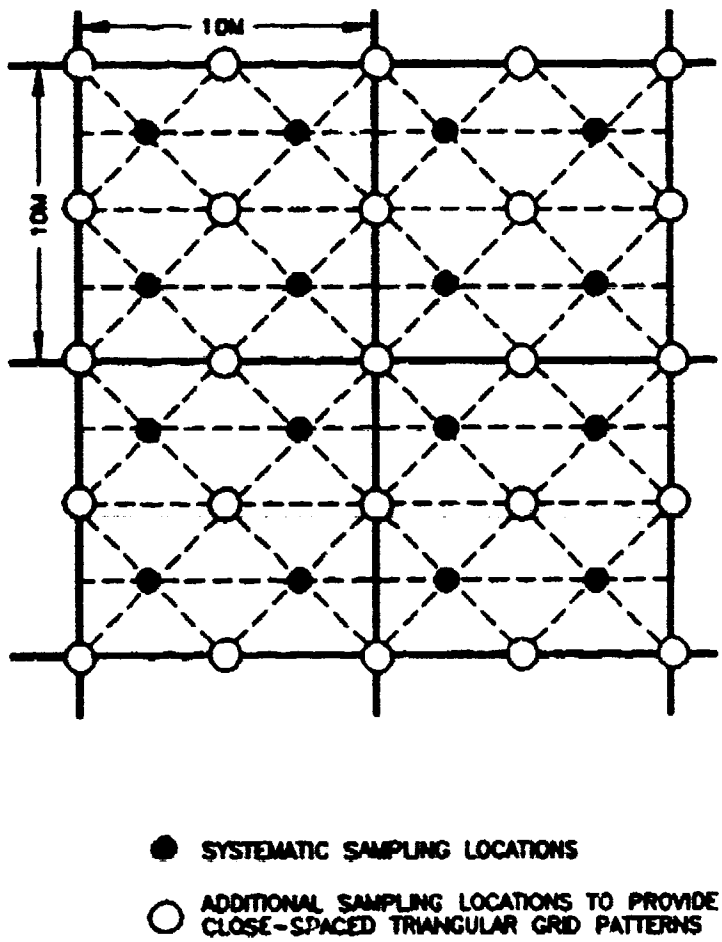


FIGURE 4-5: Sampling Pattern to Identify Soil Areas of Elevated Activity

in excess of 75% of the guideline value requires reclassification of the area as "affected".

Testing of results, relative to guidelines and confidence level objectives is performed according to Section 8.6 and any additional samples/measurements required are obtained at randomly selected locations in the survey unit.

Other Measurement/Sampling Locations

In addition to the building and land surface areas described above, there are numerous other locations where measurements and/or sampling should be performed. Examples include items of equipment and furnishings, building fixtures, drains, ducts, and piping. Many of these items or locations have both internal and external surfaces, requiring evaluation.

Each such location classified as affected should be scanned and individual measurements and/or samples obtained at representative points. Unaffected locations can, as with the building and land surfaces in such areas, be surveyed at lower frequencies, consistent with the contamination potential, the capability of scanning techniques to identify activity levels at or above guidelines, and findings as the survey progresses. Surveys of these types of locations are discussed in more detail in Section 6.0.

4.2.4 Subsurface Sampling

At the stage where the final status survey is being conducted, contaminated subsurface soil should already have been identified, characterized, and remediated, if necessary. Subsurface activity data may be required for determination of residual site inventory. In addition, if there is potential for residual activity below the surface layer, the survey plan should include subsurface sampling. The number and locations of samples should follow the same pattern as described above in section 4.2.3 sampling depth of surface soil. As an initial evaluation, samples may be collected at 1 m intervals, starting at the surface and continuing to at least 1 m below the suspected or potential region of activity. Shallow sampling may be conducted using manual equipment (post-hole diggers, small-diameter split barrel or Shelby tube samplers, and portable hand-operated or motorized augers). For depths below several meters, heavier equipment, such as a drill rig with an auger and/or a core sampler will be required. Use of electromagnetic sensing techniques, such as ground penetrating radar and magnetrometry will assist in locating potential sampling areas and also should be a safety consideration if buried utilities or containers of potentially hazardous material (radiological or chemical) may be present. Use of a subsurface sampling technique which results in a borehole or soil face, accessible with a gamma sensitive detector, also enables scanning of the exposed soil surface to identify the presence and distribution of subsurface activity.

If a potential exists for activity to enter subsurface water, samples of water should be collected (if available) from the same locations as the subsurface soil samples. Knowledge of expected constituents is necessary when collecting subsurface water to determine whether special precautions for sample handling and collection are required to ensure representative samples. Expertise of hydrology specialists and those knowledgeable in subsurface water sampling technique should be sought, when such conditions are anticipated.

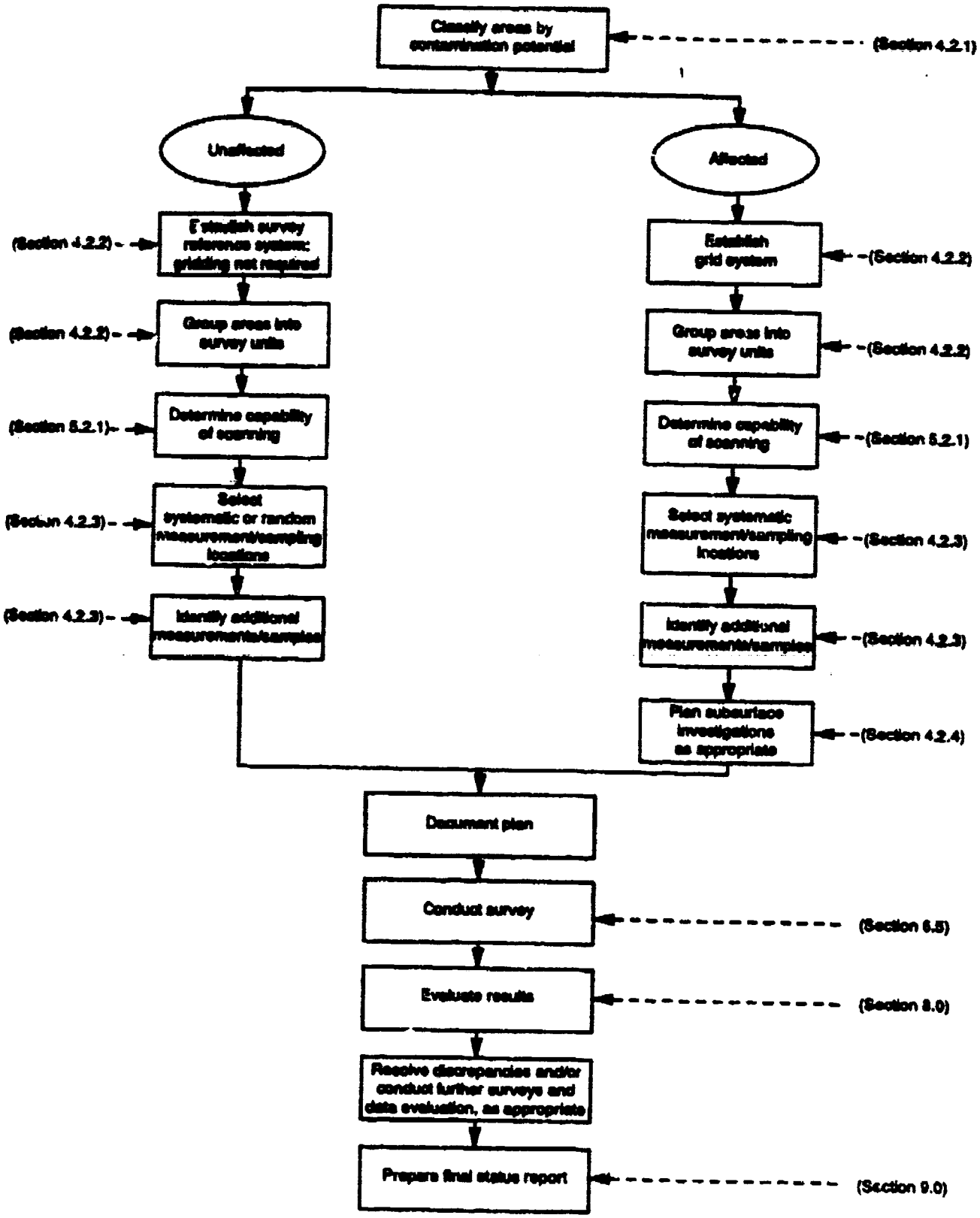


FIGURE 4.6: Flow Diagram for Planning Final Status Surveys

APPENDIX C

RADIOLOGICAL ASSESSMENT

RADIATION DETECTION

INSTRUMENT SURVEY

The following instrument surveys were taken in these designated laboratories located in Physics Building:

- Laboratory - Room 203 - Sample Preparation
- Laboratory - Room 204 - Chemistry Laboratory
- Laboratory - Room 205 - Storage Area
- Laboratory - Room 209 - Courting Room and Weighing Room
- Laboratory - Room 210 - Counting Room
- Office - Room 107A - Radiation Safety Office

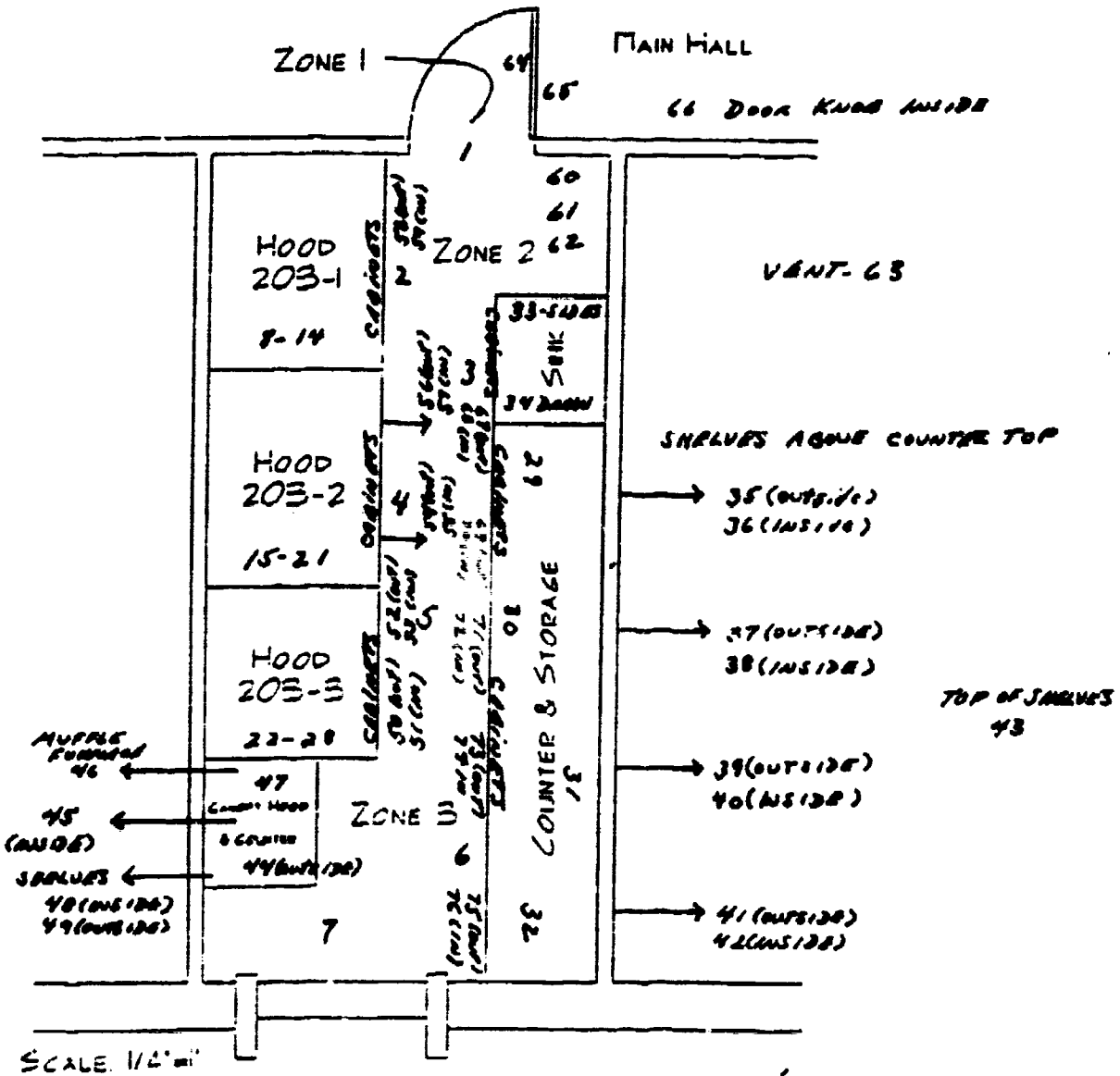
Laboratory 203--Sample Preparation
Physics Building
National Center
Reston, Virginia

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
1	floor	entrance to lab	0.020	0.020	15.0
2	floor	below hood #1	0.020	0.020	15.0
3	floor	below sink	0.020	0.020	15.0
4	floor	below hood #2	0.020	0.020	15.0
5	floor	center of lab	0.020	0.020	15.0
6	floor	south side below counter	0.020	0.020	15.0
7	floor	below window	0.020	0.020	15.0
8	hood #1	bottom	0.020	0.020	15.0
9	hood #1	right side	0.020	0.020	15.0
10	hood #1	left side	0.020	0.020	15.0
11	hood #1	back	0.020	0.020	15.0
12	hood #1	front of glass	0.020	0.020	15.0
13	hood #1	lip of hood	0.020	0.020	15.0
14	hood #1	front of vent	0.020	0.020	15.0
15	hood #2	bottom	0.020	0.020	15.0
16	hood #2	right side	0.020	0.020	15.0
17	hood #2	left side	0.020	0.020	15.0
18	hood #2	back	0.020	0.020	15.0
19	hood #2	front of glass	0.020	0.020	15.0
20	hood #2	lip of hood	0.020	0.020	15.0
21	hood #2	front of vent	0.020	0.020	15.0
22	hood #3	bottom	0.020	0.020	15.0
23	hood #3	right side	0.020	0.020	15.0
24	hood #3	left side	0.020	0.020	15.0
25	hood #3	back	0.020	0.020	15.0

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
26	hood #3	front of glass	0.020	0.020	15.0
27	hood #3	lip of hood	0.020	0.020	15.0
28	hood #3	front of vent	0.020	0.020	15.0
29	counter top	south side	0.020	0.020	15.0
30	counter top	south side (middle)	0.020	0.020	15.0
31	counter top	south side	0.020	0.020	15.0
32	counter top	south side (near window)	0.020	0.020	15.0
33	sink	inside	0.020	0.020	15.0
34	sink	drain	0.020	0.020	15.0
35	shelves (outside)	above counter top	0.020	0.020	15.0
36	shelves (inside)	above counter top	0.020	0.020	15.0
37	shelves (outside)	above counter top (middle)	0.020	0.020	15.0
38	shelves (inside)	above counter top (middle)	0.020	0.020	15.0
39	shelves (outside)	above counter top	0.020	0.020	15.0
40	shelves (inside)	above counter top	0.020	0.020	15.0
41	shelves (outside)	above counter top (near window)	0.020	0.020	15.0
42	shelves (inside)	above counter top (near window)	0.020	0.020	15.0
43	shelves	south side (top)	0.020	0.020	15.0
44	canopy hood	outside	0.020	0.020	15.0
45	canopy hood	inside	0.020	0.020	15.0
46	muffle furnace	outside	0.020	0.020	15.0
47	counter top	top of counter	0.020	0.020	15.0
48	shelves	north side (inside)	0.020	0.020	15.0
49	shelves	north side (outside)	0.020	0.020	15.0
50	storage cabinets	below hood #3 (outside)	0.020	0.020	15.0

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
51	storage cabinets	below hood #3 (inside)	0.020	0.020	15.0
52	storage cabinets	below hood #3 (outside)	0.020	0.020	15.0
53	storage cabinets	below hood #3 (inside)	0.020	0.020	15.0
54	storage cabinets	below hood #2 (outside)	0.020	0.020	15.0
55	storage cabinets	below hood #2 (inside)	0.020	0.020	15.0
56	storage cabinets	below hood #2 (outside)	0.020	0.020	15.0
57	storage cabinets	below hood #2 (inside)	0.020	0.020	15.0
58	storage cabinets	below hood #1 (outside)	0.020	0.020	15.0
59	storage cabinets	below hood #1 (inside)	0.020	0.020	15.0
60	entrance to lab	5-gallon poly bottle-counter	0.020	0.020	15.0
61	entrance to lab	5-gallon poly bottle on stool	0.020	0.020	15.0
62	entrance to lab	water purification system	0.020	0.020	15.0
63	ceiling	vent	0.020	0.020	15.0
64	door	inside	0.020	0.020	15.0
65	door	outside	0.020	0.020	15.0
66	door	knob (inside)	0.020	0.020	15.0
67	cabinets below sink	outside	0.020	0.020	15.0
68	cabinets below sink	inside	0.020	0.020	15.0
69	cabinets below counter	outside	0.020	0.020	15.0
70	cabinets below counter	inside	0.020	0.020	15.0
71	cabinets below counter	outside	0.020	0.020	15.0
72	cabinets below counter	inside	0.020	0.020	15.0
73	cabinets below counter	outside	0.020	0.020	15.0
74	cabinets below counter	inside	0.020	0.020	15.0
75	cabinets below counter	outside	0.020	0.020	15.0
76	cabinets below counter	inside	0.020	0.020	15.0

ROOM 203
USGS PHYSICS BUILDING



Laboratory 204--Chemistry Laboratory
Physics Building
National Center
Reston, Virginia

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
1	floor	entrance to lab	0.020	0.020	15.0
2	floor	inside entrance	0.020	0.020	15.0
3	floor	beside hood #3	0.020	0.020	15.0
4	floor	beside middle counter	0.020	0.020	15.0
5	floor	below hood #2	0.020	0.020	15.0
6	floor	below hood #3	0.020	0.020	15.0
7	floor	below counter top--north side	0.020	0.020	15.0
8	floor	between counter top	0.020	0.020	15.0
9	floor	below window	0.020	0.020	15.0
10	floor	below counter tops	0.020	0.020	15.0
11	floor	below aisle counter top--middle	0.020	0.020	15.0
12	floor	below sink	0.020	0.020	15.0
13	floor	below counter top--south	0.020	0.020	15.0
14	counter top	south side counter top	0.020	0.020	15.0
15	counter top	south side counter top	0.020	0.020	15.0
16	counter top	south side corner counter top	0.020	0.020	15.0
17	counter top	west side middle of counter top	0.020	0.020	15.0
18	counter top	west side--end of counter top	0.020	0.020	15.0
19	counter top	north side--counter	0.020	0.020	15.0
20	counter top	north side--middle of counter	0.020	0.020	15.0
21	counter top	north side of counter	0.020	0.020	15.0
22	counter top	between sinks	0.020	0.020	15.0
23	counter top	middle counter adjacent to sink	0.020	0.020	15.0
24	counter top	top	0.020	0.020	15.0
25	counter top	top	0.020	0.020	15.0

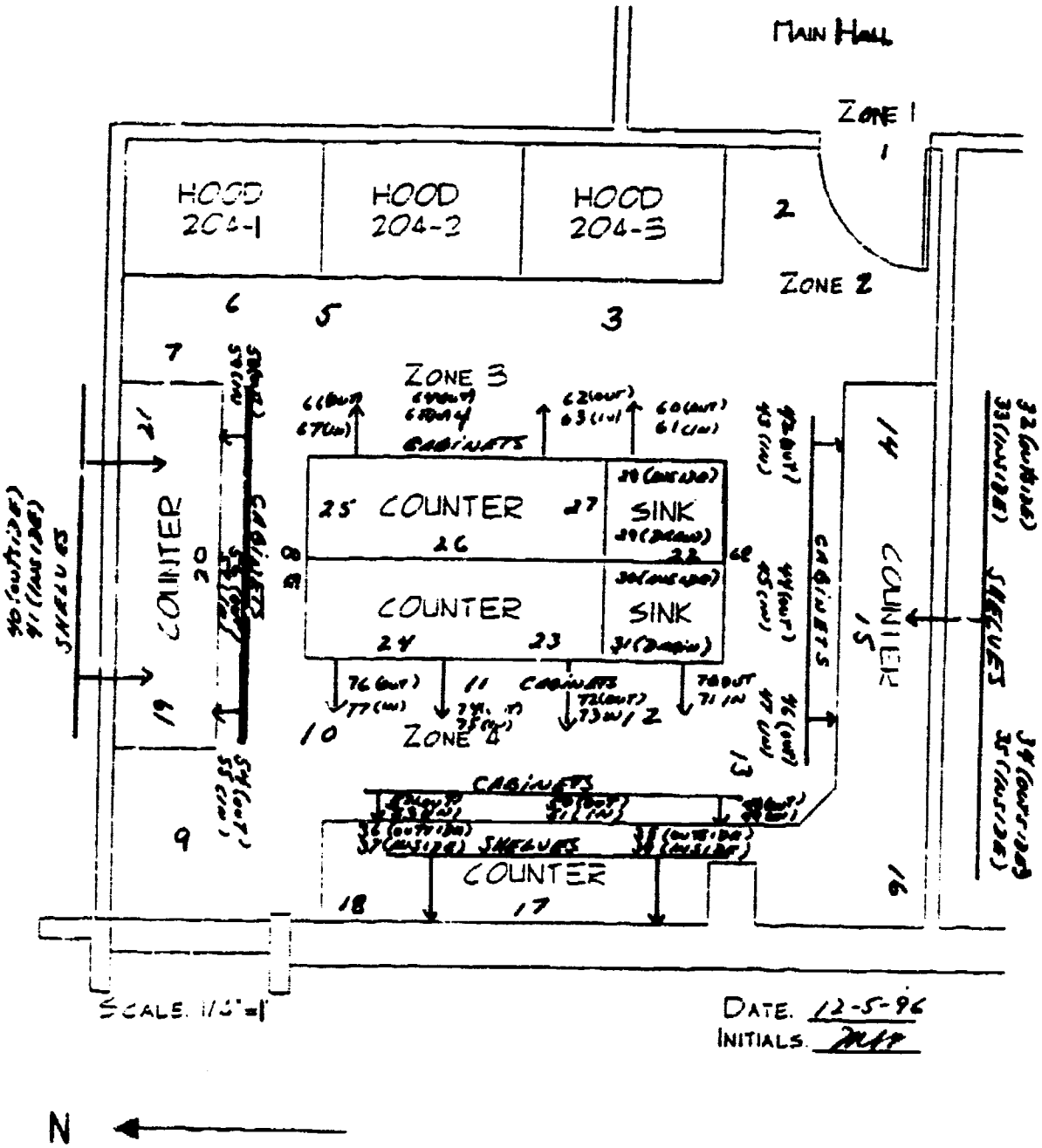
Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
26	counter top	middle of counter	0.020	0.020	15.0
27	counter top	middle counter adjacent to sink	0.020	0.020	15.0
28	sink	inside	0.020	0.020	15.0
29	sink	drain	0.020	0.020	15.0
30	sink	inside	0.020	0.020	15.0
31	sink	drain	0.020	0.020	15.0
32	shelves	south side of lab (outside)	0.020	0.020	15.0
33	shelves	south side of lab (inside)	0.020	0.020	15.0
34	shelves	south side of lab (outside)	0.020	0.020	15.0
35	shelves	south side of lab (inside)	0.020	0.020	15.0
36	shelves	west side of lab (outside)	0.020	0.020	15.0
37	shelves	west side of lab (inside)	0.020	0.020	15.0
38	shelves	west side of lab (outside)	0.020	0.020	15.0
39	shelves	west side of lab (inside)	0.020	0.020	15.0
40	shelves	north side of lab (outside)	0.020	0.020	15.0
41	shelves	north side of lab (inside)	0.020	0.020	15.0
42	cabinets	south side of lab (outside)	0.020	0.020	15.0
43	cabinets	south side of lab (inside)	0.020	0.020	15.0
44	cabinets	south side of lab (outside)	0.020	0.020	15.0
45	cabinets	south side of lab (inside)	0.020	0.020	15.0
46	cabinets	south side of lab (outside)	0.020	0.020	15.0
47	cabinets	south side of lab (inside)	0.020	0.020	15.0
48	cabinets	west side of lab (outside)	0.020	0.020	15.0
49	cabinets	west side of lab (inside)	0.020	0.020	15.0
50	cabinets	west side of lab (outside)	0.020	0.020	15.0

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
51	cabinets	west side of lab (inside)	0.020	0.020	15.0
52	cabinets	west side of lab (outside)	0.020	0.020	15.0
53	cabinets	west side of lab (inside)	0.020	0.020	15.0
54	cabinets	north side of lab (outside)	0.020	0.020	15.0
55	cabinets	north side of lab (inside)	0.020	0.020	15.0
56	cabinets	north side of lab (outside)	0.020	0.020	15.0
57	cabinets	north side of lab (inside)	0.020	0.020	15.0
58	cabinets	north side of lab (outside)	0.020	0.020	15.0
59	cabinets	north side of lab (inside)	0.020	0.020	15.0
60	cabinets center counter top	below sink outside	0.020	0.020	15.0
61	cabinets center counter top	below sink inside	0.020	0.020	15.0
62	cabinets center counter top	adjacent to sink outside	0.020	0.020	15.0
63	cabinets center counter top	adjacent to sink inside	0.020	0.020	15.0
64	cabinets center counter top	middle of counter (outside)	0.020	0.020	15.0
65	cabinets center counter top	middle of counter (inside)			
66	cabinets center counter top	end portion of counter--outside	0.020	0.020	15.0 15.0
67	cabinets center counter top	end portion of counter inside	0.020	0.020	15.0 15.0
68	middle counter	south side--2 feet up	0.020	0.020	15.0
69	middle counter	north side--3 feet up	0.020	0.020	15.0
70	cabinets center counter top	below sink outside	0.020	0.020	15.0
71	cabinets center counter top	below sink inside	0.020	0.020	15.0
72	cabinets center counter top	adjacent to sink outside	0.020	0.020	15.0
73	cabinets center counter top	adjacent to sink inside	0.020	0.020	15.0
74	cabinets center counter top	middle of counter outside	0.020	0.020	15.0
75	cabinets center counter top	middle of counter inside	0.020	0.020	15.0

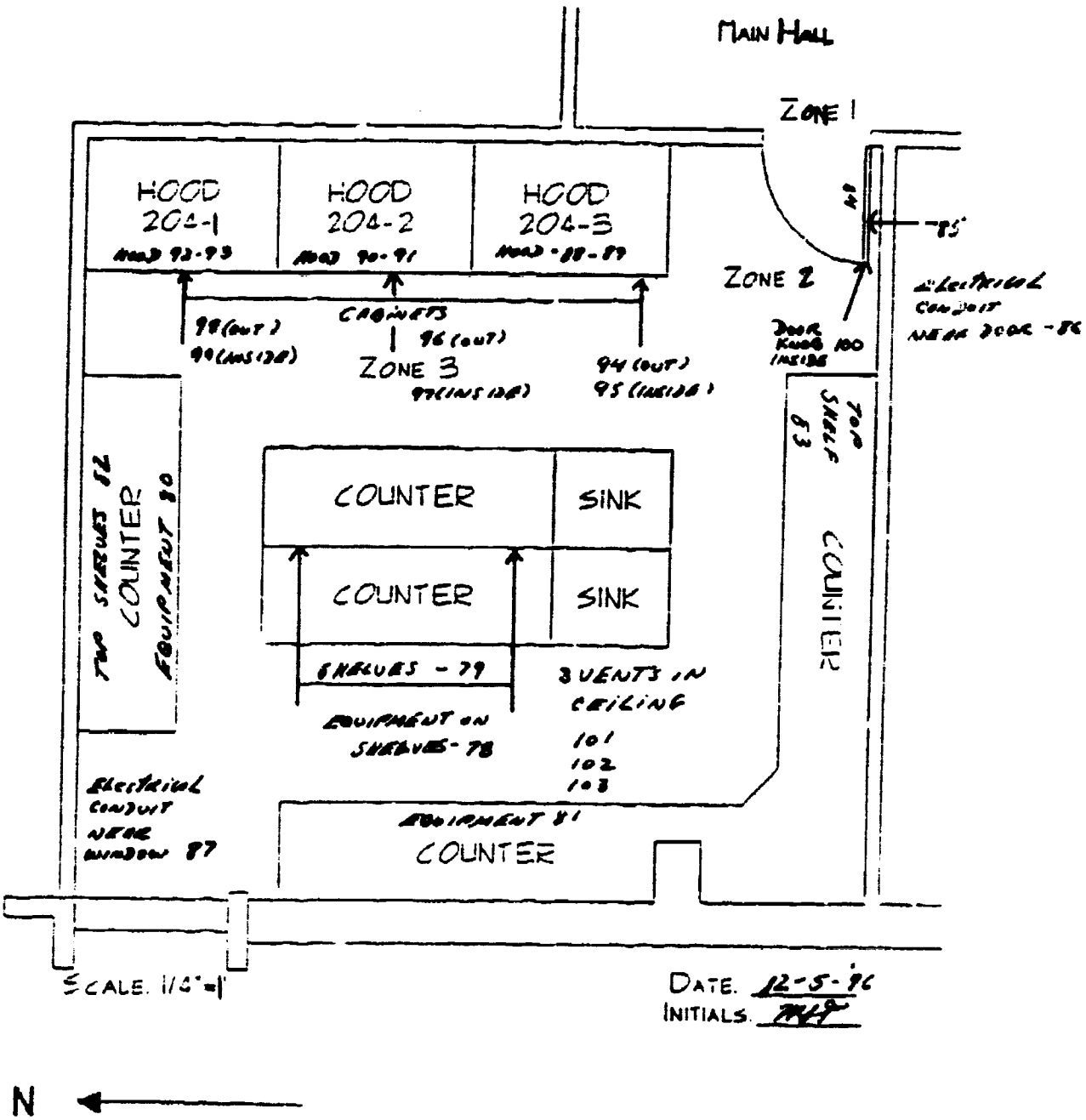
Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
76	cabinets center counter top	end portion of counter outside	0.020	0.020	15.0
77	cabinets center counter top	end portion of counter inside	0.020	0.020	15.0
78	center shelves above counter top	equipment on shelves	0.020	0.020	15.0
79	center shelves above counter top	shelf top	0.020	0.020	15.0
80	north side of lab counter top	equipment on shelves	0.020	0.020	15.0
81	west side of lab counter top	equipment on shelves	0.020	0.020	15.0
82	north side of lab above counter top	shelf top	0.020	0.020	15.0
83	south side of lab above counter top	shelf top	0.020	0.020	15.0
84	door to lab	outside panel	0.020	0.020	15.0
85	door to lab	inside panel	0.020	0.020	15.0
86	elecurical conduit near door	top	0.020	0.020	15.0
87	electrical conduit near window	top	0.020	0.020	15.0

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading μR/hr at 1 meter
88	hood #3	inside	0.020	0.020	15.0
89	hood #3	outside glass/vent	0.020	0.020	15.0
90	hood #2	inside	0.020	0.020	15.0
91	hood #2	outside glass/vent	0.020	0.020	15.0
92	hood #1	inside	0.020	0.020	15.0
93	hood #1	outside glass/vent	0.020	0.020	15.0
94	cabinets	below hood #3 (out)	0.020	0.020	15.0
95	cabinets	below hood #3 (in)	0.020	0.020	15.0
96	cabinets	below hood #2 (out)	0.020	0.020	15.0
97	cabinets	below hood #2 (in)	0.020	0.020	15.0
98	cabinets	below hood #1 (outside)	0.020	0.020	15.0
99	cabinets	below hood #1 (inside)	0.020	0.020	15.0
100	door	knob--inside	0.020	0.020	15.0
101	ceiling	vent	0.020	0.020	15.0
102	ceiling	vent	0.020	0.020	15.0
103	ceiling	vent	0.020	0.020	15.0

ROOM 204
USGS PHYSICS BUILDING



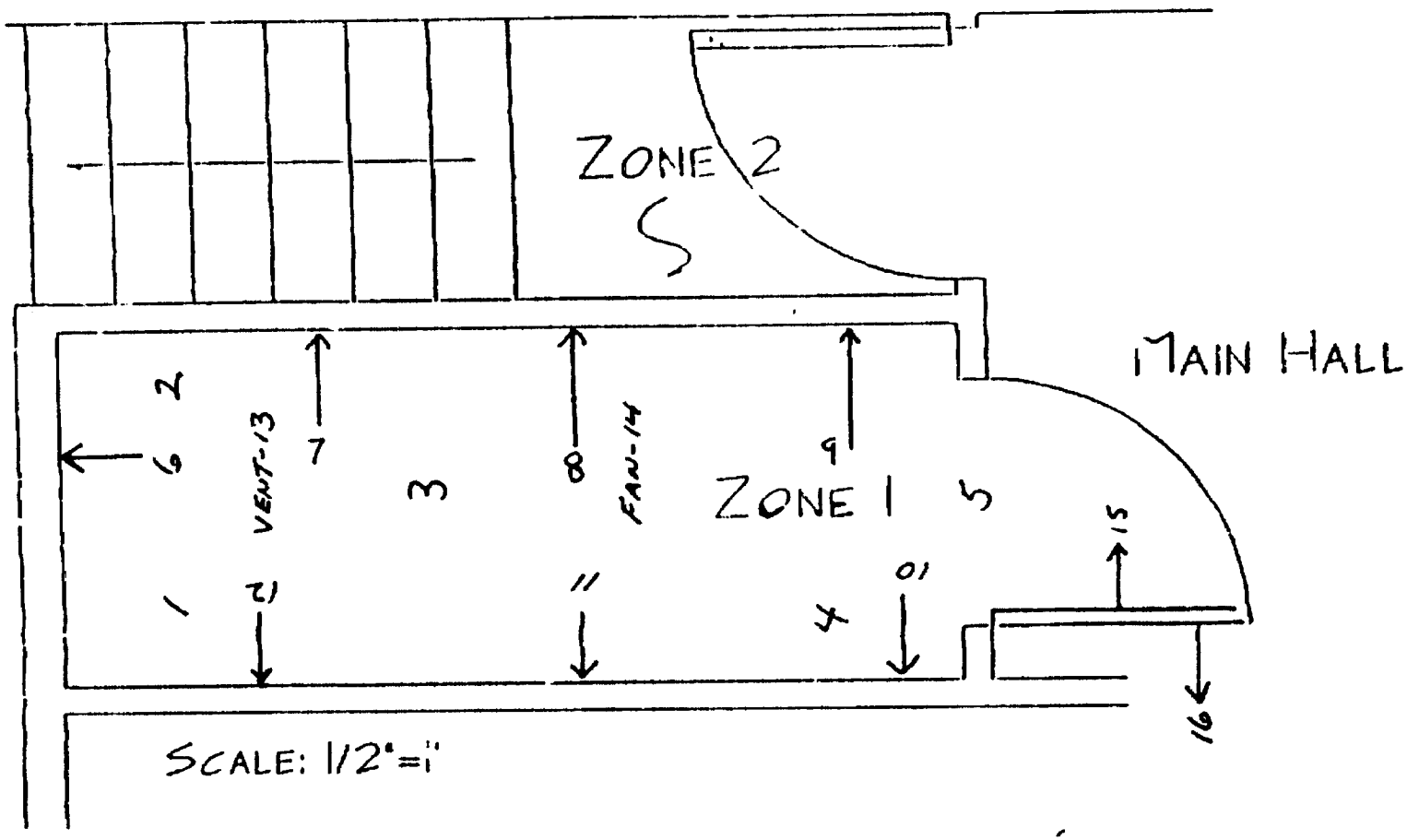
ROOM 204
USGS PHYSICS BUILDING



Laboratory 205--Storage Area
Physics Building
National Center
Reston, Virginia

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
1	floor	north corner	0.020	0.020	15.0
2	floor	east corner	0.020	0.020	15.0
3	floor	middle of room	0.020	0.020	15.0
4	floor	west side of room	0.020	0.020	15.0
5	floor	entrance to room	0.020	0.020	15.0
6	wall	north side--3 feet up	0.020	0.020	15.0
7	wall	east side--2 feet up	0.020	0.020	15.0
8	wall	east side center or room--3 feet up	0.020	0.020	15.0
9	wall	east side near door--2 feet up	0.020	0.020	15.0
10	wall	west side near door--3 feet up	0.020	0.020	15.0
11	wall	west side--center of room--2 feet up	0.020	0.020	15.0
12	wall	west side--far corner--3 feet up	0.020	0.020	15.0
13	ceiling	vent	0.020	0.020	15.0
14	ceiling	fan	0.020	0.020	15.0
15	door panel	inside	0.020	0.020	15.0
16	door panel	outside	0.020	0.020	15.0

ROOM 205
USGS PHYSICS BUILDING



SCALE: 1/2" = 1'

DATE: 12-5-96

INITIALS: MEP

N

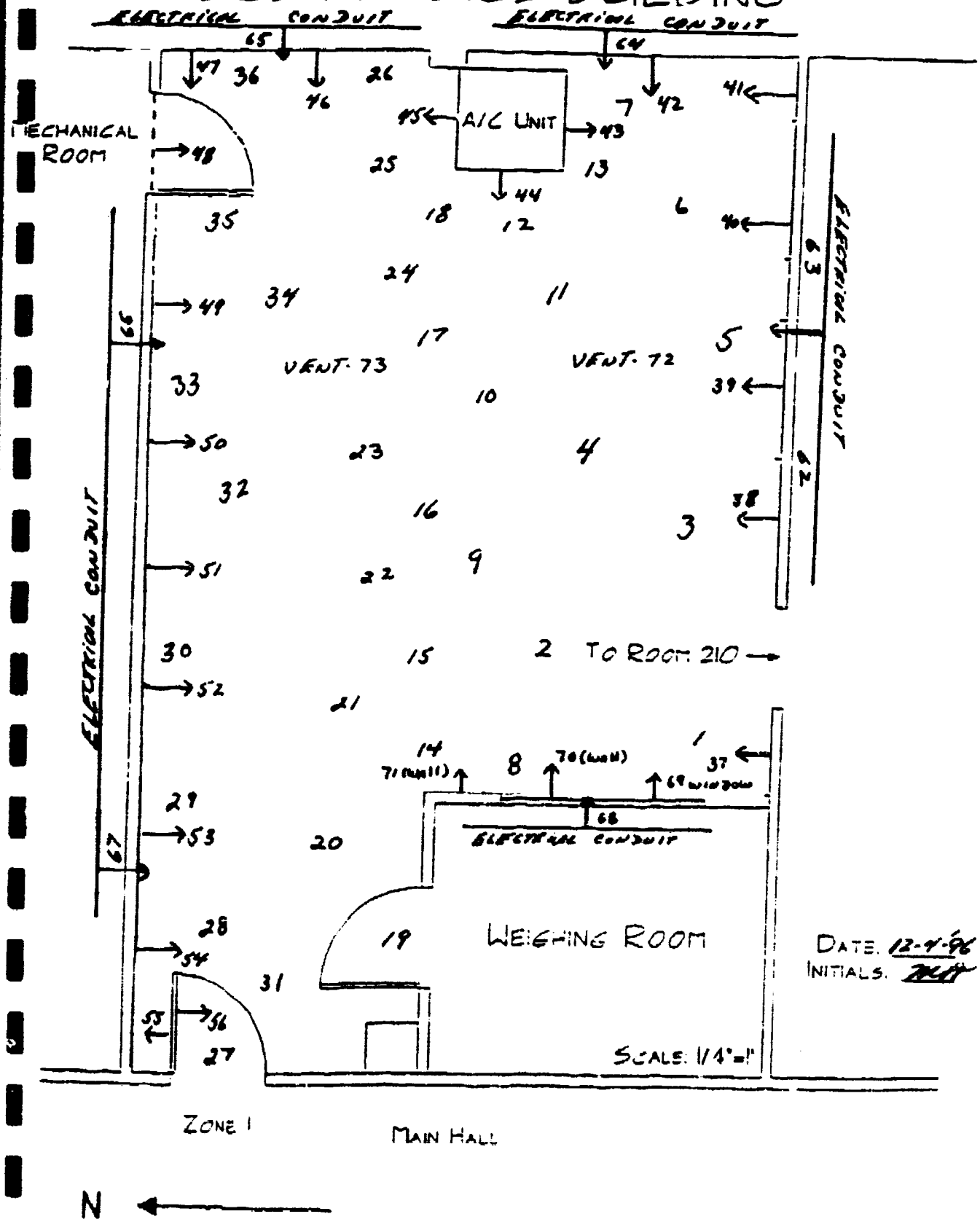
Laboratory 209--Counting Room
Physics Building
National Center
Reston, Virginia

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
1	floor	entrance near to room 210	0.020	0.020	15.0
2	floor	see diagram	0.020	0.020	15.0
3	floor	entrance near to room 210	0.020	0.020	15.0
4	floor	see diagram	0.020	0.020	15.0
5	floor	see diagram	0.020	0.020	15.0
6	floor	see diagram	0.020	0.020	15.0
7	floor	east side of room near AC	0.020	0.020	15.0
8	floor	below window weighing room	0.020	0.020	15.0
9	floor	see diagram	0.020	0.020	15.0
10	floor	see diagram	0.020	0.020	15.0
11	floor	see diagram	0.020	0.020	15.0
12	floor	front of AC	0.020	0.020	15.0
13	floor	near AC unit	0.020	0.020	15.0
14	floor	corner of weighing room	0.020	0.020	15.0
15	floor	see diagram	0.020	0.020	15.0
16	floor	see diagram	0.020	0.020	15.0
17	floor	see diagram	0.020	0.020	15.0
18	floor	front of AC	0.020	0.020	15.0
19	floor	entrance to weighing room	0.020	0.020	15.0
20	floor	see diagram	0.020	0.020	15.0
21	floor	see diagram	0.020	0.020	15.0
22	floor	see diagram	0.020	0.020	15.0
23	floor	see diagram	0.020	0.020	15.0
24	floor	see diagram	0.020	0.020	15.0
25	floor	see diagram	0.020	0.020	15.0

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
26	floor	see diagram	0.020	0.020	15.0
27	floor	entrance to room 209	0.020	0.020	15.0
28	floor	see diagram	0.020	0.020	15.0
29	floor	see diagram	0.020	0.020	15.0
30	floor	see diagram	0.020	0.020	15.0
31	floor	see diagram	0.020	0.020	15.0
32	floor	see diagram	0.020	0.020	15.0
33	floor	see diagram	0.020	0.020	15.0
34	floor	see diagram	0.020	0.020	15.0
35	floor	see diagram	0.020	0.020	15.0
36	floor	see diagram	0.020	0.020	15.0
37	wall	near entrance to room 210	0.020	0.020	15.0
38	wall	see diagram	0.020	0.020	15.0
39	wall	see diagram	0.020	0.020	15.0
40	wall	see diagram	0.020	0.020	15.0
41	wall	see diagram	0.020	0.020	15.0
42	wall	see diagram	0.020	0.020	15.0
43	wall	south side AC unit	0.020	0.020	15.0
44	wall	east front AC unit	0.020	0.020	15.0
45	wall	north side AC unit	0.020	0.020	15.0
46	wall	see diagram	0.020	0.020	15.0
47	wall	see diagram	0.020	0.020	15.0
48	wall	inside door panel	0.020	0.020	15.0
49	wall	see diagram	0.020	0.020	15.0
50	wall	see diagram	0.020	0.020	15.0

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
51	wall	see diagram	0.020	0.020	15.0
52	wall	see diagram	0.020	0.020	15.0
53	wall	see diagram	0.020	0.020	15.0
54	wall	near door wall--2 feet up	0.020	0.020	15.0
55	door	inside door panel	0.020	0.020	15.0
56	door	outside door entrance to Room 209	0.020	0.020	15.0
57	shelves	north side of lab--inside	0.020	0.020	15.0
58	shelves	north side of lab--inside	0.020	0.020	15.0
59	shelves	north side of lab--outside	0.020	0.020	15.0
60	shelves	north side of lab--inside	0.020	0.020	15.0
61	shelves	north side of lab--inside	0.020	0.020	15.0
62	electrical conduit	south side of lab--top	0.020	0.020	15.0
63	electrical conduit	south side of lab--top	0.020	0.020	15.0
64	electrical conduit	east side of lab--top	0.020	0.020	15.0
65	electrical conduit	east side of lab--top	0.020	0.020	15.0
66	electrical conduit	north side of lab--top	0.020	0.020	15.0
67	electrical conduit	north side of lab--top	0.020	0.020	15.0
68	electrical conduit	front of weighing room--top	0.020	0.020	15.0
69	weighing room	front window	0.020	0.020	15.0
70	weighing room	front wall--3-feet up	0.020	0.020	15.0
71	weighing room	front wall--2 feet-up	0.020	0.020	15.0
72	ceiling	vent--south side of lab	0.020	0.020	15.0
73	ceiling	vent--north side of lab	0.020	0.020	15.0

ROOM 209
USGS PHYSICS BUILDING

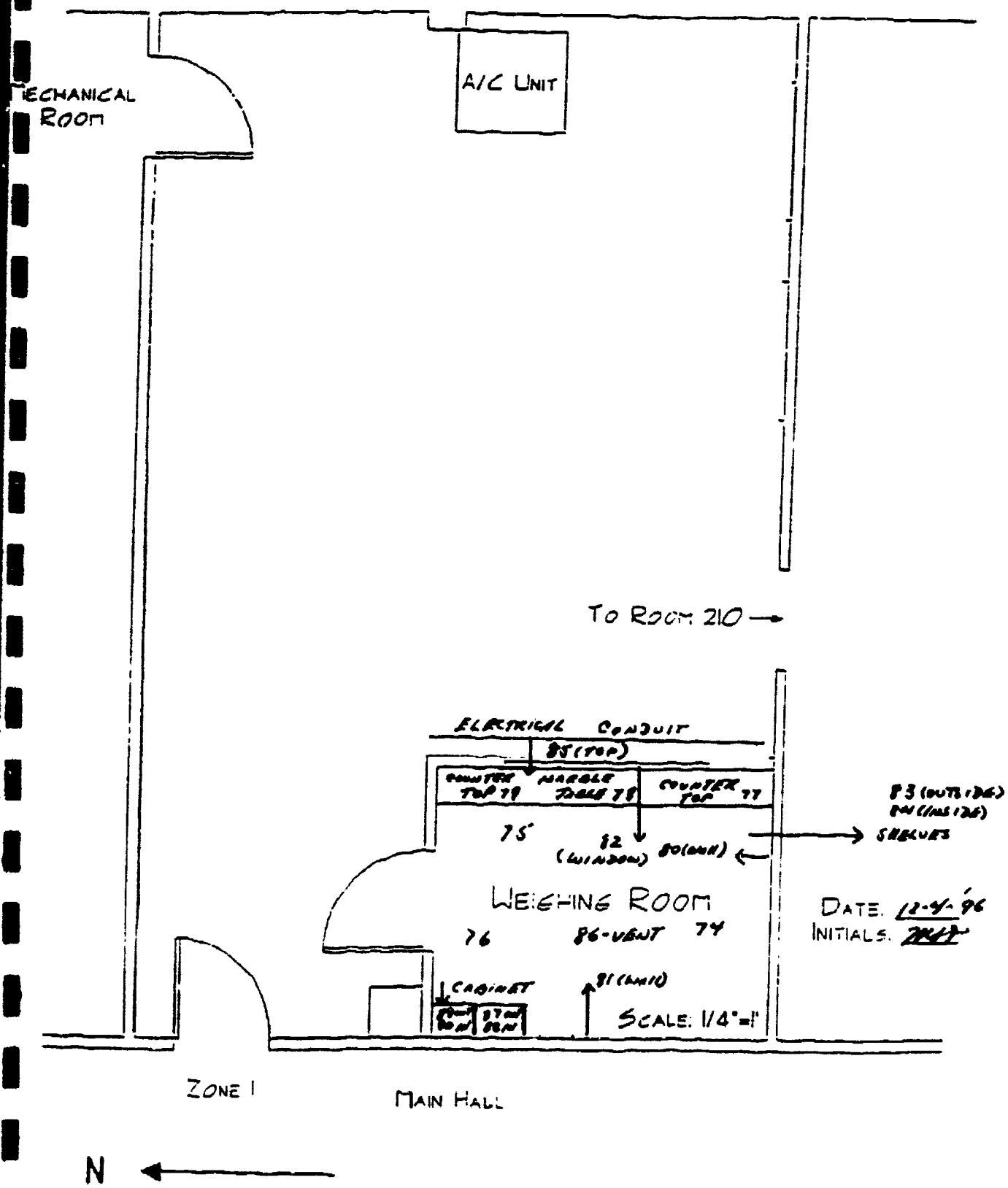


DATE: 12-4-96
INITIALS: [illegible]

Laboratory 209--Weighing Room
Physics Building
National Center
Reston, Virginia

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
74	floor	south side of room	0.020	0.020	15.0
75	floor	east side below counter	0.020	0.020	15.0
76	floor	near entrance to room	0.020	0.020	15.0
77	counter top	top below window	0.020	0.020	15.0
78	counter top	marble table below window	0.020	0.020	15.0
79	counter top	top below window	0.020	0.020	15.0
80	wall	south side of room--3 feet up	0.020	0.020	15.0
81	wall	east side of room--2 feet up	0.020	0.020	15.0
82	window	front of glass	0.020	0.020	15.0
83	shelves	south side of room (outside)	0.020	0.020	15.0
84	shelves	south side of room (inside)	0.020	0.020	15.0
85	electrical conduit	tope of conduit inside room	0.020	0.020	15.0
86	ceiling	vent	0.020	0.020	15.0
87	cabinet	west side of room outside	0.020	0.020	15.0
88	cabinet	west side of room inside	0.020	0.020	15.0
89	cabinet	west side of room outside	0.020	0.020	15.0
90	cabinet	west side of room inside	0.020	0.020	15.0

ROOM 209
USGS PHYSICS BUILDING



Laboratory 210
Physics Building
National Center
Reston, Virginia

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
1	floor	entrance to room 210	0.020	0.020	15.0
2	floor	see diagram	0.020	0.020	15.0
3	floor	see diagram	0.020	0.020	15.0
4	floor	see diagram	0.020	0.020	15.0
5	floor	see diagram	0.020	0.020	15.0
6	floor	see diagram	0.020	0.020	15.0
7	floor	see diagram	0.020	0.020	15.0
8	floor	see diagram	0.020	0.020	15.0
9	floor	see diagram	0.020	0.020	15.0
10	table	top	0.020	0.020	15.0
11	floor	see diagram	0.020	0.020	15.0
12	floor	see diagram	0.020	0.020	15.0
13	floor	see diagram	0.020	0.020	15.0
14	floor	see diagram	0.020	0.020	15.0
15	floor	see diagram	0.020	0.020	15.0
16	floor	see diagram	0.020	0.020	15.0
17	floor	see diagram	0.020	0.020	15.0
18	floor	below work table	0.020	0.020	15.0
19	floor	below work table	0.020	0.020	15.0
20	floor	see diagram	0.020	0.020	15.0
21	floor	see diagram	0.020	0.020	15.0
22	floor	see diagram	0.020	0.020	15.0
23	floor	see diagram	0.020	0.020	15.0
24	floor	see diagram	0.020	0.020	15.0
25	floor	see diagram	0.020	0.020	15.0

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
26	floor	see diagram	0.020	0.020	15.0
27	floor	see diagram	0.020	0.020	15.0
28	floor	see diagram	0.020	0.020	15.0
29	floor	see diagram	0.020	0.020	15.0
30	floor	see diagram	0.020	0.020	15.0
31	floor	see diagram	0.020	0.020	15.0
32	floor	see diagram	0.020	0.020	15.0
33	floor	see diagram	0.020	0.020	15.0
34	floor	see diagram	0.020	0.020	15.0
35	floor	see diagram	0.020	0.020	15.0
36	floor	see diagram	0.020	0.020	15.0
37	floor	see diagram	0.020	0.020	15.0
38	floor	see diagram	0.020	0.020	15.0
39	floor	entrance to room 2.	0.020	0.020	15.0
40	floor	see diagram	0.020	0.020	15.0
41	floor	see diagram	0.020	0.020	15.0
42	floor	see diagram	0.020	0.020	15.0
43	wall	see diagram	0.020	0.020	15.0
44	wall	see diagram	0.020	0.020	15.0
45	wall	see diagram	0.020	0.020	15.0
46	wall	see diagram	0.020	0.020	15.0
47	wall	see diagram	0.020	0.020	15.0
48	wall	see diagram	0.020	0.020	15.0
49	wall	see diagram	0.020	0.020	15.0
50	wall	see diagram	0.020	0.020	15.0

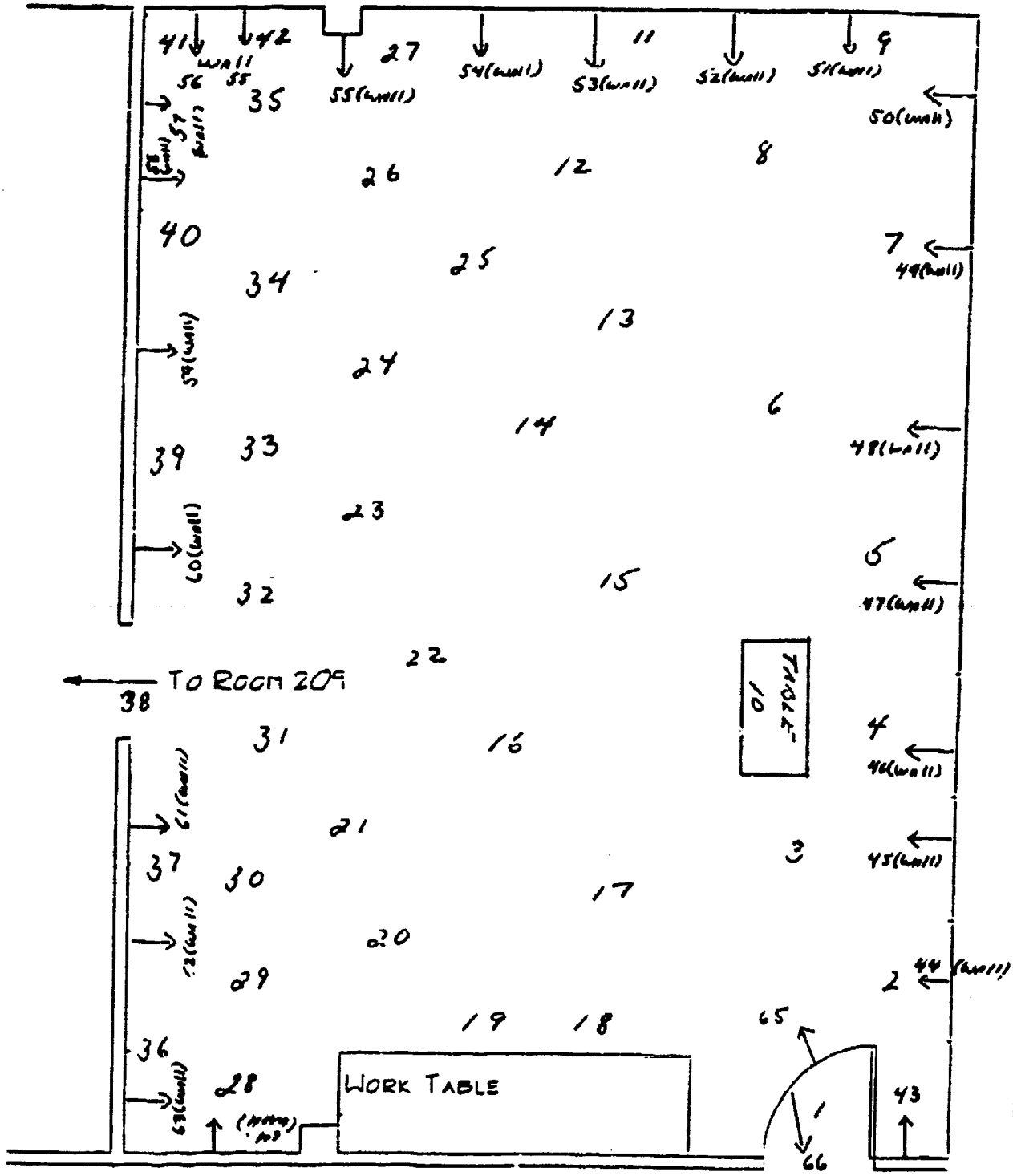
Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
51	wall	see diagram	0.020	0.020	15.0
52	wall	see diagram	0.020	0.020	15.0
53	wall	see diagram	0.020	0.020	15.0
54	wall	see diagram	0.020	0.020	15.0
55	wall	see diagram	0.020	0.020	15.0
56	wall	see diagram	0.020	0.020	15.0
57	wall	see diagram	0.020	0.020	15.0
58	wall	see diagram	0.020	0.020	15.0
59	wall	see diagram	0.020	0.020	15.0
60	wall	see diagram	0.020	0.020	15.0
61	wall	see diagram	0.020	0.020	15.0
62	wall	see diagram	0.020	0.020	15.0
63	wall	see diagram	0.020	0.020	15.0
64	wall	see diagram	0.020	0.020	15.0
65	wall	see diagram	0.020	0.020	15.0
66	wall	see diagram	0.020	0.020	15.0
67	shelves	south side of lab (outside)	0.020	0.020	15.0
68	shelves	south side of lab (inside)	0.020	0.020	15.0
69	shelves	south side of lab (outside)	0.020	0.020	15.0
70	shelves	south side of lab (inside)	0.020	0.020	15.0
71	shelves	south side of lab (outside)	0.020	0.020	15.0
72	shelves	south side of lab (inside)	0.020	0.020	15.0
73	shelves	south side of lab (inside)	0.020	0.020	15.0
74	shelves	south side of lab (outside)	0.020	0.020	15.0
75	shelves	south side of lab (inside)	0.020	0.020	15.0

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
76	shelves	south side of lab (outside)	0.020	0.020	15.0
77	shelves	south side of lab (inside)			
78	shelves	south side of lab (outside)	0.020	0.020	15.0
79	shelves	south side of lab (inside)			
80	shelves	east side of lab (outside)	0.020	0.020	15.0
81	shelves	east side of lab (inside)			
82	shelves	east side of lab (outside)	0.020	0.020	15.0
83	shelves	east side of lab (inside)			
84	shelves	east side of lab (outside)	0.020	0.020	15.0
85	shelves	east side of lab (inside)			
86	shelves	east side of lab (outside)	0.020	0.020	15.0
87	shelves	east side of lab (inside)	0.020	0.020	15.0
88	shelves	east side of lab (outside)			
89	shelves	east side of lab (inside)	0.020	0.020	15.0
90	shelves	north side of lab (outside)			
91	shelves	north side of lab (inside)	0.020	0.020	15.0
92	shelves	north side of lab near entrance to Room 209 (outside)	0.020	0.020	15.0
93	shelves	north side of lab near entrance to Room 209 (inside)	0.020	0.020	15.0
94	shelves	north side of lab (inside)	0.020	0.020	15.0
95	shelves	west side of lab (inside)	0.020	0.020	15.0
96	shelves	west side of lab (outside)	0.020	0.020	15.0
97	shelves	west side of lab (inside)	0.020	0.020	15.0
98	shelves	west side of lab (outside)	0.020	0.020	15.0
99	shelves	west side of lab (inside)	0.020	0.020	15.0

Swipe	Area	Location	Rediation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
100	shelves	west side of lab (outside)	0.020	0.020	15.0
101	counter top	work table top--west side of lab	0.020	0.020	15.0
102	counter top	work table top--west side of lab	0.020	0.020	15.0
103	counter top	work table top--west side of lab	0.020	0.020	15.0
104	cabinets	under work table--west side of lab (outside)	0.020	0.020	15.0
105	cabinets	under work table--west side of lab (inside)	0.020	0.020	15.0
106	cabinets	under work table--west side of lab (outside)	0.020	0.020	15.0
107	cabinets	under work table--west side of lab (inside)	0.020	0.020	15.0
108	cabinets	under work table--west side of lab (outside)	0.020	0.020	15.0
109	cabinets	under work table--west side of lab (inside)	0.020	0.020	15.0
110	cabinets	under work table--west side of lab (outside)	0.020	0.020	15.0
111	cabinets	under work table--west side of lab (inside)	0.020	0.020	15.0
112	cabinets	under work table--west side of lab (outside)	0.020	0.020	15.0
113	cabinets	under work table--west side of lab (inside)	0.020	0.020	15.0
114	cabinet	east side of lab	0.020	0.020	15.0
115	cabinet	east side of lab	0.020	0.020	15.0
116	cabinet	east side of lab	0.020	0.020	15.0
117	cabinet	east side of lab	0.020	0.020	15.0
118	cabinet	east side of lab	0.020	0.020	15.0
119	cabinet	east side of lab	0.020	0.020	15.0
120	vent	see diagram	0.020	0.020	15.0
121	vent	see diagram	0.020	0.020	15.0
122	vent	see diagram	0.0[illegible]	0.020	15.0
123	vent	see diagram	[illegible]	0.020	15.0
124	vent	see diagram	[illegible]	[illegible]020	15.0
125	electrical conduit	see diagram	[illegible]20	[illegible]020	15.0
126	electrical conduit	see diagram	[illegible]	0.020	15.0
127	electrical conduit	see diagram	[illegible]	0.020	15.0
128	electrical conduit	see diagram	0.020	0.020	15.0
129	electrical conduit	see diagram	0.020	0.020	15.0
130	electrical conduit	see diagram	0.020	0.020	15.0
131	equipment	see diagram	0.020	0.020	15.0
132	PC's and equipment	see diagram	0.020	0.020	15.0

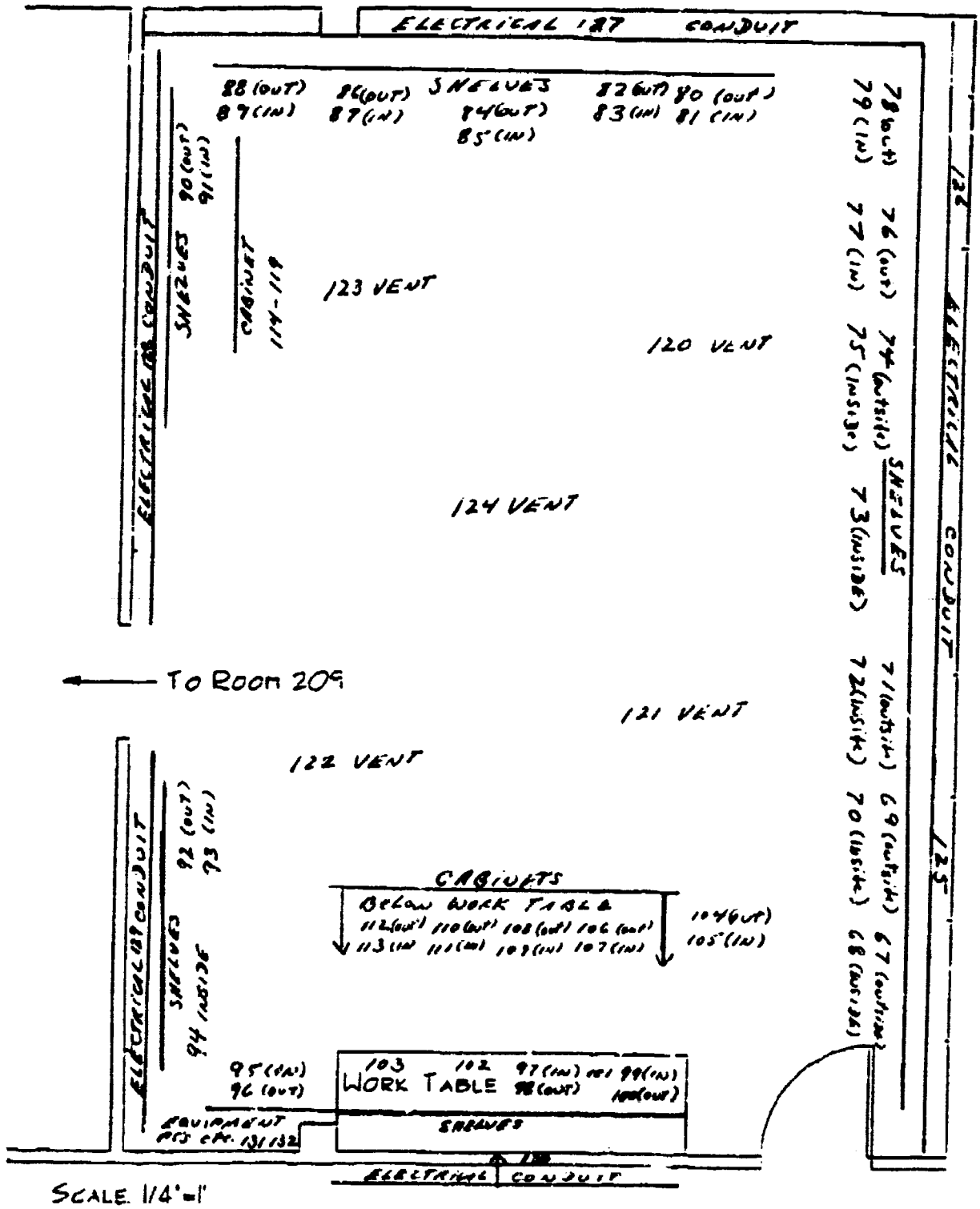
ROOM 210
USGS PHYSICS BUILDING

DATE: 12-4-96
INITIALS: [illegible]



ROOM 210
USGS PHYSICS BUIDLING

DATE: _____
INITIALS: _____



SCALE 1/4" = 1'

N ←

MAIN HALL

Laboratory 107A--Radiation Safety Office
Physics Building
National Center
Reston, Virginia

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading µR/hr at 1 meter
77	floor	see diagram	0.020	0.020	15.0
78	floor	see diagram	0.020	0.020	15.0
79	floor	see diagram	0.020	0.020	15.0
80	floor	see diagram	0.020	0.020	15.0
81	floor	entrance to lab 107B	0.020	0.020	15.0
82	floor	see diagram	0.020	0.020	15.0
83	floor	see diagram	0.020	0.020	15.0
84	floor	see diagram	0.020	0.020	15.0
85	floor	see diagram	0.020	0.020	15.0
86	floor	see diagram	0.020	0.020	15.0
87	floor	see diagram	0.020	0.020	15.0
88	floor	see diagram	0.020	0.020	15.0
89	wall	near door	0.020	0.020	15.0
90	wall	north side of room--entrance to room 107B	0.020	0.020	15.0
91	wall	north side of lab--entrance to room 107B	0.020	0.020	15.0
92	wall	north side of room--2 feet up	0.020	0.020	15.0
93	wall	west side of room--3 feet up	0.020	0.020	15.0
94	wall	west side of room--2 feet up	0.020	0.020	15.0
95	electrical conduit	north side of room--top	0.020	0.020	15.0

Swipe	Area	Location	Radiation Reading mR/hr at 1cm	Radiation Reading mR/hr at 1 meter	Radiation Reading μR/hr at 1 meter
96	electrical conduit	west side of room--top	0.020	0.020	15.0
97	counter top	adjacent to sink	0.020	0.020	15.0
98	sink	sides of sink	0.020	0.020	15.0
99	sink	drain of sink	0.020	0.020	15.0
100	cabinet	below sink outside	0.020	0.020	15.0
101	cabinet	below sink inside	0.020	0.020	15.0
102	hood	bottom	0.020	0.020	15.0
103	hood	right side	0.020	0.020	15.0
104	hood	left side	0.020	0.020	15.0
105	hood	back	0.020	0.020	15.0
106	hood	front of glass	0.020	0.020	15.0
107	hood	front vent	0.020	0.020	15.0
108	hood	front of sill	0.020	0.020	15.0
109	hood	drain--inside hood			
110	cabinet	below hood outside	0.020	0.020	15.0
111	cabinet	below hood inside			
112	ceiling	overhead tile	0.020	0.020	15.0
113	door	inside panel	0.020	0.020	15.0
114	door	outside panel	0.020	0.020	15.0
115	door knob	inside	0.020	0.020	15.0

RADIATION SAFETY OFFICE

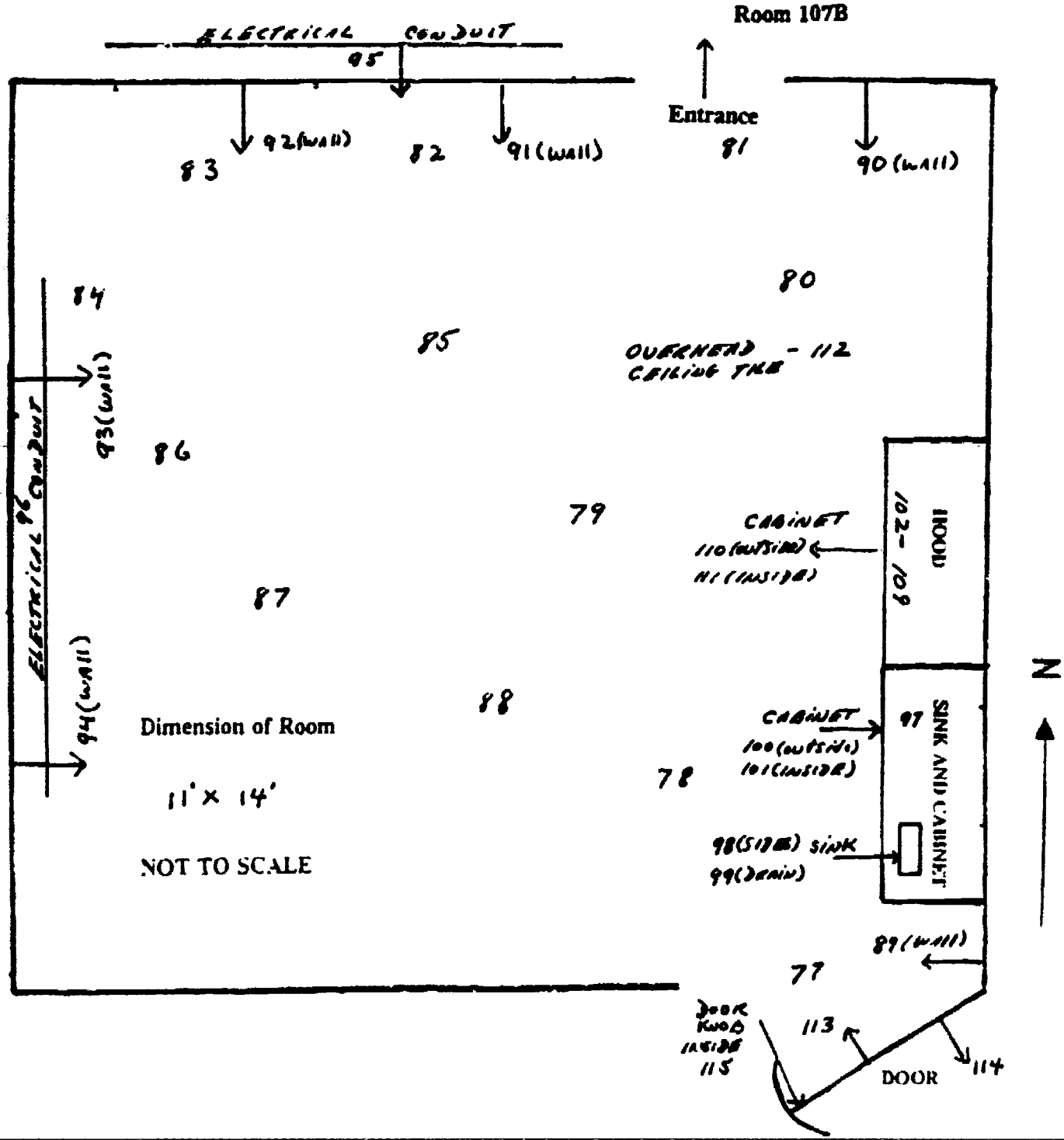
PHYSICS BUILDING

FIRST FLOOR

Room 107A

Dr. Allan B. Tanner Laboratory

Room 107B



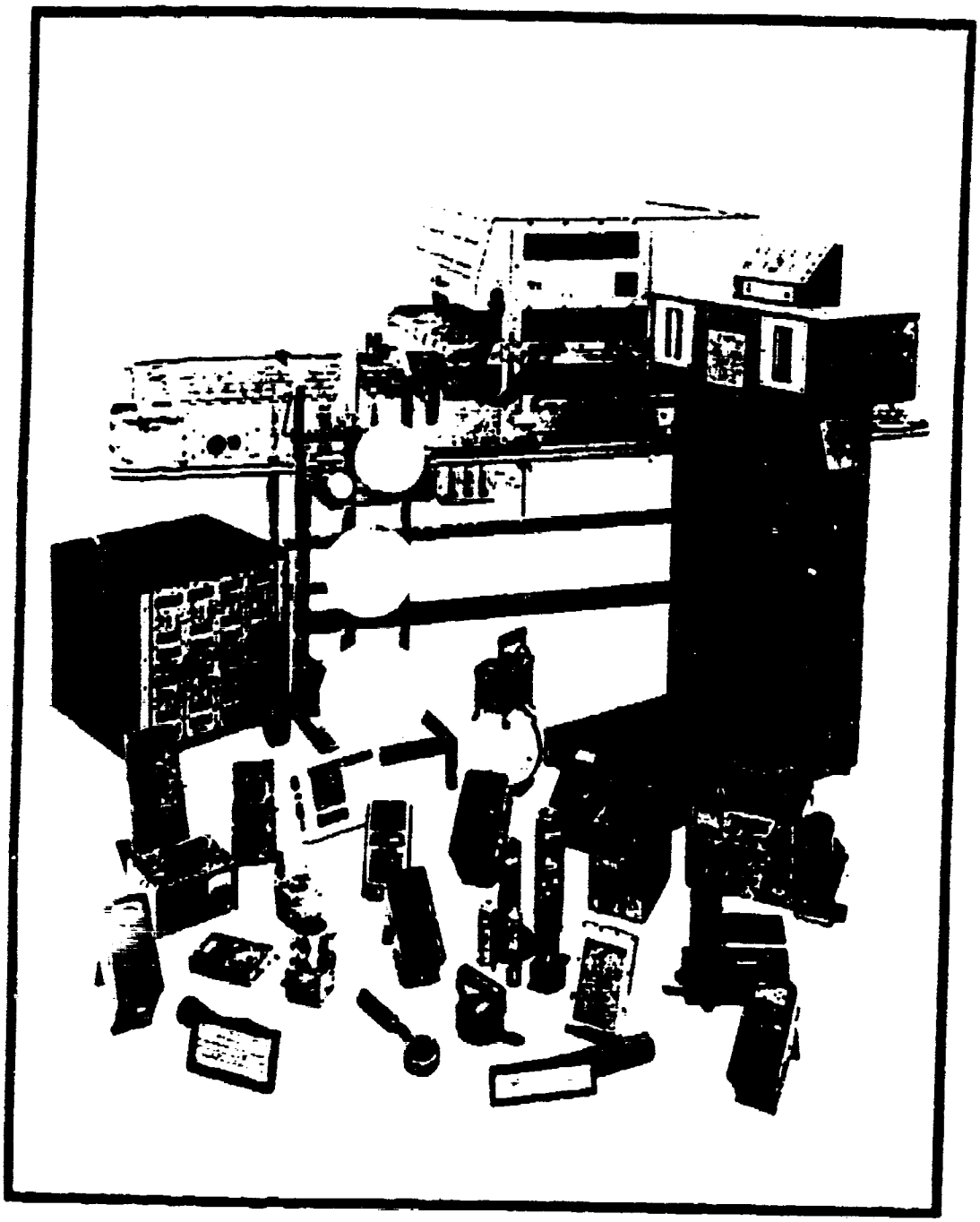
Dimension of Room

11' × 14'

NOT TO SCALE

APPENDIX D

PORTABLE RADIATION SURVEY INSTRUMENTS UTILIZED IN SCANNING SURVEY



LUDLUM MEASUREMENTS, INC.

P.O. Box 810 • 501 Oak • Sweetwater, Texas 79556

915-235-5494 • Fax 915-235-4672 • 800-622-0828(USA)

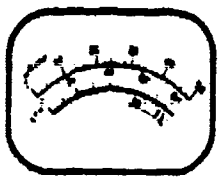
GENERAL PURPOSE PORTABLE SURVEY METERS

METER DIALS

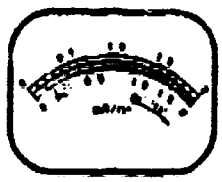
202-2 for Models 2,3
with any detector
0 - 5k cpm

202-666 for Model 3
with 44-2
0 - 50 µR/hr

202-654 for Model 3
with 44-2
Dual Scale
0 - 50 µR/hr
0 - 8.4k cpm

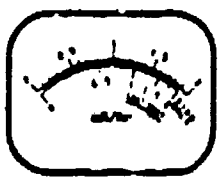


202-084 for Models 3, 14C
with 44-6, 44-38
0 - 2 mR/hr

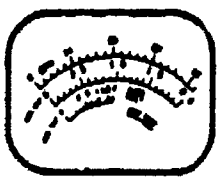


202-241 for Models 3, 14C
with 44-6, 44-38
Dual Scale
0 - 2 mR/hr
0 - 2.4k cpm

202-085 for Models 3, 14C
with 44-7
0 - 2 mR/hr

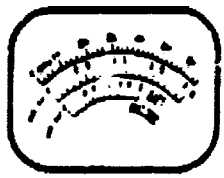


202-330 for Models 3, 14C
with 44-7
Dual Scale
0 - 2 mR/hr
0 - 4.2k cpm

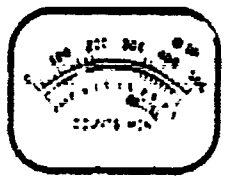


202-627 for Models 3, 14C
with 44-9
0 - 2 mR/hr

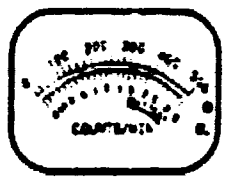
202-608 for Models 3, 14C
with 44-9
Dual Scale
0 - 2 mR/hr
0 - 6.6k cpm



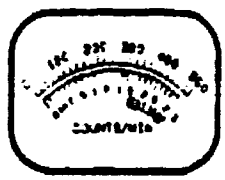
202-558 for Models 4
with any detector
0 - 500 cpm
0 - 2.5 kV
OR (overrange)



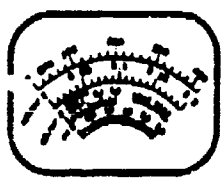
202-643 for Model 16
with any detector
0 - 500 cpm
0 - 2.5 kV
OL (overload)



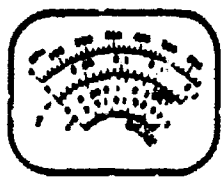
202-356 for Models 12, 18
with any detector
0 - 500 cpm
0 - 2.5 kV



202-365 for Models 12, 18
with 44-7
Dual Scale
0 - 0.2 mR/hr
0 - 420 cpm
0 - 2.5 kV



202-618 for Models 12, 18
with 44-9
Dual Scale
0 - 0.2 mR/hr
0 - 660 cpm
0 - 2.5 kV



ABOVE METER DIALS ARE MOST COMMON OTHERS ARE AVAILABLE ON REQUEST

1 GENERAL PURPOSE PORTABLE SURVEY METERS

COMMON SPECIFICATIONS

CONNECTOR: Series "C" (*others available*)
AUDIO: Built in unimorph speaker with ON/OFF switch (*greater than 60 dB at 2 feet*)
LINEARITY: Reading within ±10% of true value with detector connected
CALIBRATION CONTROLS: Accessible from front of instrument (*protective cover provided*)
RESPONSE: Toggle switch for FAST (4 seconds) or SLOW (22 seconds) from 10% to 90% of final reading
RESET: Pushbutton to zero meter
POWER: 2 each "D" cell batteries
(*housed in sealed compartment that is externally accessible*
BATTERY LIFE: Typically 600 hours with alkaline batteries
(*battery condition can be checked on meter*)
BATTERY DEPENDANCE: Less than 3% change in readings to battery endpoint.
METER: 2.5"(6.4cm) arc. 1 mA analog type
CONSTRUCTION: Cast and drawn aluminum with beige polyurethane enamel paint.
TEMPERATURE RANGE: 5°F(-15°C) to 122°F(50°C)
May be certified for operation from -40°F(-40°C) to 150°F(65°C)
SIZE: 6.5"(16.5cm)H X 3.5"(8.9cm)W X 8.5"(21.6cm) L including handle
WEIGHT: 3.5 lbs (1.6kg) including batteries

MODEL 3 Survey Meter

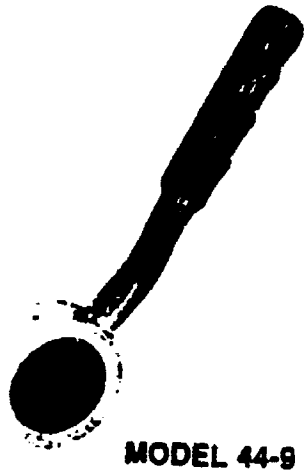
COMPATIBLE DETECTORS: G-M, scintillation
METER DIAL: 0 - 2 mR/hr, or 0 - 5k cpm, BAT TEST
(*others available*)
MULTIPLIERS: X0.1, X1, X10, X100
HIGH VOLTAGE: Adjustable from 200 - 1500 volts
THRESHOLD: 30 mV ± 10 mV

NOTE: The 3 range version of the Model 3 is the Model 2 Survey Meter

4 Range General Purpose Survey Meter (typical range 0 - 200 mR/hr or 0 - 500,000 cpm)

ALPHA BETA-GAMMA G-M DETECTORS

MODEL 44-7
End Window G-M Detector



MODEL 44-9
Pancake G-M Detector

MODEL 44-7

INDICATED USE: Alpha, beta-gamma survey and sample counting
DETECTOR: End window halogen quenched G-M
WINDOW: 1.7 ± 0.3 mg cm² mica
WINDOW AREA:
Active - 6 cm²
Open - 5 cm²
EFFICIENCY(2pi geometry): 5%-^{14}C, 20%-^{90}Sr/^{90}Y, 15%-^{239}Pu
SENSITIVITY: Typically 2100 cpm/mR/hr (^{137}Cs gamma)
ENERGY RESPONSE: Energy dependant
DEAD TIME: Typically 160 µs
COMPATIBLE INSTRUMENTS: General purpose survey meters, ratemeters, and scalers
OPERATING VOLTAGE: 900 volts
CONNECTOR: Series "C" (*others available*)
CONSTRUCTION: Anodized Aluminum housing with stainless steel protective screen (*79% open*)
TEMPERATURE RANGE: 5°F(-15°C) to 122°F(50°C)
May be certified to operate from -40°F(-40°C) to 150°F(65°C)
SIZE: 1.8"(4.6cm) diameter X 5.8"(14.7cm)L
WEIGHT: 1 lb(0.5kg)

MODEL 44-9

INDICATED USE: Alpha, beta-gamma survey, frisking
DETECTOR: Pancake type halogen quenched G-M
WINDOW: 1.7 ± 0.3 mg cm² mica
WINDOW AREA:
Active - 15 cm²
Open - 12 cm²
EFFICIENCY(2pi geometry): Typically 10%-^{14}C, 45%-^{90}Sr/^{90}Y, 38%-^{99}Tc, 65%-^{32}P, 30%-^{239}Pu
SENSITIVITY: Typically 3300 cpm/mR/hr (^{137}Cs gamma)
ENERGY RESPONSE: Energy dependant
DEAD TIME: Typically 80 µs
COMPATIBLE INSTRUMENTS: General purpose survey meters, ratemeters, and scalers
OPERATING VOLTAGE: 900 volts
CONNECTOR: Series "C" (*others available*)
CONSTRUCTION: Aluminum body with beige polyurethane enamel paint, and stainless steel protective screen (*79% open*)
TEMPERATURE RANGE: 5°F(-15°C) to 122°F(50°C)
May be certified to operate from -40°F(-40°C) to 150°F(65°C)
SIZE: 1.8"(4.6cm)H X 2.7"(6.9cm)W X 10.7"(27.2cm)L
WEIGHT: 1 lb (0.5kg)

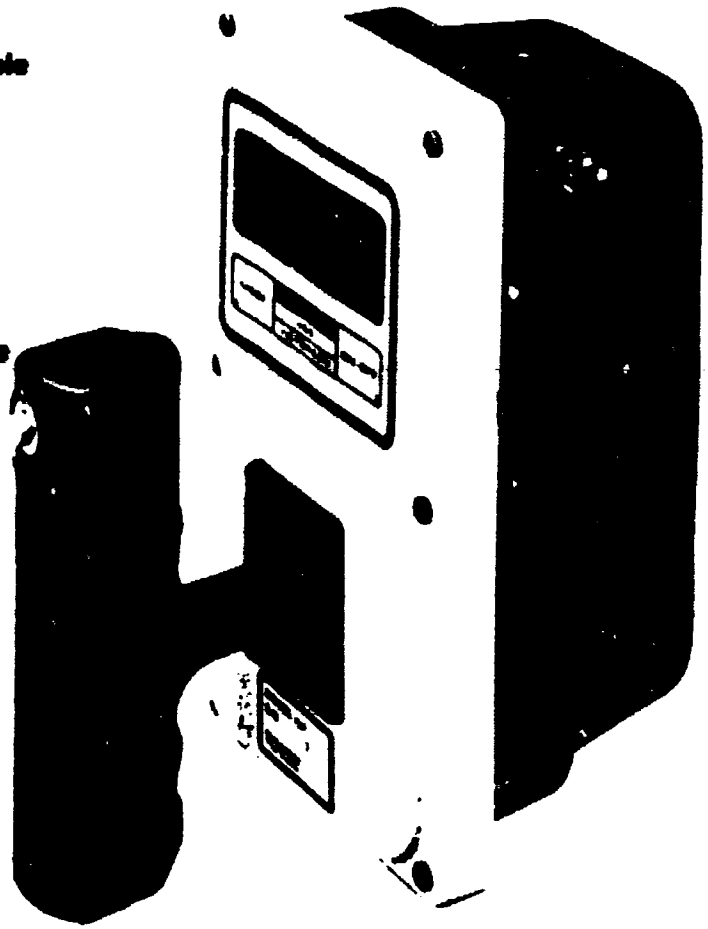
NOTE: Handle is available in different lengths

VICTOREEN

Pressurized Ion Chamber Survey Meter

Model 450P

- **Extremely Fast Response to measure radiation from leakage, scatter, beams, and pin holes.**
- **High Sensitivity Micro-R measurements of exposures and exposure rates.**
- **Display Flash Alarm Feature programmable on any range.**
- **Unique Method of Communication for calibration and use as a remote detector.**
- **Serves Wide Range of Applications for NDT, x-ray, accelerator, environmental and others.**
- **Illuminated Analog/Digital Display can be used in the dark.**
- **Available with a Dose Equivalent Energy Response and SI units.***



The Model 450P is a light-weight portable survey meter consisting of a pressurized ionization chamber, microprocessor-based with a combined analog/digital liquid crystal display. The 450P has the extremely fast response required to measure ionizing radiation from leakage, scatter, beams and pinholes. The 450P has an illuminated analog/digital LCD display. The instrument utilizes an infrared communicator for calibration and allows the instrument to be used as a remote detector. The Model 450P has a programmable "flash alarm" which causes the display to pulsate at a rate of once per second when the measured dose rate exceeds a preset limit (set via a terminal). The ionization chamber is filled to a pressure of 6 atmospheres to enhance sensitivity and energy independence.

The 450P measures exposure, exposure rate, and can be used to "freeze" the maximum exposure rate encountered. The user can configure either integrate or freeze mode.

*Model 450P-DE-SI.

(continued on reverse side)

Detector: 300 cc volume air ionization chamber pressurized to 6 atmospheres.

Controls: Two push button switches are provided on the front surface of the instrument: "ON/OFF" and "MODE".

Automatic Features:
Auto-ranging and auto-zeroing.

Response Time: Analog response time from 10% to 90% of reading for a full scale step increase is dependent on operating range.

Response time for a step increase in radiation exposure rate from background:

Step increase, background to:	Time to reach 90% of final value (seconds)
400 µR/h	4.8
4 mR/h	3.3
10 mR/h	4.3
40 mR/h	4.5
100 mR/h	2.7
1 R/h	2.0
4 R/h	2.7

The following table shows time measured from 10% to 90% of final value for a step increase or decrease in exposure rate such that a range change does not occur. These values are the response times for the various ranges.

Range	10%-90% Response (sec.)
0-500 µR/h (5 µSv/h)	5
0-5 mR/h (50 µSv/h)	2
0-50 mR/h (500 µSv/h	1.8
0-500 mR/h (5 mSv/h)	1.8
0-5 R/h (50 mSv/h)	1.8

Options: Model 450-1A Communicator Consists of RS-232 serial port with 1200 baud operation.

The Model 450-1A Communicator, connected to the survey meter and a dumb terminal or a computer with a terminal program, provides the following functions.

Read stored calibration coefficients and other data from the internal EEPROM device; Recall current factors and data; Modify current calibration coefficients; Enter test mode; Change function FREEZE or Integrate, or Read internal integrate value when in FREEZE. Change units Conventional or Si; Baud rate 1200; Exit and store current calibration coefficients, display units, and user notes. Quit, and do not modify any calibration coefficients, or user notes.

Display: A liquid crystal Analog/Digital display is provided.

Analog display:
100 element bar graph 2.5 inches (6.4cm) long. Bar graph is divided into 5 major segments, each labeled with the appropriate value for the range of the instrument.

Digital display:
2 1/2 digit display is followed by a significant zero digit depending on the operating range of the instrument. The units of measurement are indicated on the display at all times. Digits are 1/4 inch (6.4mm) high. "Low Battery" and "Freeze" messages, indicating the operating condition of the instrument, are also provided on the display.

Batteries: Two 9 volt transistor batteries

Battery Life: 200 hours continuously on new batteries. To continue integration, batteries may be changed one at a time permitting the instrument to remain operational.

Warm-Up Time:
Less than two minutes for initial operation when the instrument is in equilibrium with ambient temperature.

Environmental Effects

Temp. range: -20°C to +50°C.

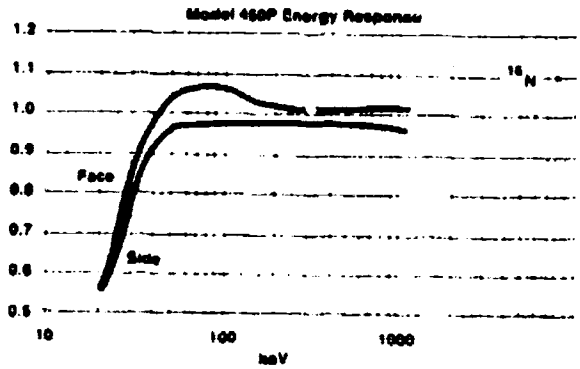
Humidity range:
0 to 100%, instrument is designed to be moisture-proof.

Geotropism: negligible

Dimensions: 4 inches (10cm) wide, 8 inches (20cm) long, 6 inches (15cm) high.

Weight: 2 lb. 6 oz. (1.07 kg

Energy Response:
^{16}Nitrogen gamma rays are 110% to 120% of indicated readings as determined at the University of Lowell



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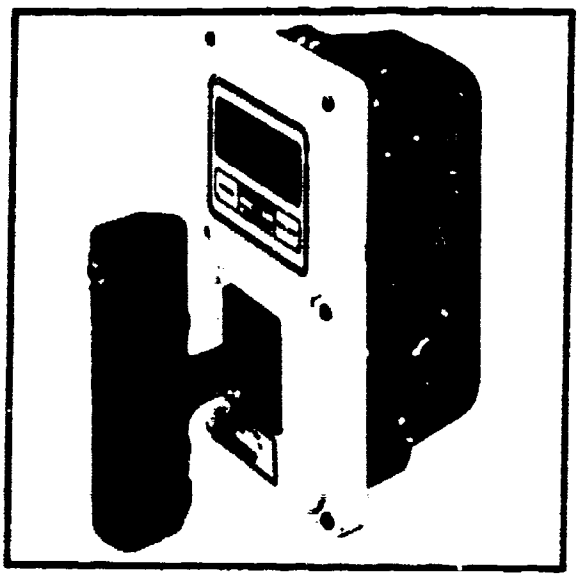
Model 450P Pressurized Ion Chamber Survey Meter

VICTOREEN



- **Extremely fast response to measure radiation from leakage, scatter beams, and pinholes**
- **High sensitivity micro-R measurements of exposures and exposure rates**
- **Display flash alarm, programmable on any range**
- **Unique method of communication for calibration and use as a remote detector**
- **Serves wide range of applications for NDT, X-ray, accelerator, environmental and others**
- **Illuminated display can be used in the dark**
- **Available with a dose equivalent energy response and SI units ***

Introduction:

The Model 450P is an innovative radiation survey instrument. It is based on the proven characteristics of the ion chamber radiation detector married to the latest CMOS microprocessor technology and liquid crystal displays.

The only controls present on the basic instrument are an ON/OFF button and a MODE button. No other controls are necessary because the instrument is both auto-ranging and auto-zeroing.

The display is unique, offering both a 100 element analog bargraph that is fully labelled with scale digits and a 2 1/2 digit digital display that also provides the proper units of measurement. The bar graph is provided with a faster time constant than the digital display making the instrument ideal for surveys.

*** Model 450P-DE-SI**

The top surface of the instrument has an overlay which covers both of the display switches, completely sealing this surface. The instrument is fully gasketed to make it moisture proof. The gasket also serves to shock-mount the printed circuit boards, liquid crystal display, and ion chamber assembly. The instrument will remain operational after a drop from a height of 3 ft. onto a concrete floor.

The variables FREEZE, INTEGRATE: R or Sv are factory set when the Model 450P is purchased without a communicator. The customer can choose settings.

The FREEZE button is a special feature that permits the instrument to remember and indicate the highest dose rate from the time the instrument is placed in the freeze mode. This feature permits placing an instrument in a potentially high radiation area and determining the maximum value the instrument sees.

The Integrate Mode operates continuously 30 seconds after the instrument has been turned on. Integration is performed even if the instrument is displaying in mR/h or R/h.

The Model 450P has a programmable "flash" alarm which causes the display to pulsate at a rate of once per second when the measured dose rate exceeds a preset limit (set via a terminal). The ionization chamber is filled to a pressure of 6 atmospheres to enhance sensitivity and energy independence.

Calibration is accomplished by an infra-red two-way communication, Model 450-1A. The communicator uses a RS-232 port. The two-way communicator can be used to interrogate the instrument for calibration information, perform a calibration of the instrument, change between the integrate display mode or the FREEZE display mode, or change units (English-Si).

The IR Communicator also allows the use of the Model 450P as a remote detector.

To guard against battery-related instrument failure, a "Low Battery" condition is indicated continuously on the face of the display when a battery change is required.

Specifications

Radiation Detected:

Beta above 1 MeV, gamma and X-rays above 25 keV.

Operating Ranges:

0-500 µR/h or 0-5 µSv/h
0-5 mR/h or 0-50 µSv/h
0-50 mR/h or 0-500 µSv/h
0-500 mR/h or 0-5 mSv/h
0-5 R/h or 0-50 mSv/h

Accuracy: Within 10% of reading between 10% and 100% of full scale indication on any range, exclusive of energy response. Calibration source is ^{137}Cs.

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SPECIFICATIONS:

Radiation Types Detected: Beta above 1 MeV, gamma and X-rays above 25 keV.

Operating Ranges:

0-500 μR/h or 0-5 μSv/h
0-5 mR/h or 0-50 μSv/h
0-50 mR/h or 0-500 μSv/h
0-500 mR/h or 0-5 mSv/h
0-5 R/h or 0-50 mSv/h

Accuracy: Within 10% of reading between 10% and 100% of full scale, indication on any range, exclusive of energy response. Calibration source is ^{137}Cs.

Detector: 300 cc volume air ionization chamber pressurized to 6 atmospheres.

Warm-Up Time: Less than 2 minutes for initial operation when the instrument is in equilibrium with ambient temperature.

Energy Response: See curve. ^{109}N data taken at the University of Lowell.

Angular Response: At ^{137}Cs and 38 keV - within 10% through 180°.

Response Time: Analog response time from 10% to 90% of reading for a full scale step increase is dependent on operating range.

Response time for a step increase in radiation exposure rate from background:

Step increase, background to:	*Time to reach 90% of final value (seconds)*
400 μR/h	4.8
4 mR/h	3.3
10 mR/h	4.3
40 mR/h	4.5
100 mR/h	1.8
400 mR/h	2.7
1 R/h	2.0
4 R/h	2.7

The following table shows time measured from 10% to 90% of final value for a step increase or decrease in exposure rate such that a range change does not occur. These values are the response times for the various ranges.

Range

Range	*10%-90% Response (sec.)*
0-500 μR/h (5 μSv/h)	5
0-5 mR/h (50 μSv/h)	2
0-50 mR/h (500 μSv/h)	1.8
0-500 mR/h (5 mSv/h)	1.8
0-5 R/h (50 mSv/h)	1.8

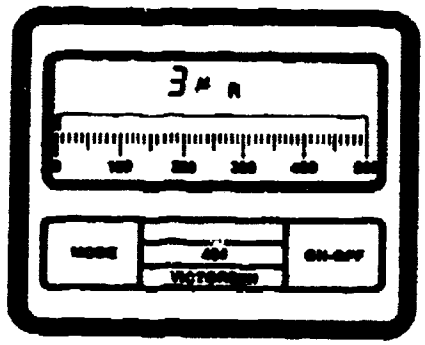
Dimensions: 4" (10 cm) wide x 8" (20 cm) long x 6" (15 cm) high

Weight: 1 lbx. 14 oz. (0.85 kg)

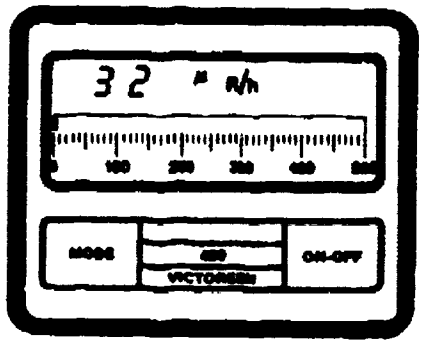
Option: Model 450-1A Communicator: Consists of RS232 serial port 1200 baud operation. The Model 450-1A Communicator, connected to the survey meter and a dumb terminal or computer with terminal emulation program, provides the following functions:

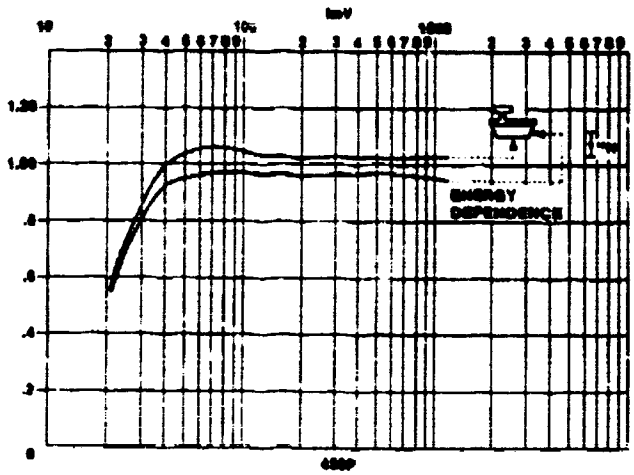
- Read stored calibration coefficients and other data from the internal EEPROM device;
- Recall current factors and data;
- Modify current calibration coefficients;
- Enter test mode;
- Change function: FREEZE, Integrate, or Read internal integrate value when in FREEZE;
- Change units: Conventional or Si;
- Baud rate: 1200;
- Exit and store current calibration coefficients, display units, and user notes;
- Quit, and do not modify any calibration coefficients, or user notes.

Integrated Exposure: *<0.1 second to hours exposure time.*



Exposure Rate: *<5 second response 0-500 μR/h, upper ranges even faster.*





APPENDIX E

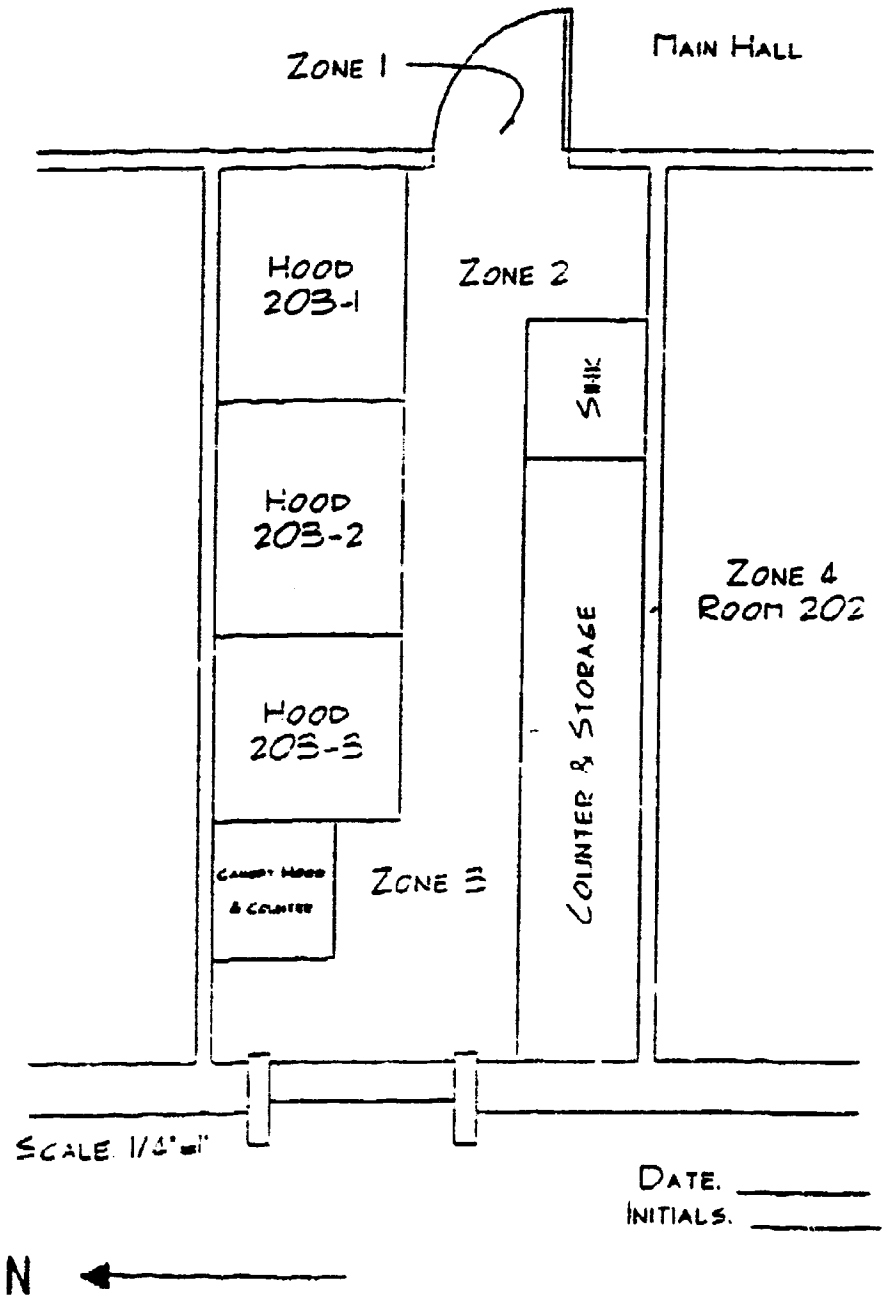
RADIOLOGICAL ASSESSMENT

SWIPE SAMPLE ANALYSIS

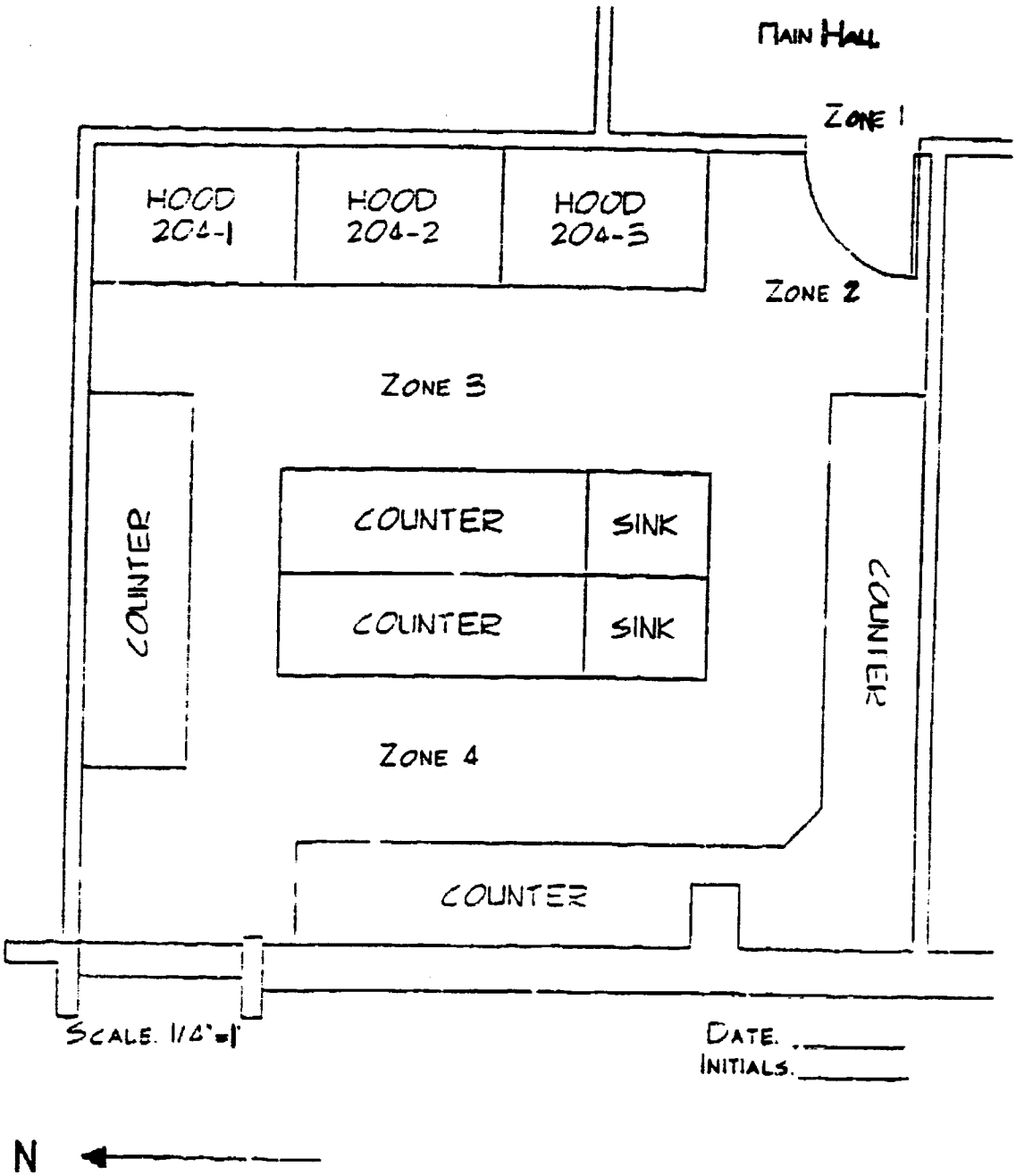
The following instrument surveys were taken in these designated laboratories located in Physics Building:

- Laboratory - Room 203 - Sample Preparation
- Laboratory - Room 204 - Chemistry Laboratory
- Laboratory - Room 205 - Storage Area
- Laboratory - Room 209 - Courting Room and Weighing Room
- Laboratory - Room 210 - Counting Room
- Office - Room 107A - Radiation Safety Office

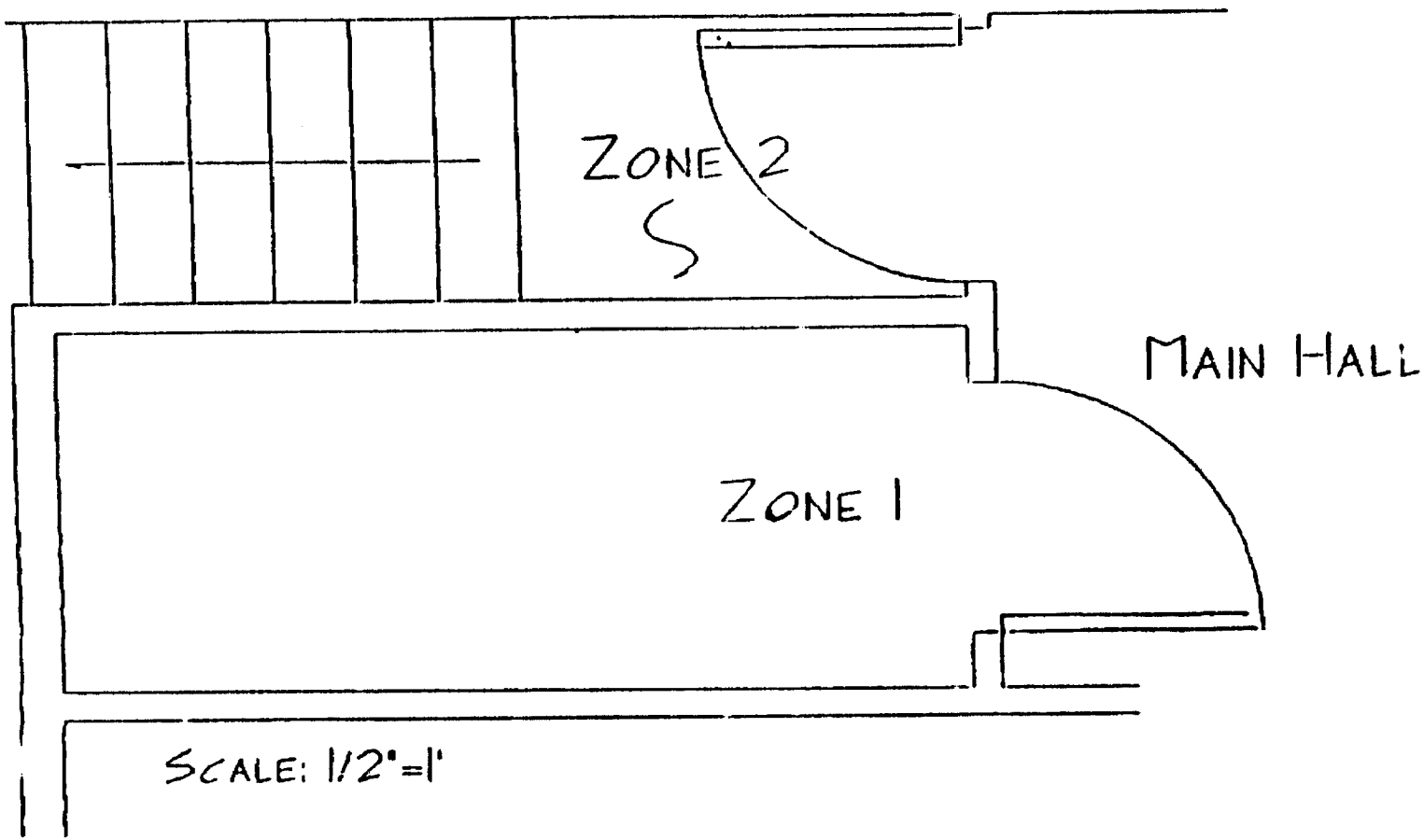
ROOM 203
USGS PHYSICS BUILDING



ROOM 204
USGS PHYSICS BUILDING



ROOM 205
USGS PHYSICS BUILDING

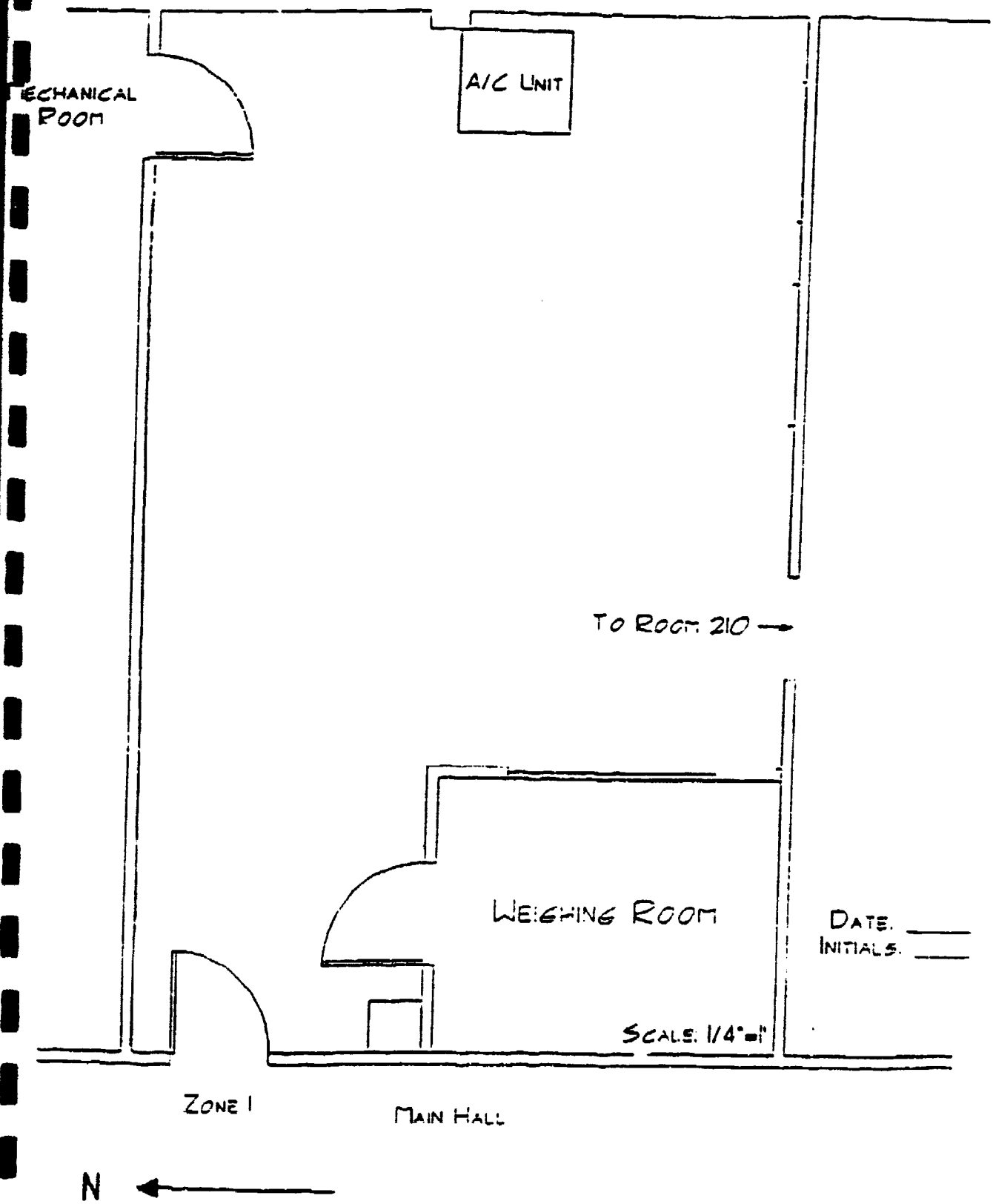


N ←

DATE: _____

INITIALS: _____

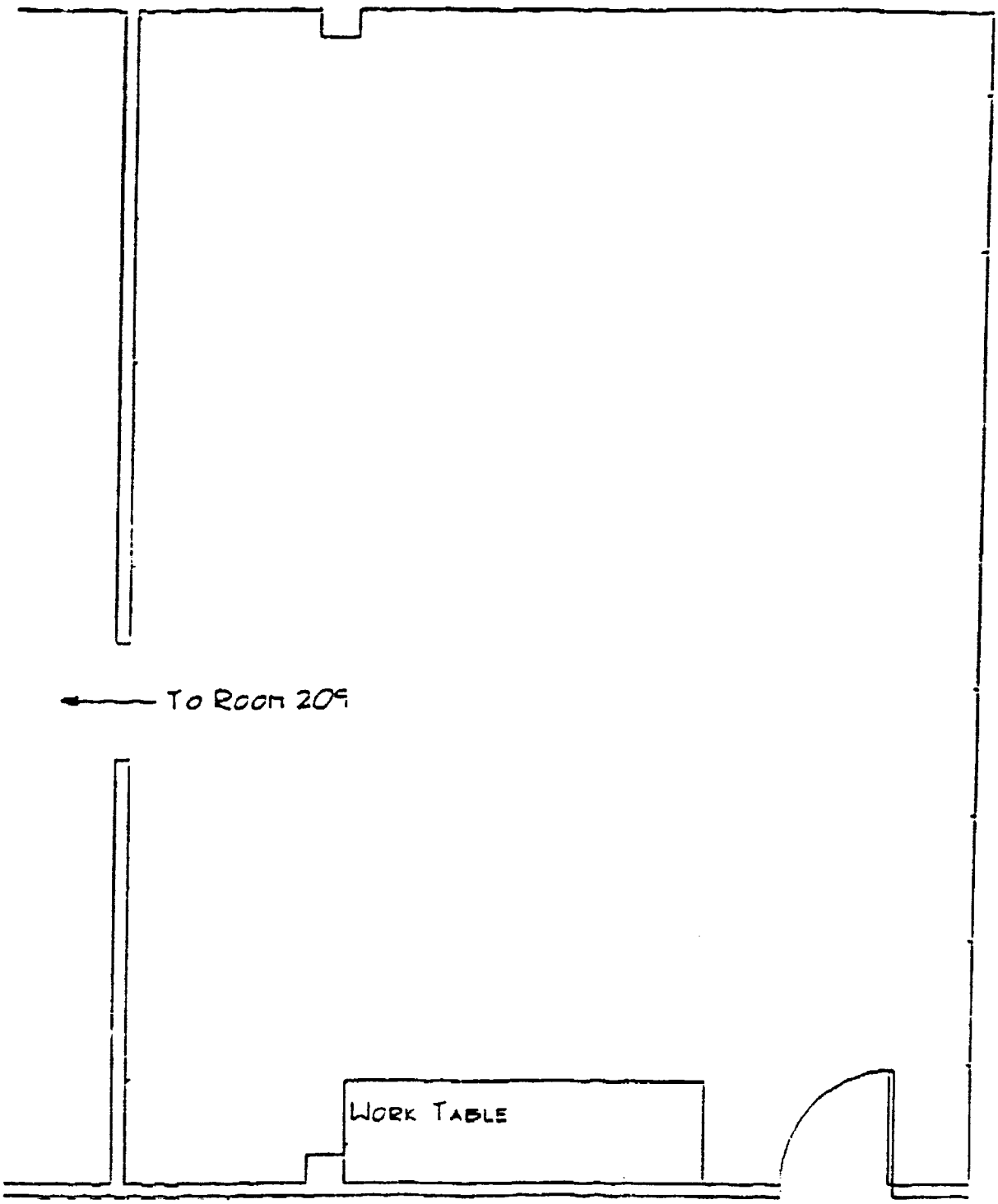
ROOM 209
USGS PHYSICS BUILDING



ROOM 210
USGS PHYSICS BUILDING

DATE: _____

INITIALS: _____



SCALE: 1/4" = 1'

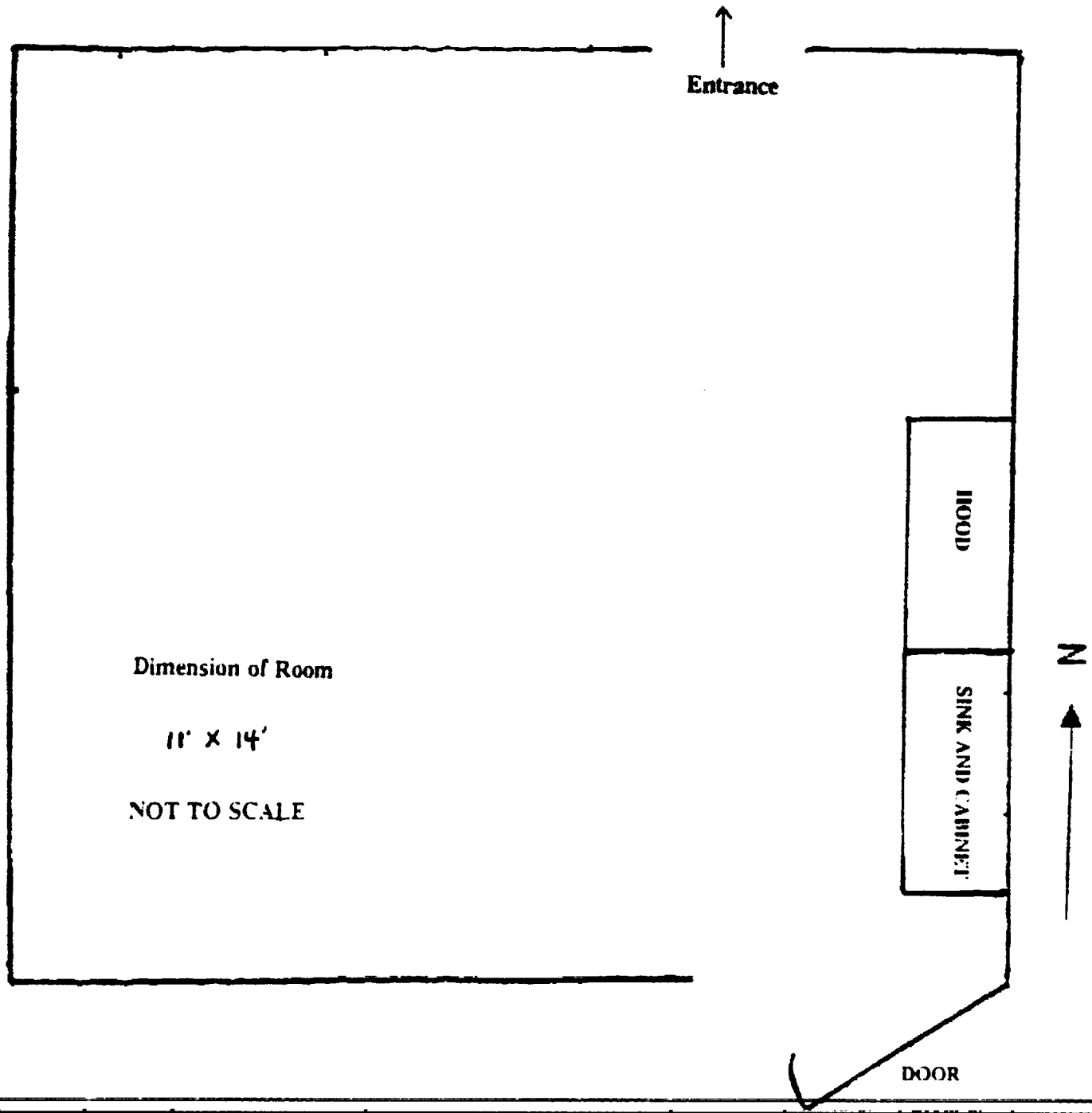
RADIATION SAFETY OFFICE

PHYSICS BUILDING

FIRST FLOOR

Room 107A

Dr. Allan B. Tanner Laboratory



Dimension of Room

11' X 14'

NOT TO SCALE

REPORT OF SAMPLE ANALYSIS

Rev 1.0

For: Mike Terpiliak
Job: Wipe Samples(H.P. Survey)
Sample Type: Gross Gamma

Date: 12/23/96
By: ELW

Sample Date: 12/3/96

Equipment Description:

Counter	Detector
Packard Prias 1	NaI

Counting Parameters: Gross Gamma

Input Background Data:

Background Cts	Ct Time (m)	Background CPM	% Error
464	1	464	9.10%

Input Efficiency Data:

Isotope	Gross Counts	Time (m)	DPM	Efficiency (4 Pi)	% Error
I-129	18476	1	31080	57.95%	0.1

MDA Calculation:

MDA (CPM)	MDA (DPM)	MDA (uCi)
1.034E+02	1.784E+02	8.04E-05

Sample Data: Note: A zero reading for DPM or uCi values indicates only that the sample activity was less than the MDA.

Sequence Number	Sample ID	Gross C P M	Ct Time (m)	*DPM*	*uCi*	% Error at 95% C.L.
1	Rm205 Storage Area 1-5	477	1	0	0.000	0.000
2	6-10	505	1	0	0.000	0.000
3	11-16	484	1	0	0.000	0.000
4	Rm 204 1-5	490	1	0	0.000	0.000
5	6-10	473	1	0	0.000	0.000
6	11-15	495	1	0	0.000	0.000
7	16-20	483	1	0	0.000	0.000
8	21-25	541	1	0	0.000	0.000
9	26-30	494	1	0	0.000	0.000
10	31-35	468	1	0	0.000	0.000
11	36-40	457	1	0	0.000	0.000
12	41-45	493	1	0	0.000	0.000
13	46-50	508	1	0	0.000	0.000
14	51-55	525	1	0	0.000	0.000
15	56-60	468	1	0	0.000	0.000
16	61-65	501	1	0	0.000	0.000
17	66-70	534	1	0	0.000	0.000
18	71-75	447	1	0	0.000	0.000
19	76-80	462	1	0	0.000	0.000
20	81-85	505	1	0	0.000	0.000
21	86-90	465	1	0	0.000	0.000
22	91-95	466	1	0	0.000	0.000
23	96-100	508	1	0	0.000	0.000
24	101-103	475	1	0	0.000	0.000

REPORT OF SAMPLE ANALYSIS

Rev 1.0

For: Mike Terpiliak
Job: Wipe Samples(H.P. Survey)
Sample Type: Gross Gamma

Date: 12 23 96
By: ELW

Sample Date: 12 3 96

Equipment Description:

Counter	Detector
Packard Pnas 1	NaI

Counting Parameters:
Gross Gamma

Input Background Data:

Background Cts	Ct Time (m)	Background CPM	% Error
464	5	92.8	9.10%

Input Efficiency Data:

Isotope	Gross Counts	Time (m)	DPM	Efficiency (4 Pi)	% Error
I-129	18476	1	31080	59.15%	0.1

MDA Calculation:

MDA (CPM)	MDA (DPM)	MDA (uCi)
2.068E+01	3.496E-01	1.57E-05

Sample Data: Note: A zero reading for DPM or uCi values indicates only that the sample activity was less than the MDA.

Sequence Number	Sample ID	Gross CPM	Ct Time (m)	*DPM*	*uCi*	% Error at 95% C.I.
1	Rm 210 1-5	496	5	0	0	0
2	6-10	491	5	0	0	0
3	11-15	492	5	0	0	0
4	16-20	501	5	0	0	0
5	21-25	498	5	0	0	0
6	26-30	493	5	0	0	0
7	31-35	510	5	0	0	0
8	36-40	470	5	0	0	0
9	41-45	471	5	0	0	0
10	46-50	475	5	0	0	0
11	51-55	487	5	0	0	0
12	56-60	548	5	0	0	0
13	61-65	462	5	0	0	0
14	66-70	498	5	0	0	0
15	71-75	491	5	0	0	0
16	76-80	442	5	0	0	0
17	81-85	516	5	0	0	0
18	86-90	517	5	0	0	0
19	91-95	456	5	0	0	0
20	96-100	474	5	0	0	0
21	101-105	485	5	0	0	0
22	106-110	540	5	0	0	0
23	111-115	466	5	0	0	0
24	116-120	496	5	0	0	0
25	121-125	490	5	0	0	0

REPORT OF SAMPLE ANALYSIS
Rev 1.0

Mike Terplink
Wipe Samples(H.P. Survey)
Type: Gross Gamma

Date: 12/23/96
By: LLW

Sample Date: 12/3/96

Description:

Counter	Detector
Packard Prias 1	NaI

Counting Parameters: Gross Gamma

Background Data:

Background Cts	Ct Time (m)	Background CPM	% Error
464	5	92.8	9.10%

Isotope	Gross Counts	Time (m)	DPM	Efficiency (4 Pi)	% Error
I-129	18476	1	31080	59.15%	0.1

MDA (CPM)	MDA (DPM)	MDA (uCi)
2.068E+01	3.496E+01	1.57E-05

Note: A zero reading for DPM or uCi values indicates only that the sample activity was less than the MDA

Sample ID	Gross CPM	Ct Time (m)	*DPM*	*uCi*	% Error at 95% C.L.
Rm 210 126-132	497	5	0	0	0
RSO Office 1-5 Room 107A	507	5	0	0	0
6-10	496	5	0	0	0
11-15	458	5	0	0	0
16-20	438	5	0	0	0
21-25	475	5	0	0	0
26-30	500	5	0	0	0
31-35	498	5	0	0	0
36-38	486	5	0	0	0
Rm 209 1-5	493	5	0	0	0
6-10	455	5	0	0	0
11-15	512	5	0	0	0
16-20	477	5	0	0	0
21-25	496	5	0	0	0
26-30	514	5	0	0	0
31-35	536	5	0	0	0
36-40	535	5	0	0	0
41-45	516	5	0	0	0
46-50	521	5	0	0	0
51-55	481	5	0	0	0

REPORT OF SAMPLE ANALYSIS
Rev 1.0

For: Mike Terpilak
Job: Wipe Samples(H.P. Survey)
Sample Type: Gross Gamma

Date: 12/23/96
By: ELW

Sample Date: 12/3/96

Equipment Description:

Counter	Detector
Packard Prias 1	NaI

Counting Parameters: Gross Gamma

Input Background Data:

Background Cts	Ct Time (m)	Background CPM	% Error
464	5	92.8	9.10%

Input Efficiency Data:

Isotope	Gross Counts	Time (m)	DPM	Efficiency (4 Pi)	% Error
I-129	18476	1	31080	59.15%	0.1

MDA Calculation:

MDA (CPM)	MDA (DPM)	MDA (uCi)
2.068E+01	3.496E+01	1.57E-05

Sample Data: Note: A zero reading for DPM or uCi values indicates only that the sample activity was less than the MDA.

Sequence Number	Sample ID	Gross C P M	Ct Time (m)	*DPM*	*uCi*	% Error at 95% C.L.
1	Rm 209 56-60	527	5	0	0	0
2	61-65	516	5	0	0	0
3	66-70	537	5	0	0	0
4	71-73	494	5	0	0	0
5	Weigh Rm 1-5 Room	531	5	0	0	0
6	6-10 209	481	5	0	0	0
7	11-15	515	5	0	0	0
8	Rm203 1-5	482	5	0	0	0
9	6-10	492	5	0	0	0
10	11-15	500	5	0	0	0
11	16-20	504	5	0	0	0
12	21-25	445	5	0	0	0
13	26-30	501	5	0	0	0
14	31-35	473	5	0	0	0
15	36-40	505	5	0	0	0
16	41-45	513	5	0	0	0
17	46-50	488	5	0	0	0
18	51-55	509	5	0	0	0
19	56-60	525	5	0	0	0
20	61-65	486	5	0	0	0
21	66-70	528	5	0	0	0
22	71-75	465	5	0	0	0

Mike Terpilak Wipe Survey

LS Counter Data Reduction Program - ESI (LS 1*01)

Report Date 12/23/96
Sample Date 12/3/96

Wide Window (User No. 1)

Bkg CPM	Count Time (min)	% Error (95% C.L.)
38	1	31.80%

MDA (CPM) 32 MDA (DPM) 51

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

Sample ID	Count Time (min)	S/P	CPM	Efficiency	CF	DPM	Error (95% C.L.)
31	Room 204 #1	1	0.152	22	[illegible]	1.00	0	0.00%
32	2	1	[illegible]	32	[illegible]	1.00	0	0.00%
33	3	1	[illegible]	24	[illegible]	1.00	0	0.00%
34	4	1	[illegible]	17	[illegible]	1.00	0	0.00%
35	5	1	[illegible]	28	[illegible]	1.00	0	0.00%
36	6	1	[illegible]	20	[illegible]	1.00	0	0.00%
37	7	1	[illegible]	29	[illegible]	1.00	0	0.00%
38	8	1	[illegible]	32	[illegible]	1.00	0	0.00%
39	9	1	[illegible]	15	[illegible]	1.00	0	0.00%
40	10	1	[illegible]	44	[illegible]	1.00	0	0.00%

Mike Terpeluk Wipe Survey

LS Counter Data Reduction Program - ESI (2/5/91)

Report Date: 12/21/96
Sample Date: 12/3/96

Backup: 12/2/96

Wide Window (User No. 1)

Bkg CPM	Count Time (min)	% Error (95% C.L.)
38	1	31.80%

MDA (CPM): 12 MDA (DPM): 52

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.L.)
1	Lab Room 204 #11	1	0.142	33	61.805%	1.00	0	0.00%
2	12	1	0.162	37	61.066%	1.00	0	0.00%
3	13	1	0.222	27	56.635%	1.00	0	0.00%
4	14	1	0.261	23	53.759%	1.00	0	0.00%
5	15	1	0.194	31	58.701%	1.00	0	0.00%
6	16	1	0.158	38	61.362%	1.00	0	0.00%
7	Lab Room 204 #1	1	0.189	32	59.087%	1.00	0	0.00%
8	2	1	0.207	29	57.743%	1.00	0	0.00%
9	3	1	0.200	25	58.260%	1.00	0	0.00%
10	4	1	0.091	33	66.310%	1.00	0	0.00%
11	5	1	0.276	29	52.647%	1.00	0	0.00%
12	6	1	0.209	43	57.494%	1.00	0	0.00%
13	7	1	0.156	32	61.409%	1.00	0	0.00%
14	8	1	0.063	32	68.177%	1.00	0	0.00%
15	9	1	0.147	31	62.174%	1.00	0	0.00%
16	10	1	0.150	30	61.953%	1.00	0	0.00%
17	11	1	0.214	28	57.224%	1.00	0	0.00%
18	12	1	0.088	34	66.531%	1.00	0	0.00%
19	13	1	0.150	30	61.953%	1.00	0	0.00%
20	14	1	0.171	35	60.103%	1.00	0	0.00%
21	15	1	0.183	35	59.669%	1.00	0	0.00%
22	16	1	0.167	36	60.927%	1.00	0	0.00%
23	17	1	0.179	39	59.811%	1.00	0	0.00%
24	18	1	0.100	40	65.644%	1.00	0	0.00%
25	19	1	0.103	29	65.423%	1.00	0	0.00%
26	20	1	0.250	32	54.567%	1.00	0	0.00%
27	21	1	0.167	32	60.697%	1.00	0	0.00%
28	22	1	0.156	32	61.409%	1.00	0	0.00%
29	23	1	0.071	28	67.787%	1.00	0	0.00%
30	24	1	0.097	31	65.867%	1.00	0	0.00%
31	25	1	0.182	41	59.480%	1.00	0	0.00%
32	26	1	0.150	41	62.691%	1.00	0	0.00%
33	27	1	0.179	41	61.409%	1.00	0	0.00%
34	28	1	0.063	31	68.230%	1.00	0	0.00%
35	29	1	0.142	40	63.287%	1.00	0	0.00%
36	30	1	0.111	46	65.834%	1.00	0	0.00%
37	31	1	0.118	29	62.830%	1.00	0	0.00%
38	32	1	0.118	29	62.830%	1.00	0	0.00%
39	33	1	0.227	27	56.266%	1.00	0	0.00%
40	34	1	0.200	31	57.817%	1.00	0	0.00%
41	35	1	0.038	26	70.224%	1.00	0	0.00%
42	36	1	0.107	28	64.120%	1.00	0	0.00%
43	37	1	0.158	39	61.362%	1.00	0	0.00%
44	38	1	0.163	37	60.993%	1.00	0	0.00%
45	39	1	0.123	30	63.208%	1.00	0	0.00%
46	40	1	0.265	26	53.165%	1.00	0	0.00%
47	41	1	0.259	32	54.004%	1.00	0	0.00%
48	42	1	0.163	37	61.066%	1.00	0	0.00%
49	43	1	0.197	27	59.980%	1.00	0	0.00%
50	44	1	0.262	21	53.944%	1.00	0	0.00%

Mike Terpiliak Wipe Survey

LS Counter Data Reduction Program - ESI (LS 1*01)

Report Date: 12/23/96
Sample Date: 12/3/96

[illegible]

Wide Window (User No. 1)

Bkg CPM	Count Time (min)	% Error (95% C.L.)
38	1	31.80%

MDA (CPM): 32 MDA (DPM): 52

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.L.)
1	Lab Room 204 m45	1	0.261	23	53.759%	1.00	0	0.00%
2	46	1	0.159	44	61.288%	1.00	0	0.00%
3	47	1	0.217	23	57.004%	1.00	0	0.00%
4	48	1	0.176	34	60.032%	1.00	0	0.00%
5	49	1	0.081	37	67.048%	1.00	0	0.00%
6	50	1	0.190	21	58.999%	1.00	0	0.00%
7	51	1	0.216	37	57.078%	1.00	0	0.00%
8	52	1	0.050	10	69.338%	1.00	0	0.00%
9	53	1	0.229	15	56.118%	1.00	0	0.00%
10	54	1	0.207	29	57.743%	1.00	0	0.00%
11	55	1	0.051	39	69.264%	1.00	0	0.00%
12	56	1	0.125	32	63.790%	1.00	0	0.00%
13	57	1	0.143	28	62.469%	1.00	0	0.00%
14	58	1	0.185	27	59.368%	1.00	0	0.00%
15	59	1	0.150	30	61.954%	1.00	0	0.00%
16	60	1	0.154	26	61.657%	1.00	0	0.00%
17	61	1	0.111	36	64.833%	1.00	0	0.00%
18	62	1	0.111	27	64.833%	1.00	0	0.00%
19	63	1	0.156	32	61.600%	1.00	0	0.00%
20	64	1	0.146	26	62.478%	1.00	0	0.00%
21	65	1	0.013	30	70.591%	1.00	0	0.00%
22	66	1	0.227	22	56.266%	1.00	0	0.00%
23	67	1	0.182	33	59.589%	1.00	0	0.00%
24	68	1	0.189	37	59.072%	1.00	0	0.00%
25	69	1	0.207	29	57.743%	1.00	0	0.00%
26	70	1	0.259	27	53.903%	1.00	0	0.00%
27	71	1	0.158	38	61.362%	1.00	0	0.00%
28	72	1	0.105	19	65.276%	1.00	0	0.00%
29	73	1	0.040	24	70.076%	1.00	0	0.00%
30	74	1	0.290	31	51.631%	1.00	0	0.00%
31	75	1	0.156	32	61.600%	1.00	0	0.00%
32	76	1	0.115	24	63.537%	1.00	0	0.00%
33	77	1	0.100	40	65.654%	1.00	0	0.00%
34	78	1	0.189	37	59.072%	1.00	0	0.00%
35	79	1	0.189	35	59.072%	1.00	0	0.00%
36	80	1	0.191	31	58.928%	1.00	0	0.00%
37	81	1	0.240	24	55.306%	1.00	0	0.00%
38	82	1	0.109	37	65.054%	1.00	0	0.00%
39	83	1	0.167	40	60.639%	1.00	0	0.00%
40	84	1	0.161	41	61.184%	1.00	0	0.00%
41	85	1	0.216	19	57.078%	1.00	0	0.00%
42	86	1	0.133	40	63.200%	1.00	0	0.00%
43	87	1	0.125	40	63.790%	1.00	0	0.00%
44	88	1	0.115	37	63.900%	1.00	0	0.00%
45	89	1	0.156	32	61.600%	1.00	0	0.00%
46	90	1	0.158	39	61.362%	1.00	0	0.00%
47	91	1	0.156	32	61.600%	1.00	0	0.00%
48	92	1	0.071	29	67.787%	1.00	0	0.00%
49	93	1	0.176	44	60.032%	1.00	0	0.00%
50	94	1	0.241	29	55.232%	1.00	0	0.00%

Mike Terpilak Wipe Survey

LS Counter Data Reduction Program - ESI (LS 1*01)

Report Date 12/23/96
Sample Date 12/3/96

[illegible]

Wide Window (User No. 1)

Bkg CPM	Count Time (min)	% Error (95% C.L.)
38	1	31.80%

MDA (CPM): 32 MDA (DPM): 51

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.L.)
1	Lab Room 204 #95	1	0.219	32	56.85%	1.00	0	0.00%
2	96	1	0.214	28	57.226%	1.00	0	0.00%
3	97	1	0.143	28	62.469%	1.00	0	0.00%
4	98	1	0.194	31	58.703%	1.00	0	0.00%
5	99	1	0.114	35	64.611%	1.00	0	0.00%
6	100	1	0.214	28	57.226%	1.00	0	0.00%
7	101	1	0.154	39	61.65%	1.00	0	0.00%
8	102	1	0.056	36	68.894%	1.00	0	0.00%
9	103	1	0.061	34	68.52%	1.00	0	0.00%
10	Lab Room 210 #1	1	0.217	23	57.00%	1.00	0	0.00%
11	2	1	0.125	32	63.799%	1.00	0	0.00%
12	3	1	0.189	37	59.075%	1.00	0	0.00%
13	4	1	0.143	35	62.469%	1.00	0	0.00%
14	5	1	0.152	33	61.80%	1.00	0	0.00%
15	6	1	0.179	28	59.811%	1.00	0	0.00%
16	7	1	0.158	38	61.362%	1.00	0	0.00%
17	8	1	0.179	28	59.811%	1.00	0	0.00%
18	9	1	0.121	33	64.094%	1.00	0	0.00%
19	10	1	0.240	25	55.406%	1.00	0	0.00%
20	11	1	0.225	40	56.113%	1.00	0	0.00%
21	12	1	0.208	24	57.669%	1.00	0	0.00%
22	13	1	0.147	34	62.174%	1.00	0	0.00%
23	14	1	0.100	30	65.65%	1.00	0	0.00%
24	15	1	0.120	25	63.168%	1.00	0	0.00%
25	16	1	0.133	30	63.208%	1.00	0	0.00%
26	17	1	0.188	32	59.146%	1.00	0	0.00%
27	18	1	0.079	38	67.196%	1.00	0	0.00%
28	19	1	0.261	23	53.755%	1.00	0	0.00%
29	20	1	0.143	28	62.469%	1.00	0	0.00%
30	21	1	0.069	29	67.944%	1.00	0	0.00%
31	22	1	0.121	33	64.094%	1.00	0	0.00%
32	23	1	0.094	32	66.088%	1.00	0	0.00%
33	24	1	0.146	38	62.248%	1.00	0	0.00%
34	25	1	0.063	32	68.377%	1.00	0	0.00%
35	26	1	0.154	39	61.65%	1.00	0	0.00%
36	27	1	0.122	41	64.020%	1.00	0	0.00%
37	28	1	0.179	28	59.811%	1.00	0	0.00%
38	29	1	0.056	36	68.894%	1.00	0	0.00%
39	30	1	0.104	29	65.124%	1.00	0	0.00%
40	31	1	0.167	21	60.697%	1.00	0	0.00%
41	32	1	0.135	37	63.069%	1.00	0	0.00%
42	33	1	0.171	41	60.402%	1.00	0	0.00%
43	34	1	0.125	32	63.799%	1.00	0	0.00%
44	35	1	0.125	32	63.799%	1.00	0	0.00%
45	36	1	0.100	30	65.615%	1.00	0	0.00%
46	37	1	0.120	25	63.168%	1.00	0	0.00%
47	38	1	0.200	15	58.268%	1.00	0	0.00%
48	39	1	0.071	28	67.758%	1.00	0	0.00%
49	40	1	0.157	35	58.821%	1.00	0	0.00%
50	41	1	0.167	21	60.697%	1.00	0	0.00%

Mike Terpilak Wipe Survey

LS Counter Data Reduction Program - ESI (LS 1"01)

Report Date: 12 23 96
Sample Date: 12/3/96

[illegible]

Wide Window (User No 1)

Bkg CPM	Count Time (min)	% Error (95% C.I.)
38	1	31 80%

MDA (CPM): 32 MDA (DPM): 53

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.I.)
1	Lab Room 210 #42	1	0 091	33	66 310%	1 00	0	0 00%
2	43	1	0 250	24	54 567%	1 00	0	0 00%
3	44	1	0 115	26	64 537%	1 00	0	0 00%
4	45	1	0 143	35	62 469%	1 00	0	0 00%
5	46	1	0 139	36	62 765%	1 00	0	0 00%
6	47	1	0 222	27	56 635%	1 00	0	0 00%
7	48	1	0 167	30	60 697%	1 00	0	0 00%
8	49	1	0 158	38	61 362%	1 00	0	0 00%
9	50	1	0 235	33	55 675%	1 00	0	0 00%
10	51	1	0 147	34	62 174%	1 00	0	0 00%
11	52	1	0 139	36	62 765%	1 00	0	0 00%
12	53	1	0 190	42	58 999%	1 00	0	0 00%
13	54	1	0 188	32	59 116%	1 00	0	0 00%
14	55	1	0 063	16	68 37[illegible]%	1 00	0	0 00%
15	56	1	0 167	36	60 697%	1 00	0	0 00%
16	57	1	0 081	17	67 038%	1 00	0	0 00%
17	58	1	0 231	29	55 971%	1 00	0	0 00%
18	59	1	0 156	32	61 500%	1 00	0	0 00%
19	60	1	0 271	22	52 869%	1 00	0	0 00%
20	61	1	0 151	29	61 731%	1 00	0	0 00%
21	62	1	0 100	36	64 980%	1 00	0	0 00%
22	63	1	0 269	26	53 164%	1 00	0	0 00%
23	64	1	0 091	22	66 310%	1 00	0	0 00%
24	65	1	0 071	27	67 565%	1 00	0	0 00%
25	66	1	0 111	35	64 833%	1 00	0	0 00%
26	67	1	0 161	36	61 110%	1 00	0	0 00%
27	68	1	0 105	38	65 276%	1 00	0	0 00%
28	69	1	0 268	41	53 218%	1 00	0	0 00%
29	70	1	0 171	35	60 402%	1 00	0	0 00%
30	71	1	0 265	31	53 460%	1 00	0	0 00%
31	72	1	0 229	35	56 118%	1 00	0	0 00%
32	73	1	0 129	31	63 503%	1 00	0	0 00%
33	74	1	0 118	31	64 316%	1 00	0	0 00%
34	75	1	0 233	33	55 823%	1 00	0	0 00%
35	76	1	0 195	31	58 629%	1 00	0	0 00%
36	77	1	0 210	31	57 817%	1 00	0	0 00%
37	78	1	0 091	33	66 310%	1 00	0	0 00%
38	79	1	0 200	35	58 260%	1 00	0	0 00%
39	80	1	0 250	32	54 567%	1 00	0	0 00%
40	81	1	0 111	35	65 011%	1 00	0	0 00%
41	82	1	0 304	33	50 653%	1 00	0	0 00%
42	83	1	0 080	25	67 122%	1 00	0	0 00%
43	84	1	0 200	35	58 260%	1 00	0	0 00%
44	85	1	0 206	34	57 817%	1 00	0	0 00%
45	86	1	0 114	24	61 631%	1 00	0	0 00%
46	87	1	0 300	30	50 [illegible]%	1 00	0	0 00%
47	88	1	0 071	27	67 565%	1 00	0	0 00%
48	89	1	0 240	28	54 567%	1 00	0	0 00%
49	90	1	0 086	15	66 670%	1 00	0	0 00%
50	91	1	0 289	18	51 658%	1 00	0	0 00%

Mike Terpiluk Wipe Survey

LS Counter Data Reduction Program - ESI (LS 1701)

Report Date: 12/23/96
Sample Date: 12/3/96

Beckman LS 1701

Wide Window (User No. 1)

Bkg CPM	Count Time (min)	% Error (95% C.L.)
38	1	31.80%

MDA (CPM): 32 MDA (DPM): 55

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.L.)
1	Lab Room 210 #92	1	0.273	33	52.869%	1.00	0	0.00%
2	93	1	0.143	35	62.469%	1.00	0	0.00%
3	94	1	0.297	37	51.097%	1.00	0	0.00%
4	95	1	0.235	34	55.675%	1.00	0	0.00%
5	96	1	0.250	32	54.567%	1.00	0	0.00%
6	97	1	0.265	34	53.460%	1.00	0	0.00%
7	98	1	0.222	36	56.635%	1.00	0	0.00%
8	99	1	0.130	23	63.430%	1.00	0	0.00%
9	100	1	0.138	29	62.839%	1.00	0	0.00%
10	101	1	0.256	39	54.124%	1.00	0	0.00%
11	102	1	0.225	40	56.414%	1.00	0	0.00%
12	103	1	0.179	28	59.811%	1.00	0	0.00%
13	104	1	0.121	33	64.093%	1.00	0	0.00%
14	105	1	0.294	34	51.418%	1.00	0	0.00%
15	106	1	0.171	23	60.180%	1.00	0	0.00%
16	107	1	0.094	32	66.088%	1.00	0	0.00%
17	108	1	0.226	31	56.340%	1.00	0	0.00%
18	109	1	0.143	28	62.169%	1.00	0	0.00%
19	110	1	0.200	30	58.260%	1.00	0	0.00%
20	111	1	0.125	40	63.799%	1.00	0	0.00%
21	112	1	0.094	32	66.088%	1.00	0	0.00%
22	113	1	0.125	32	63.799%	1.00	0	0.00%
23	114	1	0.263	19	53.607%	1.00	0	0.00%
24	115	1	0.189	37	59.072%	1.00	0	0.00%
25	116	1	0.179	28	59.811%	1.00	0	0.00%
26	117	1	0.222	27	56.635%	1.00	0	0.00%
27	118	1	0.295	44	51.244%	1.00	0	0.00%
28	119	1	0.111	27	64.813%	1.00	0	0.00%
29	120	1	0.227	22	56.266%	1.00	0	0.00%
30	121	1	0.160	25	61.215%	1.00	0	0.00%
31	122	1	0.179	39	59.811%	1.00	0	0.00%
32	123	1	0.241	31	55.011%	1.00	0	0.00%
33	124	1	0.276	29	52.647%	1.00	0	0.00%
34	125	1	0.148	27	62.108%	1.00	0	0.00%
35	126	1	0.088	34	66.531%	1.00	0	0.00%
36	127	1	0.705	105	20.966%	1.00	320	21.97%
37	128	1	0.222	36	56.635%	1.00	0	0.00%
38	129	1	0.278	18	52.500%	1.00	0	0.00%
39	130	1	0.212	33	54.154%	1.00	0	0.00%
40	131	1	0.135	37	63.060%	1.00	0	0.00%
41	132	1	0.256	36	54.567%	1.00	0	0.00%

Mike Terpiliak Wipe Survey

LS Counter Data Reduction Program - ESI (LS 1701)

Report Date: 12/23/96
Sample Date: 12/3/96

[illegible]

Wide Window (User No. 1)

Bkg CPM	Count Time (min)	% Error (95% C.L.)
38	1	31.80%

MDA (CPM): 32 MDA (DPM): 54

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.L.)
16	Room 107A #1	1	0.065	31	63.230%	1.00	0	0.00%
17	2	1	0.343	35	47.699%	1.00	0	0.00%
18	3	1	0.290	31	51.614%	1.00	0	0.00%
19	4	1	0.205	39	57.891%	1.00	0	0.00%
20	5	1	0.233	30	55.823%	1.00	0	0.00%
21	6	1	0.143	35	62.469%	1.00	0	0.00%
22	7	1	0.182	33	59.589%	1.00	0	0.00%
23	8	1	0.267	30	53.312%	1.00	0	0.00%
24	9	1	0.205	39	57.891%	1.00	0	0.00%
25	10	1	0.216	37	57.078%	1.00	0	0.00%
26	11	1	0.167	24	60.697%	1.00	0	0.00%
27	12	1	0.229	35	56.118%	1.00	0	0.00%
28	13	1	0.036	28	70.371%	1.00	0	0.00%
29	14	1	0.238	42	55.454%	1.00	0	0.00%
30	15	1	0.192	26	58.851%	1.00	0	0.00%
31	16	1	0.152	33	61.805%	1.00	0	0.00%
32	17	1	0.267	30	53.312%	1.00	0	0.00%
33	18	1	0.233	30	55.823%	1.00	0	0.00%
34	19	1	0.207	29	57.744%	1.00	0	0.00%
35	20	1	0.154	26	61.657%	1.00	0	0.00%
36	21	1	0.147	34	62.174%	1.00	0	0.00%
37	22	1	0.167	30	60.697%	1.00	0	0.00%
38	23	1	0.265	34	53.460%	1.00	0	0.00%
39	24	1	0.079	38	67.196%	1.00	0	0.00%
40	25	1	0.189	37	59.072%	1.00	0	0.00%
41	26	1	0.240	25	55.306%	1.00	0	0.00%
42	27	1	0.125	24	63.799%	1.00	0	0.00%
43	28	1	0.222	36	56.635%	1.00	0	0.00%
44	29	1	0.161	33	61.140%	1.00	0	0.00%
45	30	1	0.159	44	61.289%	1.00	0	0.00%
46	31	1	0.171	41	60.402%	1.00	0	0.00%
47	32	1	0.258	31	53.977%	1.00	0	0.00%
48	33	1	0.161	31	61.140%	1.00	0	0.00%
49	34	1	0.171	35	60.402%	1.00	0	0.00%
50	35	1	0.121	58	64.094%	1.00	0	0.00%

Mike Terpilak Wipe Survey

LS Counter Data Reduction Program - ESI (LS 1701)

Report Date: 12/23/96
Sample Date: 12/3/96

Backmap (LS 1701)

Wide Window (User No. 1)

Bkg CPM	Count Time (min)	% Error (95% C.L.)
38	1	31.80%

MDA (CPM): 32 MDA (DPM): 51

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.L.)
1	Room 107A #36	1	0.139	36	62.765%	1.00	0	0.00%
2	37	1	0.179	28	59.811%	1.00	0	0.00%
3	38	1	0.051	39	69.264%	1.00	0	0.00%
4	39	1	0.136	44	62.986%	1.00	0	0.00%
5	Room 209 #1	1	0.125	32	63.799%	1.00	0	0.00%
6	2	1	0.094	32	66.088%	1.00	0	0.00%
7	3	1	0.107	28	65.128%	1.00	0	0.00%
8	4	1	0.172	29	60.328%	1.00	0	0.00%
9	5	1	0.148	27	62.100%	1.00	0	0.00%
10	6	1	0.087	23	66.605%	1.00	0	0.00%
11	7	1	0.222	36	56.635%	1.00	0	0.00%
12	8	1	0.120	25	64.168%	1.00	0	0.00%
13	9	1	0.227	22	56.266%	1.00	0	0.00%
14	10	1	0.217	23	57.015%	1.00	0	0.00%
15	11	1	0.190	32	58.999%	1.00	0	0.00%
16	12	1	0.192	26	58.851%	1.00	0	0.00%
17	13	1	0.163	31	61.110%	1.00	0	0.00%
18	14	1	0.226	21	56.310%	1.00	0	0.00%
19	15	1	0.172	29	60.328%	1.00	0	0.00%
20	16	1	0.194	31	58.703%	1.00	0	0.00%
21	17	1	0.129	41	63.503%	1.00	0	0.00%
22	18	1	0.233	24	55.438%	1.00	0	0.00%
23	19	1	0.150	30	61.953%	1.00	0	0.00%
24	20	1	0.192	26	58.851%	1.00	0	0.00%
25	21	1	0.146	22	62.986%	1.00	0	0.00%
26	22	1	0.185	27	59.368%	1.00	0	0.00%
27	23	1	0.267	15	53.312%	1.00	0	0.00%
28	24	1	0.091	33	66.310%	1.00	0	0.00%
29	25	1	0.114	35	64.611%	1.00	0	0.00%
30	26	1	0.189	37	59.073%	1.00	0	0.00%
31	27	1	0.147	34	62.175%	1.00	0	0.00%
32	28	1	0.050	20	69.338%	1.00	0	0.00%
33	29	1	0.097	31	65.867%	1.00	0	0.00%
34	30	1	0.211		57.114%	1.00	0	0.00%
35	31	1	0.216	37	57.078%	1.00	0	0.00%
36	32	1	0.156	42	61.500%	1.00	0	0.00%
37	33	1	0.103	39	65.323%	1.00	0	0.00%
38	34	1	0.167	40	60.6[illegible]	1.00	0	0.00%
39	35	1	0.189	37	59.073%	1.00	0	0.00%
40	36	1	0.125	32	63.799%	1.00	0	0.00%
41	37	1	0.010	25	70.076%	1.00	0	0.00%
42	38	1	0.135	37	63.060%	1.00	0	0.00%
43	39	1	0.151	26	61.657%	1.00	0	0.00%
44	40	1	0.061	33	68.524%	1.00	0	0.00%
45	41	1	0.133	30	63.208%	1.00	0	0.00%
46	42	1	0.191	31	59.703%	1.00	0	0.00%
47	43	1	0.194	36	58.703%	1.00	0	0.00%
48	44	1	0.174	23	60.180%	1.00	0	0.00%
49	45	1	0.080	25	67.122%	1.00	0	0.00%
50	46	1	0.118	41	64.316%	1.00	0	0.00%

Mike Terpiliak Wipe Survey

LS Counter Data Reduction Program - ESI (LS 1°01)

Report Date: 12 23/96
Sample Date: 12/3/96

Beckman LS 1701

Wide Window (User No 1)

Bkg CPM	Count Time (min)	% Error (95% C L)
38	1	31 80%

MDA (CPM): 32 MDA (DPM): 53

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C L)
1	Room 209 #47	1	0 176	34	60 032%	1 00	0	0 00%
2	48	1	0.310	29	50 137%	1 00	0	0 00%
3	49	1	0 188	146	59 146%	1 00	183	21 37%
4	50	1	0 208	24	57.669%	1 00	0	0 00%
5	51	1	0 176	34	60 032%	1 00	0	0 00%
6	52	1	0 071	28	67 78%	1 00	0	0.00%
7	53	1	0 190	42	58 990%	1 00	0	0 00%
8	54	1	0 069	29	67 934%	1 00	0	0 00%
9	55	1	0 133	30	63 208%	1 00	0	0 00%
10	56	1	0 160	25	61 214%	1 00	0	0 00%
11	57	1	0 156	32	61 509%	1 00	0	0 00%
12	58	1	0 107	28	65 128%	1 00	0	0 00%
13	59	1	0 207	29	57 743%	1 00	0	0 00%
14	60	1	0 282	39	52 204%	1 00	0	0 00%
15	61	1	0 233	33	55 801%	1 00	0	0 00%
16	62	1	0 194	31	58 703%	1 00	0	0 00%
17	63	1	0 069	29	67 934%	1 00	0	0 00%
18	64	1	0 125	32	63 799%	1 00	0	0 00%
19	65	1	0 162	37	61 066%	1 00	0	0 00%
20	66	1	0 261	23	53 755%	1 00	0	0 00%
21	67	1	0 083	23	66 900%	1 00	0	0 00%
22	68	1	0 214	28	57 226%	1 00	0	0 00%
23	69	1	0 079	38	67 196%	1 00	0	0 00%
24	70	1	0 125	40	63 799%	1 00	0	0 00%
25	71	1	0 170	24	60 498%	1 00	0	0 00%
26	72	1	0 167	30	60 697%	1 00	0	0 00%
27	73	1	0 083	36	66 900%	1 00	0	0 00%
28	Weighing Rm 209 #1	1	0 089	15	66 457%	1 00	0	0 00%
29	2	1	0 286	32	51 900%	1 00	0	0 00%
30	3	1	0 238	21	55 154%	1 00	0	0 00%
31	4	1	0 118	31	63 316%	1 00	0	0 00%
32	5	1	0 182	33	59 589%	1 00	0	0 00%
33	6	1	0 194	31	58 703%	1 00	0	0 00%
34	7	1	0 065	31	68 230%	1 00	0	0 00%
35	8	1	0 231	39	55 971%	1 00	0	0 00%
36	9	1	0 200	35	58 260%	1 00	0	0 00%
37	10	1	0 214	28	57 226%	1 00	0	0 00%
38	11	1	0 222	27	56 635%	1 00	0	0 00%
39	12	1	0 241	29	55 232%	1 00	0	0 00%
40	13	1	0 343	35	47 699%	1 00	0	0 00%
41	14	1	0 088	31	66 531%	1 00	0	0 00%
42	15	1	0 077	26	67 331%	1 00	0	0 00%
43	16	1	0 139	36	62 765%	1 00	0	0 00%
44	17	1	0 125	32	63 799%	1 00	0	0 00%
45	Room 203 #1	1	0 242	33	55 158%	1 00	0	0 00%
46	2	1	0 250	32	54 567%	1 00	0	0 00%
47	3	1	0 140	43	62 691%	1 00	0	0 00%
48	4	1	0 188	32	59 146%	1 00	0	0 00%
49	5	1	0 229	35	56 118%	1 00	0	0 00%
50	6	1	0 172	29	60 328%	1 00	0	0 00%

Mike Terpilak Wipe Survey

LS Counter Data Reduction Program - ESI (LS 1701)

Report Date: 12/23/96
Sample Date: 12/3/96

Beckman LS 1701

Wide Window (User No 1)

Bkg CPM	Count Time (min)	% Error (95% C.I.)
38	1	31.80%

MDA (CPM): 32 MDA (DPM): 53

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.I.)
1	Room 203 #7	1	0.148	27	62.100%	1.00	0	0.00%
2	8	1	0.267	30	53.312%	1.00	0	0.00%
3	9	1	0.154	26	61.657%	1.00	0	0.00%
4	10	1	0.065	31	68.230%	1.00	0	0.00%
5	11	1	0.257	35	54.051%	1.00	0	0.00%
6	12	1	0.200	25	58.260%	1.00	0	0.00%
7	13	1	0.161	31	61.140%	1.00	0	0.00%
8	14	1	0.282	39	52.204%	1.00	0	0.00%
9	15	1	0.138	29	62.839%	1.00	0	0.00%
10	16	1	0.194	36	58.703%	1.00	0	0.00%
11	17	1	0.226	31	56.340%	1.00	0	0.00%
12	18	1	0.143	28	62.469%	1.00	0	0.00%
13	19	1	0.133	30	63.208%	1.00	0	0.00%
14	20	1	0.200	35	58.260%	1.00	0	0.00%
15	21	1	0.167	21	60.697%	1.00	0	0.00%
16	22	1	0.190	21	58.999%	1.00	0	0.00%
17	23	1	0.130	23	63.430%	1.00	0	0.00%
18	24	1	0.138	29	62.839%	1.00	0	0.00%
19	25	1	0.185	27	59.368%	1.00	0	0.00%
20	26	1	0.185	27	59.368%	1.00	0	0.00%
21	27	1	0.222	27	56.635%	1.00	0	0.00%
22	28	1	0.176	74	60.032%	1.00	60	30.18%
23	29	1	0.250	32	54.567%	1.00	0	0.00%
24	30	1	0.167	30	60.697%	1.00	0	0.00%
25	31	1	0.061	33	68.525%	1.00	0	0.00%
26	32	1	0.121	33	63.094%	1.00	0	0.00%
27	33	1	0.194	31	58.703%	1.00	0	0.00%
28	34	1	0.231	39	55.971%	1.00	0	0.00%
29	35	1	0.060	50	68.599%	1.00	0	0.00%
30	36	1	0.158	38	61.362%	1.00	0	0.00%
31	37	1	0.200	30	58.260%	1.00	0	0.00%
32	38	1	0.111	36	63.833%	1.00	0	0.00%
33	39	1	0.366	41	46.001%	1.00	0	0.00%
34	40	1	0.095	42	66.011%	1.00	0	0.00%
35	41	1	0.233	30	55.823%	1.00	0	0.00%
36	42	1	0.205	39	57.891%	1.00	0	0.00%
37	43	1	0.219	32	56.857%	1.00	0	0.00%
38	44	1	0.139	36	62.765%	1.00	0	0.00%
39	45	1	0.192	26	58.851%	1.00	0	0.00%
40	46	1	0.280	25	52.352%	1.00	0	0.00%
41	47	1	0.125	48	63.799%	1.00	0	0.00%
42	48	1	0.167	36	60.697%	1.00	0	0.00%
43	49	1	0.148	27	62.100%	1.00	0	0.00%
44	50	1	0.250	16	54.567%	1.00	0	0.00%
45	51	1	0.200	25	58.260%	1.00	0	0.00%
46	52	1	0.200	30	58.260%	1.00	0	0.00%
47	53	1	0.200	35	58.260%	1.00	0	0.00%
48	54	1	0.097	31	65.867%	1.00	0	0.00%
49	55	1	0.091	33	66.310%	1.00	0	0.00%
50	56	1	0.211	38	57.448%	1.00	0	0.00%

Mike Terpiliak Wipe Survey

LS Counter Data Reduction Program - ESI (LS 1701)

Report Date: 12/23/96
Sample Date: 12/3/96

Beckman LS 1701

Wide Window (User No. 1)

Bkg CPM	Count Time (min)	% Error (95% C.L.)
38	1	31.80%

MDA (CPM): 32 MDA (DPM): 53

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.L.)
1	Room 203 #57	1	0.233	30	55.823%	1.00	0	0.00%
2	58	1	0.167	30	60.697%	1.00	0	0.00%
3	59	1	0.087	23	66.605%	1.00	0	0.00%
4	60	1	0.205	39	57.891%	1.00	0	0.00%
5	61	1	0.078	38	67.270%	1.00	0	0.00%
6	62	1	0.167	36	60.697%	1.00	0	0.00%
7	63	1	0.189	37	59.072%	1.00	0	0.00%
8	64	1	0.097	31	65.867%	1.00	0	0.00%
9	65	1	0.200	35	58.260%	1.00	0	0.00%
10	66	1	0.133	30	63.208%	1.00	0	0.00%
11	67	1	0.194	31	58.703%	1.00	0	0.00%
12	68	1	0.233	30	55.823%	1.00	0	0.00%
13	69	1	0.207	29	57.743%	1.00	0	0.00%
14	70	1	0.160	25	61.214%	1.00	0	0.00%
15	71	1	0.195	31	58.629%	1.00	0	0.00%
16	72	1	0.286	35	51.909%	1.00	0	0.00%
17	73	1	0.167	36	60.697%	1.00	0	0.00%
18	74	1	0.260	31	53.839%	1.00	0	0.00%
19	75	1	0.077	26	67.334%	1.00	0	0.00%
20	76	1	0.189	37	59.072%	1.00	0	0.00%

ADDENDUM A

Room 203

One swipe in Room 203 taken at location 28--Hood #3-- vent at hood indicated a value of 60 DPM/100 cm^2 well below the value identified in the USGS Radiation Safety Manual (100 DPM/cm^2), and well below the U.S. NRC Guidelines.

A reswipe of the area indicated a value to be Minimum Detectable Activity (MDA), i.e., Zero Disintegrations per Minutes (DPM) which indicates that there was no removable and/or loose contamination identified.

REPORT OF SAMPLE ANALYSIS

Rev 1.0

For: Mike Terpilak
Job: HP Survey
Sample Type: Gross Gamma

Date: 1/15/97
By: ELW

Sample Date: 1/15/97

Equipment Description:

Counter	Detector
Packard Prias 1	NaI

Counting Parameters: Gross Gamma

Input Background Data:

Background Cts	Ct Time (m)	Background CPM	% Error
461	1	461	9.13%

Input Efficiency Data:

Isotope	Gross Counts	Time (m)	DPM	Efficiency (4 Pi)	% Error
I-129	18644	1	31080	58.50%	0.1

MDA Calculation:

MDA (CPM)	MDA (DPM)	MDA (uCi)
1.031E+02	1.761E+02	7.93E-05

Sample Data: Note A zero reading for DPM or uCi values indicates only that the sample activity was less than the MDA.

Sequence Number	Sample ID	Gross CPM	Ct Time (m)	*DPM*	*uCi*	% Error at 95% C.L.
1	#1 Electric Conduit	502	1	0	0.000	0.000
2	#2 Hood Vent	538	1	0	0.000	0.000

Mike Terpilak H.P. Survey

Report Date: 1/15/97
Sample Date: 1/15/97

LS Counter Data Reduction Program - ESI (LS 1701)

Beckman LS 1701

Wide Window (User No 1)

Bkg CPM	Count Time (min)	% Error (95% C.L.)
33	1	34.12%

MDA (CPM) 30 MDA (DPM): 47

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA.

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.L.)
1	Electric Conduit #1	1	0.125	40	63.999%	1.00	0	0.00%
2	Hood Vent #2	1	0.152	33	61.805%	1.00	0	0.00%

ex19w wks

ADDENDUM B

Room 210

One swipe in Room 210 taken at location 127--electrical conduit--indicated a value of 320 DPM/100 cm^2 well below the U.S. NRC Guidelines.

A reswipe of the area indicated a value to be Minimum Detectable Activity (MDA), i.e., Zero Disintegrations per Minutes (DPM) which indicates that there was no removable and/or loose contamination identified.

REPORT OF SAMPLE ANALYSIS

Rev 1.0

For: Mike Terpilak
Job: HP Survey
Sample Type: Gross Gamma

Date: 1/15/97
By: ELW

Sample Date: 1/15/97

Equipment Description:

Counter	Detector
Packard Prias 1	NaI

Counting Parameters: Gross Gamma

Input Background Data:

Background Cts	Ct Time (m)	Background CPM	% Error
461	1	461	9.13%

Input Efficiency Data:

Isotope	Gross Counts	Time (m)	DPM	Efficiency (4 Pi)	% Error
I-129	18644	1	31080	58.50%	0.1

MDA Calculation:

MDA (CPM)	MDA (DPM)	MDA (uCi)
1.031E+02	1.761E+02	7.93E-05

Sample Data: Note: A zero reading for DPM or uCi values indicates only that the sample activity was less than the MDA.

Sequence Number	Sample ID	Gross CPM	Ct Time (m)	*DPM*	*uCi*	% Error at 95% C.L.
1	#1 Electric Conduit	502	1	0	0.000	0.000
2	#2 Hood Vent	538	1	0	0.000	0.000

Mike Terpilak H.P. Survey

LS Counter Data Reduction Program - ESI (LS 1701)

Report Date: 1/15/97
Sample Date: 1/15/97

Beckman LS-1701

Wide Window (User No. 1)

Bkg CPM	Count Time (min)	% Error (95% C.L.)
33	1	34.12%

MDA (CPM): 30 MDA (DPM): 47

Note: A zero reading for DPM values indicates only that the sample activity was less than the MDA.

	Sample ID	Count Time (min)	SCR	CPM	Efficiency	CF	DPM	Error (95% C.L.)
1	Electric Conduit #1	1	0.125	40	63.799%	1.00	0	0.00%
2	Hood Vent #2	1	0.152	33	61.805%	1.00	0	0.00%

esi9w wks

ADDENDUM C

Room 210

A radiation survey of the counter top cabinets identified two small areas approximately about 100 cm^2 (10 cm x 10 cm) of fixed radiation levels with a reading of 0.02 mR/hr at 1 cm, and approximately 0.020 mR/hr at 1 meter and 15.0-20.0 μR/hr at 1 meter. The value is within the U.S. NRC guideline item 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 absorber.

The two small areas of the table top portions of the fixed surface contamination have been removed from the counter top and placed in storage in the "Hot-Rock Shed" for ultimate disposal as Low-Level Radioactive Waste (LLRW) in the near future.

APPENDIX F

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE, OR SPECIAL NUCLEAR MATERIAL

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE, OR SPECIAL NUCLEAR MATERIAL

U.S. Nuclear Regulatory Commission
Division of Fuel Cycle, Medical, Academic,
and Commercial Use Safety
Washington, DC 20555

April 1993

The instructions in this guide, in conjunction with Table 1, specify the radionuclides and radiation exposure rate limits which should be used in decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table 1 do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control is considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 1 prior to the application of the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces of premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

    a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent and degree of residual surface contamination.

    b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table 1. A copy of the survey report shall be filed with the Division of Fuel Cycle Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, and also the Administrator of the NRC Regional Office having jurisdiction. The reports should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

   a. Identify the premises.

   b. Show that reasonable effort has been made to eliminate residual contamination.

   c. Describe the scope of the survey and general procedures followed.

   d. State the findings of the survey in units specified in the instructions.

   Following review of the report, the NRC will consider visiting the facilities to confirm the survey.

TABLE 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 known 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.

APPENDIX G

CALIBRATION CERTIFICATES

FOR

RADIATION SURVEY INSTRUMENTS

UTILIZED IN

SCANNING SURVEY

ECOLOGY SERVICES, INC.

10220 Old Columbia Road
Columbia, Maryland 21046
(410) 381-2600
1-800-932-7299
Fax (410) 381-2602

Certificate of Calibration

Calibrated on: 08.12.96 Calibration Due: 02.12.97

Job # 60589

Issued To:
Ray-Safe Associates
1916 Grayslake Drive
Silver Spring, Maryland 20906

Mike Terpilak
(301)598-5[illegible]3

Instrument Identification:
Instrument: Ludlum Model 2 SN: 22331
Detectors:
1 Ludlum Model 44-7 S/N: PR05338

Calibration Data: mR/hr
Equipment: J.L. Shepherd Model 28-5A
(SN: 10245, 137Cs, 51 mRHM)

Scale/Range	Actual	As Found	Indicated	Correction
X 0.1	0.100	0.100	0.100	1.00
	0.400	0.400	0.400	1.00
X 1	1.00	1.00	1.00	1.00
	4.00	3.80	3.80	1.05
X 10	10.0	7.5	10.0	1.00
	40.0	31.0	40.0	1.00

Precalibration Checks:

Battery Reading	Bat. Test
Detector Shield	Open
Condition Received	Good
Contamination Levels	[X] < 100 DPM
	[ ] > 100 DPM
Input Sensitivity	31.2 mV
High Voltage	880 V
Audio Response	Sat
Meter deflection/response	Sat
Zero adj	Zeroed
Reset Sw	Sat
Other	

Environmental Conditions:

Temperature (C)	22.03
Pressure (mmHg)	754.6
Relative Humidity (%)	58.64

Detector Response:

Detector Orientation	Perpendicular
Nuclide	N/A
Nuclide S/N	N/A
Efficiency	N/A
Uncertainty	N/A
Correction Factors	
a) Temp/Pressure	1.000
b) Branching Ratio	1.000
c) Geometry	1.000
d) Total	1.000

Check Source:

Nuclide	Unknown
Scale/Range	X 1
Indication	0.9 mR/hr

Serviced By: [signature]

Reviewed By: ESI QC 1

Comments:

Ecology Services, Inc., certifies that the above instrument has been calibrated by standards traceable to the NIST, have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration technique. The calibration system conforms to the requirements of MIL-[illegible]

HPSI Corp and Affiliated Companies
1350 Piccard Dr, Suite 121, Rockville, MD 20850
(301) 670-1818
(800) 969-HPSI

CALIBRATION CERTIFICATE

Facility: U.S. Department of the Interior Date: 4.5.96
Due: 4.97

Survey Meter:
Manufacturer: Ludlum Model: 3 Serial #: 88228

Probe:
Manufacturer: Ludlum Model: 44-9 Serial #: 010560

Calibrated [✓] Cs-137 [ ] Electronic

Meter zeroed [✓] Operators check [✓] Battery check [✓] Internal Adjustment [ ]

Scale	Calculated Exposure Rate	Meter Reading	Correction Factor (C.F.)
x100	100 20	100 20	1.0
x10	10 2	10 2	1.0
x1	1.0 .2	1.0 .2	1.0
x.1	.10 .02	.10 .02	1.0

Efficiencies: Isotope — % Efficiency —
Isotope % Efficiency
Isotope % Efficiency

Detector center axis [ ] parallel [ ] perpendicular [✓] to radiation field. Beta shield: [ ] Open [ ] Close

Instrument check source: Scale: Reading HV applied to detector:

This instrument has been calibrated using procedures recommended by the U.S.N.R.C. and was functioning correctly at the time of calibration with the following exceptions:

None

Calibrated By: Scott Benjamin (Md License No. 31-035-01)

Victoreen, Inc.

Survey Meter Calibration Report / Certificate of Calibration

For RESPONS RENTALS

Victoreen # REP #36626

Model 450
Serial # 1618

CALIBRATION NOTES

Exposure levels are based on standards whose calibrations are traceable to the N.I.S.T..

The suggested re-calibration date is only a suggestion. The actual frequency of re-calibration may vary depending on Federal, state or local requirements.

During calibration the survey meter was positioned with the detector perpendicular to the beam axis.

The source used for calibration was Cs-137 .

All readings were corrected for Air Density. To determine the Air Density Correction Factor use the formula:

$$((273.2 + T) / 295.2) X (760 / P)$$

Where T = temperature in degrees Celsius
and P = barometric pressure in mm/hg.

All readings below 10 mR/h were corrected for Background Radiation.

The formula for % Error is:

$$(\text{Reading} - \text{Rate}) / \text{Rate} \times 100$$

IMPORTANT

Any correction to the instrument readings (e.g. Air Density or Energy Dependence) are up to the user to apply. Care must be used in applying those factors.

The test response data is on page two (2) of this report.

6000 Cochran Road
Cleveland Ohio 44139-3395

Victoreen, Inc.

VICTOREEN

Model 450 Serial #1618

CALIBRATION DATA

RATE

	Range (mR/h)	Rate (mR/h)	Reading (mR/h)	% Error	Comments
Background	0 - 5	N/A	0.021	N/A	
	0 - 5	3.67	3.71	1.09	Cal Point
	0 - 5	1.15	[illegible]	[illegible]	
	0 - 50	41.0	41.3	0.73	Cal Point
	0 - 50	11.7	[illegible]	4.27	
	0 - 500	436.7	[illegible]	-1.53	Cal Point
	0 - 500	148.7	156	4.91	
	(R/h)	(R/h)	(R/h)		
	0 - 5	3.26	3.20	-1.84	Cal Point
	0 - 50	40.68	40.3	-0.93	Cal Point

INTEGRATE

Range (mR)	Exposure (mR)	Reading (mR)		
0 - 50	14.6 mR	14.6	0.00	Cal Point

Calibrated by [signature] 10-Sep-[illegible]

Operational checkout by [signature] [illegible]

Please enter recall date [illegible]

Traceable to the N.I.S.T.
Test No. DG-[illegible]
Dated Jan. 25, 19[illegible]
RTW Chamber Model [illegible]
Serial No. 174

Temperature 22.7 °C

Humidity 52 %

6000 Cochran Road
Cleveland, Ohio 44139-3395
216 248 9000
FAX 216 248 9001
TWX 810-421-8287