

MATERIALS LICENSE

Amendment No. 58

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

OFFICIAL RECORD COPY

Licensee

1. Genzyme Transgenics Corporation
2. 57 Union Street
Worcester, Massachusetts 01608

In accordance with the letter dated
February 27, 1997,
3. License Number 20-01489-01 is amended in
its entirety to read as follows:

4. Expiration Date October 31, 2001

5. Docket or
Reference No. 030-04605

6. Byproduct, Source, and/or
Special Nuclear Material7. Chemical and/or Physical
Form8. Maximum Amount that Licensee
May Possess at Any One Time
Under This License

- A. Any byproduct material with
atomic number 3 through 83
with half life of 120 days
or less
- B. Any byproduct material with
atomic number 1 through 95
with half life of greater
than 120 days
- C. Technetium 99m
- D. Iodine 125
- E. Hydrogen 3

- A. Any
- B. Any
- C. Any
- D. Any
- E. Foils

- A. Not to exceed
10 millicuries
per radionuclide and
1 curie total
- B. See Condition 12
- C. 100 millicuries
- D. 50 millicuries
- E. Not to exceed 250
millicuries per foil and
5000 millicuries total

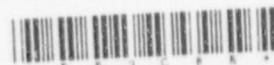
9. Authorized use

- A. through D. Research and development as defined in 10 CFR 30.4; animal studies.
- E. In electron capture detector cells that are distributed under a specific license issued by the U.S. Nuclear Regulatory Commission or any Agreement State.

CONDITIONS

10. Licensed material may be used only at the licensee's facilities located at 57 Union Street, Worcester, Massachusetts; and 83 Rogers Street, Cambridge, Massachusetts.
11. A. Licensed material shall be used by, or under the supervision of individuals designated in writing by the Radiation Safety Committee, Paul Zavorskas, Chairperson.
B. The Radiation Safety Officer for this license is R. Jeffrey Grant.

030074



**MATERIALS LICENSE
SUPPLEMENTARY SHEET**

License Number

20-01489-01

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12. If only one radionuclide is possessed, the possession limit is 10,000 times the quantity specified for that radionuclide in Appendix B to 10 CFR 30. If two or more radionuclides are possessed, the possession limit is determined as follows: For each radionuclide, determine the ratio of the quantity possessed to 10,000 times the applicable quantity specified in Appendix B to 10 CFR 30 for that radionuclide. The sum of the ratios for all radionuclides possessed under the license shall not exceed unity.
13. Licensed material shall not be used in or on human beings.
14. Experimental animals, or the products from experimental animals, that have been administered licensed materials shall not be used for human consumption.
15. The licensee shall not use licensed material in field applications where activity is released except as provided otherwise by specific condition of this license.
16. The licensee shall not acquire licensed material in a sealed source or device unless the source or device has been registered with the U.S. Nuclear Regulatory Commission pursuant to 10 CFR 32.210 or equivalent regulations of an Agreement State.
17. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.
18.
 - A. Detector cells containing a titanium tritide foil or a scandium tritide foil shall only be used in conjunction with a properly operating temperature control mechanism which prevents the foil temperatures from exceeding that specified in the certificate of registration referred to in 10 CFR 32.210.
 - B. When in use, detector cells containing a titanium tritide foil or a scandium tritide foil shall be vented to the outside.
19. The licensee shall conduct a physical inventory every six months to account for all sealed sources and devices containing licensed material received and possessed under the license.
20.
 - A. Sealed sources and detector cells containing licensed material shall be tested for leakage and/or contamination at intervals not to exceed six months or at such other intervals as are specified by the certificate of registration referred to in 10 CFR 32.210, not to exceed three years.
 - B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed three months.
 - C. In the absence of a certificate from a transferor indicating that a leak test has been made within six months prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.

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- D. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.
- E. Sealed sources and detector cells need not be leak tested if:
- (i) they contain only hydrogen-3; or
 - (ii) they contain only a radioactive gas; or
 - (iii) the half-life of the isotope is 30 days or less; or
 - (iv) they contain not more than 100 microcuries of beta and/or gamma emitting material or not more than 10 microcuries of alpha emitting material; or
 - (v) they are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or transfer to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.
- F. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission and the source or detector cell shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations. The report shall be filed within five days of the date the leak test result is known with the U.S. Nuclear Regulatory Commission, Region I, ATTN: Chief, Nuclear Materials Safety Branch, 475 Allendale Road, King of Prussia, Pennsylvania 19406. The report shall specify the source or detector cell involved, the test results, and corrective action taken.
- G. The licensee is authorized to collect leak test samples for analysis by licensee. Alternatively, tests for leakage and/or contamination may be performed by persons specifically licensed by the Commission or an Agreement State to perform such services.
21. The licensee is authorized to hold radioactive material with a physical half-life of less than or equal to 120 days for decay-in-storage before disposal in ordinary trash, provided:
- A. Waste to be disposed of in this manner shall be held for decay a minimum of ten half-lives.
 - B. Before disposal as ordinary trash, the waste shall be surveyed at the container surface with the appropriate survey instrument set on its most sensitive scale and with no interposed shielding to determine that its radioactivity cannot be distinguished from background. All radiation labels shall be removed or obliterated.

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- C. A record of each such disposal permitted under this License Condition shall be retained for three years. The record must include the date of disposal, the date on which the byproduct material was placed in storage, the radionuclides disposed, the survey instrument used, the background dose rate, the dose rate measured at the surface of each waste container, and the name of the individual who performed the disposal.
22. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."
23. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.
- A. Application dated May 14, 1996
B. Letter dated September 9, 1996
C. Letter dated October 4, 1996

Date

MAR 11 1997

For the U.S. Nuclear Regulatory Commission

ORIGINAL SIGNED BY:

By **PENNY A. LANZISERA**

Division of Nuclear Materials Safety
Region I

King of Prussia, Pennsylvania 19406

MAR 11 1997

R. Jeffrey Grant
Radiation Safety Officer
Genzyme Transgenics Corporation
57 Union Street
Worcester, MA 01608

Dear Mr. Grant:

This refers to your license amendment request. Enclosed with this letter is the amended license. Room 202 at 30 Memorial Drive and Rooms 128 and 129 at 134 Main Street, in Cambridge, Massachusetts may be released for unrestricted use. The remainder of the facilities at 30 Memorial Drive and 134 Main Street were released for unrestricted use with Amendment No. 57 to License No. 20-01489-01 (Mail Control No. 124154).

Please review the enclosed document carefully and be sure that you understand and fully implement all the conditions incorporated into the amended license. If there are any errors or questions, please notify the U.S. Nuclear Regulatory Commission, Region I Office, Licensing Assistance Team, (610) 337-5093 or 5239, so that we can provide appropriate corrections and answers.

Thank you for your cooperation.

Sincerely,

Original Signed By:

Penny Lanzisera
Division of Nuclear Materials Safety

License No. 20-01489-01
Docket No. 030-04605
Control No. 124325

Enclosure:
Amendment No. 58

R. Grant
Genzyme Transgenics

-2-

DOCUMENT NAME: R:\WPS\MLTR\L2001489.01

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OFFICE	DNMS/RI	<input checked="" type="checkbox"/> N	DNMS/RI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NAME	Lanzisera <i>RL</i>						
DATE	03/04/97	03/ /97	03/ /97	03/ /97	03/ /97	03/ /97	03/ /97

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TELEPHONE CONVERSATION RECORD		Date: 3/3&4/97	Time: 1pm, 3:15pm
Mail Control No.: 124325		License No.: 20-01489-01	Docket No.: 030-04605
Person Called: Denise Hayes, Director Compliance		Organization: Genzyme Transgenics	Telephone Number: 617 234-5250
Person Calling: Penny Lanzisera			
Subject: Amendment request			
<p>Summary: 1) Questioned Denise about the last time the incinerator was used. Denise stated that it was last used Dec., 1996 for H-3 and C-14 RAW and Nov. 15, 1996 for incineration of 0.25 uCi of I-125, 0.14 uCi of P-33 and 0.01 uCi of S-35.</p> <p>2) Denise stated that all waste had been removed from both the 30 Memorial Drive location as well as the 134 Main Street location.</p> <p>3) Questioned whether any surveys were performed on roof of incinerator. Denise stated that the egress point from the incinerator was surveyed and swiped and that the stack height was 10 feet above the highest roof level, so no surveys were considered necessary on the roof.</p>			
Action Required/Taken: issue amendment			
Signature: <i>Penny Lanzisera</i>		Date: 3-4-97	

February 27, 1997

Ms. Penny Lanzisera
United States Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406-1415

030-04605

Subject: Control #124154

Dear Ms. Lanzisera:

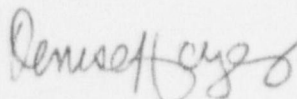
The purpose of this letter is to request the amendment of our Byproduct Material License No. 20-01489-01 to eliminate and release for unrestricted use currently licensed areas in our Cambridge MA site as described in the enclosed radiological termination survey report.

Enclosed please find two copies of the termination survey report. With the submission of this report, we have completed the survey of all areas in our sites at 30 Memorial Drive and 134 Main Street and ask that the license be amended to remove these sites in their entirety.

The terms of the lease at this site require us to vacate the property no later than May 31, 1997. As such, we would like to work with the NRC to resolve any issues that might be required to approve this amendment as soon as possible.

Should you require any additional information, please do not hesitate to contact me (617-234-5250) or our Radiation Safety Officer, Mr. Jeff Grant (508-791-0931).

Sincerely,



Denise Hayes
Director, Compliance

Enclosure

cc: J. Grant, RSO

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FEB 28 1997

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TERMINATION RADIOLOGICAL SURVEY REPORT
FOR
134 MAIN STREET INCINERATOR

Prepared For:

BioDevelopment Laboratories, Inc.

USNRC License No. 20-01489-01

Cambridge, Massachusetts

February, 1997

Prepared By:

A
C
I

Applied Consultants, Inc.

1501 Main Street-Suite 40, Tewksbury, Massachusetts 01876

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FEB 28 1997

TERMINATION RADIOLOGICAL SURVEY REPORT

**134 MAIN STREET INCINERATOR
AND SUPPORT AREAS**

For

**U.S. NRC License Number 20-01489-01
Cambridge, Massachusetts**

February, 1997

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APPENDIX B	OTHER INFORMATION

1. INTRODUCTION

Pursuant to the most recent amendment request for 30 Memorial Drive and 134 Main Street, BioDevelopment Laboratories (BDL) is requesting termination of all remaining areas of the former Cambridge site covered under broad scope U.S. Nuclear Regulatory Commission (NRC) License Number 20-01489-01. This consists of the 134 Main Street biohazard incinerator (burn box), located and utilized within rooms 128 and 129 at 134 Main Street as well as the associated discharge stack.. A Floor plan showing the areas covered by this submission is included as Figure 1.

Survey and decontamination efforts were conducted with independent contract support reporting to a BDL project manager. Any identified laboratory equipment, fixtures, piping, etc., that were found to be in excess of NRC guidelines for unrestricted use were either decontaminated or removed and disposed of as radioactive waste. This document describes the methodology used in the conduct of the final status survey for the incinerator and provides documentation of the results.

Guidance used in design and conduct of the survey included the NRC's "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source, or Special Nuclear Material" and NUREG 5849 "Manual for Conducting Radiological Surveys in Support of License Termination". This report describes the results of the survey and demonstrates that these laboratories satisfy the NRC guidelines established for release for unrestricted use.

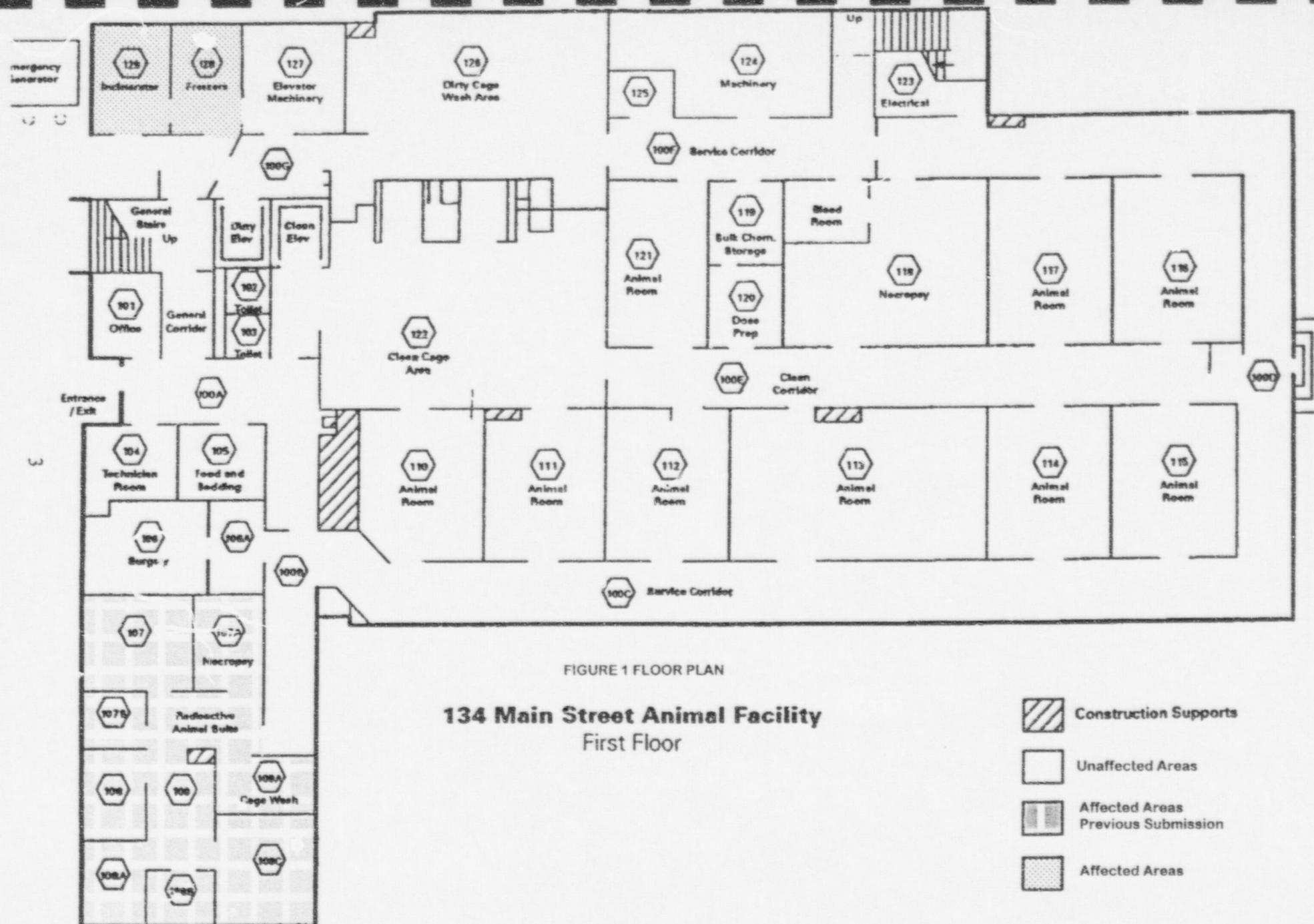






FIGURE 1 FLOOR PLAN

134 Main Street Animal Facility
First Floor

-  Construction Supports
-  Unaffected Areas
-  Affected Areas Previous Submission
-  Affected Areas

BIODEVELOPMENT Laboratories, Inc.

2. Final Survey Overview

2.1 Objective

The purpose of the final radiation survey was to demonstrate that the radiological conditions at the areas affected by the BDL incinerator, 134 Main Street satisfy the U.S. Nuclear Regulatory Commission (NRC) guidelines and that specified licensed areas at this site can therefore be released from licensing restrictions.

2.2 Decontamination Criteria

The decontamination criteria were based on the NRC and ANSI guides and standards. Based on knowledge of the facilities and review of licensing documentation, the main potential contaminants were low energy beta emitting radionuclides, primarily H-3 and C-14. In addition, short lived isotopes were used in some locations at various times. Short lived isotopes which have had sufficient decay time were not considered significant in terms of survey protocol design. However, areas utilizing these materials were surveyed as described in section 2.3. On the basis of the potential combination of contaminants, the following survey criteria were established for this assessment.

2.2.1 Surface Contamination

The specific decontamination criteria are taken from "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Material", prepared by the NRC. The specifically applicable criteria are as follows:

- Removable contamination, determined by smearing with a dry filter: 1,000 dpm/100 cm², beta/gamma.
- Average contamination, based on a maximum area of 1 m²: 5,000 dpm/100 cm², beta/gamma.
- Maximum contamination, based on an area of not more than 100 cm²: 15,000 dpm/100 cm², beta/gamma.

Decontamination efforts attempted to reduce contamination levels to ALARA.

2.2.2 External Gamma Exposure Rate

The net residual external gamma exposure rate should be less than 10 mrem/year, or 5 uR/hr above background, based on regulatory criteria and ALARA. The verification of this criteria was based on gamma exposure rate measurements with calibrated micro R survey meters.

2.2.3 Release of Waste Materials for Disposal by Sanitary Landfill

All wastes from directly contaminated materials (e.g., metal, floor tile, glass) were packaged for disposal as low-level radioactive waste (LLRW). However, materials and equipment that were not contaminated or that could be adequately cleaned were released for disposal by sanitary landfill. Written documentation is available for any materials released for unrestricted disposal. Workers were instructed to maintain a written record of the origin of the waste and the measured levels of contamination. Materials that did not comply with the stated criteria were not released.

2.3 Implementation of Decontamination Criteria

To demonstrate that the decontaminated areas complied with the specified cleanup criteria, detailed surveys were performed at locations throughout the licensed areas. The level of surveying accomplished was based on the potential for contamination and was classified for affected areas and unaffected areas. The number of samples taken in each location was stratified based on the potential for residual radioactivity. Contamination potential has been based on a review of site history and available radiological data. The bases for these classifications are as follows:

- **Affected Areas:** These are areas that had potential radioactive contamination, based on operating history or known radioactive contamination identified during radiological surveillance. This also includes buffer areas immediately surrounding or adjacent to known affected areas.

- Unaffected Areas. These are all other areas supporting licensed activities which were not classified as affected. These areas are not suspected of containing residual radioactivity, based on knowledge of the site history and previous survey data.

Table 1 lists the various areas covered by this submission, their classification category, and a listing of potential contaminants.

The survey and analytical instrumentation used for conduct of survey activities are listed in Table 2. All instruments were calibrated prior to the survey and decontamination effort, using NIST or NBS traceable standards for low energy beta radiation. In addition, background and operational checks for portable instrumentation were performed at least once every 8 hours on instrument use.

2.3.1 Reference Grids

Grids were established for the purpose of referencing locations of samples and measurements, relative to building and other features. The grid intervals were based on the potential for residual contamination in the various areas. (See Table 1). All affected building area floor and lower wall (up to 2 m) surfaces were gridded at 1 m intervals. Upper walls and ceilings of affected areas were not gridded however measurements were keyed to other grid systems or to prominent building features.

Unaffected areas identified by scans or direct measurements as exceeding guidelines were subject to reclassification as affected areas, with the same gridding and surveying requirements of affected areas.

Classification of BDL Site Surfaces and Areas According to Contamination Potential

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2.3.2 Surface Scans

Scanning of surfaces to identify locations of residual surface and near surface contamination was performed according to the following schedule:

- Affected Area Surfaces - 100% of surface
- Non-contaminated upper surfaces in affected areas - scans in immediate vicinity of measurement
- Unaffected Area Surfaces - 10% of lower surfaces
- Incinerator Discharge Stack - At inlet and outlet

Scanning speeds were no greater than 1 detector width per second for beta-gamma detection instruments. Audible indicators were used to identify locations having elevated (1.5 to 3 times ambient) levels of direct radiation. All scanning results were noted on standard field record forms; locations of elevated radiation were identified for remediation and follow-up survey.

2.3.3 Surface Activity Measurements

2.3.3.1 Direct Measurements

Direct measurements of beta-gamma surface activity were performed at selected locations using the instrumentation listed in Table 12. Measurements were conducted by integrating counts over a 1 minute period. Appendix A contains maps and drawings keyed to the various measurement locations and survey data for the areas.

Direct measurements were taken based on the following spacing frequency:

Floor and lower walls

- Affected Areas: 1 m intervals

- Unaffected Areas: 1 per 50 m² of surface

Other Surfaces

- Affected Areas: 1 per 20 m²
- Unaffected Areas: 1 per 50 m²
- Incinerator Discharge Stack – At inlet and outlet

2.3.3.2 Removable Measurements

A smear for removable contamination was taken at each measurement location.

Table 2

Instrumentation for Radiological Surveys

Type of Measurement	Instrumentation Detector	Meter	Background	Efficiency	Detection Sensitivity
Surface scan-beta-gamma	Ludlum Gas Flow Large Area.	Ludlum Floor Monitor	1000-1500 cpm	10% C-14, 20% Tc-99	100-500 dpm
Surface activity beta-gamma	Pancake GM, Ludlum 44-9 equiv.	Ludlum Digital Scaler or ESP-2	40 cpm ambient, 90 cpm brick, ceramic tile	5% C-14, 25% Tc-99	200-800 dpm
H-3, C-14 Smears	Liquid Scintillation	Beckman LS-6000	20 cpm H-3 20 cpm C-14	57% H-3 78% C-14	40 dpm H-3 25 dpm C-14
Exposure Rate	Pressurized Ion Chamber	Victoreen 450P	9-12 uR/hr		2-3 uR/hr

2.3.4 Exposure Rate Measurements

Gamma exposure rates were measured at 1 m above ground or floor surfaces using a pressurized ionization chamber. Measurements were taken at a rate of one per 20 m² or a minimum of one per distinct area or laboratory.

2.3.5 Special Measurements and Samples

Drains and piping in affected areas were also accessed, with direct beta-gamma scans and measurements taken at all access points. In addition, sediment scrapings were obtained from trap areas and large area swabs were obtained from the piping using long cotton tipped swabs. All samples were evaluated for removable activity via liquid scintillation counting.

Hoods, ducts, conduit or other interior surfaces that remained in affected areas and that may have contained residual contamination were accessed at both beginning and discharge locations and measurements of direct and removable activity performed.

2.4 Background Level Determinations

Radiological measurements were taken to determine background exposure rates and ambient radiation levels for building interiors. Measurements were taken at various locations without history of radioactive materials use. Exposure rate measurements were performed using a pressurized ionization chamber while ambient air radiation levels were determined with a Ludlum Digital Scaler or equivalent coupled with a GM pancake probe.

2.5 Data Interpretation

Data interpretation was required for comparison of results with guideline values. Scanning results and fixed measurement data were converted to units of dpm/100 cm² for comparison with guidelines. With the exception of low energy tritium, scanning data were used to identify elevated areas of contamination. All contamination detected was remediated prior to performing final scans and fixed and removable activity measurements. For tritium, a large number of preliminary wipe tests were taken in conjunction with surface scans for other isotopes, to determine if any remediation was required prior to

conducting final surveys. Sample calculations for surface activity measurements are provided in Appendix B.

3. Survey Findings and Results

3.1 Summary

Appendix A contains results of the final status surveys, keyed to map locations. As indicated in Section 2, decontamination efforts undertaken during this effort were aimed to reduce any contamination to levels ALARA. In general, contamination was easily remediated to background levels eliminating the need for averaging or other statistical evaluation to demonstrate compliance with the residual radioactivity guidelines. This is evidenced by the supporting data which shows more than 99% of the measurements below detectable levels.

3.2 Disposition of Radioactive Materials

A small quantity of radioactive waste was generated during this effort. As follow-up to the prior decommissioning of other areas, some volume reduction of previously generated waste was also conducted during this final phase of the Cambridge site decommissioning. This primarily consisted of survey/release and/or cutting/nesting of plastic containers that had been set aside during the previous effort. This waste was defined in the prior submission as a large number of plastic containers formerly used to house biohazard material which was packaged in bags and drums for future dispositioning by BDL and/or a contractor. In total, volume reduction of 30 ft³ was realized for this material. The remaining waste inventory was transferred to BDL's parent company, Genzyme Trangenics/Mason Laboratories in Worcester, MA under the same USNRC License Number. This waste will ultimately be shipped for disposal by Genzyme/Mason Laboratories during a future regularly scheduled waste pickup.

4. GLOSSARY DEFINITIONS

Actinides	A series of heavy radioactive metallic elements of increasing atomic number (Z) beginning with antinium (89) or thorium (90) through element hahnium of atomic number 105.
Activity	See Radioactivity.
Airborne Radioactive Materials	Radioactive particulates, mists, fumes, and/or gases in air.
ALARA	A regulatory design philosophy to maintain radiation exposure <u>A</u> s <u>L</u> ow <u>A</u> s is <u>R</u> easonably <u>A</u> chievable.
Atomic Number (Z)	The number of protons in the nucleus of an atom; also its positive charge. Each chemical element has its characteristic atomic number, and the atomic numbers of the known elements form a complete series from 1 (hydrogen) through 105 (hahnium).
Background	The level of radioactivity from sources other than the one directly under consideration, in this case those existing without the presence of the nuclear facility.
Beta Decay	Radioactive decay in which a beta particle is emitted or in which an orbital electron capture occurs.
Burial Grounds	Areas designated for storage of packaged radioactive wastes in soils below the surface.
Byproduct Material	Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.
Certification Survey	See terminal radiation survey.
Chemical Decontamination	Decontamination accomplished by the use of chemical solutions to remove surface films containing radioactive materials.

Code of Federal Regulations (CFR)

The Code of Federal Regulations is a documentation of the general rules by the Executive departments and agencies of the Federal Government. The Code is divided into 50 titles that represent broad areas subject to Federal regulation. Each title is divided into Chapters that usually bear the name of the issuing agency. Each Chapter is further subdivided into Parts covering specific regulatory areas.

Commissioning

The licensing and startup of a nuclear facility.

Contamination

Undesired material that have been deposited on the surfaces, or are internally ingrained into structures or equipment, or that have been mixed with another material.

Curie

A special unit of radioactivity. One curie equals 3.7×10^{10} nuclear transformations per second. (Abbreviated Ci.) Several fractions of the curie are in common usage:

Millicurie. One-thousandth of a curie. Abbreviated mCi (3.7×10^7 d/s).

Microcurie. One-millionth of a curie. Abbreviated uCi (3.7×10^4 d/s).

Nanocurie. One-billionth of a curie. Abbreviated nCi (37 d/s).

Picocurie. One-millionth of a microcurie. Abbreviated pCi (0.037 d/s).

Decay, Radioactive

A spontaneous nuclear transformation in which a particle, gamma radiation, or x-ray radiation is emitted.

Decommissioning

To safely remove a nuclear facility, including its site, from radioactive service and to dispose of associated radioactive materials. The level of any residual radioactivity remaining in the facility or on the site after decommissioning must be low enough to allow unrestricted use of the facility and site.

DECON

To immediately remove all radioactive materials down to levels which are considered acceptable to permit the property to be released for unrestricted use.

Decontamination

Those activities employed to reduce the levels of contamination in or on structures, equipment and materials. Also used to infer decontamination to levels corresponding to release of a facility for unrestricted use.

Decontamination Factor (DF)

The ratio of the initial concentration of an undesired material to the final concentration resulting from a treatment process. The term may also be used as a ratio of quantities.

Disintegration, Nuclear

The transformation of the nucleus of an atom from one element to another, characterized by a definite half-life and the emission of particles or electromagnetic radiation.

Disintegration Rate

The rate at which disintegration's occur, characterized in units of inverse time, i.e., disintegration's per minute (dpm), etc.

Dismantlement

Those actions required to disassemble and/or remove radioactive or contaminated materials from the facility and site.

Dispersion

A process of mixing one material within a larger quantity of another. For example, the mixing of material released to the atmosphere with air causes a reduction in concentration with distance from the source.

Disposal

The disposition of materials with the intent that the materials will not enter man's environment in sufficient amounts to cause a health hazard.

Dose, Absorbed

The mean energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The unit of absorbed dose is the rad. One rad equals 0.01 joules/ kilogram in any medium (100 ergs per gram).

Dose Commitment	The integrated dose that results unavoidably from an intake of radioactive material starting at the time of intake and continuing to a later time (usually specified to be 50 years from intake).
Dose, Equivalent	Expresses the amount of radiation that is effective in the human body, expressed in rems. Modifying factors associated with human tissue and body are considered. Equivalent dose is the product of absorbed dose multiplied by a quality factor multiplied by a distribution factor.
Dose, Occupational	The exposure of an individual to radiation as a result of his employment, expressed in rems.
Dose Rate	The radiation dose delivered per unit time and measured, for instance, in rem per hour.
Enrichment	The ratio (usually expressed as a percentage) of fissile isotope to the total amount of the element (e.g., the % of ^{235}U in uranium).
Exposure	The condition of being made subject to the action of radiation; also frequently the quantity of radiation received. The special unit of exposure is the roentgen (see Roentgen).
Exposure Pathway	The mechanisms by which radioactive material passes from the source of the material through the environment to an exposed individual.
External Exposure	As used in this Document, an exposure pathway in which an individual is externally exposed directly to radioactive materials dispersed in the air (immersion) or is exposed directly to surfaces containing radioactive materials.
Facility	The physical complex of buildings and equipment within a site.
Food Chain	The pathways by which any material passes through man's environment through edible plants and/or animals to man.

Fuel Cycle	<p>The series of steps involved in supplying fuel for nuclear power reactors and handling spent fuel and radioactive waste, including transportation. These steps are usually divided up as the head end and back end as follows:</p> <p><u>Head end</u>: Mining, milling, conversion, enrichment, and fabrication of fuel.</p> <p><u>Back end</u>: Includes reactors, spent fuel storage, spent fuel reprocessing, mixed-oxide fuel fabrication, and waste management.</p>
Gamma Rays	<p>Short-wavelength electromagnetic radiation. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are best stopped or shielded against by dense materials such as lead or uranium. These rays originate from within the nucleus of the atom.</p>
Half-Life, Radioactive	<p>The time in which half the atoms of a particular radioactive substance disintegrates to another nuclear form. Each radionuclide has a unique half-life. Measured half-lives vary from millionths of a second to billions of years.</p>
Heavy Metal	<p>Jargon used in reference to metals with atomic numbers 90 and greater. It usually refers to nuclear fissile or fertile fuels such as thorium, uranium, and plutonium.</p>
HEPA Filter	<p>A filter used in facility ventilation systems whose purpose is to remove particulate material from the ventilation air stream.</p>
Hot Spots	<p>Relatively small areas of radioactive contamination of higher magnitude than surrounding averages.</p>
Ingestion	<p>An exposure pathway in which radioactive materials reach the exposed individual through the ingestion of food and water.</p>
Inhalation	<p>An exposure pathway in which radioactive materials reach the exposed individual through the breathing process.</p>

Ion Exchange	A chemical process involving the selective absorption or desorption of various chemical ions in a solution onto a solid material, usually a plastic or resin. The process is used to separate and purify chemicals, such as fission products from plutonium or "hardness" from water (i.e., water softening).
Licensed Material	Nuclear source material, special nuclear material, or nuclear by-product material received, possessed, used, or transferred under a license issued by the Nuclear Regulatory Commission.
Long-Lived Nuclides	Radioactive isotopes with long half-lives typically taken to be greater than about ten years. Most nuclides of interest to waste management have half-lives on the order of one year to millions of years.
Low-Level Radioactive Wastes	Wastes contaminated with radioactive materials emitting primarily beta or gamma radiation, not high-level waste (see high-level wastes) and which are not transuranic wastes, i.e., they contain less than 10 nanocuries per gram of transuranic elements (see transuranic waste).
Management (Waste)	The planning, execution, and surveillance of essential functions related to radioactive waste, including treatment, solidification, packaging, interim or long-term storage, transportation, and disposal.
Man-rem	A measure of radiation dose distributed to a population. To calculate radiation dose to the population, the dose equivalent in rem received by each person in the population is summed.
Mass Number	The number of nucleons (protons and neutrons) in the nucleus of an atom. (Symbol: A).
Maximum Exposed Individual	The hypothetical member of the public who receives the maximum radiation dose. For the common case where exposures from airborne radionuclides result in the highest radiation exposure, this individual resides at the location of the highest airborne radionuclide concentration and eats food grown at that location.

Metric Ton	1000 kilograms.
Monitoring	Taking measurements or observations for recognizing the status, or significant changes in conditions or performance, of a facility or area.
Normal Operating Conditions	Operation (including startup, shutdown, and maintenance) of systems within the normal range of applicable parameters of an operating facility.
Off-site	Beyond the boundary line marking the limits of plant property.
On-site	Within the boundary line marking the limits of plant property.
Operable	Capable of performing the required function.
Package	The packaging plus the contents of radioactive materials.
Packaging	The assembly of radioactive material in one or more containers or other components necessary to assure compliance with prescribed regulations.
Physical Decontamination	Decontamination accomplished by the use of mechanical cleaning means or by the removal of the surface itself.
Plant	The physical complex of buildings and equipment, including the site.
Premature Closure	The permanent shutdown of a nuclear facility prior to the end of its planned operating lifetime.
Protective Clothing	Special clothing worn by a person in a radioactively contaminated area to minimize the potential for contamination of his body or personal clothing and to control the spread of contamination.
Quality Assurance	The systematic actions necessary to provide adequate confidence that a material, component, system, process, or facility performs satisfactorily, or as planned, in service.

Quality Control	The quality assurance actions that control the attributes of the material, process, component, system, or facility in accordance with predetermined quality requirements.
Rad	A unit of absorbed dose. The energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. One rad equals 0.01 joule/kilogram of absorbing material.
Radiation	(1) The emission and propagation of radiant energy through space or through a material medium in the form of waves; for instance, that of electromagnetic waves or of sound and elastic waves; (2) the energy of such waves; and (3) corpuscular emissions, such as alpha and beta radiation, or rays of mixed or unknown types.
Radiation Background	See Background.
Radioactive Material	Any material or combination of materials which spontaneously emit ionizing radiation, generally alpha or beta particles, often accompanied by gamma rays.
Radioactivity	The number of nuclear transformations occurring in a given quantity of material per unit of time with the emission of particles, gamma radiation, or x-ray radiation. Often shortened to "activity".
Radioactivity, Natural	The property of radioactivity exhibited by more than fifty naturally occurring radionuclides.
Radiological Protection	Protection against the effects of internal and external exposure to radiation and to radioactive materials.
Realistic Pathway Analysis	A methodology for evaluation of doses to the population from a decommissioned facility, that provides a realistic assessment of the potential dose by taking into account actual conditions that may exist such as occupancy, source of sustenance, self-shielding and decreasing resuspension and bioavailability.

Regulatory Guides

Regulatory Guides are issued by the NRC, to describe and make available to the public, methods acceptable to the NRC staff, for implementing specific parts of the NRC's regulations, to delineate techniques used by the staff in evaluating specific problems or postulated accidents, or to provide other guidance to applicants for nuclear operations. Guides are not substitutes for regulations and compliance with them is not explicitly required. Methods and solutions different from those set out in the guides may be acceptable if they provide a basis for the finding requisite to the issuance or continuance of a permit or license by the NRC.

Rem

A unit of radiation dose equivalence. The radiation dose equivalence in Rem is numerically equal to the absorbed dose in rad multiplied by the quality factor, the distribution factor, and any other necessary modifying factors.

Residual Radioactivity Levels

The amount of radioactively contaminated material remaining in a nuclear facility after decommissioning has been completed and the facility license terminated. To be acceptable, this level must be low enough to permit the facility to be released for unrestricted use.

Restricted Area

Any area to which access is controlled for protection of individuals from exposure to radiation and radioactive materials.

Resuspension

The physical process by which radioactive materials deposited on building or equipment surfaces or on soil become airborne either naturally or as the result of some decontamination procedure.

Roentgen

A unit of exposure to ionizing radiation. It is that amount of gamma or x-rays required to produce ions carrying one electrostatic unit of electrical charge (either positive or negative) in one cubic centimeter of dry air under standard conditions. One roentgen equals 2.58×10^{-4} coulombs per kilogram of air. (See also Exposure.)

Safe Storage	A period of time starting after the initial decommissioning activities of preparation for safe storage cease and in which surveillance and maintenance of the facility takes place. The duration of time can vary from a few years to on the order of 100 years.
Site	The geographic area upon which the facility is located that is subject to controlled public access by the facility licensee (includes the restricted area designated in the NRC license).
Solid Radioactive Waste	Material that is essentially solid and dry but may contain sorbed radioactive fluids in sufficiently small amounts as to be immobile.
Solidification	Conversion of radioactive wastes (gases or liquids) to dry, stable solids.
Special Nuclear Material	Plutonium, uranium enriched in the isotopes 233 or 235, and any other material as defined in 10 CFR 70 by the NRC.
Surface Contamination	Contamination that is the result of the deposition and attachment of foreign materials to a surface.
Surveillance	Those activities necessary to assure that the site remains in a safe condition (including inspection and monitoring of the site, maintenance of barriers to access to radioactive materials left on the site, and prevention of activities on the site that might impair these barriers).
Survey	An evaluation of the radiation hazards incident to the production, use, release, disposal or presence of radioactive materials or other sources of radiation under a specific set of conditions.
Terminal Radiation Survey	The radiation survey conducted by a licensee to certify and demonstrate that residual radioactivity levels in licensed area are within prescribed guidelines and acceptable for releasing the facility for unrestricted use.

Transuranic Elements

Elements with atomic number (Z number) greater than 92. Includes plutonium and uranium isotopes.

Transuranic Waste

Any waste material measured or assumed to contain more than a specified concentration (i.e., proposed as 10 nanocuries of alpha emitters per gram of waste, or more presently proposed as 100 nanocuries/cm³ of waste ²³⁹U) of transuranic elements.

Unrestricted Access

The condition of a nuclear facility after decommissioning is complete and the facility license is terminated. At this time the general public would be allowed use of the facility without radiation protection controls.

Wastes, Radioactive

Equipment and materials (from nuclear operations) that are radioactive and for which there is no further known use.

APPENDICES

APPENDIX A

RADIOLOGICAL SURVEY RELEASE DOCUMENTATION

A
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RADIOLOGICAL RELEASE SURVEY COVER SHEET

DATE	Originals	INSTRUMENTATION USED		
TIME	On	MODEL	SERIAL NO.	CAL. DATE
SURVEYOR	File			
LOCATION	Room 128	See Radiological Release Survey Report Page 1		
REVIEWED BY				
PURPOSE OF SURVEY: RELEASE FOR UNRESTRICTED USE				
Animal Facility Room 128				

General area background was established with a pancake GM tube coupled to a Ludlum digital scaler by performing a ten (10) minute background count and dividing that number by ten to determine counts per minute (CPM). **Background Observed: 50 cpm beta-gamma.**

Background for scanning with large area gas flow detector was established by setting Ludlum floor monitor detector at scanning height in an unaffected area and observing count rate on analog scale of ratemeter.

Floor Monitor Background Observed: 2200 cpm beta-gamma

Elevated construction material background includes refractories brick used to line the incinerator burn box and discharge stack. A gamma spectrographic analysis is included in Appendix B showing the natural radioactivity component. Concrete floors also exhibit a higher than ambient natural background. Used where denoted by asterisk.

Construction material background observed: 150-200 cpm GM, Incinerator Brick; 70-100 cpm for concrete floors.

100% of accessible affected area surfaces were scanned using Ludlum Floor Monitor. All areas with detectable activity were decontaminated to background levels.

Ⓢ Denotes smear location (approximate)

Ⓢ Denotes internal smear

Ⓢ Denotes (1) minute static reading in gross cpm beta-gamma

Denotes general area exposure rate in uR/hr

#/A Denotes grid identification

See attached maps for survey locations.

RADIOLOGICAL RELEASE SURVEY REPORT

ITEM NO.	ROOM 128		AMBIENT RADIATION	FIXED CONTAMINATION (dpm/100 cm ²)		REMOVABLE CONTAMINATION (dpm/100 cm ²)	
	MAP	LOCATION	uR/hr	α	B- γ	H-3	C-14
1	1	A.1	N/A	N/A	<MDA	<MDA	<MDA
2	1	A.2	N/A	N/A	<MDA	<MDA	<MDA
3	1	A.3	N/A	N/A	<MDA	<MDA	<MDA
4	1	B.1	N/A	N/A	<MDA	<MDA	<MDA
5	1	B.2	N/A	N/A	<MDA	<MDA	<MDA
6	1	B.3	N/A	N/A	<MDA	<MDA	<MDA
7	1	C.1	N/A	N/A	<MDA	<MDA	<MDA
8	1	C.2	N/A	N/A	<MDA	<MDA	<MDA
9	1	C.3	N/A	N/A	<MDA	<MDA	<MDA
10	1	D.1	N/A	N/A	<MDA	<MDA	<MDA
11	1	D.2	N/A	N/A	<MDA	<MDA	<MDA
12	1	D.3	N/A	N/A	<MDA	<MDA	<MDA
13	1	E.1	N/A	N/A	<MDA	<MDA	<MDA
14	1	E.2	N/A	N/A	<MDA	<MDA	<MDA
15	1	E.3	N/A	N/A	<MDA	<MDA	<MDA
16	2	A.1	N/A	N/A	<MDA	<MDA	<MDA
17	2	A.2	N/A	N/A	<MDA	<MDA	<MDA
18	2	A.3	N/A	N/A	<MDA	<MDA	<MDA
19	2	B.1	N/A	N/A	<MDA	<MDA	<MDA
20	2	B.2	N/A	N/A	<MDA	<MDA	<MDA

INSTRUMENTATION USED	MODEL	SERIAL NO.	CAL. DATE	EFFICIENCY	MDA
AMBIENT	V-450P	1685	3/25/96	N/A	N/A
FIXED ALPHA	N/A	N/A	N/A	N/A	N/A
FIXED BETA-GAMMA	ESP-2	1203	02/18/97	5.81%	620 DPM
REMOVABLE ALPHA	N/A	N/A	N/A	N/A	N/A
REMOVABLE H-3/C-14	BECK LS-6000	7065011	ROUTINE	57/78 %	40/25 DPM
SURVEYOR: ORIGINALS ON FILE		DATE:	REVIEWED:		

RADIOLOGICAL RELEASE SURVEY REPORT (CONTINUATION SHEET)

ITEM NO.	ROOM 128		AMBIENT RADIATION	FIXED CONTAMINATION (dpm/100 cm ²)		REMOVABLE CONTAMINATION (dpm/100 cm ²)	
	MAP	LOCATION	uR/hr	α	B- γ	H-3	C-14
21	2	B.3	N/A	N/A	<MDA	<MDA	<MDA
22	2	C.2	N/A	N/A	<MDA	<MDA	<MDA
23	2	A.1	N/A	N/A	<MDA	<MDA	<MDA
24	2	A.2	N/A	N/A	<MDA	<MDA	<MDA
25	2	A.3	N/A	N/A	<MDA	<MDA	<MDA
26	3	B.1	N/A	N/A	<MDA	<MDA	<MDA
27	3	B.2	N/A	N/A	<MDA	<MDA	<MDA
28	3	B.3	10	N/A	<MDA	<MDA	<MDA
29	3	C.1	N/A	N/A	<MDA	<MDA	<MDA
30	4	A.1	N/A	N/A	<MDA	<MDA	<MDA
31	4	A.2	N/A	N/A	<MDA	<MDA	<MDA
32	4	A.3	N/A	N/A	<MDA	<MDA	<MDA
33	4	A.4	N/A	N/A	<MDA	<MDA	<MDA
34	4	A.5	N/A	N/A	<MDA	<MDA	<MDA
35	4	B.1	N/A	N/A	<MDA	<MDA	<MDA
36	4	B.2	N/A	N/A	<MDA	<MDA	<MDA
37	4	B.3	N/A	N/A	<MDA	<MDA	<MDA
38	4	B.4	N/A	N/A	<MDA	<MDA	<MDA
39	4	B.5	N/A	N/A	<MDA	<MDA	<MDA
40	4	C.3	N/A	N/A	<MDA	<MDA	<MDA
41	5	A.1	N/A	N/A	<MDA	<MDA	<MDA
42	5	A.2	N/A	N/A	<MDA	<MDA	<MDA
43	5	A.3	N/A	N/A	<MDA	<MDA	<MDA
44	5	A.4	N/A	N/A	<MDA	<MDA	<MDA
45	5	A.5	N/A	N/A	<MDA	<MDA	<MDA
46	5	B.1	N/A	N/A	<MDA	<MDA	<MDA

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RADIOLOGICAL RELEASE SURVEY REPORT (CONTINUATION SHEET)

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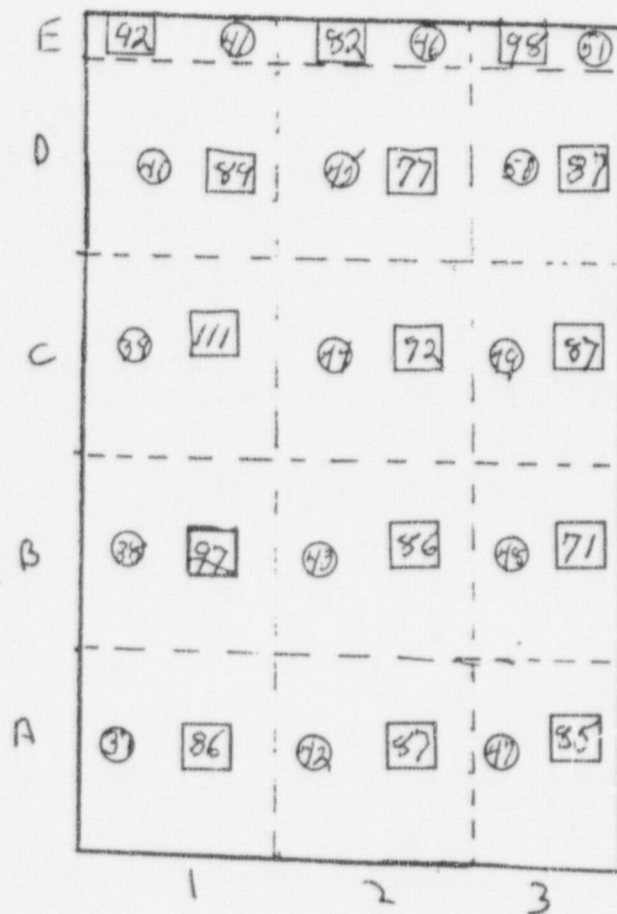
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RADIOLOGICAL RELEASE SURVEY REPORT (CONTINUATION SHEET)

ROOM 128

MAP 1 - FLOOR *

* Concrete Floor



NORTH
↓

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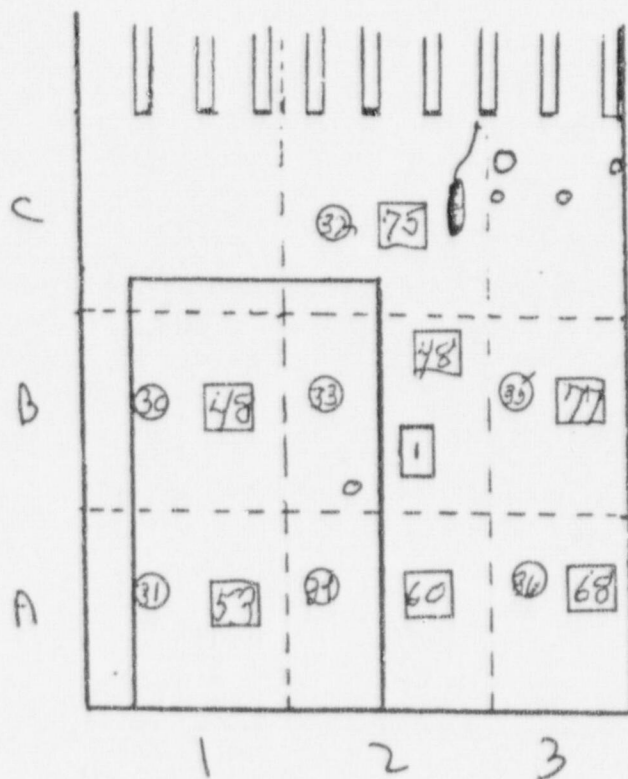
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RADIOLOGICAL RELEASE SURVEY REPORT (CONTINUATION SHEET)

ROOM 128

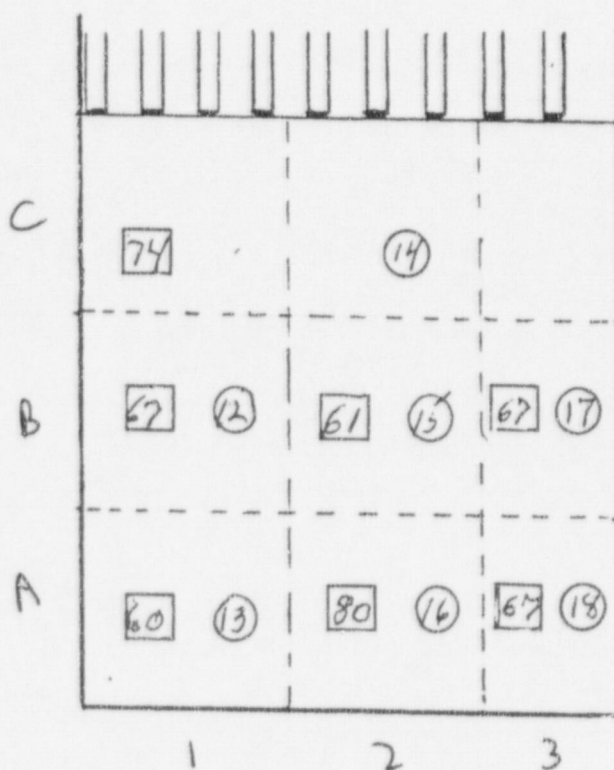
MAP 2 - NORTH WALL



**RADIOLOGICAL RELEASE SURVEY REPORT
(CONTINUATION SHEET)**

ROOM 128

MAP 3 - SOUTH WALL



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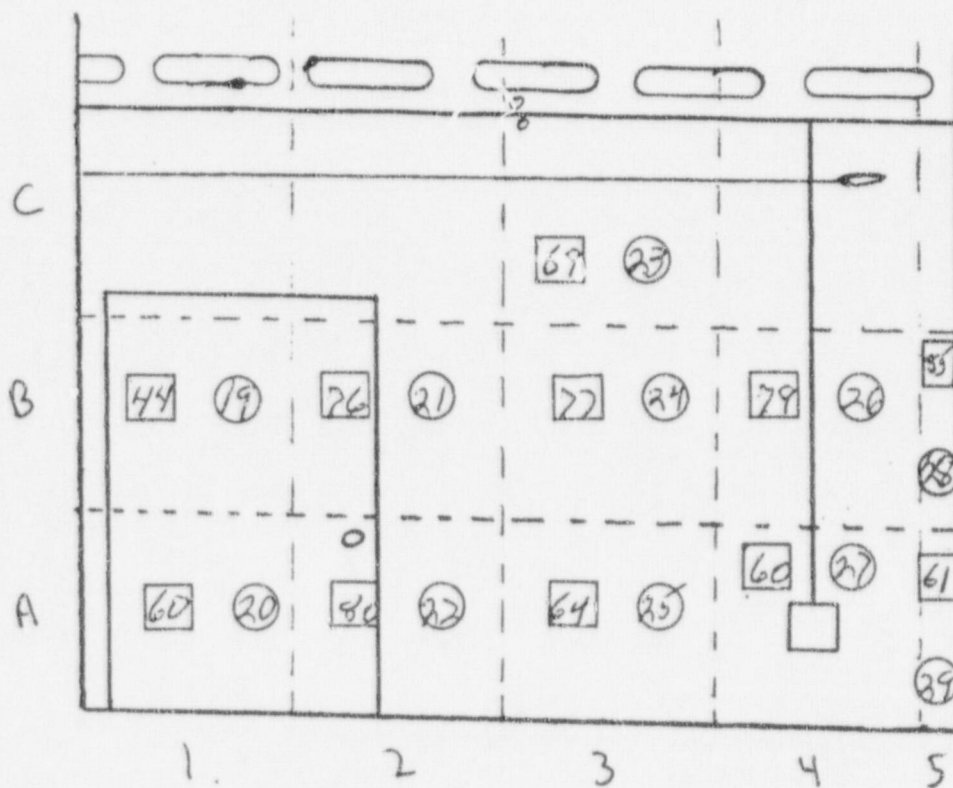
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RADIOLOGICAL RELEASE SURVEY REPORT (CONTINUATION SHEET)

ROOM 128

MAP 4- EAST WALL



**RADIOLOGICAL RELEASE SURVEY REPORT
(CONTINUATION SHEET)**

ROOM 128

MAP 5-WEST WALL



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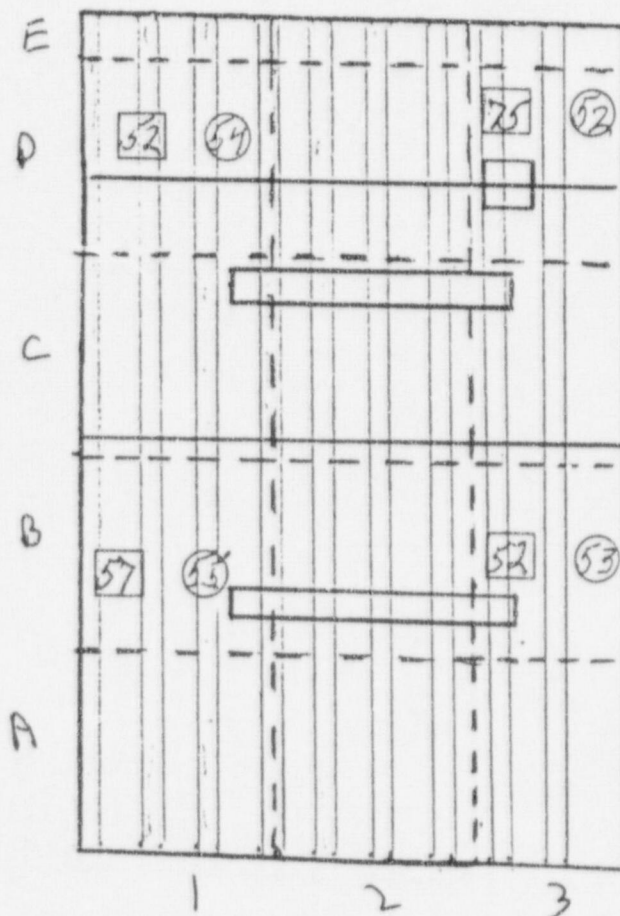
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RADIOLOGICAL RELEASE SURVEY REPORT (CONTINUATION SHEET)

ROOM 128

MAP 6-CEILING

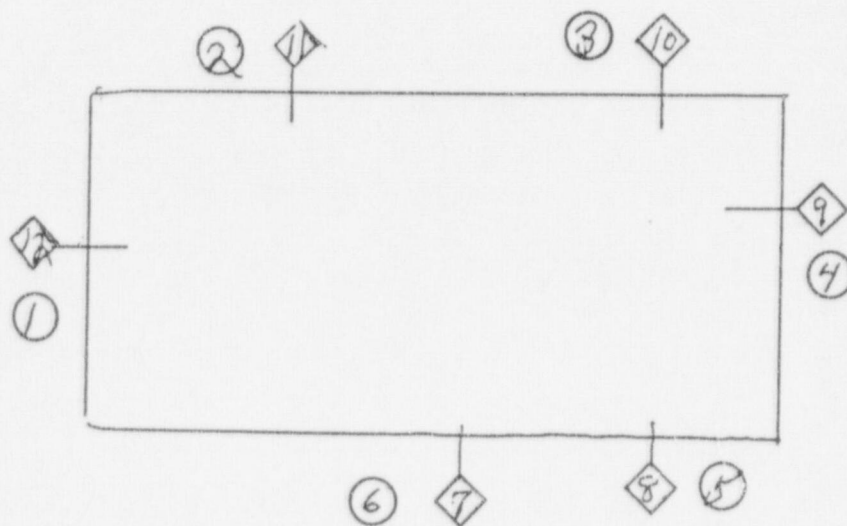


**RADIOLOGICAL RELEASE SURVEY REPORT
(CONTINUATION SHEET)**

ROOM 128

MAP7-FREEZER

FREEZER



ID: 3H-14C BLK SUB

25 FEB 1997 14:17

6H 2/25/97

USER: 8 COMMENT: AQC+LUM-EX OFF
 PRESET TIME: 1.00
 DATA CALC: DL DPM H# 1 YES SAMPLE REPEATS: 1 PRINTER: STD
 COUNT BLANK: YES IC# 1 NO REPLICATES: 1 RS232: OFF
 TWO PHASE: NO ABC: YES CYCLE REPEATS: 1
 SCINTILLATOR: LIQUID LUMEX: YES LOW SAMPLE REJ: 0
 LOW LEVEL: NO HALF LIFE CORRECTION DATE: none

ISOTOPE 1: 3H ZERRR: 0.00 FACTOR: 1.000000 BKG. SUB: 0
 ISOTOPE 2: 14C ZERRR: 0.00 FACTOR: 1.000000 BKG. SUB: 0

BACKGROUND QUENCH CURVE: Off COLOR QUENCH CORRECTION: Off

Quench Limits Low: 17.046 High: 315.71

SAM NO	POS	TIME MIN	H#	3H		14C		3H DPM	14C DPM	3H		14C		RATIO	LUMEX %	ELAPSED TIME
				CPM	ZERRR	CPM	ZERRR			EFF-1	EFF-2	EFF-1	EFF-2			
81	11-1	1.00	94.6	22.00	42.64	23.00	41.70	33.80	29.98	48.29	0.53	18.95	76.12	1.127	0.71	1.45
			Blank Average	DPM for	3H:			33.80	COEF. OF VAR:	0.000						
			Blank Average	DPM for	14C:			29.98	COEF. OF VAR:	0.000						
1	11-3	1.00	112.8	10.00	63.25	12.00	57.74	-17.78	-14.17	43.68	0.53	19.00	75.34	1.255	0.92	3.03
2	11-4	1.00	107.7	11.00	60.30	8.00	70.71	-13.76	-19.53	44.99	0.53	18.99	75.57	0.704	1.02	4.57
3	11-5	1.00	111.4	16.00	50.00	14.00	53.45	-5.38	-11.61	44.03	0.53	19.00	75.40	0.464	0.51	5.12
4	11-6	1.00	104.0	15.00	51.64	10.00	63.25	-6.52	-16.97	45.93	0.53	18.98	75.73	0.384	0.92	7.66
5	11-7	1.00	115.1	11.00	60.30	18.00	47.14	-18.77	-6.16	43.08	0.53	19.00	75.24	3.045	0.72	9.20
6	11-8	1.00	121.0	15.00	51.64	13.00	55.47	-5.54	-12.84	41.57	0.54	19.00	74.97	0.432	0.98	10.75
7	11-9	1.00	109.7	15.00	51.64	17.00	48.51	-9.62	-7.63	44.47	0.53	19.00	75.48	1.261	1.59	12.31
8	11-10	1.00	102.5	20.00	44.72	20.00	44.72	-1.32	-3.82	46.29	0.53	18.98	75.79	0.346	1.41	13.86
9	11-11	1.00	100.8	17.00	48.51	15.00	51.64	-5.36	-10.40	46.72	0.53	18.97	75.66	0.515	0.91	15.42
10	11-12	1.00	102.9	13.00	55.47	15.00	51.64	-13.74	-10.32	46.20	0.53	18.98	75.77	1.330	1.31	16.97
11	11-1	1.00	100.9	7.00	75.59	7.00	75.59	-22.52	-20.83	46.69	0.53	18.97	75.66	1.081	3.38	18.63
12	11-2	1.00	99.5	15.00	51.64	16.00	50.00	-10.35	-9.07	47.06	0.53	18.97	75.92	1.142	1.34	20.17
13	11-3	1.00	99.5	14.00	53.45	12.00	57.74	-10.35	-14.34	47.05	0.53	18.97	75.92	0.722	0.87	21.74
14	11-4	1.00	98.1	22.00	42.64	17.00	48.51	3.76	-7.87	47.41	0.53	18.96	75.98	-0.478	1.00	23.31
15	11-5	1.00	99.2	19.00	45.88	19.00	45.88	-3.47	-5.17	47.13	0.53	18.97	75.93	0.671	0.75	24.88
16	11-6	1.00	95.9	17.00	48.51	15.00	51.64	-6.08	-10.45	47.98	0.53	18.95	76.07	0.582	1.01	26.42
17	11-7	1.00	96.8	21.00	43.64	11.00	60.30	4.55	-15.78	47.74	0.53	18.96	76.03	-0.288	0.80	27.99
18	11-8	1.00	96.6	17.00	48.51	21.00	43.64	-9.11	-2.53	47.79	0.53	18.96	76.04	3.596	1.10	29.54
19	11-9	1.00	99.9	11.00	60.30	16.00	50.00	-18.85	-9.00	46.96	0.53	18.97	75.90	2.093	1.11	31.10
20	11-10	1.00	98.8	13.00	55.47	12.00	57.74	-12.56	-14.33	47.23	0.53	18.97	75.95	0.877	0.87	32.64
21	11-11	1.00	106.6	25.00	40.00	17.00	48.51	12.15	-7.82	45.25	0.53	18.99	75.61	-1.555	0.79	34.21
22	11-12	1.00	113.1	16.00	50.00	15.00	51.64	-5.68	-10.27	43.58	0.53	19.00	75.33	0.553	0.62	35.75
23	11-1	1.00	101.6	14.00	53.45	12.00	57.74	-10.10	-14.32	46.54	0.53	18.98	75.83	0.705	0.88	37.41
24	11-2	1.00	94.7	15.00	51.64	10.00	63.25	-7.81	-17.02	48.28	0.53	18.95	76.12	0.459	1.07	38.97
25	11-3	1.00	94.2	18.00	47.14	19.00	45.88	-6.30	-5.22	48.41	0.53	18.95	76.14	1.206	1.07	40.55
26	11-4	1.00	100.0	24.00	40.22	9.00	66.67	12.67	-18.45	46.94	0.53	18.97	75.90	-0.687	1.36	42.10
27	11-5	1.00	103.3	21.00	43.64	15.00	51.64	3.71	-10.44	46.10	0.53	18.98	75.76	-0.356	1.19	43.68
28	11-6	1.00	99.3	14.00	53.45	12.00	57.74	-10.38	-14.34	47.12	0.53	18.97	75.93	0.724	1.22	45.22
29	11-7	1.00	102.2	18.00	47.14	10.00	63.25	-0.28	-17.02	46.37	0.53	18.98	75.80	0.016	1.88	46.79
30	11-8	1.00	112.9	13.00	55.47	14.00	53.45	-12.04	-11.55	43.65	0.53	19.00	75.34	1.042	1.62	48.34
31	11-9	1.00	108.6	12.00	57.74	4.00	100.00	-9.15	-24.86	44.75	0.53	18.99	75.53	0.368	1.37	49.91
32	11-10	1.00	112.5	10.00	63.25	12.00	57.74	-17.81	-14.17	43.75	0.53	19.00	75.36	1.257	1.21	51.46
33	11-11	1.00	105.7	8.00	70.71	13.00	55.47	-23.35	-12.87	45.49	0.53	18.99	75.65	1.815	1.89	53.02
34	11-12	1.00	124.1	11.00	60.30	13.00	55.47	-14.85	-12.74	40.77	0.54	18.99	74.83	1.165	1.59	54.58
35	11-1	1.00	99.1	12.00	57.74	14.00	53.45	-15.72	-11.67	47.17	0.53	18.97	75.94	1.347	1.17	56.25
36	11-2	1.00	98.1	18.00	47.14	17.00	48.51	-4.70	-7.81	47.41	0.53	18.96	75.98	0.602	0.73	57.80
37	11-3	1.00	121.2	19.00	45.88	14.00	53.45	3.54	-11.57	41.52	0.54	19.00	74.96	-0.306	1.09	59.37

SAM NO	POS	TIME MIN	HD	3H		14C		3H DPM	14C DPM	3H		14C		RATIO	LUMEX %	ELAPSED TIME
				CPM	%ERROR	CPM	%ERROR			EFF-1	EFF-2	EFF-1	EFF-2			
38	11-4	1.00	105.1	13.00	51.64	13.00	55.47	-8.00	-12.98	45.64	0.53	18.99	75.68	0.616	0.96	60.94
39	11-5	1.00	123.8	13.00	55.47	12.00	57.74	-9.34	-14.12	40.84	0.54	18.99	74.84	0.561	0.97	62.50
40	11-6	1.00	134.9	13.00	55.47	12.00	57.74	-7.55	-14.03	38.01	0.55	18.94	74.32	0.538	1.29	64.05
41	11-7	1.00	150.9	5.00	89.44	16.00	50.00	-31.11	-8.23	33.94	0.57	18.80	73.51	3.778	1.57	65.61
42	11-8	1.00	121.4	15.00	51.64	22.00	42.64	-11.00	-0.79	41.48	0.54	19.00	74.96	13.864	1.30	67.16
43	11-9	1.00	113.5	17.00	48.51	24.00	40.82	-8.27	1.74	42.99	0.53	19.00	75.22	-4.744	0.95	68.72
44	11-10	1.00	102.4	14.00	53.45	11.00	60.30	-9.45	-15.64	46.32	0.53	18.98	75.79	0.604	1.19	70.27
45	11-11	1.00	131.9	12.00	57.74	17.00	48.51	-13.94	-7.30	38.77	0.55	18.96	74.46	1.911	1.92	71.82
46	11-12	1.00	117.1	6.00	81.65	15.00	55.47	-27.40	-12.73	42.58	0.53	19.00	75.15	2.153	2.47	73.38
47	11-1	1.00	116.4	18.00	47.14	13.00	55.47	0.74	-12.93	42.74	0.53	19.00	75.18	-0.057	1.96	75.06
48	11-2	1.00	114.7	15.00	51.64	15.00	51.64	-7.76	-10.23	43.20	0.53	19.00	75.26	0.758	2.35	76.51
49	11-3	1.00	110.2	15.00	51.64	38.00	32.44	-21.51	20.29	44.34	0.53	19.00	75.46	-1.060	1.67	78.17
50	11-4	1.00	114.1	32.00	35.36	123.00	18.03	-31.58	133.38	43.35	0.53	19.00	75.29	-0.237	1.02	79.74
51	11-5	1.00	117.1	14.00	53.45	25.00	40.00	-15.70	3.16	42.58	0.53	19.00	75.15	-4.973	2.11	81.31
52	11-6	1.00	111.3	13.00	55.47	11.00	60.30	-10.50	-15.56	44.04	0.53	19.00	73.41	0.675	2.44	82.87
53	11-7	1.00	135.1	12.00	57.74	22.00	42.64	-16.89	-0.50	37.94	0.55	18.94	74.31	33.928	1.75	84.44
54	11-8	1.00	126.7	11.00	60.30	22.00	42.64	-20.26	-0.63	40.10	0.54	18.98	74.71	32.116	1.54	85.99
55	11-9	1.00	125.8	8.00	70.71	24.00	40.82	-29.06	2.09	40.34	0.54	18.99	74.75	-13.89	1.56	87.56

6H 2/26/97

ID: 3H-14C BLK SUB

25 FEB 1997 15:44

USER: 8

COMMENT: AOC+LUM-EX OFF

PRESET TIME :

1.00

DATA CALC :

DL DPM H# :

YES SAMPLE REPEATS: 1

PRINTER :

STD

COUNT BLANK :

YES IC# :

NO REPLICATES : 1

RS232 :

OFF

TWO PHASE :

NO AOC :

YES CYCLE REPEATS : 1

SCINTILLATOR:

LIQUID LUMEX: YES

LOW SAMPLE REQ: 0

LOW LEVEL :

NO HALF LIFE CORRECTION DATE:

none

ISOTOPE 1:

3H XERROR: 0.00

FACTOR: 1.000000

BKS. SUB: 0

ISOTOPE 2:

14C XERROR: 0.00

FACTOR: 1.000000

BKS. SUB: 0

BACKGROUND QUENCH CURVE: Off

COLOR QUENCH CORRECTION: Off

Quench Limits

Low: 17.046

High: 315.71

SAM NO	POS	TIME MIN	H#	3H		14C		3H DPM	14C DPM	3H		14C		RATIO	LUMEX %	ELAPSED TIME
				CPM	XERROR	CPM	XERROR			EFF-1	EFF-2	EFF-1	EFF-2			
B1	#1-1	1.00	95.3	20.00	44.72	20.00	44.72	31.29	26.07	42.13	0.53	18.95	75.10	1.201	0.77	1.44
			Blank Average	DPM for	3H :	31.29	COEF. OF VAR:		0.000							
			Blank Average	DPM for	14C :	26.07	COEF. OF VAR:		0.000							
1	#1-3	1.00	105.7	13.00	55.47	14.00	55.45	-10.38	-7.71	45.48	0.53	18.99	75.65	1.346	1.67	3.01
2	#1-4	1.00	109.4	10.00	63.25	13.00	55.47	-16.14	-8.95	44.55	0.53	19.00	75.49	1.803	2.32	4.94
3	#1-5	1.00	104.4	17.00	48.51	12.00	57.74	-0.67	-10.43	45.82	0.53	18.99	75.71	0.064	2.04	6.11
4	#1-6	1.00	130.5	17.00	48.51	12.00	57.74	4.48	-10.23	39.12	0.54	18.97	74.53	-0.439	1.08	7.64
5	#1-7	1.00	102.0	17.00	48.51	17.00	48.51	-3.76	-3.83	46.43	0.53	18.98	75.81	0.982	1.50	9.21
6	#1-8	1.00	106.2	14.00	55.45	13.00	55.47	-7.55	-9.04	45.35	0.53	18.99	75.63	0.835	1.89	10.76
7	#1-9	1.00	112.1	16.00	50.00	20.00	44.72	-6.22	0.29	43.85	0.53	19.00	75.37	-21.29	2.11	12.31
8	#1-10	1.00	123.2	16.00	47.14	13.00	51.64	3.44	-6.28	41.01	0.54	18.99	74.87	-0.547	1.16	13.86
9	#1-11	1.00	131.5	9.00	66.67	9.00	66.67	-13.98	-14.11	38.88	0.55	18.96	74.48	0.991	1.67	15.42
10	#1-12	1.00	131.3	19.00	45.88	21.00	43.64	3.91	1.87	38.93	0.54	18.96	74.49	2.093	0.95	16.97
11	#1-1	1.00	130.7	13.00	55.47	13.00	55.47	-6.41	-8.80	39.09	0.54	18.97	74.52	0.728	1.00	18.64
12	#1-2	1.00	128.7	13.00	55.47	16.00	50.00	-8.66	-4.79	39.60	0.54	18.98	74.62	1.809	1.37	20.19
13	#1-3	1.00	124.9	16.00	50.00	20.00	44.72	-4.27	0.48	40.56	0.54	18.99	74.79	-8.901	1.60	21.76
14	#1-4	1.00	114.3	18.00	47.14	19.00	45.88	-0.69	-1.04	43.28	0.53	19.00	75.38	0.654	1.74	23.31
15	#1-5	1.00	115.0	20.00	44.72	21.00	43.64	2.91	1.60	43.10	0.53	19.00	75.24	1.818	1.72	24.88
16	#1-6	1.00	127.9	16.00	50.00	16.00	50.00	-1.21	-4.85	39.80	0.54	18.98	74.65	0.249	2.22	26.44

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RADIOLOGICAL RELEASE SURVEY COVER SHEET

DATE	Originals	INSTRUMENTATION USED		
TIME	On	MODEL	SERIAL NO.	CAL. DATE
SURVEYOR	File			
LOCATION	Room 129	See Radiological Release Survey Report Page 1		
REVIEWED BY				
PURPOSE OF SURVEY: RELEASE FOR UNRESTRICTED USE				
Animal Facility Room 129				

General area background was established with a pancake GM tube coupled to a Ludlum digital scaler by performing a ten (10) minute background count and dividing that number by ten to determine counts per minute (CPM). **Background Observed: 61 cpm beta-gamma.**

Background for scanning with large area gas flow detector was established by setting Ludlum floor monitor detector at scanning height in an unaffected area and observing count rate on analog scale of ratemeter.

Floor Monitor Background Observed: 2200 cpm beta-gamma

Elevated construction material background includes refractories brick used to line the incinerator burn box and discharge stack. A gamma spectrographic analysis is included in Appendix B showing the natural radioactivity component. Concrete floors also exhibit a higher than ambient natural background. Used where denoted by asterisk.

Construction material background observed: 150-200 cpm GM, Incinerator Brick; 70-100 cpm for concrete floors.

100% of accessible affected area surfaces were scanned using Ludlum Floor Monitor. All areas with detectable activity were decontaminated to background levels.

Ⓢ Denotes smear location (approximate)

Ⓢ Denotes internal smear

Ⓢ Denotes (1) minute static reading in gross cpm beta-gamma

Denotes general area exposure rate in uR/hr

#/A Denotes grid identification

See attached maps for survey locations.

RADIOLOGICAL RELEASE SURVEY REPORT

ITEM NO.	ROOM 129		AMBIENT RADIATION	FIXED CONTAMINATION (dpm/100 cm2)		REMOVABLE CONTAMINATION (dpm/100 cm2)	
	MAP	LOCATION	uR/hr	α	B- γ	H-3	C-14
1	1	A.1	N/A	N/A	<MDA	<MDA	<MDA
2	1	A.2	N/A	N/A	<MDA	<MDA	<MDA
3	1	A.3	N/A	N/A	<MDA	<MDA	<MDA
4	1	B.1	N/A	N/A	<MDA	<MDA	<MDA
5	1	B.2	N/A	N/A	<MDA	<MDA	<MDA
6	1	B.3	N/A	N/A	<MDA	<MDA	<MDA
7	1	C.1	N/A	N/A	<MDA	<MDA	<MDA
8	1	C.2	N/A	N/A	<MDA	<MDA	<MDA
9	1	C.3	N/A	N/A	<MDA	<MDA	<MDA
10	1	D.1	N/A	N/A	<MDA	<MDA	<MDA
11	1	D.2	N/A	N/A	<MDA	<MDA	<MDA
12	1	D.3	N/A	N/A	<MDA	<MDA	<MDA
13	1	E.1	N/A	N/A	<MDA	<MDA	<MDA
14	1	E.2	N/A	N/A	<MDA	<MDA	<MDA
15	1	E.3	N/A	N/A	<MDA	<MDA	<MDA
16	2	A.1	N/A	N/A	<MDA	<MDA	<MDA
17	2	A.2	N/A	N/A	<MDA	<MDA	<MDA
18	2	A.3	N/A	N/A	<MDA	<MDA	<MDA
19	2	B.1	N/A	N/A	<MDA	<MDA	<MDA
20	2	B.2	N/A	N/A	<MDA	<MDA	<MDA

INSTRUMENTATION USED	MODEL	SERIAL NO.	CAL. DATE	EFFICIENCY	MDA
AMBIENT	V-450P	1685	3/25/96	N/A	N/A
FIXED ALPHA	N/A	N/A	N/A	N/A	N/A
FIXED BETA-GAMMA	ESP-2	1203	02/18/97	5.81%	620 DPM
REMOVABLE ALPHA	N/A	N/A	N/A	N/A	N/A
REMOVABLE H-3/C-14	BECK LS-6000	7065011	ROUTINE	57/78 %	40/25 DPM
SURVEYOR: ORIGINALS ON FILE		DATE:	REVIEWED:		

RADIOLOGICAL RELEASE SURVEY REPORT (CONTINUATION SHEET)

ITEM NO.	ROOM 129		AMBIENT RADIATION	FIXED CONTAMINATION (dpm/100 cm ²)		REMOVABLE CONTAMINATION (dpm/100 cm ²)	
	MAP	LOCATION	uR/hr	α	B- γ	H-3	C-14
21	2	B.3	N/A	N/A	<MDA	<MDA	<MDA
22	2	C.2	N/A	N/A	<MDA	<MDA	<MDA
23	2	A.1	N/A	N/A	<MDA	<MDA	<MDA
24	2	A.2	N/A	N/A	<MDA	<MDA	<MDA
25	2	A.3	N/A	N/A	<MDA	<MDA	<MDA
26	3	B.1	N/A	N/A	<MDA	<MDA	<MDA
27	3	B.2	N/A	N/A	<MDA	<MDA	<MDA
28	3	B.3	10	N/A	<MDA	<MDA	<MDA
29	3	C.2	N/A	N/A	<MDA	<MDA	<MDA
30	4	A.1	N/A	N/A	<MDA	<MDA	<MDA
31	4	A.2	N/A	N/A	<MDA	<MDA	<MDA
32	4	A.3	N/A	N/A	<MDA	<MDA	<MDA
33	4	A.4	N/A	N/A	<MDA	<MDA	<MDA
34	4	A.5	N/A	N/A	<MDA	<MDA	<MDA
35	4	B.1	N/A	N/A	<MDA	<MDA	<MDA
36	4	B.2	N/A	N/A	<MDA	<MDA	<MDA
37	4	B.3	N/A	N/A	<MDA	<MDA	<MDA
38	4	B.4	N/A	N/A	<MDA	<MDA	<MDA
39	4	B.5	N/A	N/A	<MDA	<MDA	<MDA
40	4	C.3	N/A	N/A	<MDA	<MDA	<MDA
41	5	A.1	N/A	N/A	<MDA	<MDA	<MDA
42	5	A.2	N/A	N/A	<MDA	<MDA	<MDA
43	5	A.3	N/A	N/A	<MDA	<MDA	<MDA
44	5	A.4	N/A	N/A	<MDA	<MDA	<MDA
45	5	A.5	N/A	N/A	<MDA	<MDA	<MDA
46	5	B.1	N/A	N/A	<MDA	<MDA	<MDA

RADIOLOGICAL RELEASE SURVEY REPORT **(CONTINUATION SHEET)**

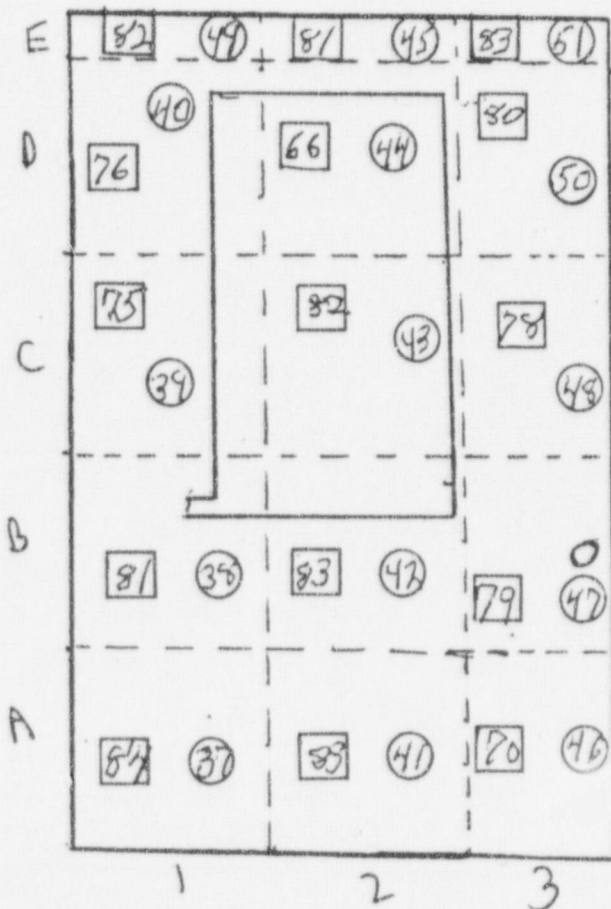
ITEM NO.	ROOM 129		AMBIENT RADIATION	FIXED CONTAMINATION (dpm/100 cm ²)		REMOVABLE CONTAMINATION (dpm/100 cm ²)	
	MAP	LOCATION	uR/hr	α	B- γ	H-3	C-14
47	5	B.2	N/A	N/A	<MDA	<MDA	<MDA
48	5	B.3	N/A	N/A	<MDA	<MDA	<MDA
49	5	B.4	N/A	N/A	<MDA	<MDA	<MDA
50	5	B.5	N/A	N/A	<MDA	<MDA	<MDA
51	5	C.3	N/A	N/A	<MDA	<MDA	<MDA
52	6	A.1	N/A	N/A	<MDA	<MDA	<MDA
53	6	A.3	N/A	N/A	<MDA	<MDA	<MDA
54	6	D.1	N/A	N/A	<MDA	<MDA	<MDA
55	6	D.3	N/A	N/A	<MDA	<MDA	<MDA
56	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
57	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
58	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
59	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
60	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
61	7	Burn Box	N/A	N/A	<MDA	227	<MDA
62	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
63	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
64	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
65	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
66	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
67	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
68	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
69	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
70	7	Burn Box	N/A	N/A	<MDA	<MDA	<MDA
71-73	8	Stack	N/A	N/A	<MDA	<MDA	<MDA

RADIOLOGICAL RELEASE SURVEY REPORT (CONTINUATION SHEET)

ROOM 129

MAP 1 - FLOOR *

* Concrete Floor



NORTH
↓

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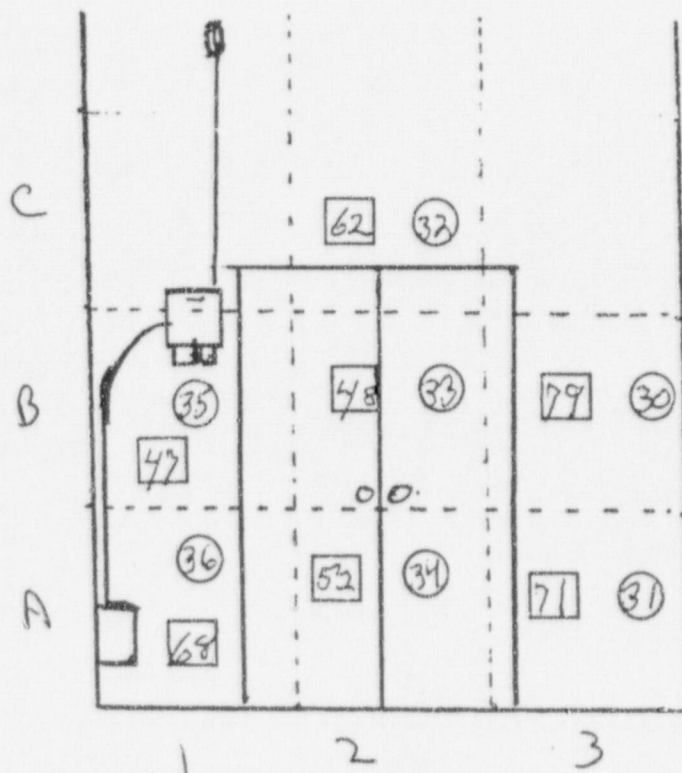
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RADIOLOGICAL RELEASE SURVEY REPORT (CONTINUATION SHEET)

ROOM 129

MAP 2 - NORTH WALL



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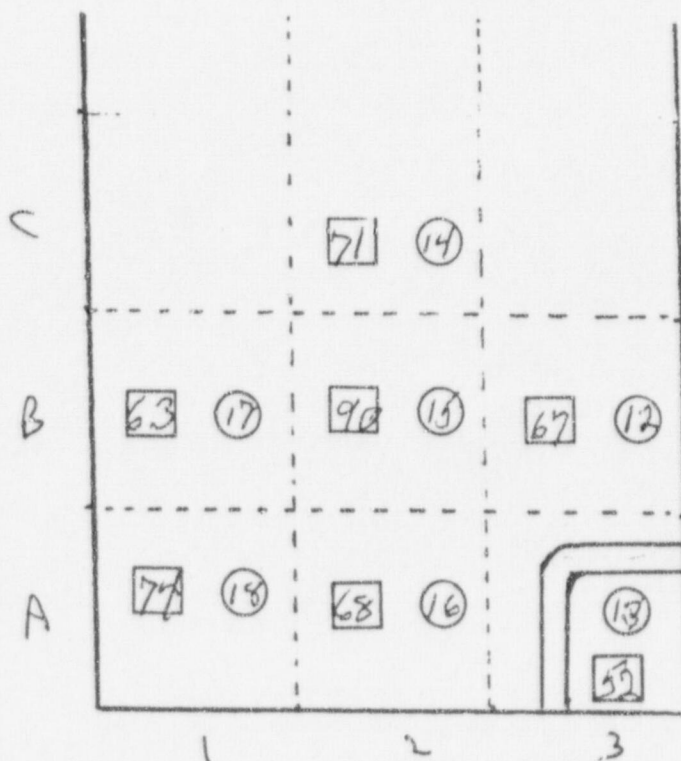
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PAGE 7 of 12

**RADIOLOGICAL RELEASE SURVEY REPORT
(CONTINUATION SHEET)**

ROOM 129

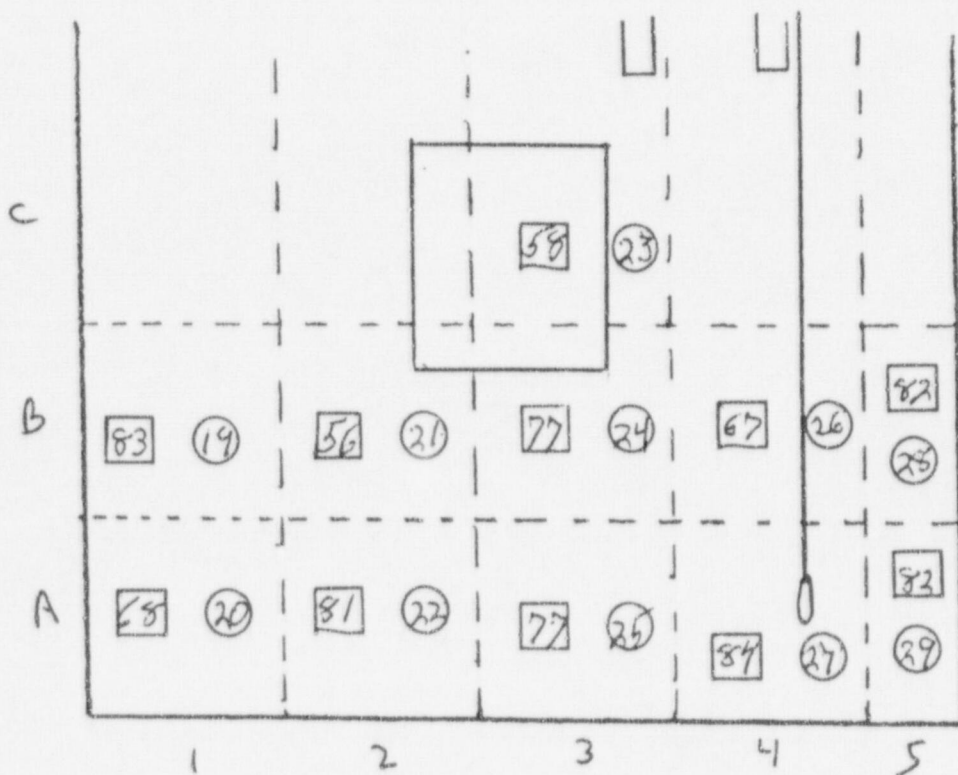
MAP 3 - SOUTH WALL



**RADIOLOGICAL RELEASE SURVEY REPORT
(CONTINUATION SHEET)**

ROOM 129

MAP 4- EAST WALL



RADIOLOGICAL RELEASE SURVEY REPORT
(CONTINUATION SHEET)

ROOM 129

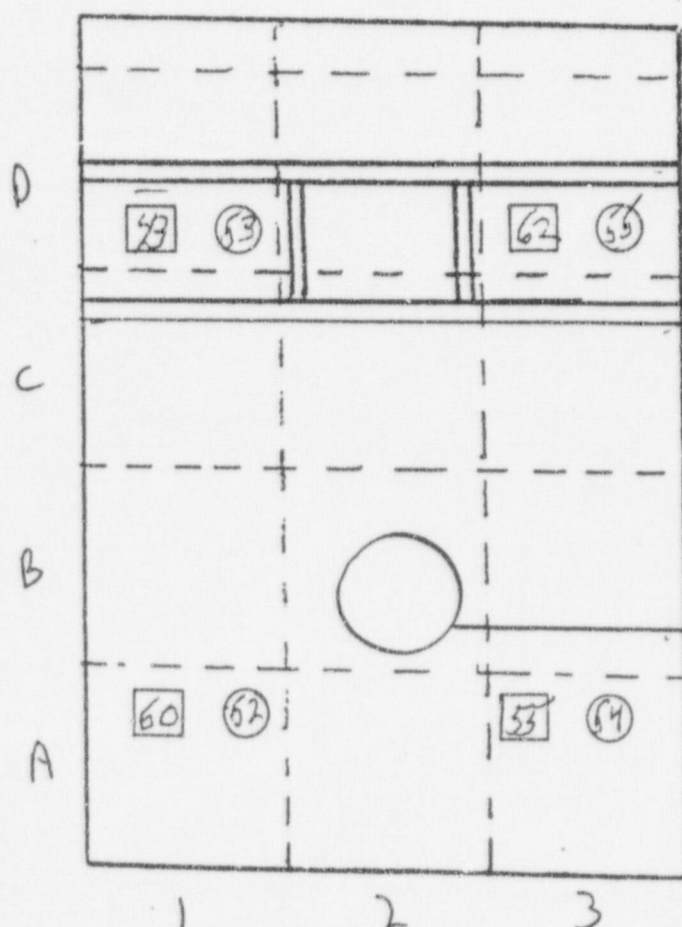
MAP 5-WEST WALL



**RADIOLOGICAL RELEASE SURVEY REPORT
(CONTINUATION SHEET)**

ROOM 129

MAP 6-CEILING

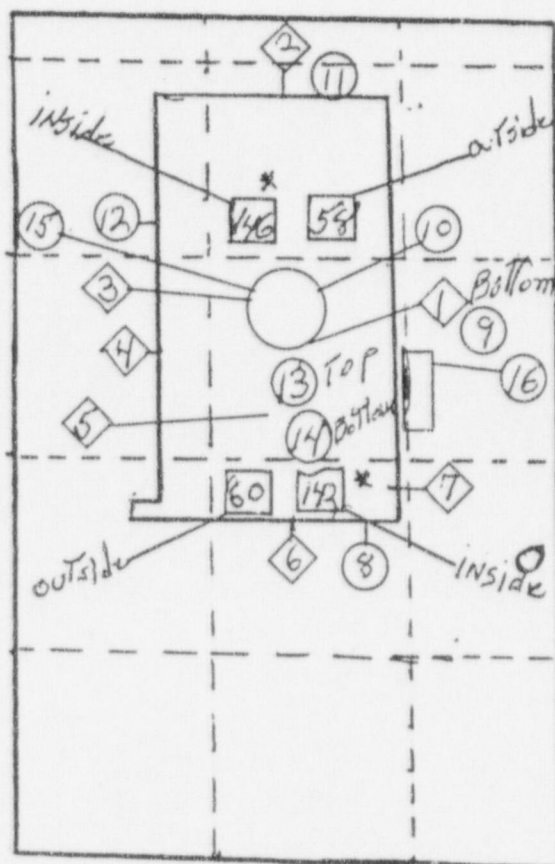


NORTH
↓

**RADIOLOGICAL RELEASE SURVEY REPORT
(CONTINUATION SHEET)**

ROOM 129

MAP 7-BURN BOX



* Brick

NORTH
↓

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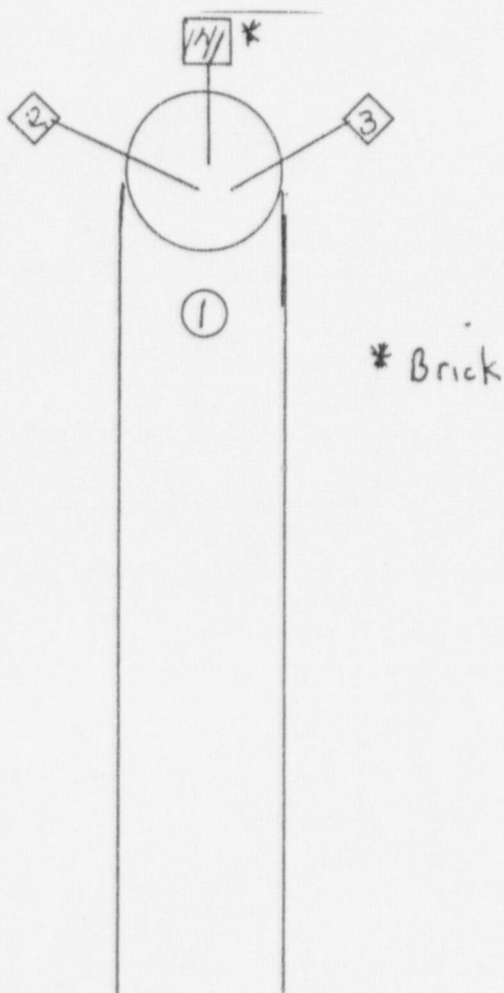
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PAGE 12 of 12

**RADIOLOGICAL RELEASE SURVEY REPORT
(CONTINUATION SHEET)**

ROOM 129

MAP 8-DISCHARGE STACK



ID: 3H-14C BLK SUB

25 FEB 1997 12:49

6H 2/25/97

USER: 8

COMMENT: ADC+LUM-EX OFF

PRESET TIME: 1.00

DATA CALC: DL DPM H# :YES SAMPLE REPEATS: 1 PRINTER: STD

COUNT BLANK: YES IC# : NO REPLICATES: 1 RS232: OFF

TWO PHASE: NO ADC :YES CYCLE REPEATS: 1

SCINTILLATOR: LIQUID LUMEX: YES LOW SAMPLE RES: 0

LOW LEVEL: NO HALF LIFE CORRECTION DATE: none

ISOTOPE 1: 3H ERROR: 0.00 FACTOR: 1.000000 BKS. SUB: 0

ISOTOPE 2: 14C ERROR: 0.00 FACTOR: 1.000000 BKS. SUB: 0

BACKGROUND QUENCH CURVE: Off COLOR QUENCH CORRECTION: Off

Quench Limits Low: 17.046 High: 315.71

SAM NO	PDS	TIME MIN	H#	3H		14C		3H DPM	14C DPM	3H		14C		RATIO	LUMEX %	ELAPSED TIME
				CPM	ERROR	CPM	ERROR			EFF-1	EFF-2	EFF-1	EFF-2			
B1	#1-1	1.00	95.6	11.00	60.30	8.00	70.71	18.80	10.38	48.05	0.53	18.95	76.08	1.820	1.90	1.46
	Blank Average			DPM for	3H:	18.80	COEF. OF VAR:		0.000							
	Blank Average			DPM for	14C:	10.38	COEF. OF VAR:		0.000							
1	#1-3	1.00	103.0	17.00	48.51	18.00	47.14	8.33	13.18	46.18	0.53	18.98	75.77	0.632	1.41	3.03
2	#1-4	1.00	105.5	21.00	43.64	25.00	40.00	13.64	22.43	45.54	0.53	18.99	75.66	0.606	0.96	4.35
3	#1-5	1.00	99.6	17.00	48.51	11.00	60.30	11.58	3.89	47.05	0.53	18.97	75.92	2.974	1.29	6.11
4	#1-6	1.00	95.6	20.00	44.72	19.00	45.88	13.07	14.37	48.04	0.53	18.95	76.08	0.910	0.79	7.64
5	#1-7	1.00	101.0	16.00	50.00	11.00	60.30	9.66	3.92	46.69	0.53	18.97	75.86	2.465	1.29	9.21
6	#1-8	1.00	98.5	16.00	50.00	14.00	53.45	7.71	7.86	47.31	0.53	18.97	75.96	0.980	0.86	10.74
7	#1-9	1.00	112.9	8.00	70.71	11.00	60.30	-6.79	4.13	43.65	0.53	19.00	75.34	-1.643	1.36	12.31
8	#1-10	1.00	99.2	12.00	57.74	11.00	60.30	0.89	3.97	47.13	0.53	18.97	75.93	0.224	1.22	13.83
9	#1-11	1.00	101.1	18.00	47.14	13.00	55.47	12.90	6.53	46.66	0.53	18.97	75.85	1.975	1.09	15.40
10	#1-12	1.00	101.6	24.00	40.82	12.00	57.74	26.46	5.13	46.53	0.53	18.98	75.83	5.162	1.89	16.94
11	#1-1	1.00	104.3	13.00	55.47	16.00	50.00	0.87	10.61	45.84	0.53	18.98	75.71	0.082	1.50	18.60
12	#1-2	1.00	98.2	18.00	47.14	20.00	44.72	8.73	15.75	47.38	0.53	18.96	75.97	0.554	0.80	20.16
13	#1-3	1.00	94.3	17.00	48.51	19.00	45.88	6.65	14.39	48.36	0.53	18.95	76.14	0.462	0.89	21.74
14	#1-4	1.00	96.0	14.00	53.45	14.00	53.45	3.19	7.87	47.94	0.53	18.95	76.06	0.406	1.06	23.29
15	#1-5	1.00	95.2	14.00	53.45	11.00	60.30	4.65	3.91	48.15	0.53	18.95	76.10	1.191	0.78	24.85
16	#1-6	1.00	103.6	17.00	48.51	19.00	45.88	7.87	14.51	46.02	0.53	18.98	75.74	0.543	1.09	26.38
17	#1-7	1.00	97.6	14.00	53.45	8.00	70.71	6.52	-0.03	47.55	0.53	18.96	76.00	-192.9	1.07	27.95
18	#1-8	1.00	108.3	11.00	60.30	17.00	48.51	-3.74	12.02	44.91	0.53	18.99	75.94	-0.312	0.88	29.48
19	#1-9	1.00	107.0	12.00	57.74	14.00	53.45	0.05	8.00	45.15	0.53	18.99	75.89	0.006	1.79	31.05
20	#1-10	1.00	117.4	18.00	47.14	15.00	51.64	14.74	9.34	42.50	0.53	19.00	75.14	1.578	1.46	32.61
21	#1-11	1.00	100.2	11.00	60.30	18.00	47.14	-4.90	13.24	46.89	0.53	18.97	75.89	-0.370	0.76	34.17
22	#1-12	1.00	104.7	17.00	48.51	14.00	53.45	10.78	7.90	45.74	0.53	18.99	75.69	1.364	0.89	35.74
23	#1-1	1.00	97.8	6.00	81.65	15.00	51.64	-14.03	9.32	47.50	0.53	18.96	75.99	-1.905	2.05	37.40
24	#1-2	1.00	97.9	15.00	51.64	12.00	57.74	6.57	5.23	47.46	0.53	18.96	75.98	1.256	1.46	38.95
25	#1-3	1.00	102.7	16.00	47.14	15.00	51.64	12.08	9.19	46.26	0.53	18.98	75.78	1.314	1.44	40.51
26	#1-4	1.00	98.0	25.00	40.00	14.00	53.45	26.66	7.73	47.44	0.53	18.96	75.98	3.452	1.10	42.05
27	#1-5	1.00	99.5	27.00	38.49	20.00	44.72	28.10	15.63	47.05	0.53	18.97	75.92	1.797	1.03	43.61
28	#1-6	1.00	95.9	14.00	53.45	19.00	45.88	0.58	14.46	47.96	0.53	18.95	76.07	0.040	1.40	45.16
29	#1-7	1.00	102.0	27.00	38.49	18.00	47.14	29.79	13.02	46.43	0.53	18.98	75.81	2.288	1.52	46.74
30	#1-8	1.00	100.9	21.00	43.64	19.00	45.88	16.09	14.42	46.70	0.53	18.97	75.86	1.116	2.04	48.29
31	#1-9	1.00	101.0	17.00	48.51	15.00	51.64	9.67	9.19	46.68	0.53	18.97	75.85	1.032	2.27	49.85
32	#1-10	1.00	95.8	11.00	60.30	22.00	42.64	-7.26	18.46	47.99	0.53	18.95	76.07	-0.394	2.14	51.41
33	#1-11	1.00	101.8	17.00	48.51	10.00	63.20	12.48	2.59	46.49	0.53	18.98	75.82	4.824	1.80	52.99
34	#1-12	1.00	104.3	22.00	42.64	14.00	53.45	21.65	7.82	45.84	0.53	18.98	75.71	2.767	1.93	54.54
35	#1-1	1.00	103.8	17.00	48.51	11.00	60.30	12.27	3.92	45.98	0.53	18.98	75.74	3.128	1.66	56.22
36	#1-2	1.00	100.3	14.00	53.45	16.00	50.00	2.61	10.55	46.85	0.53	18.97	75.88	0.247	1.99	57.78
37	#1-3	1.00	117.8	18.00	47.14	16.00	47.14	13.03	13.35	42.39	0.53	19.00	75.12	0.976	0.95	59.34

SAM NO	POS	TIME MIN	H#	3H		14C		3H DPM	14C DPM	3H		14C		RATIO	LUMEX %	ELAPSED TIME
				CPM	%ERROR	CPM	%ERROR			EFF-1	EFF-2	EFF-1	EFF-2			
38	11-4	1.00	131.1	9.00	66.67	15.00	51.64	-5.45	9.65	38.97	0.54	18.97	74.50	-0.565	1.53	60.90
39	11-5	1.00	132.3	21.00	43.64	12.00	57.74	27.78	5.39	38.66	0.55	18.96	74.44	5.151	1.71	62.47
40	11-6	1.00	122.8	18.00	47.14	15.00	55.47	17.09	6.72	41.10	0.54	18.99	74.89	2.545	1.95	64.02
41	11-7	1.00	112.8	20.00	44.72	15.00	55.47	19.62	6.60	43.66	0.53	19.00	75.34	2.973	1.77	65.60
42	11-8	1.00	106.6	13.00	51.64	11.00	60.30	8.33	3.97	45.25	0.55	18.99	75.61	2.096	1.37	67.13
43	11-9	1.00	112.8	14.00	53.45	19.00	45.88	2.35	14.68	43.68	0.53	19.00	75.34	0.160	1.21	68.71
44	11-10	1.00	125.5	16.00	50.00	15.00	51.64	11.46	9.46	40.42	0.54	18.99	74.77	1.212	1.23	70.26
45	11-11	1.00	135.8	13.00	55.47	14.00	53.45	6.27	8.28	37.76	0.55	18.94	74.27	0.757	1.02	71.82
46	11-12	1.00	122.0	15.00	51.64	10.00	63.25	11.47	2.74	41.32	0.54	19.00	74.93	4.180	0.77	73.37
47	11-1	1.00	116.8	7.00	75.59	9.00	66.67	-7.68	1.51	42.65	0.53	19.00	75.16	-5.087	1.07	75.04
48	11-2	1.00	112.5	13.00	55.47	11.00	60.30	4.65	4.05	43.76	0.53	19.00	75.36	1.148	1.69	76.59
49	11-3	1.00	136.3	11.00	60.30	16.00	50.00	-0.34	11.03	37.64	0.55	18.94	74.25	-0.031	2.20	78.15
50	11-4	1.00	134.3	17.00	48.51	21.00	43.64	11.84	17.64	38.17	0.55	18.95	74.35	0.671	0.84	79.69
51	11-5	1.00	127.8	7.00	75.59	16.00	50.00	-11.41	10.99	39.82	0.54	18.98	74.66	-1.038	1.53	81.25
52	11-6	1.00	128.0	7.00	75.59	16.00	50.00	-11.40	11.00	39.76	0.54	18.98	74.65	-1.036	1.79	82.81
53	11-7	1.00	145.1	8.00	70.71	19.00	45.88	-9.88	15.29	35.39	0.56	18.86	73.80	-0.646	0.82	84.37
54	11-8	1.00	124.4	17.00	48.51	18.00	47.14	11.86	13.45	40.68	0.54	18.99	74.82	0.882	1.15	85.92
55	11-9	1.00	139.4	12.00	57.74	11.00	60.30	6.25	4.27	36.84	0.55	18.91	74.09	1.462	0.93	87.48

6H 2/25/97

ID: 3H-14C BLK SUB

25 FEB 1997 16:11

USER: B

COMMENT: AGC+LUM-EX OFF

PRESET TIME: 1.00

DATA CALC: DL DPM HH YES SAMPLE REPEATS: 1 PRINTER: STD

COUNT BLANK: YES IC# NO REPLICATES: 1 RS232: OFF

TWO PHASE: NO AGC YES CYCLE REPEATS: 1

SCINTILLATOR: LIQUID LUMEX: YES LOW SAMPLE RES: 0

LOW LEVEL: NO HALF LIFE CORRECTION DATE: none

ISOTOPE 1: 3H ZERROR: 0.00 FACTOR: 1.000000 BIG. SUB: 0

ISOTOPE 2: 14C ZERROR: 0.00 FACTOR: 1.000000 BIG. SUB: 0

BACKGROUND QUENCH CURVE: Off COLOR QUENCH CORRECTION: Off

Quench Limits Low: 17.046 High: 315.71

SAM	POS	TIME	HH	3H		14C		3H	14C	3H		14C		RATIO	LUMEX	ELAPSED
NO		MIN		CPM	ZERROR	CPM	ZERROR	DPM	DPM	EFF-1	EFF-2	EFF-1	EFF-2	%		TIME
B1	11-1	1.00	95.5	17.00	48.51	19.00	45.88	25.59	24.79	48.07	0.53	18.95	76.09	1.032	0.96	1.47
	Blank Average			DPM for	3H:	25.59	COEF. OF VAR:	0.000								
	Blank Average			DPM for	14C:	24.79	COEF. OF VAR:	0.000								
1	11-3	1.00	96.4	20.00	44.72	13.00	55.47	9.53	-7.94	47.85	0.53	18.96	76.05	-1.200	1.47	3.03
2	11-4	1.00	88.6	19.00	45.88	17.00	48.51	4.19	-2.74	49.80	0.53	18.92	76.37	-1.528	1.61	4.58
3	11-5	1.00	93.7	20.00	44.72	18.00	47.14	6.48	-1.38	48.53	0.53	18.94	76.16	-4.687	1.67	6.10
4	11-6	1.00	95.1	26.00	39.22	16.00	50.00	20.24	-4.09	48.17	0.53	18.95	76.10	-4.952	1.68	7.66
5	11-7	1.00	96.7	25.00	40.00	9.00	66.67	22.19	-13.29	47.76	0.53	18.96	76.03	-1.670	2.16	9.22
6	11-8	1.00	96.9	124.00	17.96	15.00	51.64	227.17	-6.82	47.71	0.53	18.96	76.03	-33.32	1.01	10.78
7	11-9	1.00	98.4	36.00	33.33	17.00	48.51	41.67	-2.88	47.35	0.53	18.96	75.97	-14.46	1.93	12.33
8	11-10	1.00	103.4	19.00	45.88	23.00	41.70	3.23	5.37	46.07	0.53	18.98	75.75	0.601	2.34	13.89
9	11-11	1.00	91.2	22.00	42.64	25.00	40.00	6.63	7.76	49.16	0.53	18.93	76.27	0.854	1.93	15.45
10	11-12	1.00	92.4	18.00	47.14	17.00	48.51	2.70	-2.68	48.83	0.53	18.94	76.21	-1.004	1.96	17.01
11	11-1	1.00	101.0	11.00	60.30	14.00	53.45	-9.48	-6.45	46.69	0.53	18.97	75.86	1.470	2.28	18.66
12	11-2	1.00	93.9	16.00	50.00	10.00	53.25	2.36	-11.86	48.48	0.53	18.94	76.16	-0.199	2.50	20.23
MISSING SAMPLE																
13	11-4	1.00	110.9	14.00	53.45	11.00	60.30	-0.08	-10.39	44.16	0.53	19.00	75.43	0.008	1.76	21.79
215	11-5	1.00	97.5	14.00	53.45	12.00	57.74	-2.39	-9.17	47.57	0.53	18.96	76.00	0.260	2.00	23.37
316	11-6	1.00	93.2	17.00	48.51	15.00	51.64	1.76	-5.29	48.66	0.53	18.94	76.18	-0.332	2.60	24.91

APPENDIX B

OTHER PROJECT INFORMATION

APPENDIX B

CONTENTS

1. Sample Calculations
2. Calibration Certificates
3. Waste Shipment Records

SAMPLE CALCULATIONS

1. MDA

The basic equation for determining minimum detectable activities is as follows:

$$MDA = \frac{2.71 + 4.65\sqrt{R_B \times t}}{t \times E}$$

where:

$$\begin{aligned} R_B &= \text{background count rate} \\ t &= \text{counting time} \\ E &= \text{detection efficiency} \end{aligned}$$

Sample Calculation for MDA for C-14 activity

$$\begin{aligned} R_B &= 49 \text{ cpm} \\ t &= 1 \text{ min} \\ E &= 0.05 \text{ counts per disintegration} \end{aligned}$$

$$MDA = \frac{2.71 + 4.65\sqrt{49 \times 1}}{1 \times 0.05}$$

$$= 705 \text{ dpm}$$

2. Surface Activity Measurement

The basic equation for determining surface activity in units of the guidelines (dpm/100 cm²) using a direct static measurement is as follows:

$$SA = \frac{\text{Net CPM}}{E \times \frac{A}{100}}$$

where:

SA	=	Surface activity in dpm/100 cm ²
Net		
cpm	=	Gross counts minus background counts, per minute
E	=	detection efficiency

The net cpm must exceed the minimum detectable net count per minute (MDCPM) which is defined by the following, before applying the SA equation above: If this condition is not met, the activity is reported as less than MDA:

$$MDCPM = \frac{2.71 + 4.65\sqrt{R_B \times t}}{t}$$

where:

R_B	=	background count rate
t	=	counting time
E	=	detection efficiency

Sample Calculation for C-14 surface activity using ESP-2 scaler with 44-9 pancake probe

R_B	=	49 cpm
t	=	1 min
E	=	0.05 counts per disintegration

$$MDCPM = \frac{2.71 + 4.65\sqrt{49 \times 1}}{1}$$
$$= 35 \text{ cpm}$$

Hence, a net count of >35 in one minute is necessary prior to using the SA Equation. In this case, the surface activity would be established as follows:

$$SA = \frac{35 \text{ CPM}}{0.05 \times \frac{16}{100}}$$
$$= 4407 \text{ dpm/100 cm}^2$$

CALIBRATION CERTIFICATES

**ION Technology, Inc.
Radiochemistry Results**

Sample: Incinerator Brick
Customer: Applied Consultants, Inc.
Date Analyzed: 2/25/97
Type of Analysis: HPGe Gamma Spectroscopy
Sample Weight: 19.4 grams

RESULTS

Isotope	Conc pCi/g	Error pCi/g	MDA pCi/g	Summary
K-40	29.6	2.5	1.8	K-40 30.0 pCi/g
Tl-208	3.52	0.32	0.3	
Pb-212	3.47	0.16	0.12	
Ac-228	3.73	0.44	0.46	Th-232 Progeny Average 3.6 pCi/g
Pb-214	3.18	0.23	0.18	
Bi-214	3.22	0.27	0.21	Ra-226/U-238 Prog Avg 3.2 pCi/g
Th-234	2.91	0.66	0.59	U-238 progeny 2.9 pCi/g

The gamma spectroscopy analysis indicates that the Incinerator Brick radioactivity is due to naturally occurring radionuclides.

Reviewed/Approved: ANB/fup 2/26/97



CALIBRATION CERTIFICATE

91 Portsmouth Avenue
Stratham, NH 03885-2468

A Division of RSCS, Inc.

CUSTOMER NAME: Applied Consultants, Inc.
1501 Main Street Suite 40
Tewksbury, MA 01876

COMPANY CONTACT: Mario Vigliani PHONE: 508-851-0933

INSTRUMENT MAKE: VICTOREEN Model: 450P Serial Number: 1685

PRECISION CHECK				
TEST 1	TEST 2	TEST 3	MEAN	SAT/UNSAT
400.0	400.0	400.0	400.0	SAT

ACCURACY CHECK			
SCALE	EXPOSURE RATE	AS FOUND	AS LEFT
500MR	400.00 mR/hr	400.00 mR/hr	400.00 mR/hr
	100.00 mR/hr	98.00 mR/hr	98.00 mR/hr
	40.00 mR/hr	40.00 mR/hr	40.00 mR/hr
50MR	10.00 mR/hr	10.00 mR/hr	10.00 mR/hr
	4.00 mR/hr	3.90 mR/hr	3.90 mR/hr
5MR	1.00 mR/hr	1.00 mR/hr	1.00 mR/hr
	400.00 uR/hr	400.00 uR/hr	400.00 uR/hr
.5MR	100.00 uR/hr	100.00 uR/hr	100.00 uR/hr

All readings are within +/- 10% unless otherwise noted

CALIBRATED BY: *m Jull* ON: 03/25/96 EXPIRES ON: 03/25/97

This calibration was performed using a NIST Traceable radiation source, in conformance to MIL-STD 45662.
RSCS New Hampshire Radioactive Material License Number: 381R, Cesium Calibration Source: Tech Ops Mod 773.
Serial Number 58, Activity 112 millicuries on 9/9/92.
RSCS recommends that their customers remit a check source with their meters for calibration. If supplied,
the check source will be characterized at the time of calibration.



DUPONT
CALIBRATION CERTIFICATE

CARBON-14 REFERENCE SOURCE HALF - LIFE : 5730 +/- 40. YEARS
MODEL NO. NES-200A LOT NUMBER : NES-200A-062788

THE CARBON-14 ACTIVITY WAS DETERMINED TO BE 6.6 KILOBECQUELS (0.176 uCi) ON 6/27/88.

DESCRIPTION OF THE SOURCE THE ACTIVITY WAS DEPOSITED IN A 5 MM DIAMETER ACTIVE AREA ON A 0.25 MM THICK STAINLESS STEEL PLANCHET, COVERED WITH A 0.90 MG / SQUARE CENTIMETER ALUMINIZED MYLAR WINDOW, AND SEALED INTO THE ALUMINUM MOUNT. THE OVERALL DIMENSIONS OF THE SOURCE ARE 3.6 MM IN HEIGHT AND 25 MM IN DIAMETER. THE MASS OF THE DEPOSIT WAS LESS THAN 0.01 MG AND SELF-ABSORPTION WAS CONSIDERED NEGLIGIBLE.

DECAY SCHEME

REFERENCE

NUCLIDE	MAXIMUM AVERAGE INTENSITY	BOOK OF RADIOACTIVITY MEASUREMENTS PROCEDURES
(MEV)	(Z)	
CARBON-14: BETA-1	0.156 0.049 100	NCRP REPORT NO. 58, SECOND ED., FEBRUARY, 1985

METHOD OF CALIBRATION THE SOURCE WAS CALIBRATED BY MEASUREMENT IN A 2 PI INTERNAL PROPORTIONAL COUNTER WHOSE RESPONSE FOR THE RADIONUCLIDE AND GEOMETRY HAD BEEN VERIFIED THROUGH THE USE OF A SECONDARY STANDARD. THE SECONDARY STANDARD WAS PREPARED FROM A SOLUTION WHOSE ACTIVITY WAS DETERMINED BY LIQUID SCINTILLATION COUNTING. THE LIQUID SCINTILLATION COUNTING EFFICIENCY HAD BEEN DETERMINED USING ALIQUOTS OF A SOLUTION CERTIFIED BY THE NATIONAL BUREAU OF STANDARDS FOR DUPONT UNDER P.O. NO. 34004. DUPONT PARTICIPATES IN A NATIONAL BUREAU OF STANDARDS-ATOMIC INDUSTRIAL FORUM MEASUREMENT ASSURANCE PROGRAM IN ORDER TO INSURE THE CONTINUING TRACEABILITY OF DUPONT'S RADIOASSAYS TO THE NBS.

RADIOIMPURITIES A RANDOM SAMPLE OF THIS PRODUCTION LOT WAS EXAMINED FOR PHOTON-EMITTING IMPURITIES WITH A GE(LI) SPECTROMETER SYSTEM. THE RADIOIMPURITIES WERE DETERMINED TO BE < 1 % EXPRESSED AS A PERCENTAGE OF THE BETA-RAY-EMISSION RATE OF C-14.

RANDOM ERRORS (99% CONFIDENCE LEVEL)		
PRECISION OF THE MEASUREMENT OF THE SOURCE	+/-	0.30%
PRECISION OF THE MEASUREMENT OF NBS SECONDARY STANDARD	+/-	0.34%
SYSTEMATIC ERRORS		
ACCURACY OF THE NBS SECONDARY STANDARD (LINEAR SUM OF THE ESTIMATED UPPER LIMITS OF CONCEIVABLE ERRORS INVOLVED IN ITS PREPARATION)	+/-	6.6 %
TOTAL ERROR		
$[(0.30)^2 + (0.34)^2]^{1/2} + 6.6 =$	+/-	7.1 %

SIGNATURE: _____

CALIBRATION LABORATORY

LOT NO. NES-200A-062788

DUPONT

331 JEROME COWE RD., NORTH BILLERICA, MA., 01862
CALL TOLL-FREE : 800-225-1572 TELEX : 6817017
(IN MASSACHUSETTS AND INTERNATIONAL: 617-482-9595)
REFER INQUIRIES TO - CUSTOMER SERVICES

 * DUFONT *
 * CALIBRATION CERTIFICATE *

CARBON-14 REFERENCE SOURCE HALF - LIFE : 5730 +/- 40. YEARS
 MODEL NO. NES-200A LOT NUMBER : NES-200A-062788

THE CARBON-14 ACTIVITY WAS DETERMINED TO BE 6.6 KILOBECQUERELS (0.178 uCi) ON 6/27/98.

DESCRIPTION OF THE SOURCE THE ACTIVITY WAS DEPOSITED IN A 5 MM DIAMETER ACTIVE AREA ON A 0.25 MM THICK STAINLESS STEEL PLANCHET, COVERED WITH A 0.90 MG / SQUARE CENTIMETER ALUMINIZED MYLAR WINDOW, AND SEALED INTO THE ALUMINUM MOUNT. THE OVERALL DIMENSIONS OF THE SOURCE ARE 3.6 MM IN HEIGHT AND 25 MM IN DIAMETER. THE MASS OF THE DEPOSIT WAS LESS THAN 0.01 MG AND SELF-ABSORPTION WAS CONSIDERED NEGLIGIBLE.

DECAY SCHEME

REFERENCE

NUCLIDE		MAXIMUM (MEV)	AVERAGE (MEV)	INTENSITY (%)	BROOK OF RADIOACTIVITY MEASUREMENTS PROCEDURES NCRP REPORT NO. 58, SECOND ED., FEBRUARY, 1985
CARBON-14:	BETA-1	0.156	0.049	100	

METHOD OF CALIBRATION THE SOURCE WAS CALIBRATED BY MEASUREMENT IN A 2 PI INTERNAL PROPORTIONAL COUNTER WHOSE RESPONSE FOR THE RADIONUCLIDE AND GEOMETRY HAD BEEN VERIFIED THROUGH THE USE OF A SECONDARY STANDARD. THE SECONDARY STANDARD WAS PREPARED FROM A SOLUTION WHOSE ACTIVITY WAS DETERMINED BY LIQUID SCINTILLATION COUNTING. THE LIQUID SCINTILLATION COUNTING EFFICIENCY HAD BEEN DETERMINED USING ALIQUOTS OF A SOLUTION CERTIFIED BY THE NATIONAL BUREAU OF STANDARDS FOR DUFONT UNDER P.O. NO. 34004. DUFONT PARTICIPATES IN A NATIONAL BUREAU OF STANDARDS-ATOMIC INDUSTRIAL FORUM MEASUREMENT ASSURANCE PROGRAM IN ORDER TO INSURE THE CONTINUING TRACEABILITY OF DUFONT'S RADIOASSAYS TO THE NBS.

RADIOIMPURITIES A RANDOM SAMPLE OF THIS PRODUCTION LOT WAS EXAMINED FOR PHOTON-EMITTING IMPURITIES WITH A GE(LI) SPECTROMETER SYSTEM. THE RADIOIMPURITIES WERE DETERMINED TO BE < 1 % EXPRESSED AS A PERCENTAGE OF THE BETA-RAY-EMISSION RATE OF C-14 .

RANDOM ERRORS (99% CONFIDENCE LEVEL)

PRECISION OF THE MEASUREMENT OF THE SOURCE	+/-	0.30%
PRECISION OF THE MEASUREMENT OF NEW SECONDARY STANDARD	+/-	0.34%

SYSTEMATIC ERRORS

ACCURACY OF THE NEW SECONDARY STANDARD (LINEAR SUM OF THE ESTIMATED UPPER LIMITS OF CONCEIVABLE ERRORS INVOLVED IN ITS PREPARATION)	+/-	6.6 %
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TOTAL ERROR

$[(0.30)^2 + (0.34)^2]^{1/2} + 6.6 =$	+/-	7.1 %
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CERTIFIED
TAGGED
CHEMICALS

CH



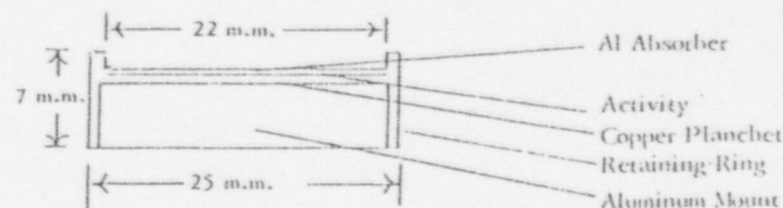
ATOMIC ACCESSORIES, INC.
811 West Merrick Road
Valley Stream, New York

UNIVERSITY 4-9347

DATA SHEET BETA REFERENCE SOURCE CTBS

Serial No.: B10024 Isotope: Cl4 Date: 11/6/61
Half Life: 5.57×10^3 years Microcurie Content: 0.151
Max. Beta Energy: 0.155 Mev.
Gamma Energy: None Specific Activity: Weightless
Absorber Thickness: 0.89 mg/cm² Range of Beta: 28 mg/cm²
Absorption Factor*: 0.89 Mass Absorption Coefficient** ($\frac{\mu}{\rho}$): 2.35 cm²/g

Construction:



BETA REFERENCE SOURCE SET

CTBS

DATA SHEETS



MODEL

SCB-1225

SERIAL #

B1020

ATOMIC ACCESSORIES, INC.
811 W. Merrick Rd., Valley Stream, N. Y.

Calibration Method:

Several standards were made using precise aliquots of a National Bureau of Standards calibrated solution. With these standards, efficiencies were determined with and without the aluminum absorbers. The error associated with these calibrations is estimated at $\pm 10\%$.

*Determined experimentally from observed counting rates with and without aluminum absorber.

**Calculated from the following equation:


$$\frac{\mu}{\rho} = \frac{\ln 2}{T_{1/2}}$$

where: μ is the linear absorption coefficient

ρ is the density of the absorber in mg/cm³

$T_{1/2}$ is the half thickness in mg/cm²

RECORD OF WASTE SHIPMENT

genzyme 
transgenics

Mason
Laboratories

STRAIGHT BILL OF LADING

TO:

GTC Mason Laboratories
57 Union Street
Worcester, MA 01608
NRC License No.: 20-01489-01

FROM:

GTC Mason Laboratories
30 Memorial Drive
Cambridge, MA 02142
NRC License No.: 20-01489-01

CONTENTS:

Number Units	Description	Weight
6 Drums	Radioactive Materials, NOS UN 2982	500 lbs

This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation, according to the applicable regulations of the Department of Transportation.

Shipper:

J. Grant

Date: February 26, 1997

23613

1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 26

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IS ENTERED / 10

REQUIRED

3/7/87

appears

Cont. reactions

us amendment

0639, I left

Penny Leiszer

BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM
AND
REGIONAL LICENSING SECTIONS

(FOR LFMS USE)
INFORMATION FROM LTS

PROGRAM CODE: 03610
STATUS CODE: 0
FEE CATEGORY: 3L
EXP. DATE: 20011031
FEE COMMENTS: -----
DECOM FIN ASSUR REQD: Y

LICENSE FEE TRANSMITTAL

A. REGION *I*

1. APPLICATION ATTACHED

APPLICANT/LICENSEE: GENZYME TRANSGENICS CORPORATION
RECEIVED DATE: 970228
DOCKET NO: 3004605
CONTROL NO.: 124325
LICENSE NO.: 20-01489-01
ACTION TYPE: AMENDMENT

2. FEE ATTACHED

AMOUNT: -----
CHECK NO.: -----

3. COMMENTS

SIGNED
DATE

M.A. Porfina
2/28/97

B. LICENSE FEE MANAGEMENT BRANCH (CHECK WHEN MILESTONE 03 IS ENTERED *1*)

1. FEE CATEGORY AND AMOUNT: *3L*

FEE NOT REQUIRED

2. CORRECT FEE PAID. APPLICATION MAY BE PROCESSED FOR:

AMENDMENT -----
RENEWAL -----
LICENSE -----

3. OTHER -----

SIGNED
DATE

3/7/97

RECEIVED BY LFDCB	
Date	<i>3/11/97</i>
Log	<i>Mar 4 1997</i>
By	<i>BA</i>
Date Completed	<i>3/11/97</i>

3/11/97
Penny
Called -
Yes, this
is a continu-
ation of
124154

I called RT, appear
to me this is a continuation
of a previous amendment
124154 or 120639, I left
message for Penny Leisner
to call me.

0.9 for 3/11/97, called RT - Proceed w/ review.

BETWEEN:

LICENSE FEE MANAGEMENT BRANCH, ARM
AND
REGIONAL LICENSING SECTIONS

(FOR LFMS USE)
INFORMATION FROM LTS

PROGRAM CODE: 03610
STATUS CODE: 0
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LICENSE FEE TRANSMITTAL

A. REGION *I*

1. APPLICATION ATTACHED
APPLICANT/LICENSEE: GENZYME TRANSGENICS CORPORATION
RECEIVED DATE: 970228
DOCKET NO: 3004605
CONTROL NO.: 124325
LICENSE NO.: 20-01489-01
ACTION TYPE: AMENDMENT

2. FEE ATTACHED

AMOUNT: */*
CHECK NO.: */*

3. COMMENTS

SIGNED *M. A. Perkins*
DATE *2/28/97*

B. LICENSE FEE MANAGEMENT BRANCH (CHECK WHEN MILESTONE 03 IS ENTERED *1*)

1. FEE CATEGORY AND AMOUNT: *3L* *Fee Not Required 154*

2. CORRECT FEE PAID. APPLICATION MAY BE PROCESSED FOR:
AMENDMENT */*
RENEWAL */*
LICENSE */*

3. OTHER */*

SIGNED */*
DATE */*

RECEIVED BY LFDCB	
Date	<i>3/1/97</i>
Log	<i>Man 4</i>
By	<i>JG</i>
Date Completed	<i>PD</i>

3/1/97

Penny

Called -

Yes, this

is a continuation

of

124154

3/7/97

*I called RT, appeared
to me this is a continuation
of a previous amendment
124154 or 120639, I left
message for Penny Leung
to call me.*

09 for 3/1/97, Called RT - Proceed w/ review