NRC FORM 591 M PART 3
(06-2010)
10 CFR 2.201

U.S. NUCLEAR REGULATORY COMMISSION

Docket File Information

SAFETY INSPECTION REPORT AND COMPLIANCE INSPECTION

1. LICENSEE	2. NRC/REGIONAL OFFICE
Aptuit, Inc REPORT NUMBER(S) 2010-001	U.S. Nuclear Regulatory Commission, Region III 2443 Warrenville Road, Suite 210 Lisle, Illinois 60532

3. DOCKET NUMBER(S)	4.LICENSE NUMBER(S)	5. DATE(S) OF INSPECTION
030-09415	24-15595-01	12/3/10 through 2/22/11

6. INSPECTION PROCEDURES	7. INSPECTION FOCUS AREAS
87104	Sections 03.01(d)(e)(f)(g) and 03.02(c)

SUPPLEMENTAL INSPECTION INFORMATION

1.PROGRAM	2. PRIORITY	3. LICENSEE CONTACT	4.TELEPHONE NUMBER
3620	5	Clint Gregg – RSO	816-767-3745

☒ Main Office Inspection Next Inspection Date: NA

☐ Field Office Inspection ☐ Temporary Job Site Inspection

PROGRAM SCOPE

This special inspection was prompted by the licensee informing the NRC of air ducts in room B2-195 contaminated with radioactive material. The NRC conducted the site inspection to review the circumstances surrounding the licensee identified contamination.

Observations and Findings

The licensee informed the inspector that the air ducts were part of a radioactive ventilation exhaust system that was partial decommissioned. The air ducts were taped sealed in room B2-195 and lead to the roof of the building where an exhaust air handling system vented the air to the environment. The entire air handling system was disabled and procedures were in place to ensure that access to the system was limited to authorized individuals.

The licensee also provided information regarding the decommissioning of room A3-367. The room was decommissioned in 2006 by Shaw Environmental, Inc. The NRC reviewed the licensee's procedures and surveys and interviewed staff regarding the systems used to decommission the area. The licensee's report regarding the decommissioning of the room is attached to this report for future decommissioning documentation of the building.

The NRC did not identify any violations of NRC requirements regarding the licensee's decommissioning activities nor possession of licensed material. The NRC will perform a routine NRC inspection related to licensed activities at a frequency dictated by NRC Manual Chapter 2800.

COPY

Final Status Survey Report
Laboratory A3-367
Aptuit, Incorporated
Kansas City, Missouri

Prepared In Support of:

Aptuit, Incorporated
10245 Hickman Mills Drive
Kansas City, Missouri 64134-0708

Prepared by:

Shaw Environmental, Inc.
312 Directors Drive
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May 2006

RECEIVED DEC 1 0 2010

Final Status Survey Report
Laboratory A3-367
Aptuit, Incorporated
10245 Hickman Mills Drive
Kansas City, Missouri

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Acronyms and Abbreviations

ALARA	as low as reasonably achievable
Aptuit	Aptuit, Incorporated in Kansas City, Missouri
^{14}C	carbon-14
CFR	Code of Federal Regulations
cm^2	square centimeter
CS	characterization survey
DCGL	derived concentration guideline level
dpm	disintegrations per minute
FSS	final status survey
FSSP	Final Status Survey Plan
License	Materials License Number 24-15595-01
LSC	liquid scintillation counter
m^2	square meters
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual*
mrem	millirem
NRC	U.S. Nuclear Regulatory Commission
RSPM	*Aptuit Radiation Safety Program Manual*
RSO	radiation safety officer
Shaw	Shaw Environmental, Inc.
TEDE	total effective dose equivalent
^3H	tritium

Definitions

Assessment. The evaluation process used to measure the performance or effectiveness of a system and its elements. Assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation, management systems review, peer review, inspection, or surveillance.

Background Radiation. Radiation from cosmic sources, naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material), and global fallout as it exists in the environment from the testing of nuclear explosive devices or from nuclear accidents like Chernobyl which contribute to background radiation and are not under the control of the cognizant organization. Background radiation does not include radiation from source, byproduct, or special nuclear materials regulated by the cognizant Federal or State agency. Different definitions may exist for this term. The definition provided in regulations or regulatory program being used for a site release should always be used if it differs from the definition provided here.

Beta Radiation. An electron emitted from the nucleus during radioactive decay.

Class 1 Survey Unit. Areas where contamination is known or suspected to exist, and insufficient evidence exists to classify the areas as Class 2 or Class 3 survey units.

Contamination. The presence of residual radioactivity in excess of levels which are acceptable for release of a site or facility for unrestricted use.

DCGL. A derived, radionuclide-specific activity concentration in a survey unit corresponding to the release criterion. The DCGL is based on the spatial distribution of the contaminant and hence is derived differently for the nonparametric statistical test ($DCGL_W$) and the Elevated Measurement Comparison ($DCGL_{EMC}$). DCGLs are derived from activity/dose relationships through various exposure pathway scenarios.

Direct Measurement. Radioactivity measurement obtained by placing the detector near the surface or media being surveyed. An indication of the resulting radioactivity level is read out directly.

DQA (Data Quality Assessment). The scientific and statistical evaluation of data to determine if the data are of the right type, quality, and quantity to support the intended use.

Exposure Pathway. The route by which radioactivity travels through the environment to eventually cause radiation exposure to a person or group.

Final Status Survey. Measurements and sampling to describe the radiological conditions of a site, following completion of decontamination activities (if any) in preparation for release.

Gamma Radiation. Penetrating high-energy, short-wavelength electromagnetic radiation (similar to X-rays) emitted during radioactive decay. Gamma rays are very penetrating and require dense materials (such as lead or steel) for shielding.

Grid. A network of parallel horizontal and vertical lines forming squares on a map that may be overlaid on a property parcel for the purpose of identification of exact locations.

Investigation. An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for character.

License Termination. Discontinuation of a license, the eventual conclusion to decommissioning.

Measurement. It is used interchangeably to mean: 1) the act of using a detector to determine the level or quantity of radioactivity on a surface or in a sample of material removed from a media being evaluated, or 2) the quantity obtained by the act of measuring.

MARSSIM. Multi-Agency Radiation Survey and Site Investigation Manual. A manual established by the EPA, NRC, DOD, and DOE that provides a nationally consistent consensus approach to conducting radiation surveys and investigations at potentially contaminated sites. The approach is both scientifically rigorous and flexible enough to be applied to a diversity of site cleanup conditions.

Quality Control (QC). The overall system of technical activities that measure the attributes and performance of a process, item, or service against defined standards to verify that they meet

the stated requirements established by the customer, operational techniques and activities that are used to fulfill requirements for quality.

Radiation Safety Officer. The Aptuit staff member responsible, with the support of the Radiation Safety Committee, for the implementation of the facilities Radiation Safety Program.

Radiation Survey. Measurements of radiation levels associated with a site together with appropriate documentation and data evaluation.

Radioactivity. The mean number of nuclear transformations occurring in a given quantity of radioactive material per unit time. The International System (SI) unit of radioactivity is the *Becquerel (Bq)*. The customary unit is the *Curie (Ci)*.

Radiological Release. The release of materials/equipment/areas from administrative controls pertaining to radioactive materials. These administrative controls refer to either local requirements as established in the RSM or license requirements as established in the EPA U.S. Nuclear Regulatory Commission Radioactive Material License. The release from radiological controls is preceded by an assessment of the radiological conditions and confirmation that these conditions meet the requirements to be released from further controls.

Radionuclide. An unstable atom of any element that undergoes radioactive decay in order to achieve a more stable state.

rem (Radiation Equivalent Man). The conventional unit of dose equivalent. The corresponding International System (SI) unit is the *Sievert (Sv)*: 1 Sv = 100 rem.

Removable Radioactivity. Surface activity that is readily removable by wiping the surface with an absorbent medium using moderate pressure and can be assessed with standard radiation detectors. It is usually expressed in units of dpm/100 cm^2.

Survey. A systematic evaluation and documentation of radiological measurements with a correctly calibrated instrument or instruments that meet the sensitivity required by the objective of the evaluation.

Wipe Test. A procedure in which a swab, e.g., Q-tip or filter paper is rubbed on a surface and its radioactivity measured to determine if the surface is contaminated with removable radioactive material.

Executive Summary

A final status survey (FSS) was conducted in Laboratory A3-367 at Aptuit, Incorporated (Aptuit) in Kansas City, Missouri on April 4, 2006. The purpose of the FSS was to establish, through a process of site investigation, that Laboratory A3-367 meets the criteria for radiological release established in the *Code of Federal Regulations*, Title 10, Part 20, Subpart E, "Radiological Criteria for License Termination." The FSS was conducted using the guidance of the *Multi-Agency Radiation Survey and Site Investigation Manual* (NUREG-1575). Laboratory A3-367 is part of the Aptuit facility licensed by the U. S. Nuclear Regulatory Commission under Materials License Number 24-15595-01 (License).

Due to a lack of historical use information the laboratory was classified as a Class 1 impacted area. Carbon-14 (^{14}C) was the contaminant of concern although the use of tritium (^{3}H) in the laboratory could not be ruled out. The license termination screening value for ^{14}C found in Table H.1 of the *Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria* (NUREG-1757, Vol. 2) was used as the derived concentration guideline level applicable to the average concentration over the survey unit ($DCGL_w$). This screening value for fixed ^{14}C contamination, 3.7E6 disintegrations per minute (dpm)/100 square centimeters (cm^2), is based on the assumption that the fraction of removable surface contamination is no greater than 10 percent. Therefore, the acceptable level for removable ^{14}C contamination was set at 3.7E5 dpm/100 cm^2. Since this value is lower than the screening value for removable ^{3}H it was used as the total $DCGL_w$ for removable contamination. To keep dose rates as low as reasonably achievable, administrative goals were set at 200 dpm/100 cm^2 removable contamination and 2000 dpm/100 cm^2 fixed contamination.

The FSS included surface scans, direct measurements and wipe sampling. Thirty-three systematic direct measurements were made and thirty-three wipe samples were collected. One biased direct measurement was made and one biased wipe sample was collected. One hundred percent of the floor surface and walls up to 2 meters were scanned. All direct measurements and all wipe sample results were below the DCGLs; therefore no statistical tests were performed. The data indicate that the laboratory is acceptable for unconditional radiological release.

1.0 Introduction

1.1 Scope and Purpose

The final status survey (FSS) described herein was limited to Laboratory A3-367 in Building A at the Aptuit facility in Kansas City, Missouri (Aptuit) (Figure 1). The purpose of the FSS was to demonstrate, through a process of site investigation, that the laboratory meets the criteria for radiological release established in the *Code of Federal Regulations* (CFR), Title 10, Part 20, Subpart E, "Radiological Criteria for License Termination."

1.2 Laboratory Location and Description

Aptuit is a drug development company serving the pharmaceutical and biotechnology industry. The Aptuit facility is located at:

Aptuit, Incorporated
10245 Hickman Mills Drive
Kansas City, Missouri 64134-0708

The facility consists of offices, laboratories, and other buildings in an urban setting. Laboratory A3-367 is located on the third floor near the center of Building A (Figure 1). Radioactive materials, primarily carbon-14 (^{14}C), were used, stored, and disposed in this laboratory.

The floor area of the laboratory is approximately 46.6 square meters (m^2). Walls from the floor up to 2 meters were also included in the survey (approximately 63.5 m^2).

1.3 Operational History

The laboratory under investigation operated under the U. S. Nuclear Regulatory Commission (NRC) Materials License Number 24-15595-01 (License). The License allows the use of several radioisotopes in a variety of physical and chemical forms. However, site personnel reported that only ^{14}C and possibly small quantities of tritium (^{3}H) were used in this laboratory.

Activities within the laboratory consisted of research using small quantities of radioactive materials.

1.4 Report Organization

A description of the nature and extent of contamination is presented in Chapter 2. This includes discussions concerning areas of potential contamination, previous investigative work, and the FSS design. Chapter 3 presents a discussion concerning dose assessment. Conclusions and the

final status determination are discussed in Chapter 4. References are included in Chapter 5. Tables, figures, and appendices follow the text.

2.0 Nature and Extent of Contamination

2.1 Sources

2.1.1 Contaminants of Concern

The radioactive contaminants of concern for Laboratory A3-367 were determined through discussions with the Radiation Safety Officer (RSO) and a review of the License. Although the radionuclides presented in Table 1 were approved by the NRC for use and storage at the facility, only ^{14}C and possibly small quantities of ^{3}H were reportedly used in this laboratory. Therefore, the contaminants of concern for this FSS were ^{14}C and ^{3}H.

2.1.2 Areas of Potential Concern

Laboratory A3-367 was a radioactive material use area. Reportedly, ^{14}C was used throughout the laboratory and not restricted to specific hoods or bench tops. Therefore, within the laboratory, all floor surfaces and walls up to two meters from the floor are areas of potential concern.

2.2 Summary of Previous Investigative Work

A characterization survey (CS) was conducted in Laboratory A3-367 by Shaw Environmental, Inc. (Shaw) in March 2006 (Shaw, 2006a). The administrative release levels, 2000 dpm/100 cm^2 for fixed contamination and 200 dpm/100 cm^2 for removable contamination, were used during the CS. The CS revealed general area fixed ^{14}C contamination above Aptuit's administrative release levels on the floor and on bench tops and table tops; one area exceeded 1E6 dpm/100 cm^2. Three floor areas had removable contamination above the administrative release level.

2.3 Summary of Remedial Actions

In March 2006, after the CS described above was performed, laboratory furniture and case work were surveyed and removed. Hoods and flooring that were investigated during the CS were removed as part of the remedial action. Items determined not to be contaminated were disposed of or reused. Remaining items became part of Aptuit's radiological waste and will be disposed of as such.

2.4 Final Status Survey

2.4.1 Objectives

The specific objectives of the FSS were to:

- Fulfill the scope of the data collection requirements defined in the Final Status Survey Plan (FSSP) (Shaw, 2006b).
- Adhere to the FSSP-required methodologies during the collection and analysis of data.
- Ensure that data collected are of sufficient quality and quantity to make release decisions with an acceptable probability of decision error.

The survey was designed and performed in accordance with the FSSP (Shaw, 2006b) and the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (NUREG-1575).

2.4.2 Defining Survey Units and Survey Design

Upon the writing of the FSSP, Laboratory A3-367 was defined as an impacted, Class 1 area for this FSS. The Class 1 designation was a result of having insufficient historical use information and survey data to justify a lower classification. The CS was conducted after the FSSP was written and the results of the CS confirmed that the laboratory was properly classified. Laboratory A3-367 comprised one Class 1 survey unit.

As determined in the FSSP, the survey unit contained a minimum of 32 survey locations on a random-start triangular grid. The survey locations were surveyed by direct measurements and wipe samples. Floor and wall surfaces (up to 2 meters) were 100 percent scanned.

2.4.3 Establishing Release Criteria

The license termination screening value for ^{14}C found in Table H.1 of the *Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria* (NUREG-1757, Volume 2) was used as the derived concentration guideline level applicable to the average concentration over the survey unit ($DCGL_w$). The $DCGL_w$, which is a derived, radionuclide-specific activity concentration corresponding to the release criterion, is based on the spatial distribution of the contaminant and is derived from activity/dose relationships through various exposure pathway scenarios. The regulatory release requirement identified in 10 CFR 20, Subpart E, for termination of radioactive materials licenses is 25 millirem (mrem)/year. The specific criteria for facility release under the NRC regulations are: 1) that residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem/year and 2) that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). The NRC published screening values for residual building surface contamination for common beta- and gamma-emitting radionuclides (Federal

Register, Chapter 63, Page 64132, November 18, 1998). Activity levels on building surfaces that fall within these screening values are in compliance with the unrestricted use dose limit for license termination. The license termination screening values are also published in Table H.1 of the *Consolidated NMSS Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria* (NUREG-1757, Vol. 2). Administrative ALARA goals were set equal to Aptuit's operational contamination limits in order to meet the ALARA condition of the license termination rule.

2.4.3.1 Total Activity (Direct Measurements)

Using the screening values presented in the look-up table H.1 found in Appendix H of NUREG 1757, Volume 2, the $DCGL_w$ for fixed activity is 3.7E6 disintegrations per minute (dpm)/100 square centimeters (cm^2) for ^{14}C and 1.2E8 dpm/100 cm^2 for ^3H. Since there are no reliable methods for direct measurement of ^3H activity and the use of ^3H in A3-367 has not been confirmed, the $DCGL_w$ for direct measurements was determined to be 3.7E6 dpm/100 cm^2. The administrative ALARA goal for total contamination was set at 2000 dpm/100 cm^2.

2.4.3.2 Removable Activity (Wipe Samples)

Screening levels presented in NUREG 1757, Volume 2, Table H.1 are based on the assumption that the fraction of removable surface contamination is no greater than 0.1 (10 percent). Therefore, 10 percent (the removable portion) of the screening value for ^3H is 1.2E7dpm/100 cm^2 and for ^{14}C is 3.7E5 dpm/100 cm^2. The screening level for ^{14}C, 3.7E5 dpm/100 cm^2, being the most conservative, was established as the $DCGL_w$ for removable activity. The administrative ALARA goal for removable contamination was set at 200 dpm/100 cm^2.

2.4.4 Quality Control/Quality Assurance

Instrument field performance checks consisting of background and source checks were conducted daily. All final status data were obtained using instruments that satisfied the performance requirement.

Periodic quality measures were performed as described in section. 3.6.7 of the FSSP (Shaw, 2006b). For direct measurements, replicates to measure operator precision were performed by using the same instrument at the same location. Two replicate direct readings were performed. For contamination smears, sampling precision was checked through recounting of smears. Two smears were recounted.

Precision is determined to be acceptable since all values are below the ALARA goals.

2.4.5 Decision Errors and Number of Data Points

The surveys were planned with the possibility that statistical testing would be required to demonstrate compliance with the license termination rule. The Sign Test was determined to be the appropriate statistical test since the average material background would be subtracted from each measurement. The acceptable probability of making a Type I decision error (concluding that residual radioactivity was within limits, when, in fact, it was not) or a Type II decision error (concluding that a survey unit is contaminated, when it truly is not) was established during the planning phase. For data collected during the investigation to be adequate for the final status determination, these probabilities were established at 0.05 for both Type I and Type II decision errors.

The minimum number of data points for the assigned statistical test is based on the selected decision error levels and the relative shift. In the absence of characterization data during the survey planning stages, the lower end of the recommended range of values for relative shift (Δ/σ), 1.0, was selected from guidance of the MARSSIM (NUREG-1575). This resulted in 32 data points needed in order to ensure that the requirements of the statistical test are met.

2.4.6 Instrumentation

2.4.6.1 Field Instruments

The radiological field survey instruments listed in Table 2 were used. Instrument detection sensitivities were determined following the guidance of NUREG-1757 (NRC, 2002). Instrument reports are presented in Appendix A.

All instrumentation had current calibration. Daily field performance checks were conducted in accordance with individual instrument use procedures. These performance checks were performed prior to daily field activities and at any time the instrument response appeared questionable. Only data obtained using instruments that satisfied the performance requirements were accepted for use in the evaluation.

Instrument response was continuously monitored during surveys through the use of the instrument audible signal. Instrumentation was used as specified in the FSSP (Shaw, 2006b).

2.4.6.2 Laboratory Instruments

Wipes samples were counted in Aptuit's on-site liquid scintillation counter (LSC) using equipment and procedures described in Appendix B.

2.4.7 Quality Checks

Replicates to measure operator precision were performed using the same instrument at the same location as the original measurement. Two replicate direct readings, at Locations C-27 and C-34, were performed, one for every 20 direct readings taken. Results are presented in Appendix C.

For wipe samples, analytical precision was checked through recounting wipes, with one wipe recounted for every 20 wipe samples collected. Two smears were recounted, one from Location C-27 and one from Location C-34. Results are presented in Appendix C.

2.4.8 Procedures

Analytical requirements can be divided into two categories: direct field measurements and sample analysis. Direct measurements for gross beta radioactivity were performed during the site investigation. Removable beta activity was determined from wipe samples collected during the investigation. More detail concerning sampling, packaging, and shipping procedures is provided in the Radiological Survey Protocol (Appendix D).

2.4.8.1 Field Procedures

Surface radioactivity surveys and wipe sampling were executed in accordance with the radiological survey protocols and the Health and Safety Plan as presented in the FSSP (Shaw, 2006b). Radiological survey protocols were designed to determine the extent and magnitude of residual radioactivity and to provide quality data for use in final status determination. These protocols are presented in Appendix D. The radiological survey protocols, which include sample storage and handling in the field, were designed to preserve the integrity of the collected samples.

2.4.8.2 Laboratory procedures

Wipe samples were analyzed for ^{14}C and ^{3}H by liquid scintillation counting using Aptuit's on-site LSC. Normal standard operating procedures were followed.

2.5 Extent of Contamination

Wipe sample results and direct measurement results are presented in Appendix E.

2.5.1 Final Status Survey

The focus of this document and of the unrestricted release of the facility from radiological controls is found in the performance of the FSS. The survey included the floors and the walls up to two meters from the floor in Laboratory A3-367.

Thirty-four final status wipe samples were collected in Laboratory A3-367 at locations presented in Figure 2. Direct measurements were also performed at those locations for gross beta activity. Thirty-three locations are systematic; C-34 is a biased sample location chosen based on the results of the CS. The results of the direct measurements and wipe samples are presented in Tables 3 and 4, respectively. All results are below the respective DCGLs.

2.5.2 Data Assessment

To determine whether or not a survey unit meets the release criteria (i.e., the survey unit passes), it is necessary to evaluate the results. If all measurements in the survey unit are below the release criteria, the survey unit passes. If all survey units pass, the laboratory can be released for unrestricted release. Tabulated summaries of the direct measurement and removable activity results are presented in Tables 3 and 4, respectively, and a text discussion is presented below. Conclusions and recommendations are presented in Chapter 4.

As presented in Table 5, all direct measurements are below the $DCGL_w$ of 3.7E6 dpm/100 cm^2 for final status release. The highest direct measurement is 1257 dpm/100 cm^2 at Location C-29. Direct measurements are also less than the ALARA goal for fixed contamination, 2000 dpm/100 cm^2. All removable activity results are below the DCGL of 200 dpm/100 cm^2 for final status release. The highest wipe sample results are 50.53 dpm/100 cm^2 for ^3H at Location C-23 and 47.55 dpm/100 cm^2 for ^{14}C at C-13. Wipe sample results are also less than the ALARA goal for removable contamination, 200 dpm/100 cm^2. Since all measurements (fixed and removable) are less than the respective DCGLs, no statistical tests are required.

3.0 Dose Assessment

3.1 Exposure Setting

The Aptuit facility is a collection of offices, laboratories, and other buildings in an urban setting. The facility is located in a biomedical and pharmaceutical research complex in Kansas City, Missouri. Laboratory A3-367 is located on the third floor of Building A within the complex.

3.2 Exposure Pathways

The hypothetical building occupant is the most reasonable potential future receptor due to the location (industrial area) of the facilities and the industrial-use purpose. Exposure pathways typically associated with the hypothetical occupancy scenario are external exposure to penetrating radiation from surface sources, inhalation of resuspended radioactive materials from surfaces, and inadvertent/incidental ingestion of removable radioactive materials.

3.3 Sources of Exposure

Radionuclides approved for use at the facility in the most recent License amendment are listed in Table 1. Based on site history, a few radionuclides were used in forms that potentially allowed dispersal of those materials onto equipment and building surfaces. The most predominant radionuclides used at the facility in those forms are ^{14}C and ^{3}H.

3.4 Quantification of Exposure

Objectives of the survey design presented in Section 2.4.1 were fulfilled, as determined during the data quality assessment process. Once survey activities were complete and the data were evaluated, performance of a dose assessment was unnecessary because all survey results are less than the respective DCGLs.

4.0 Conclusions and Recommendations

Upon completion of the FSS, the data collected were analyzed to ensure that all objectives of the FSSP were completed. Data presented in Appendix E were collected according to MARSSIM and the requirements of the FSSP (Shaw, 2006b). The data were assessed according to the methods described in MARSSIM and NUREG 1757 and this report has been completed in accordance with the requirements of the FSSP (Shaw, 2006b).

4.1 Conclusions

All objectives of the FSSP were completed and all FSS activities were performed as described in the FSSP. The data collected were analyzed and are of sufficient quality and quantity to make facility release decisions with an acceptable probability of decision error.

Systematic measurements (direct and wipe) are all less than the respective DCGLs. The radioactivity levels within the laboratory meet the criteria such that there are no residual radioactivity levels that exceed the 25 mrem/year TEDE release criteria established in 10 CFR 20, Subpart E, and Laboratory A3-367 can be released for unrestricted use. The maximum reported values for direct measurements and wipe sample results for each respective administrative and final status criteria are presented in Table 5.

Laboratory A3-367 meets the requirements for unconditional radiological release.

4.2 Remediation Requirements

Since the levels of residual radioactivity do not exceed the final status release criteria, a need for additional remediation in the laboratory does not exist.

4.3 Final Status Determination

This report has been prepared according to MARSSIM and NUREG-1757. No measurement exceeds the final status release criteria. Therefore, the laboratory meets the criteria for unrestricted radiological release established in 10 CFR 20, Subpart E. As a result, it is determined that the final status of Laboratory A3-367 in Building A at the Aptuit facility, 10245 Hickman Mills Drive, Kansas City, Missouri is acceptable for unrestricted radiological release.

5.0 References

Aptuit, Incorporated (Aptuit), 2004, ***Radiation Safety Program Manual***, Aptuit, Incorporated, Kansas City, Missouri, February.

Code of Federal Regulations (CFR), Title 10, Part 20, ***Standards for Protection Against Radiation***.

Shaw Environmental, Inc. (Shaw), 2006a, ***Radiological Characterization Survey, Laboratory A3-367***, Aptuit, incorporated, Kansas City, Missouri, April.

Shaw Environmental, Inc. (Shaw), 2006b, ***Final Status Survey Plan,Laboratory A3-367***, Aptuit, Incorporated, Kansas City, Missouri, February.

U. S. Environmental Protection Agency (EPA), 2000, ***Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),*** Revision 1, NUREG-1575, EPA 402-R-97-016, Department of Defense et al., August.

U.S. Nuclear Regulatory Commission (NRC), 2002, ***Consolidated NMSS Decommissioning Guidance, NUREG-1757, Office of Nuclear Material Safety and Safeguards, Washington, D.C.***, January.

TABLES

Table 1

License Possession Quantities, Isotopes, and Forms*
Final Status Survey Report
Laboratory A3-367
Aptuit, Incorporated
Kansas City, Missouri

Radionuclide (Any Form)	Half-life	Maximum Quantity
Tritium (^{3}H)	12.33 y	1 Ci
Carbon-14 (^{14}C)	5,730 y	2 Ci
Sulfur-35 (^{35}S)	87.2 d	20 mCi
Iodine-125 (^{125}I)	59.7 d	70 mCi
Iodine-131 (^{131}I)	8.04 d	30 mCi

* NRC license, No. 24-15595-01.

Ci – Curie.
d – day.
mCi – millicurie.
y – year.

Table 2

Scan Minimum Detectable Concentrations (Scan MDC) and Surveyor Minimum Detectable Count Rates ($MDCR_{surveyor}$)
Characterization Survey
Laboratory A3-367
Aptuit, Incorporated
Kansas City, Missouri

Description	Application	MDC[a]	$MDCR_{surveyor}$
Ludlum Model 2360 Scaler/ratemeter with a Model 43-68 probe with 0.4 mg/cm^2 window	Building/structure scanning for ^{14}C	<3,000 dpm/100 cm^2 beta[b]	200 gross cpm
Ludlum Model 2360 Scaler/ratemeter with a Model 43-68 probe with 0.4 mg/cm^2 window	Direct measurements for ^{14}C	1,300 dpm/100 cm^2 beta[c]	NA
Ludlum Model 2360 Scaler/ratemeter with a Model 43-37 gas proportional detector probe with 0.8 mg/cm^2 window	Floor scanning for ^{14}C	<10,000 dpm/100 cm^2 beta[b]	800 gross cpm
Beckman LS6000 LL liquid scintillation counter (or equivalent)	Removable beta contamination (^3H and ^{14}C)	<30 dpm/100 cm^2 beta (based on efficiency for ^3H beta energies)	NA

[a]Instrument setups were performed on site using a ^{63}Ni source. This results in a conservative estimate of the scan MDC. Scan MDCs for ^{14}C would be lower.
[b]Scan MDC
[c]Static MDC

^{14}C – carbon-14.
cm^2 – square centimeters.
dpm – disintegrations per minute
^3H – tritium
mg – milligrams
NA – not applicable
^{63}Ni – nickel-63

Table 3

Direct Measurement Results
Final Status Survey Report,
Laboratory A3-367
Aptuit, Incorporated
Kansas City, Missouri

Description	Location	Gross cpm	Bkg cpm	Net cpm	Net dpm/100 cm^2	< DCGL[a]?	< ALARA Goal[b]?
Wall (drywall)	C-1	139	146	-7	-154	Yes	Yes
Wall (drywall)	C-2	116	146	-30	-661	Yes	Yes
Wall (drywall)	C-3	122	146	-24	-529	Yes	Yes
Wall (drywall)	C-4	125	146	-21	-463	Yes	Yes
Wall (drywall)	C-5	154	146	8	176	Yes	Yes
Wall (drywall)	C-6	150	146	4	88	Yes	Yes
Wall (drywall)	C-7	122	146	-24	-529	Yes	Yes
Wall (drywall)	C-8	137	146	-9	-198	Yes	Yes
Door (wood)	C-9	147	139	8	176	Yes	Yes
Wall (drywall)	C-10	148	146	2	44	Yes	Yes
Wall (drywall)	C-11	142	146	-4	-88	Yes	Yes
Wall (drywall)	C-12	134	146	-12	-265	Yes	Yes
Wall (drywall)	C-13	130	146	-16	-353	Yes	Yes
Wall (drywall)	C-14	144	146	-2	-44	Yes	Yes
Wall (drywall)	C-15	142	146	-4	-88	Yes	Yes
Wall (drywall)	C-16	145	146	-1	-22	Yes	Yes
Wall (drywall)	C-17	146	146	0	0	Yes	Yes
Wall (drywall)	C-18	140	146	-6	-132	Yes	Yes
Wall (drywall)	C-19	150	146	4	88	Yes	Yes
Concrete (adhesive)	C-20	150	164	-14	-309	Yes	Yes
Concrete (bare)	C-21	236	232	4	88	Yes	Yes
Concrete (adhesive)	C-22	185	164	21	463	Yes	Yes

Table 3

Direct Measurement Results
Final Status Survey Report,
Laboratory A3-367
Aptuit, Incorporated
Kansas City, Missouri

Description	Location	Gross cpm	Bkg cpm	Net cpm	Net dpm/100 cm^2	< DCGL[a]?	< ALARA Goal[b]?
Concrete (adhesive)	C-23	179	164	15	331	Yes	Yes
Concrete (adhesive)	C-24	171	164	7	154	Yes	Yes
Concrete (adhesive)	C-25	181	164	17	375	Yes	Yes
Concrete (adhesive)	C-26	171	164	7	154	Yes	Yes
Concrete (adhesive)	C-27	164	164	0	0	Yes	Yes
Concrete (adhesive)	C-28	170	164	6	132	Yes	Yes
Concrete (adhesive)	C-29	221	164	57	1257	Yes	Yes
Concrete (adhesive)	C-30	170	164	6	132	Yes	Yes
Concrete (adhesive)	C-31	171	164	7	154	Yes	Yes
Concrete (adhesive)	C-32	175	164	11	243	Yes	Yes
Concrete (adhesive)	C-33	173	164	9	198	Yes	Yes
Concrete (bare)	C-34	277	232	45	992	Yes	Yes

ALARA – as low as reasonably achievable
Bkg - background
cm^2 – square centimeters
cpm – counts per minute
DCGL – derived concentration guideline limit
dpm – disintegrations per minute

[a] The DCGL is 3.7E6 dpm/100 cm^2
[b] The ALARA goal is 2000 dpm/100 cm^2

Table 4

Wipe Sample Results
Final Status Survey Report,
Laboratory A3-367
Aptuit, Incorporated
Kansas City, Missouri

Description	Location	Tritium dpm/100 cm^2	Carbon-14 dpm/100 cm^2	< DCGL[a]?	< ALARA Goal[b]?
Wall (drywall)	C-1	39.08	15.60	Yes	Yes
Wall (drywall)	C-2	26.21	14.39	Yes	Yes
Wall (drywall)	C-3	28.53	18.35	Yes	Yes
Wall (drywall)	C-4	24.10	19.71	Yes	Yes
Wall (drywall)	C-5	19.07	17.09	Yes	Yes
Wall (drywall)	C-6	30.41	18.33	Yes	Yes
Wall (drywall)	C-7	62.26	7.70	Yes	Yes
Wall (drywall)	C-8	25.89	14.38	Yes	Yes
Door (wood)	C-9	26.88	17.02	Yes	Yes
Wall (drywall)	C-10	21.53	31.65	Yes	Yes
Wall (drywall)	C-11	17.64	15.77	Yes	Yes
Wall (drywall)	C-12	32.69	22.28	Yes	Yes
Wall (drywall)	C-13	27.60	47.55	Yes	Yes
Wall (drywall)	C-14	27.86	19.67	Yes	Yes
Wall (drywall)	C-15	21.98	9.10	Yes	Yes
Wall (drywall)	C-16	31.20	15.66	Yes	Yes
Wall (drywall)	C-17	13.25	27.75	Yes	Yes
Wall (drywall)	C-18	31.39	15.67	Yes	Yes
Wall (drywall)	C-19	22.19	14.42	Yes	Yes
Concrete (adhesive)	C-20	29.87	14.35	Yes	Yes
Concrete (bare)	C-21	28.46	23.65	Yes	Yes
Concrete (adhesive)	C-22	30.14	19.67	Yes	Yes

Table 4

Wipe Sample Results
Final Status Survey Report,
Laboratory A3-367
Aptuit, Incorporated
Kansas City, Missouri

Description	Location	Tritium dpm/100 cm^2	Carbon-14 dpm/100 cm^2	< DCGL[a]?	< ALARA Goal[b]?
Concrete (adhesive)	C-23	50.53	11.53	Yes	Yes
Concrete (adhesive)	C-24	32.56	11.66	Yes	Yes
Concrete (adhesive)	C-25	30.77	18.35	Yes	Yes
Concrete (adhesive)	C-26	16.79	18.45	Yes	Yes
Concrete (adhesive)	C-27	38.28	18.26	Yes	Yes
Concrete (adhesive)	C-28	26.46	13.05	Yes	Yes
Concrete (adhesive)	C-29	16.76	18.45	Yes	Yes
Concrete (adhesive)	C-30	46.05	12.89	Yes	Yes
Concrete (adhesive)	C-31	32.77	16.98	Yes	Yes
Concrete (adhesive)	C-32	37.99	8.98	Yes	Yes
Concrete (adhesive)	C-33	25.05	27.66	Yes	Yes
Concrete (bare)	C-34	35.20	15.63	Yes	Yes

ALARA – as low as reasonably achievable
Bkg - background
cm^2 – square centimeters
cpm – counts per minute
DCGL – derived concentration guideline limit
dpm – disintegrations per minute

[a] The DCGL is 3.7E5 dpm/100 cm^2
[b] The ALARA goal is 200 dmp/100 cm^2

Table 5

Maximum Results Compared with DCGL and ALARA Goals
Final Status Survey Report
Laboratory A3-367
Aptuit, Incorporated
Kansas City, Missouri

Maximum Result dpm/100 cm^2	DCGL dpm/100 cm^2	ALARA Goal dpm/100 cm^2
Fixed Contamination		
1257	3.7E6	2000
Removable Contamination		
50.53 (tritium)	3.7E5	200
47.55 (carbon-14)	3.7E5	200

dpm – disintegrations per minute.
cm^2 – square centimeters.

FIGURES

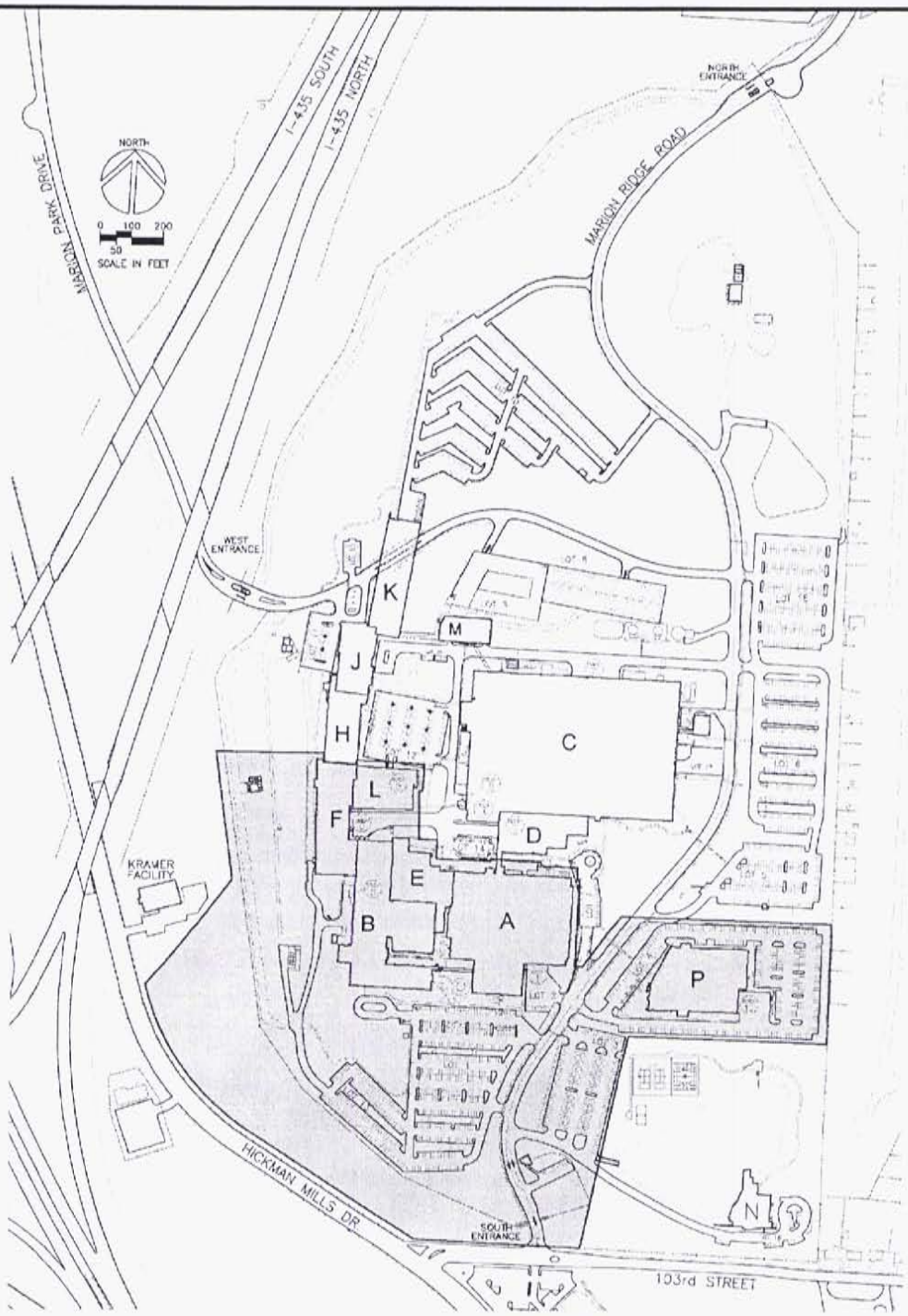


FIGURE 1
SITE LOCATION MAP

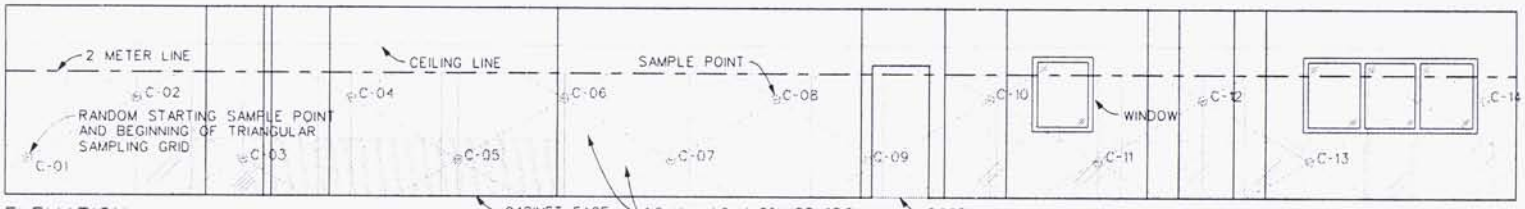
APTUIT, INC.
KANSAS CITY, MISSOURI

Shaw Shaw Environmental, Inc.

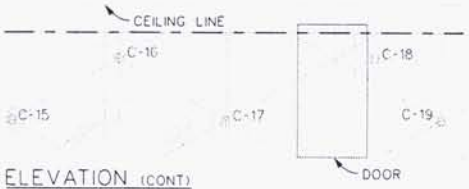
STARTING DATE: 16MAY06	INITIATOR: R.COLLINS	TECH. REVIEW: R.GREENE	DWG. NO.: aptuit_site.dgn
DRAWN BY: C.BENTLEY	CADD REVIEW: C.BENTLEY	PROJ. MGR.: G.COFFMAN	PROJ. NO.: 120089

Standard_Color.tbl
5/17/2006
10:52:21 AM

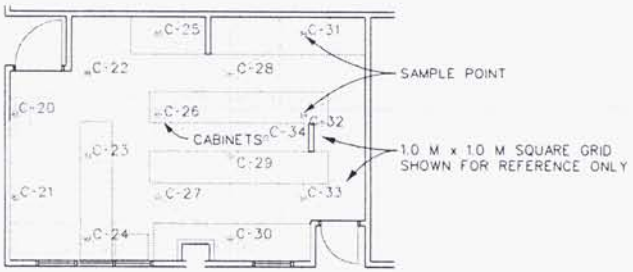
3.0000 in / IN.
cbentley
aptuit_site.dgn



ELEVATION
SCALE: 1" = 2.0 m



ELEVATION (CONT)
SCALE: 1" = 2.0 m



PLAN VIEW
SCALE: 1" = 3.0 m

NOTES

1. WALL SURFACE AREA: 63.538 SQ. M.
   FLOOR SURFACE AREA: 46.631 SQ. M.
   TOTAL SURFACE AREA: 110.169 SQ. M.
2. THE LENGTH OF EACH LEG OF THE TRIANGULAR SAMPLING GRID IS 1.99 METERS
3. SAMPLE LOCATIONS C-09, C-14 AND C-18 WERE RELOCATED TO WALL SURFACES AND AWAY FROM DOOR AND WINDOW SURFACES.

SCALE
0 3 6 METER

SCALE
0 2 4 METER

FIGURE 2
DIRECT MEASURMENT AND WIPE SAMPLE LOCATIONS FOR LABORATORY A3-367

APTUIT, INC.
KANSAS CITY, MISSOURI

Shaw Shaw Environmental, Inc.

APPENDIX A

INSTRUMENT REPORTS

Scaler Daily Instrument Check Sheet

PROJECT NAME/# Aptuit A3-367

Instrument Type / SN: 2360 / #185781

Technician: Anthony R. Martinez

Probe Type / SN: 43-68 / #PR 1020

Source Type / #: Ni-63 / # A9-813

Calibrated: 2360 7 / 5 / 05 due 7 / 5 / 06
43-68 3 / 1 / 06 due 3 / 1 / 07

Source Activity: 65900 dpm

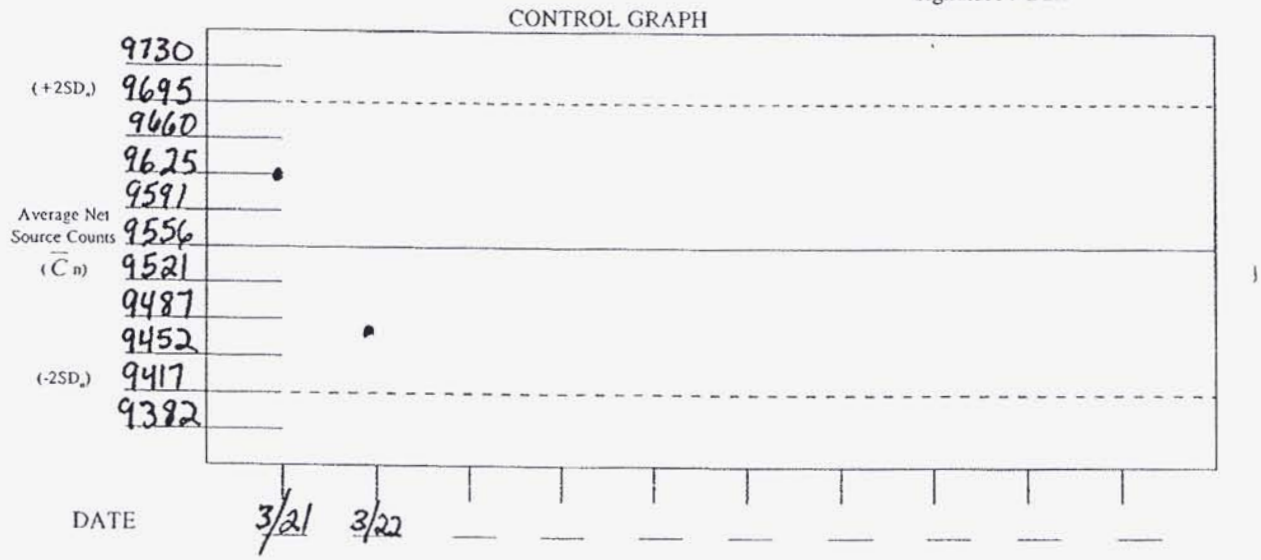
Average Background Counts ($\bar{C}_b$) (cnts): 147 (+2SD$_b$) 165 (-2SD$_b$) 129

Average Net Source Counts ($\bar{C}_n$) (cnts): 9556 (+2SD$_n$) 9695 (-2SD$_n$) 9417

Date	Calibration Check (sat /unsat)	Battery Check (sat / unsat)	Background Measurement (C_b cnts)	Net Source Measurement (C_n cnts)	Bkg & Net Results (sat / unsat)	Technician Signature	Remarks or Comments Adjustments, Corrective Actions, etc.
3/21/06	SAT	SAT	154	9625	SAT	A. Martinez	Initial/Checkout
3/22/06	SAT	SAT	131	9464	SAT	A. Martinez	

RCS Review _____
Signature / Date

CONTROL GRAPH



Scaler Instrument Check Sheet

Source Type Ni-63 Source Activity (2π em.) 65900 dpm

Background Measurements

Background Count Time = 1.00 minutes

Total counts observed:

144	156	Cb	147.40	counts
156	135			
145	159	SDb	9.12	counts
156	138			
136	149	Cbt	147.40	cpm

Source Count Time = 1.00 minutes

Source Counts observed:

9777	9620	Cg	9703.30	counts
9597	9732			
9684	9632	SDg	68.83	counts
9742	9735			
9804	9710	Cn	9555.90	counts
		SDn	69.43	counts
		Cnt	9555.90	cpm

Instrument Eff. (Ei) 0.145 cpm/dpm

Instrument/SN: Ludlum 2360 / 185781

Probe/SN: Ludlum 43-68 / PR1020

STATIC MDC

Sample Count Time = 1.00 minutes

Instrument eff. (Ei) = 0.145

Surface eff. (Es) = 0.25 Total eff. (Et) = 0.036

Probe size (A) in cm = 126.00

Comparison of MDC equations

same times MDC 1302 dpm/100cm2

diff times MDC 1302 dpm/100cm2

Daily Check Ranges

	Average	+2SD	-2SD
Bckgd	147	166	129
Source	9556	9695	9417

Graph Source Range

+2SDn	9695
	9660
	9625
	9591
Cn	9556
	9521
	9486
	9452
-2SDn	9417

SEE ATTACHED SHEET

Shaw™
Shaw E & I, Inc.
1570 Bear Creek Road
P.O. Box 4339
Oak Ridge, Tennessee 37830
Tel: (865) 482-6497
Fax: (865) 482-1890

Certificate of Instrument Calibration

INSTRUMENT INFORMATION:

Inst. Make Ludlum Model # 2360 Unit / Serial # 82107

Probe Make Ludlum Model # 43-68 Serial # PR1020

Work Order # N/A Functional Check ✓

	As Found	As Left
Beta Threshold	/ mv	3.5 mv
Beta Window	N / mv	30 mv
Alpha Threshold	/ mv	120 mv

CALIBRATION DATA:

HV (as found) 1625 (at cal) 1575 Plateau Determined (YES) / NO Pulse size 10 mv

Sources and Instruments used in calibration are traceable to NIST through primary or secondary standards.

Electronic Cal:
Pulser Make Ludlum Model # 500 Serial # N/A Cal Date ___

Efficiency Cal:
Source ID EID 13 Isotope C-14 Activity 10650 DPM Uncertainty +/- 5 %

Source ID ___ Isotope ___ Activity ___ DPM Uncertainty +/- ___ %

Scale	Analog Meter +/- 10% Input CPM	As Found	Left	Scaler +/- 2 % Input CPM	As Found	Left
X1000	400000			400000		
X100	40000			40000		
X10	4000			4000		
X1	400			400		
X1000	100000			100000		
X100	10000			10000		
X10	1000			1000		
X1	100			100		

4 π EFFICIENCY Alpha Source	Beta Source
Toe	Toe 2234
Center	Center 2294
Heel	Heel 2263
Avg. (cpm)	Avg. (cpm) 2263
- Bkg. (cpm)	- Bkg. (cpm) 175
net (cpm)	2088 net (cpm)
÷ actual dpm	÷ 10650 actual dpm
% Efficiency	~~21.2~~ 19.6 % Efficiency
%Beta Cross	N/A %Alpha Cross

Comments: used 45 cc/min continous flow

Calibrated by Bill Jordan Signature Bill Jordan Date 3-1-06

Calibration Due 3-1-07 Reviewed by ___

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

LU 115
corrected DPM
2-28-06
2.974E+05

CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide:	Ni-63	**Customer:**	SHAW ENVIRONMENTAL, INC./TERC - AP
Half-life:	96 ± 4 years	**P.O. No.:**	207785 OP
Catalog No.:	EAB-063-PL	**Reference Date:**	1-Mar-03 12:00 PST
Source No.:	A9-813	**Contained Radioactivity:**	0.1368 µCi 5.062 kBq

Physical description:

A. Capsule type:	EAB-PL (50.8 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Distributed and evaporated metallic salt on polymeric membrane
C. Active diameter/volume:	45 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

Ba-133 < 0.0001% on 1Mar 03

Method of Calibration:

This source was prepared from a weighed aliquot of solution whose activity in µCi/g was determined using a liquid scintillation counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 2.3 %
B. Type B (systematic) uncertainty:	± 3.1 %
C. Uncertainty in aliquot weighing:	± 0.4 %
D. Total uncertainty at the 99% confidence level:	± 3.9 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from NCRP Report No. 58, 1985.
- This source has a working life of 2 years.
- This source had a surface emission rate of 65970 β/min in 2π on 14 Feb 03.

Daniel James Van Dalsem
Quality Control

14-Feb-03
Date Signed

IPL Ref. No.: 952-98

Material Background Values

Instrument Information: Model: Ludlum 2360 Serial No.: 185781 Probe: 43-68 Serial No.: PR1020 Count Time: 1 (min) Setup Date: 21-Mar-06

	Bare Concrete Floor		Drywall		Concrete with adhesive	
	Alpha	Beta/gamma	Alpha	Beta/gamma	Alpha	Beta/gamma
(counts)		199		151		145
		223		142		160
		237		158		157
		253		153		169
		264		145		178
		233		170		180
		240		140		189
		201		140		153
		216		131		158
		252		133		159
Mean	#DIV/0!	231.8	#DIV/0!	146.3	#DIV/0!	164.8
(cpm)	#DIV/0!	231.8	#DIV/0!	146.3	#DIV/0!	164.8
SD	#DIV/0!	22.0	#DIV/0!	11.9	#DIV/0!	13.8
2SD	#DIV/0!	43.9	#DIV/0!	23.8	#DIV/0!	27.5

Comparison of instrument "setup" background vs. "material" background:

1.0 Setup Data

Setup Date 21-Mar-06

Instrument Model Ludlum 2360 Serial No.: 185781 Probe: 43-68 Serial No.: PR1020

Count Time: 1 (min)

Bkgd (cpm)		(+/-)		(2SD)	
	147.4		18.2		Beta/gamma

2.0 Material Data

Setup Date 21-Mar-06

	CPM		CPM + 2SD		CPM - 2SD		% Difference			
	Alpha	Beta/gamma	Alpha	Beta/gamma	Alpha	Beta/gamma	Alpha +2SD	Alpha -2SD	B/G +2SD	B/G -2SD
Bare Concrete Floor	#DIV/0!	231.8	#VALUE!	165.6	#VALUE!	129.2	#DIV/0!	#DIV/0!	1.40	1.79
Drywall	#DIV/0!	146.3	#VALUE!	165.6	#VALUE!	129.2	#DIV/0!	#DIV/0!	0.88	1.13
Concrete with adhesive	#DIV/0!	164.8	#VALUE!	165.6	#VALUE!	129.2	#DIV/0!	#DIV/0!	1.00	1.28

Material Background Values as of 21-Mar-06

Instrument	Serial No.	Probe	Serial No.	Count Time (min)
Ludlum 2360	185781	43-68	PR1020	1

Material	Alpha	Beta/gamma	
			(cpm)
		<=129.2	
		>=165.6	

Values shown at left represent the sum of the instrument average background count rate (cpm) and the value of 2 Standard Deviations (counts).

Material	Alpha	Beta/gamma	
Bare Concrete Floor	#DIV/0!		(cpm)
Drywall	#DIV/0!		(cpm)
Concrete with adhesiv	#DIV/0!		(cpm)
Bare Concrete Floor		232	(cpm)
Drywall		146.3	(cpm)
Concrete with adhesive		164.8	(cpm)

Values shown at left are the result of filtering average material background values against the criteria described above. These values will be subtracted from "gross cpm" values on the survey. Materials listed at left exhibit count rates that are greater than the sum of the instrument background count rate plus 2 standard deviations, or less than the value of the instrument background count rate minus 2 standard deviations.

RSO Approval Date

Material Background Values

Instrument Information: Model: Ludlum 2360 Serial No.: 185781 Probe: 43-68 Serial No.: PR1020 Count Time: 1 (min) Setup Date: 21-Mar-06

	Wood Door					
	Alpha	Beta/gamma	Alpha	Beta/gamma	Alpha	Beta/gamma
(counts)		143				
		134				
		135				
		149				
		125				
		132				
		139				
		135				
		151				
		150				
Mean	#DIV/0!	139.3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
(cpm)	#DIV/0!	139.3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
SD	#DIV/0!	8.7	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2SD	#DIV/0!	17.4	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Comparison of instrument "setup" background vs. "material" background:

1.0 Setup Data

Setup Date 21-Mar-06

Instrument Model Ludlum 2360
Serial No.: 185781

Probe: 43-68
Serial No.: PR1020

Count Time: 1 (min)

Bkgd (cpm)	(+/-)	(2SD)	
			Alpha
147.4		18.2	Beta/gamma

2.0 Material Data

Setup Date 21-Mar-06

	CPM		CPM + 2SD		CPM - 2SD			% Difference		
	Alpha	Beta/gamma	Alpha	Beta/gamma	Alpha	Beta/gamma	Alpha +2SD	Alpha -2SD	B/G +2SD	B/G -2SD
Wood Door	#DIV/0!	139.3	#VALUE!	165.6	#VALUE!	129.2	#DIV/0!	#DIV/0!	0.84	1.08
	#DIV/0!	#DIV/0!	#VALUE!	165.6	#VALUE!	129.2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#VALUE!	165.6	#VALUE!	129.2	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Material Background Values

as of **21-Mar-06**

Instrument	Serial No.	Probe	Serial No.	Count Time (min)
Ludlum 2360	185781	43-68	PR1020	1

Material	Alpha	Beta/gamma	
			(cpm)
		<=129.2	
		>=165.6	

Values shown at left represent the sum of the instrument average background count rate (cpm) and the value of 2 Standard Deviations (counts).

Material	Alpha	Beta/gamma	
Wood Door	#DIV/0!		(cpm)
	#DIV/0!		(cpm)
	#DIV/0!		(cpm)
Wood Door		139	(cpm)
		#DIV/0!	(cpm)
		#DIV/0!	(cpm)

Values shown at left are the result of filtering average material background values against the criteria described above. These values will be subtracted from "gross cpm" values on the survey. Materials listed at left exhibit count rates that are greater than the sum of the instrument background count rate plus 2 standard deviations, or less than the value of the instrument background count rate minus 2 standard deviations.

RSO Approval Date

Ratemeter Daily Instrument Check Sheet

3-7-06

PROJECT NAME/# Aptuit A3-367 / 120089

Instrument Type / SN: Ludlum 2360 / 38502 Technician: RTJ

Probe Type / SN: Ludlum 43-68 / 133999 Source Type / #: Ni-63 / A9-813

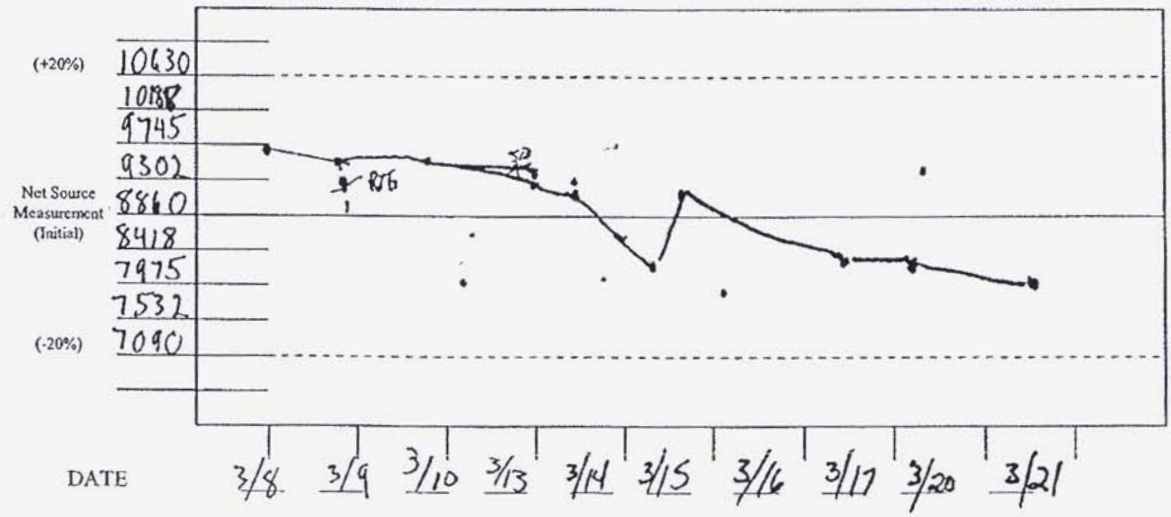
Calibrated: 7 / 6 / 05 due 7 / 6 / 06 Source Activity: 2.974×10^5 dpm (2π emission 6.59×10^9)

Initial Net Source Measurement (cnts or mrem/hr): 8860 (+20%) 10,630 (-20%) 7088

Date	Calibration Check (sat /unsat)	Battery Check (sat / unsat)	Background Measurement (cnts ~~or mrem/hr~~)	Net Source Measurement (cnts ~~or mrem/hr~~)	Bkg & Net Results (sat / unsat)	Technician Signature	Remarks or Comments Adjustments, Corrective Actions, etc.
3-8-06	Sat	Sat	125	9744	Sat	RTJ	
3-9	Sat	Sat	131	9396	Sat	RTJ	
3-10	Sat	Sat	130	9456	Sat	SCB	
3-13	Sat	Sat	110	9235	Sat	SCB	
3/14/06	SAT	SAT	130	8889	SAT	A. Martin	
3/15/06	SAT	SAT	122	8208	SAT	A. Martin	
3/16/06	SAT	SAT	122	8936	SAT	A. Martin	
3/17/06	SAT	SAT	127	8315	SAT	A. Martin	
3/20/06	SAT	SAT	120	8306	SAT	A. Martin	
3/21/06	SAT	SAT	124	8086	SAT	A. Martin	

RCS Review _____
Signature / Date

CONTROL GRAPH



Scaler Instrument Check Sheet

Source Type Ni-63 Source Activity (2π em.) 65900 dpm

Background Measurements

Background Count Time = 1.00 minutes

Total counts observed:

65	90	Cb	90.50	counts
87	107			
85	100	SDb	11.91	counts
100	99			
89	83	Cbt	90.50	cpm

Source Count Time = 1.00 minutes

Source Counts observed:

8735	8927	Cg	8950.50	counts
8904	9025			
9033	9049	SDg	102.36	counts
9065	8943			
8853	8971	Cn	8860.00	counts
		SDn	103.06	counts
		Cnt	8860.00	cpm

Instrument Eff. (Ei) 0.134 cpm/dpm

Instrument/SN: Ludlum 2360 / 38502

Probe/SN: Ludlum 43-68 / PR133999

STATIC MDC

Sample Count Time = 1.00 minutes

Instrument eff. (Ei) = 0.134

Surface eff. (Es) = 0.25 Total eff. (Et) = 0.034

Probe size (A) in cm = 126.00

Comparison of MDC equations

same times MDC 1115 dpm/100cm2

diff times MDC 1116 dpm/100cm2

Daily Check Ranges

	Average	+2SD	-2SD
Bckgd	91	114	67
Source	8860	9066	8654

Graph Source Range

+2SDn	9066
	9015
	8963
	8912
Cn	8860
	8808
	8757
	8705
-2SDn	8654

SEE ATTACHED SHEET

Shaw™
Shaw E & I, Inc.
1570 Bear Creek Road
P.O. Box 4339
Oak Ridge, Tennessee 37830
Tel: (865) 482-6497
Fax: (865) 482-1890

Certificate of Instrument Calibration

INSTRUMENT INFORMATION:

Inst. Make **Ludlum** Model # **2360** Unit / Serial # 38502

Probe Make **Ludlum** Model # 43-68 Serial # PR133999

Work Order # N/A Functional Check ✓

	As Found	As Left
Beta Threshold	N/A mv	3.5 mv
Beta Window	N/A mv	30 mv
Alpha Threshold	N/A mv	120 mv

CALIBRATION DATA:

HV (as found) 1575 (at cal) 1575 Plateau Determined YES / NO Pulse size 10 mv

**Sources and Instruments used in calibration are traceable to NIST through primary or secondary standards.*

Electronic Cal:
Pulser Make **Ludlum** Model # **500** Serial # N/A Cal Date ___/___/___

Efficiency Cal:
Source ID ETD13 Isotope C-14 Activity 10650 DPM Uncertainty +/- 5 %

Source ID ___ Isotope ___ Activity ___ DPM Uncertainty +/- ___ %

Scale	Analog Meter +/- 10% Input CPM	As Found	Left	Scaler +/- 2 % Input CPM	As Found	Left
X1000	400000			400000		
X100	40000			40000		
X10	4000			4000		
X1	400			400		
X1000	100000			100000		
X100	10000			10000		
X10	1000			1000		
X1	100			100		

4 π EFFICIENCY Alpha Source	Beta Source
Toe	Toe 2145
Center	Center 2188
Heel	Heel 2148
Avg. (cpm)	Avg. (cpm) 2160
- Bkg. (cpm)	- Bkg. (cpm) 164
net (cpm)	1996 net (cpm)
+ actual dpm	+ 10650 actual dpm
% Efficiency	18.7 % Efficiency
%Beta Cross	N/A %Alpha Cross

Comments: Det @ 40 cc/min CONTINOUS FLOW

Calibrated by Bill JORDAN Signature Bill Jordan Date 3-1-06

Calibration Due 3-1-07 Reviewed by ___

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

E/D 115
corrected DPM
2-28-06
2.974E+05

CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide:	Ni-63	**Customer:**	SHAW ENVIRONMENTAL, INC./TERC - AP
Half-life:	96 ± 4 years	**P.O. No.:**	207785 OP
Catalog No.:	EAB-063-PL	**Reference Date:**	1-Mar-03 12:00 PST
Source No.:	A9-813	**Contained Radioactivity:**	0.1368 µCi 5.062 kBq

Physical description:

A. Capsule type:	EAB-PL (50.8 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Distributed and evaporated metallic salt on polymeric membrane
C. Active diameter/volume:	45 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

Ba-133 < 0.0001% on 1Mar 03

Method of Calibration:

This source was prepared from a weighed aliquot of solution whose activity in µCi/g was determined using a liquid scintillation counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 2.3 %
B. Type B (systematic) uncertainty:	± 3.1 %
C. Uncertainty in aliquot weighing:	± 0.4 %
D. Total uncertainty at the 99% confidence level:	± 3.9 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from NCRP Report No. 58, 1985.
- This source has a working life of 2 years.
- This source had a surface emission rate of 65970 β/min in 2π on 14 Feb 03.

Daniel James Van Dalsem
Quality Control

14-Feb-03
Date Signed

IPL Ref. No.: 952-98

Ratemeter Daily Instrument Check Sheet

3-8-06

PROJECT NAME/# Aptnit Lab A3-367

Instrument Type / SN: Ludlum 2221 / 218576

Technician: RTG

Probe Type / SN: 43-68 / PR190298

Source Type / #: Ni-63 / A9-813

Calibrated: 2/23/06 due 2/23/07

Source Activity: 2.974×10^5 dpm

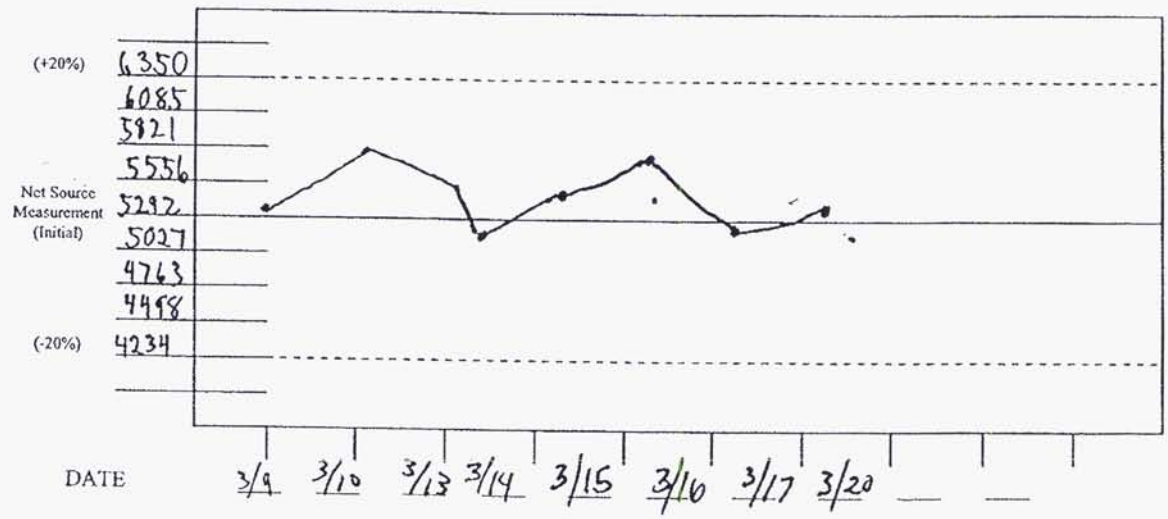
Initial Net Source Measurement (cnts or mrem/hr): 5292 (+20%) ~~4234~~ 6350 RTG 3-8-06 (-20%) 4234

Date	Calibration Check (sat /unsat)	Battery Check (sat / unsat)	Background Measurement (cnts or mrem/hr)	Net Source Measurement (cnts or mrem/hr)	Bkg & Net Results (sat / unsat)	Technician Signature	Remarks or Comments Adjustments, Corrective Actions, etc.
3/9	Sat	Sat	298	5308	Sat	RTG	
3/10	Sat	Sat	285	5820	Sat	SCB	
3/13	Sat	Sat	268	5486	Sat	SCB	
3/14	SAT	SAT	285	5207	SAT	A. Martin	
3/15	SAT	SAT	294	5418	SAT	A. Martin	
3/16	SAT	SAT	212	5638	SAT	A. Martin	
3/17	SAT	SAT	265	5261	SAT	A. Martin	
3/20	SAT	SAT	294	5304	SAT	A. Martin	

RCS Review _____

Signature / Date

CONTROL GRAPH



Scaler Instrument Check Sheet

Source Type Ni-63 Source Activity (2π em.) 65900 dpm

Background Measurements

Background Count Time = 1.00 minutes

Total counts observed:

332	320	Cb	300.30	counts
322	295			
285	303	SDb	20.45	counts
276	271			
309	290	Cbt	300.30	cpm

Source Count Time = 1.00 minutes

Source Counts observed:

5658	5525	Cg	5591.90	counts
5458	5580			
5506	5570	SDg	90.30	counts
5642	5610			
5589	5781	Cn	5291.60	counts
		SDn	92.58	counts
		Cnt	5291.60	cpm

Instrument Eff. (Ei) 0.080 cpm/dpm

Instrument/SN: Ludlum 2221 / 218576

Probe/SN: Ludlum 43-68 / PR190298

STATIC MDC

Sample Count Time = 1.00 minutes

Instrument eff. (Ei) = 0.080

Surface eff. (Es) = 0.25 Total eff. (Et) = 0.02

Probe size (A) in cm = 126.00

Comparison of MDC equations

same times MDC 3305 dpm/100cm2

diff times MDC 3307 dpm/100cm2

Daily Check Ranges

	Average	+2SD	-2SD
Bckgd	300	341	259
Source	5292	5477	5106

Graph Source Range

+2SDn	5477
	5430
	5384
	5338
Cn	5292
	5245
	5199
	5153
-2SDn	5106

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER APTUIT, INC ORDER NO. 251111

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 218576

Mfg. Ludlum Measurements, Inc. Model 43-68 Serial No. PR-190298

Cal. Date 23-Feb-06 Cal Due Date 23-Feb-07 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 27 % Alt 708.8 mm Hg

☑ New Instrument Instrument Received ☐ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 4.4 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set Comments V Input Sens. 4 mV Det. Oper. Comments V at 4 mV Threshold Dial Ratio 100 = 4 mV

☑ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2000 / 2001 V

COMMENTS:

Firmware # 26 10 10
HV for alpha = 1250 V
HV for beta = 1750 V
2221 set for beta at 1756 V
HV set with detector connected.
Overload check but not set.

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 1K	400kcpm		400
X 1K	100kcpm		100
X 100	40kcpm		400
X 100	10kcpm		100
X 10	4kcpm		400
X 10	1kcpm		100
X 1	400cpm		400
X 1	100cpm		100

*Uncertainty within ± 10% C.F. within ± 20% ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm		40008(0)	Log Scale	500kcpm		475K
	40kcpm		4001(0)		50kcpm		50K
	4kcpm		401(0)		5kcpm		5K
	400cpm		40(0)		500cpm		500
	40cpm		4(0)		50cpm		55

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ 1879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N 1-304

☑ Alpha S/N 4337 Pu239 ☑ Beta S/N 635/83 Tc99 ☐ Other

☑ m 500 S/N 141244 ☐ Oscilloscope S/N ☑ Multimeter S/N 68160950

Calibrated By: Joyce Alford Date 23-Feb-06

Reviewed By: Rita Ortego Date 27-Feb-06

The certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.
FORM C22A 11/26/2003

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data

Detector 43-68 Serial No. PR - 190 298 Order #. 251111

Customer APTUIT, INC

Counter 2221 Serial No. 218576 Counter Input Sensitivity 4 mV

Count Time CPM Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Pu 239 Size 30,900 dpm	Isotope Tc 99 Size 22,900 dpm	Isotope ____ Size ____	Isotope ____ Size ____
1100	0	7187			
1150	1	7268			
1200	1	7337			
→ 1250	1	7435			
1300	0	7502			
1350	0	7529			
1400	6	7489			
1450	12	7552			
1550	48		582		
1600	79		1903		
1650	168		3692		
1700	269		5468		
→ 1750	278		7844		
1800	408		8576		

☐ Gas proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

Signature Joyce Althof Date 23-Feb-06

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

FORM C4D 04/09/2003

Serving The Nuclear Industry Since 1962

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

UU 115
corrected DPM
2-28-06
2.974E+05

CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide:	Ni-63	**Customer:**	SHAW ENVIRONMENTAL, INC./TERC - AP
Half-life:	96 ± 4 years	**P.O. No.:**	207785 OP
Catalog No.:	EAB-063-PL	**Reference Date:**	1-Mar-03 12:00 PST
Source No.:	A9-813	**Contained Radioactivity:**	0.1368 µCi 5.062 kBq

Physical description:

A. Capsule type:	EAB-PL (50.8 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Distributed and evaporated metallic salt on polymeric membrane
C. Active diameter/volume:	45 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

Ba-133 < 0.0001% on 1Mar 03

Method of Calibration:

This source was prepared from a weighed aliquot of solution whose activity in µCi/g was determined using a liquid scintillation counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 2.3 %
B. Type B (systematic) uncertainty:	± 3.1 %
C. Uncertainty in aliquot weighing:	± 0.4 %
D. Total uncertainty at the 99% confidence level:	± 3.9 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from NCRP Report No. 58, 1985.
- This source has a working life of 2 years.
- This source had a surface emission rate of 65970 β/min in 2π on 14 Feb 03.

Daniel James Van Dalsem
Quality Control

14-Feb-03
Date Signed

IPL Ref. No.: 952-98

Floor Monitor

Ratemeter Daily Instrument Check Sheet

3-6-06

100 cc/min 10 min
60 cc/m 30 min
35-40 cc/min counting

PROJECT NAME/# Aptwit Lab A3-367

Instrument Type / SN: Ludlum 2360 / 100098 Technician: RTJ

Probe Type / SN: Ludlum 43-37-1 / 092634 Source Type / #: Ni-63 / A9-813

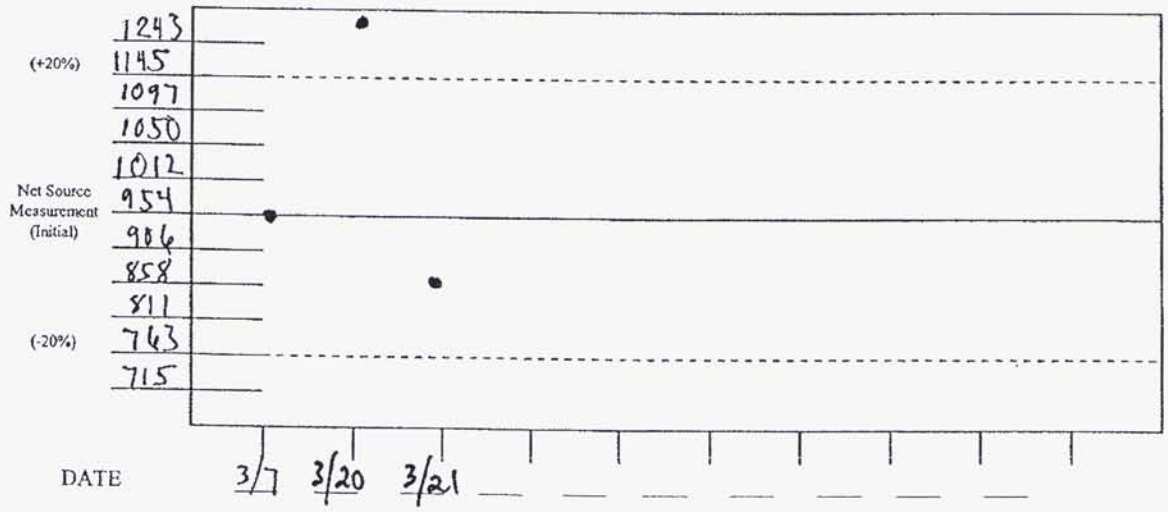
Calibrated: 2 / 28 / 06 due 2 / 28 / 07 Source Activity: 2.974×10^5 dpm

Initial Net Source Measurement (cnts or mrem/hr): 954 (+20%) 1145 (-20%) 763

Date	Calibration Check (sat /unsat)	Battery Check (sat / unsat)	Background Measurement (cnts ~~or mrem/hr~~)	Net Source Measurement (cnts ~~or mrem/hr~~)	Bkg & Net Results (sat / unsat)	Technician Signature	Remarks or Comments Adjustments, Corrective Actions, etc.
3/7/06	sat.	sat	522	954	sat	RTJ Freeve	
3/20/06	SAT	SAT	552	1319	un-SAT	A. Marling	out of Range will attempt check in AM
3/21/06	SAT	SAT	510	857	Sat	A. Marling	Back in Range Adjusted Height to 1/2" from Surface

RCS Review _____
Signature / Date

CONTROL GRAPH



Scaler Instrument Check Sheet

Source Type Ni-63 Source Activity (2π em.) 65900 dpm

Background Measurements

Background Count Time = 1.00 minutes

Total counts observed:

514	525	Cb	518.70	counts
521	520			
504	500	SDb	16.19	counts
519	502			
556	526	Cbt	518.70	cpm

Source Count Time = 1.00 minutes

Source Counts observed:

1490	1542	Cg	1472.40	counts
1451	1452			
1469	1487	SDg	37.67	counts
1415	1448			
1519	1451	Cn	953.70	counts
		SDn	41.00	counts
		Cnt	953.70	cpm

Instrument Eff. (Ei) 0.014 cpm/dpm

Instrument/SN: Ludlum 2360 / 100048

Probe/SN: Ludlum 43-37-1 / PR092634

STATIC MDC

Sample Count Time = 1.00 minutes

Instrument eff. (Ei) = 0.014

Surface eff. (Es) = 0.25 Total eff. (Et) = 0.004

Probe size (A) in cm = 582.00

Comparison of MDC equations

same times MDC 5171 dpm/100cm2

diff times MDC 5175 dpm/100cm2

Daily Check Ranges

	Average	+2SD	-2SD
Bckgd	519	551	486
Source	954	1036	872

Graph Source Range

+2SDn	1036	+20% — 1145
	1015	1097
	995	1050
	974	1012
Cn	954	cn — 954
	933	906
	913	858
	892	811
-2SDn	872	-20% — 763

Shaw
Shaw E & I, Inc.
1570 Bear Creek Road
P.O. Box 4339
Oak Ridge, Tennessee 37830
Tel: (865) 482-6497
Fax: (865) 482-1890

Certificate of Instrument Calibration

INSTRUMENT INFORMATION:

Inst. Make Ludlum Model # 2360 Unit / Serial # 100048

Probe Make Ludlum Model # 43-37.1 Serial # PR092634 PER RG.

Work Order # N/A Functional Check ✓

	As Found		As Left	
Beta Threshold	3.5	mv	~~3.5~~	mv
Beta Window	33	mv	30 ~~4mv~~	
Alpha Threshold	128	mv	120 ~~mv~~	

CALIBRATION DATA:

HV (as found) 850 (at cal) 1575 Plateau Determined (YES) / NO Pulse size 10 mv

Sources and Instruments used in calibration are traceable to NIST through primary or secondary standards.

Electronic Cal:
Pulser Make Ludlum Model # 500 Serial # 32797 Cal Date 3/23/05

Efficiency Cal:
Source ID E/D13 Isotope C-14 Activity 10650 DPM Uncertainty +/- 5 %

Source ID — Isotope — Activity — DPM Uncertainty +/- — %

Scale	Analog Meter +/- 10% Input CPM	As Found	Left	Scaler +/- 2 % Input CPM	As Found	Left
X1000	400000	400K	—	400000	398960	—
X100	40000	40K	—	40000	39946	—
X10	4000	4K	—	4000	3997	—
X1	400	400	—	400	400	—
X1000	100000	100K	—	100000	100826	—
X100	10000	10K	—	10000	10082	—
X10	1000	1K	—	1000	1008	—
X1	100	100	—	100	101	—

4 π EFFICIENCY Alpha Source	Beta Source
Toe	Toe 2405 / 2545
Center	Center 2514 / 2468
Heel	Heel 2500 / 2349
Avg. (cpm)	Avg. (cpm) 2443
Bkg. (cpm)	Bkg. (cpm) 691
net (cpm)	1772 net (cpm)
÷ actual dpm	÷ 10650 actual dpm
% Efficiency	16.64 % Efficiency
%Beta Cross	N/A %Alpha Cross

Comments:

Calibrated by Bill JORDAN Signature Bill Jordan Date 2-28-06

Calibration Due 2-28-07 Reviewed by

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

4U 115
corrected DPM
2-28-06
2.974E+05

CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide:	Ni-63	**Customer:**	SHAW ENVIRONMENTAL, INC./TERC - AP
Half-life:	96 ± 4 years	**P.O. No.:**	207785 OP
Catalog No.:	EAB-063-PL	**Reference Date:**	1-Mar-03 12:00 PST
Source No.:	A9-813	**Contained Radioactivity:**	0.1368 µCi 5.062 kBq

Physical description:

A. Capsule type:	EAB-PL (50.8 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Distributed and evaporated metallic salt on polymeric membrane
C. Active diameter/volume:	45 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

Ba-133 < 0.0001% on 1Mar 03

Method of Calibration:

This source was prepared from a weighed aliquot of solution whose activity in µCi/g was determined using a liquid scintillation counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 2.3 %
B. Type B (systematic) uncertainty:	± 3.1 %
C. Uncertainty in aliquot weighing:	± 0.4 %
D. Total uncertainty at the 99% confidence level:	± 3.9 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from NCRP Report No. 58, 1985.
- This source has a working life of 2 years.
- This source had a surface emission rate of 65970 β/min in 2π on 14 Feb 03.

Daniel James Van Dalsem
Quality Control

14-Feb-03
Date Signed

IPL Ref. No.: 952-98

Material Background Values

Instrument Information: Model: Ludlum 2360 Probe: 43-37-1 Count Time: 1 (min)
Serial No.: 100048 Serial No.: PR092634 Setup Date: 21-Mar-06

	Concrete Floor					
	Alpha	Beta/gamma	Alpha	Beta/gamma	Alpha	Beta/gamma
(counts)		608				
		625				
		631				
		599				
		594				
		618				
		593				
		614				
		645				
		659				
Mean	#DIV/0!	618.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
(cpm)	#DIV/0!	618.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
SD	#DIV/0!	21.9	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
2SD	#DIV/0!	43.7	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Comparison of instrument "setup" background vs. "material" background:

1.0 **Setup Data**

Setup Date 21-Mar-06

Instrument Model Ludlum 2360 Probe: 43-37-1
Serial No.: 100048 Serial No.: PR092634

Count Time: 1 (min)
Bkgd (cpm) (+/-) (2SD) Alpha
518.7 32.38 Beta/gamma

2.0 **Material Data**

Setup Date 21-Mar-06

	CPM		CPM + 2SD		CPM - 2SD		% Difference			
	Alpha	Beta/gamma	Alpha	Beta/gamma	Alpha	Beta/gamma	Alpha +2SD	Alpha -2SD	B/G +2SD	B/G -2SD
Concrete Floor	#DIV/0!	618.6	#VALUE!	551.08	#VALUE!	486.32	#DIV/0!	#DIV/0!	1.12	1.27
	#DIV/0!	#DIV/0!	#VALUE!	551.08	#VALUE!	486.32	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	#DIV/0!	#DIV/0!	#VALUE!	551.08	#VALUE!	486.32	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Material Background Values

as of **21-Mar-06**

Instrument	Serial No.	Probe	Serial No.	Count Time (min)
Ludlum 2360	100048	43-37-1	PR092634	1

Material	Alpha	Beta/gamma	
			(cpm)
		<=486.32	
		>=551.08	

Values shown at left represent the sum of the instrument average background count rate (cpm) and the value of 2 Standard Deviations (counts).

Material	Alpha	Beta/gamma	
Concrete Floor	#DIV/0!		(cpm)
	#DIV/0!		(cpm)
	#DIV/0!		(cpm)
Concrete Floor		619	(cpm)
		#DIV/0!	(cpm)
		#DIV/0!	(cpm)

Values shown at left are the result of filtering average material background values against the criteria described above. These values will be subtracted from "gross cpm" values on the survey. Materials listed at left exhibit count rates that are greater than the sum of the instrument background count rate plus 2 standard deviations, or less than the value of the instrument background count rate minus 2 standard deviations.

RSO Approval Date

Ratemeter Daily Instrument Check Sheet

PROJECT NAME/# Aptuit Lab A3-367

Instrument Type / SN: Model 3 / 86685

Technician: A. Martin

Probe Type / SN: 44-9 / PR080789

Source Type / #: Ni-63 / A9-813

Calibrated: 9 / 24 / 05 due 9 / 24 / 06

Source Activity: ≈ .1368 uCi

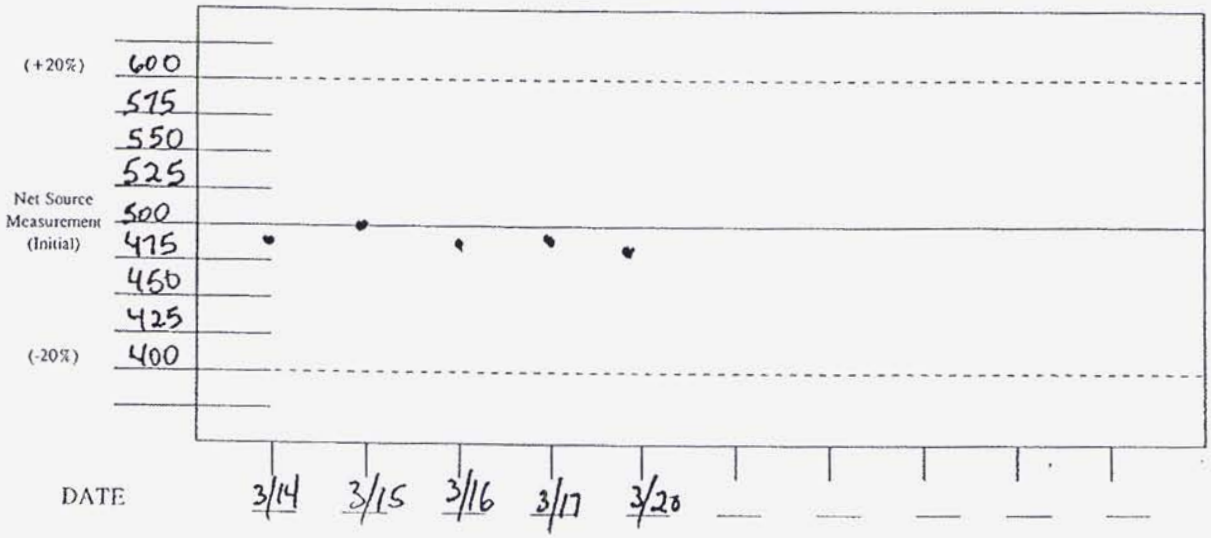
Initial Net Source Measurement (cnts or mrem/hr): 500 (+20%) 600 (-20%) 400

Date	Calibration Check (sat /unsat)	Battery Check (sat / unsat)	Background Measurement (cnts or mrem/hr)	Net Source Measurement (cnts or mrem/hr)	Bkg & Net Results (sat / unsat)	Technician Signature	Remarks or Comments Adjustments, Corrective Actions, etc.
3/14/06	SAT	SAT	20	480	SAT	A. Martin	Initial Check-out
3/15/06	SAT	SAT	20	500	SAT	A. Martin	
3/16/06	SAT	SAT	40	460	SAT	A. Martin	
3/17/06	SAT	SAT	40	480	SAT	A. Martin	
3/20/06	SAT	SAT	40	460	SAT	A. Martin	

RCS Review _____

Signature / Date

CONTROL GRAPH



Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER QUINTILES INC ORDER NO. 242864/295445

Mfg. Ludlum Measurements, Inc. Model 3 Serial No. 86685

Mfg. Ludlum Measurements, Inc. Model 44-9 Serial No. PR 080789

Cal. Date 24-Sep-05 Cal Due Date 24-Sep-06 Cal. Interval 1 Year Meterface 202-560

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 42 % Alt 697.8 mm Hg

☐ New Instrument Instrument Received ☑ Within Toler. +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☐ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☑ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 900 V Input Sens. 28 mV Det. Oper. 900 V at 28 mV Threshold Dial Ratio = mV

☐ HV Readout (2 points) Ref./Inst. / V Ref./Inst. / V

COMMENTS:

Gamma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 100	150mR/hr	1.5	1.5
X 100	50mR/hr	0.5	0.5
X 10	15mR/hr	1.5	1.5
X 10	5mR/hr	0.5	0.5
X 1	1.5mR/hr= 4950 cpm	1.5	1.5
X 1	1.0mR/hr	1.0	1.0
X 0.1	495 cpm	1.5	1.5
X 0.1	165 cpm	0.5	0.5

*Uncertainty within ± 10% C.F. within ± 20%

X 0.1 Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout				Log Scale			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.
The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☑ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☑ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 189496 ☐ Oscilloscope S/N ☑ Multimeter S/N 86470304

Calibrated By: Michael Torres Date 24 Sept, '05

Reviewed By: [illegible] Date 26 Sept

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.
FORM C22A 11/26/2003

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

UD 115
corrected DPM
2-28-06
2.974E+05

CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide: Ni-63
Half-life: 96 ± 4 years
Catalog No.: EAB-063-PL
Source No.: A9-813

Customer: SHAW ENVIRONMENTAL, INC./TERC - AP
P.O. No.: 207785 OP
Reference Date: 1-Mar-03 12:00 PST
Contained Radioactivity: 0.1368 µCi 5.062 kBq

Physical description:

A. Capsule type:	EAB-PL (50.8 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Distributed and evaporated metallic salt on polymeric membrane
C. Active diameter/volume:	45 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

Ba-133 < 0.0001% on 1Mar 03

Method of Calibration:

This source was prepared from a weighed aliquot of solution whose activity in µCi/g was determined using a liquid scintillation counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 2.3 %
B. Type B (systematic) uncertainty:	± 3.1 %
C. Uncertainty in aliquot weighing:	± 0.4 %
D. Total uncertainty at the 99% confidence level:	± 3.9 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from NCRP Report No. 58, 1985.
- This source has a working life of 2 years.
- This source had a surface emission rate of 65970 β/min in 2π on 14 Feb 03.

Daniel James Van Dalsem
Quality Control

14-Feb-03
Date Signed

IPL Ref. No.: 952-98

APPENDIX B

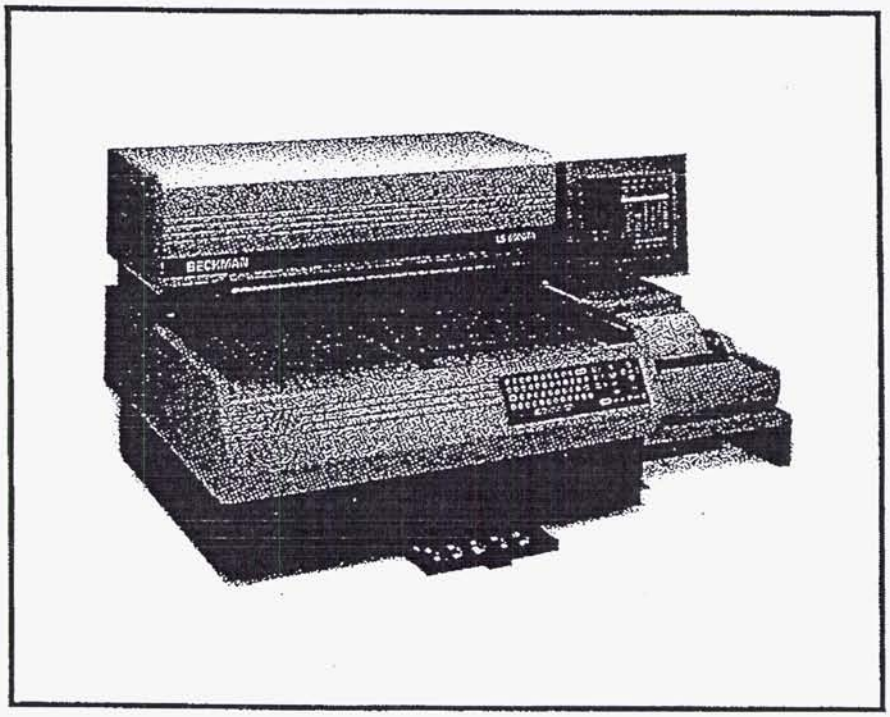
ON-SITE LABORATORY EQUIPMENT AND PROCESS

Applicable portions of the Beckman liquid scintillation counter operating manual are presented in this appendix. The full manual is approximately 230 pages. Only the title pages, table of contents, and Chapter 3 (*Counting Samples*) are presented herein.

BECKMAN

MADE IN U.S.A.

LS 6000IC, LS 6000TA and LS 6000LL Series
LIQUID SCINTILLATION SYSTEMS



Operating Manual

Beckman Instructions 015-247971-A

BECKMAN

LS 6000IC, LS 6000TA and LS 6000LL Series Liquid Scintillation System

Operating Manual

Beckman Instruments, Inc.
2500 Harbor Blvd, Fullerton, CA 92634-3100
(714) 871-4848 • TWX 910-592-1260 • Telex: 678413
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September 1989 015-247971 Printed in U.S.A.

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Chapter 3
Counting Samples

3.1 Preparations for Use

Provided the power has been left on, as recommended, the instrument is ready for use any time. When the instrument is powered up and in a standby status, the screen shown in Figure 3-1 is displayed. The Main Menu is displayed in the Main Editing Window. Press [MAIN MENU] if the Main Menu is not displayed in the Main Editing Window.

This chapter assumes you are familiar with the Operating Controls of the LS. If you are not familiar with the Operating Controls, refer to Section 2.3.

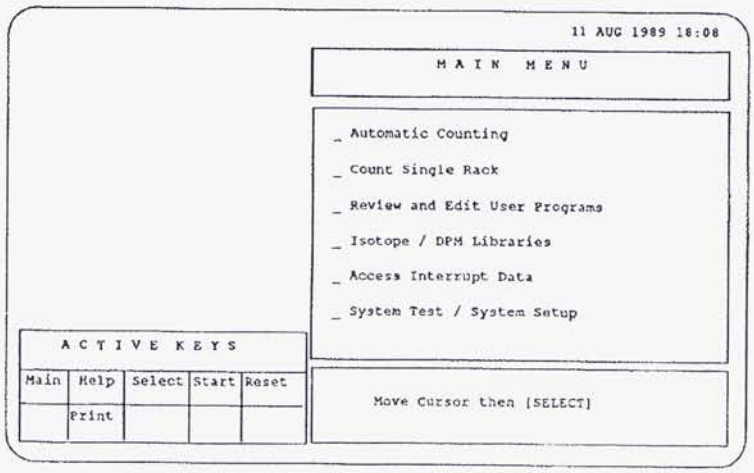

Figure 3-1. Display During Standby Status

3.2 Conducting An Automatic Count

Automatic Count permits a large number of samples to be counted without monitoring or intervention by the operator. A User Program is used to specify the counting parameters during Automatic Count. Refer to Chapter 4 for information on the User Programs and how to edit them. Different racks of samples can be counted under different User Programs.

Automatic Count continues until a stop command is given manually by pressing the two RESET keys simultaneously or automatically by using a Halt Rack. Automatic Count can be temporarily interrupted using Multi-Task. Refer to Section 3.5 for more information on Multi-Task.

3.2.1 Loading the Racks for Automatic Counting

If you are not familiar with the racks and how to place them in the LS instrument, refer to Section 2.4.

You can load up to 28 standard vial racks or 36 miniature racks or Bio-Vial racks. With Versa-Rack installed, standard, miniature and Bio-Vial racks may be intermixed within the same run. Care must be taken not to place more racks in the sample changer than it is capable of using. An error message is displayed if the sample changer is overloaded.

If you want to calibrate the instrument before counting your samples, first place the Calibrate Rack into the sample changer. Be sure this rack has the Auto Calibrate Card installed and the ^{14}C unquenched standard is in position #1. Refer to Section 2.7 for more information on calibration.

Note

Programs using blanks, replicates, % of Reference, or Xtal DPM require specific sample loading sequences within the racks. Refer to the appropriate sections in Chapter 5 for

more information on the required loading sequences of the samples within the racks.

Load your samples that have been placed in the appropriate Sample Racks. The first Sample Rack must be the rack with the User Number Card installed that corresponds to the User Program you wish to use. During Automatic Count, only the first rack of samples requires a User Number Card. All following racks are counted under the same program, until a new User Number Card or Halt Card is encountered.

Samples Racks may be loaded even if they are less than full. The instrument skips past the empty positions and proceeds to the next rack. Rack Number Cards are not required on the racks. If they are installed, however, Sample Racks can be used in any rack number order. The system reads and prints the number from the card before processing the rack.

Place all the racks together that are to be counted under the same User Program. If one or more additional sample sets are to be counted under different User Numbers during the same Automatic Count, make certain that the first rack in each set bears the correct User Number Card. When a Sample Rack with a User Number Card reaches the position for processing, the instrument "reads" the new user number and changes the processing parameters to those specified in that User Program.

When all the Sample Racks to be counted are loaded, place the red Halt Rack behind the last rack of samples to terminate Automatic Count.

Note

Samples placed in the Halt Rack are not counted. Do not place samples to be counted in the Halt Rack.

Additional sample sets may be loaded after Automatic Count has been initiated. Load the new sample sets in front of the Halt Rack, being careful that the new sample sets are not loaded in the middle of a set of samples waiting to be counted.

3.2.2 Starting the Automatic Count

Note

Check that the printer is ON (it should be left on). Also check that the ON LINE light is lit, and that paper is loaded and is at the top of the form. Refer to Section 2.5 for more information on setting up the printer.

Automatic Count is initiated from the Main Menu. Highlight Automatic Counting and press [SELECT] to begin the counting process. The Main Editing Window displays instructions to load your samples. Load the samples as described in Section 3.2.1 and press [START]. The racks are advanced to the rear of the instrument and counting commences. A typical screen displayed during Automatic Count is shown in Figure 3-2.

Note

If your samples have already been placed in the sample changer, you may simply press [START] after selecting Automatic Counting on the Main Menu.

```
                                                        11 AUG 1989 18:04
          COUNTING IN AUTOMATIC MODE

User:  2   Data Calc:          CPM     Time:   0.90 of   1.00    IC#:4.426

SAMPLE       3H        14C              SAMPLE       3H        14C

  4      142500.0       0.0
  3       20026.0       0.0
  2      228726.0     122.0
  1      245785.0    1745.0

   A C T I V E   K E Y S                 M U L T I - T A S K
        Help  Select        Reset   Interrupt Count / Edit / Review
                     Stop
                                     [SELECT] for Multi-Task Menu
```

Figure 3-2. Screen Displayed During Automatic Count

During Automatic Count, pressing the two RESET keys simultaneously terminates the counting process and returns the LS to Standby. The STOP COUNT key is used to terminate the counting of the current sample. The system prints the data accumulated up to the time of termination and advances to the next sample. Counting continues. The Halt Rack automatically terminates counting after all the samples are counted.

Data is printed and/or transmitted to the RS232 port depending on the User Program setup for Output Formats. Typical printouts for each data calculation program are shown in Chapter 5. For more information on the printout parameters, refer to Section 4.2.16.

To temporarily use the instrument during Automatic Count, press [SELECT]. The system is in the Multi-Task mode. You may count a small batch of samples, edit or review a User Program, or manually set up a new isotope or quench curve. Refer to Section 3.5 for more information on Multi-Task. You may also count samples during Automatic Counting using the Interrupt key. Pressing the Interrupt key presents the Count Single Rack Menu shown in Figure 3-9. Refer to the instructions in Section 3.5.1 for conducting an Interrupt Count.

3.3 Conducting Count Single Rack

Count Single Rack is especially useful for counting a single sample such as a blank standard or a reference standard, or a few experimental samples (up to one rack). A count of the sample can be obtained using a default program or a User Program.

3.3.1 Counting a Single Rack with the Default Parameters

A permanent set of default parameters can be used to obtain a quick count of samples under Count Single Rack. The default parameters, shown in Figure 3-3, provide a window of 0 to 1000, the entire 2000 KeV energy range of the instrument and a counting time of 1.00 minute. The results are presented as cpm. IC# (or H# Plus, if installed) and Lum-Ex (if installed) are turned on. Only the counting time may be changed.

```
C O U N T   S I N G L E   R A C K

_ Count Any Isotope

_ Counting Time:  1.00   min

_ Select User Program

    Any Isotope (0-1000 ch)
    CPM  H#    LUM-EX
```

Figure 3-3. Count Single Rack Menu

To perform Count Single Rack:

1. With the Main Menu displayed, highlight "Count Single Rack" and press [SELECT]. The Count Single Rack Menu shown in Figure 3-3 is displayed.

2. To count without any changes in the program setup, press [SELECT].

To change the counting time, highlight "Counting Time." Enter the desired counting time (0.01 to 999.99 mins.). Highlight "Count Any Isotope," and press [SELECT].

Note

The counting time is not permanently stored; following the count of the one rack, the counting time is reset to 1.00 minute.

3. The Main Editing Window prompts you to load your Sample Rack containing the vials you wish to count. Load the rack into the right side of the sample changer so it will be the first rack counted, and press [START].

4. The sample(s) are counted and the results printed. A typical printout is shown in Figure 3-4. The Main Menu is displayed.

PAGE: 1

SAM NO	POS	TIME MIN	H#	W I D E CPM	%ERROR	LUMEX %	ELAPSED TIME
1	**-1	0.10	11.3	249330.0	1.27	0.00	0.55
2	**-2	0.10	40.8	230260.0	1.32	0.00	1.12
3	**-3	0.10	333.4	20420.00	4.43	0.02	1.78
4	**-4	0.10	123.0	142670.0	1.67	0.00	2.47

Figure 3-4. Typical Printout from Count Single Rack

3.3.2 Counting a Single Rack with a User Program

A single rack of samples may be counted with any one of the User Programs. You may not edit the program in the Count Single Rack mode, except for counting time. Refer to Chapter 4 for editing a User Program prior to using this operating mode.

To perform Count Single Rack using a User Program:

1. With the Main Menu displayed, highlight "Count Single Rack" and press [SELECT]. The Count Single Rack Menu shown in Figure 3-3 is displayed.

```
User Selection                COUNT SINGLE RACK
_____________________________________________________

_   Next 10 User Programs
_   Previous 10 User Programs

_ 1  Default Values  1.00    3H    14C   NONE
_ 2  Default Values  1.00    3H    14C   NONE
_ 3  Default Values  1.00    3H    14C   NONE
_ 4  Default Values  1.00    3H    14C   NONE
_ 5  Default Values  1.00    3H    14C   NONE
_ 6  Default Values  1.00    3H    14C   NONE
_ 7  Default Values  1.00    3H    14C   NONE
_ 8  Default Values  1.00    3H    14C   NONE
_ 9  Default Values  1.00    3H    14C   NONE
_10  Default Values  1.00    3H    14C   NONE
```

Figure 3-5. User Program Selection Menu

```
COUNT SINGLE RACK

_ Count with Program of User: 1

_ Counting Time:  1.00   min

      3H    14C   NONE
         LUM-EX IC#
```

Figure 3-6. Summary Of User Program in Count Single Rack

2. Highlight "Select User Program" and press [SELECT]. The User Program Selection Menu shown in Figure 3-5 is displayed.

3. Select the desired User Program. A summary of the counting time and isotope settings is displayed. A typical example is illustrated in Figure 3-6.

To change the counting time, highlight "Counting Time," and enter the desired counting time (0.01 to 999.99 minutes).

Note

The counting time is not permanently stored; following the count of the one rack, the counting time is reset to the previously stored value.

4. Highlight "Count With Program of User," and press [SELECT]. The Main Editing Window prompts you to load your Sample Rack containing the vials you wish to count. Load the rack into the right side of the sample changer so it will be the first rack counted, and press [START].

If the User Program selected is setup for single photon monitoring, the Main Editing Window displays instructions to start elapsed time before starting the sample count. Press [START] when you initiate the sample reaction to obtain elapsed time from the start of the reaction. The Main Editing Window then prompts you to load your samples and initiate counting by

PAGE: 1

SAM NO	POS	TIME MIN	H#	3 H CPM	3 H %ERROR	1 4 C CPM	1 4 C %ERROR	W I D E CPM	W I D E %ERROR	QUENCH %	ELAPSED TIME
1	**-1	0.50	13.7	242875.4	0.57	2982.65	5.18	245876.1	0.57	0.02	1.23
2	**-2	0.50	43.1	222580.8	0.60	2549.12	5.60	225136.0	0.60	0.02	5.11
3	**-3	0.50	336.0	12947.66	2.48	5708.81	3.74	18660.54	2.07	0.19	8.73
4	**-4	0.50	126.8	134470.2	0.77	2284.05	5.92	136757.5	0.76	0.03	12.14

Figure 3-7. Typical Printout from Count Single Rack

pressing [START] again. Refer to Section 5.9 for more information on Single Photon Monitor.

5. The sample(s) are counted and the results printed. Figure 3-7 shows an example of a resulting printout from Count Single Rack using a User Program. The Main Menu is displayed.

3.4 Auto DPM

Auto DPM allows you to obtain dpm values for single label samples labeled with a pure beta-emitting isotope(i.e. ^{3}H, ^{14}C, ^{32}P, ^{35}S, ^{45}Ca, or ^{86}Rb) without running quench curves.

Auto DPM can be initiated from a Command Card. This program uses default parameters set by the instrument. The count time and counting precision may be set under System Parameters. Refer to Section 2.6.10 for more information on setting these parameters.

Auto DPM may also be selected as a Data Calculation Program and initiated with a User Number Card. The parameters set in the User Program are used to count the samples. Refer to Section 5.4 for more information on using Auto DPM as a Data Calculation Program.

Note

Auto DPM is designed for use with liquid scintillators only. Using this operating mode for counting samples on Xtalscint products may give erroneous results.

3.4.1 Auto DPM Calibration

Auto DPM Calibration is performed at the factory and the calibration stored. The calibration data is stored under System Setup. Auto DPM Calibration is recommended before you count samples using Auto DPM. Verify the calibration data stored in System Setup agrees with the unquenched ^{3}H and ^{14}C standards of your instrument. Refer to Section 2.6.10 for verifying the data under System Setup.

The Calibrate Rack is used to perform Auto DPM Calibration. Place the unquenched ^{14}C standard in position #1 and the unquenched ^{3}H standard in position #2. The instrument first performs calibration and then when a second vial is detected in position #2, the system backs up to the ^{14}C standard and performs Auto DPM Calibration.

Note

The Calibrate Rack must contain the unquenched ^{14}C standard in position #1 and the unquenched ^{3}H standard in position #2. Standard DPM and the date of standardization of the unquenched standard used for Auto DPM Calibration must be stored under System Setup.

3.4.2 Counting With Auto DPM

Counting in Auto DPM is similar to Automatic Count. Refer to Section 3.2 if you are not familiar with counting in the automatic mode. Place your samples to count in the Auto DPM Rack. Refer to Section 2.4.2 for information on setting up the Auto DPM Rack. Place remaining samples in Sample Racks that do not have a User Number Card installed on them.

For Auto DPM Calibration, place the Calibrate Rack set up as described in Section 3.4.1 in the instrument so it is the first rack to be counted. Place the Auto DPM Rack after the Calibrate Rack. Place the remaining Sample Racks into the instrument. Place a Halt Rack after the last sample and initiate Automatic Count. A typical printout of the results is shown in Figure 5-6.

3.5 Multi-Task

Multi-Task allows you to obtain an immediate count of a small number of samples (a maximum of one full rack) using Count Single Rack mode, to edit a User Program, or to manually set up a new isotope or quench curve (if DPM is installed). The counting process is terminated only when you initiate counting samples in Interrupt Count.

Note

Multi-Task is automatically terminated if no user action (either editing or counting) takes place within a 10 minute period while in Multi-Task.

3.5.1 Interrupt Count in Multi-Task

A single sample or up to one rack of samples may be counted in this mode during Multi-Task. Load the priority samples to count into the Interrupt Rack. Refer to Section 2.4.2 if you are not familiar with the Interrupt Rack. The rack must have the Interrupt Card installed. It will not be counted again if left in the sample changer with the Sample Racks during Automatic

```
M U L T I - T A S K

_ Interrupt Count
_ Review and Edit User Programs
_ Isotope / DPM Libraries
_ Access Interrupt Data
_ Return to Automatic Counting
```

Figure 3-8. The Multi-Task Menu

Count. The samples may be counted using the default parameters for Count Single Rack or a User Program.

Note

Interrupt Count may also be initiated by pressing [INTERRUPT] during Automatic Counting. The menu shown in Figure 3-9 is displayed.

To count a few samples during Automatic Counting:

1. During Automatic Count, press [SELECT] to display the Multi-Task Menu shown in Figure 3-8.

2. From the Multi-Task Menu, highlight "Interrupt Count" and press [SELECT]. The menu shown in Figure 3-9 is displayed.

3. Highlight "Count Single Rack" and press [SELECT]. The Count Single Rack Menu (Figure 3-3) is displayed.

Note

If Interrupt Data is stored, this data must be reviewed, printed or deleted before another Interrupt Count can be performed. Refer to Section 3.5.2 for information on

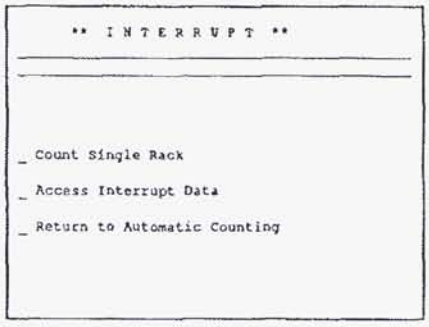

Figure 3-9. The Interrupt Menu

Interrupt Data. Press [PREVIOUS MENU] to return to the Count Single Rack Menu when you are finished in Interrupt Count.

4. To count using the default parameters without any changes, press [SELECT].

To change the counting time, highlight "Counting Time," and enter the desired counting time (0.01 to 999.99 minutes). Highlight "Count Any Isotope," and press [SELECT].

To count with a User Program, refer to Counting with a User Program at the end of this section.

5. The Main Editing Window displays instructions to load the samples. Load the Interrupt Rack with the samples you wish to count as described on the screen.

Note

The Interrupt Rack with the Interrupt Card installed must be used to count samples during Multi-Task. Once the samples are counted, the rack is skipped when Auto Count is resumed.

6. Press [START] to begin Interrupt Count. The screen displays a message "Suspending Auto Count" and the sample being counted is terminated. The Sample Rack in position is moved out of the count position and the instrument searches for the Interrupt Rack. The screen displays "Searching for Interrupt Rack."

Note

You may abort the Interrupt Count and resume Automatic Count by pressing [SELECT] at any time after this point.

7. When the samples in the Interrupt Rack have been counted, the instrument resumes the previous Automatic Count where it was interrupted.

Results of Interrupt Count are displayed and stored. They are not printed out. Refer to Section 3.5.2 for information on accessing Interrupt Data.

```
Count Single Rack                INTERRUPT COUNT
_____________________________________________________
_____________________________________________________

_ Count with Program of User: 3

_ Counting Time:  0.50   min

        3H    14C   WIDE
           LUM-EX  H0

_ Change Counting Parameters
```

Figure 3-10. Summary of User Program in Interrupt Count

Interrupt Count Using a User Program During Multi-Task

To count with a User Program:

1. Highlight "Select User Program" from the Count Single Rack Menu (Figure 3-3) and press [SELECT]. The User Program Selection Menu (Figure 3-5) is displayed.

2. Select the desired User Program. The Main Editing Window displays a summary of the program. A typical summary is shown in Figure 3-10.

3. To change only the counting time, highlight "Counting Time" and enter the desired count time. Highlight "Count With Program of User:" and press [SELECT]. Refer back to step 5 above to continue Interrupt Count.

4. To change other counting parameters, highlight "Change Counting Parameters" and press [SELECT]. The Main Editing Window displays the parameters of the User Program. The User Program Review is displayed in the Supplementary Window to the left. See Figure 3-11.

5. Make the desired changes in the User Program. Refer to Chapter 4 for more information on editing. Any changes to the User Program are not permanently stored. They are used to count the samples during Interrupt Count only.

```
                                                          11 Aug 1989 17:43
      USER PROGRAM REVIEW      User Selection                  INTERRUPT COUNT

User:  3   ID: ML                                  _ Id: ML
Count time: 0.50                CPM
Repeats:        3   Hf     Liquid                  _ Comments:
Replicates:     1          Lum-Ex
Cycle Reps:     1          2Phase                  _ Counting Time:  0.50 min
Low Reject:     0

Isotope:     3H      14C     WID E                  _ Scintillator: Liquid
2 sig:     0.00    0.00     0. 00                  _ Isotope 1:     3H
Bkgsub:    0.00    0.00      0.00
Factor:1.00000 1.00000 1.00000                      _ Isotope 2:     14C

Printer:  Std     RS-232:  Off                      _ Isotope 3:   WIDE

        A C T I V E   K E Y S                       _ Edit Other Parameters

| Main | Help | Select |  | Reset |                Enter program identification:
| Prev |  | Cancel | Stop |  |
```

Figure 3-11. Summary User Program in Interrupt

6. When editing is complete, press [PREVIOUS MENU]. The menu shown in Figure 3-10 is displayed. Highlight "Count with Program of User:" and press [SELECT]. Refer back to step 5 above to continue Interrupt Count.

3.5.2 Interrupt Data

The results of an Interrupt Count during Multi-Task are not printed out at the time of the count to avoid interference with the printout of the results for the Automatic Count. The results of the Interrupt Count are displayed and stored. Once stored, Interrupt Data can be viewed on the display, printed, sent to the RS232 port, and/or deleted.

To access Interrupt Data:

1. From either the Main Menu (Figure 3-1) or the Multi-Task Menu (Figure 3-8), highlight "Access Interrupt Data," and press [SELECT]. The Access Stored Interrupt Data Menu shown in Figure 3-12 is displayed.

```
Access Stored Interrupt Data          INTERRUPT
_ View Interrupt Data
_ Print Interrupt Data
_ Send Interrupt Data to RS232

_ Erase Interrupt Data
```

Figure 3-12. Access Stored Interrupt Data Menu

2. To view the data, highlight "View Interrupt Data" and press [SELECT]. The data is presented on the screen as shown in Figure 3-13. If more data is present than displayed on the screen, use the Down Cursor Arrow key to view more data. Press [PREVIOUS MENU] to return to the Access Stored Interrupt Data Menu.

```
                                                  17 MAY 1989 06:46
        Access Stored Interrupt Data

    Data Calc:          CPM                 Data Stored : 17 MAY 1989 06:39

  SAM  POS   TIME    H#     WIDE

    1 63-1    1.00  83.5   103.00
    2 63-2    1.00   5.9 38861.00
    3 63-3    1.00  63.1 43432.00

        A C T I V E  K E Y S
| Main | Help | Select | Start | Reset |
| Prev | Print | Cancel | Stop |

    v  to view more data
```

Figure 3-13. Data Displayed During View Interrupt Data

PAGE: 1

Printout of Stored Interrupt Count Data 17 MAY 1989 06:30

USER: 0 DATA CALC : CPM
Data Stored : 17 MAY 1989 06:23

SAM NO	POS	TIME MIN	H#	WIDE CPM	WIDE %ERROR	LUMEX %	ELAPSED TIME
1	63-1	1.00	83.2	115.00	18.65	8.08	1.38
2	63-2	1.00	4.2	39259.00	1.01	0.00	2.90
3	63-3	1.00	65.5	38768.00	1.11	0.00	4.31

Figure 3-14. Typical Printout of Interrupt Results

3. To print the data, highlight "Print Interrupt Data" and press [SELECT]. All stored data are printed. Figure 3-14 shows a typical printout. If data is printed during Automatic Count, the printer advances to the top of the next page before it prints the Interrupt Data. When Automatic Count is resumed, the Automatic Count data is put on a new page. The Access Stored Interrupt Data Menu is displayed.

4. To transmit data to the RS232 port, highlight "Send Interrupt Data to RS232" and press [SELECT]. All stored data are transmitted. The Access Stored Interrupt Data Menu is displayed.

Note

RS232 cannot be used if the current count is generating RS232 output.

5. To erase data, highlight "Erase Interrupt Data" and press [SELECT]. The data is erased and the Multi-Task Menu or Main Menu is displayed.

6. If you initiated Access Interrupt Data from Multi-Task, press [PREVIOUS MENU] to return to the Auto Count display.

3.5.3 Editing A User Program in Multi-Task

While Auto Count is in progress, you may edit any of the User Programs under Multi-Task. Editing is performed as described in Chapter 4. To avoid confusion in the interpretation of results, the User Program currently in use may only be edited with respect to length of processing time per sample.

To edit a User Program under Multi-Task:

1. During Automatic Count, press [SELECT] to display the Multi-Task Menu shown in Figure 3-8.

2. From the Multi-Task Menu, highlight "Review and Edit User Programs" and press [SELECT]. A menu similar to that shown in Figure 3-5 is displayed.

3. Select the desired User Number. The screen displayed is similar to the one shown in Figure 3-11.

If the User Program in use during Automatic Count is selected, refer to the instructions given below, Editing the Current User Program.

4. Edit the program as described in Chapter 4. When editing is complete, press [MAIN MENU]. These new parameters are stored in the User Program until changed again. The Multi-Task Menu is displayed.

5. Press [PREVIOUS MENU] to return to the Auto Count display.

Editing the Current User Program

Only the counting time or counting precision of the User Program in use during Automatic Count can be edited. A change made to the processing time of the samples applies only to the Interrupt Count. It is not stored as a permanent change to the program.

To edit the User Program currently in use during Auto Count:

1. During Automatic Count, press [SELECT] to display the Multi-Task Menu shown in Figure 3-8.

```
Change Count Parameters   INTERRUPT COUNT
_ Counting Time:  1.00
_ Counting Precision for     3H:  0.00
_ Counting Precision for    14C:  0.00
```

Figure 3-15. Edit Current User Program During Multi-Task

2. From the Multi-Task Menu, highlight "Review and Edit User Programs" and press [SELECT]. A menu similar to that shown in Figure 3-5 is displayed.

3. Select the current User Number. The menu shown in Figure 3-15 is displayed.

4. With "Counting Time" highlighted, enter the desired counting time.

5. Highlight "Counting Precision" and enter the desired precision for each isotope selected in the User Program.

6. Press [MAIN MENU] to store the values and return to the Multi-Task Menu. The new values are valid only for the current sample set and are not permanent. They take effect on the next sample, not the sample being counted while changes are made.

7. Press [PREVIOUS MENU] to return to the Auto Count display.

3.5.4 Using New Isotope Setup in Multi-Task

During Automatic Count, New Isotope Setup can be accessed using Multi-Task. An isotope not currently stored in the Isotope Library may be set up manually or an isotope can be deleted. Refer to Section 6.1 for more information on the Isotope Library.

```
NEW ISOTOPE SETUP                    Multi-Task
_ Scintillator: Liquid

_ Select Another Isotope
_ Isotope Selection Complete

_ Delete Isotope from Library
```

Figure 3-16. New Isotope Setup Menu in Multi-Task

To use New Isotope Setup:

1. During Automatic Count, press [SELECT] to display the Multi-Task Menu shown in Figure 3-8.

2. From the Multi-Task Menu, highlight "Isotope/DPM Libraries" and press [SELECT]. The Main Editing Window displays two prompts: Setup and Review Isotopes and Setup and Review DPM Quench Curves.

3. Highlight "Setup and Review Isotopes" and press [SELECT]. The New Isotope Menu for Multi-Task shown in Figure 3-16 is displayed.

4. A new isotope can be manually stored in the library, or a stored isotope may be deleted, just as if you were in New Isotope Setup. When you select "Select Another Isotope," the menu shown in Figure 3-17 is displayed. Enter the appropriate information. Refer to Section 6.1.4 and 6.1.5 for adding and deleting isotopes if you are not familiar with these tasks.

Note

You may not set up an isotope in Multi-Task using Automatic Setup.

```
NEW ISOTOPE SETUP                    Multi-Task
_ Isotope Name:
_ Half Life:  0.00
_ Manual Window Setup  Channels
```

Figure 3-17. Select Another Isotope Menu in Multi-Task

5. When you are finished using New Isotope Setup, highlight "Isotope Selection Complete" and press [SELECT]. The Multi-Task Menu is displayed.

6. Press [PREVIOUS MENU] to return to the Auto Count display.

3.5.5 Using the DPM Library in Multi-Task

The DPM Library can be accessed during an Automatic Count using Multi-Task. Stored quench curves can be reviewed, edited or deleted. A quench curve not currently stored in the DPM Library may be set up manually.

To set up a new quench curve:

1. During Automatic Count, press [SELECT] to display the Multi-Task Menu shown in Figure 3-8.

2. From the Multi-Task Menu, highlight "Isotope/DPM Libraries" and press [SELECT]. The Main Editing Window displays two prompts: Setup and Review Isotopes and Setup and Review DPM Quench Curves.

3. Highlight "Setup and Review DPM Quench Curves" and press [SELECT]. The menu shown in Figure 3-18 is displayed.

```
SETUP QUENCH CURVE          Multi-Task
_ Select Type of Curve

_ Background Correction:  No

_ Setup Single Label DPM

_ Setup Dual Label DPM

_ Setup Triple Label DPM
```

Figure 3-18. Menu to Edit Quench Curves in Multi-Task

4. A new quench curve is manually entered just as if you were manually entering it in the DPM Setup. Refer to Section 6.2.7 for more information on entering quench curves manually. You may also edit or delete a stored quench curve. Refer to Sections 6.2.5 and 6.2.6, respectively, for more information.

Note

You cannot count standards to set up quench curves or print correlation tables in Multi-Task.

5. When you are finished using the DPM Library, press [PREVIOUS MENU]. The Multi-Task Menu is displayed.

6. Press [PREVIOUS MENU] again to return to the Auto Count display.

APPENDIX C

QUALITY CONTROL RESULTS

Final Status Survey A3-367 QC Check conducted 4/4/06

area description	Sample Location	gross cpm	Reference bkg cpm	net cpm	Instrument Probe Model	Probe area cm^2	Total efficiency cpm/dpm	net dpm/100 cm^2	DCGL dpm/100 cm^2 3.70E+06	1.86 dpm/100 cm^2 5.00E+03	Aptuit dpm/100 cm^2 2.00E+03
Wall (Drywall)	C-1			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-2			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-3			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-4			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-5			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-6			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-7			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-8			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Door (wood)	C-9			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-10			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-11			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-12			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-13			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-14			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-15			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-16			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-17			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-18			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Wall (Drywall)	C-19			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-20			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (bare)	C-21			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-22			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-23			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-24			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-25			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-26			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-27	163	164	-1	43-68	126	0.036	-22	OK	OK	OK
Concrete (adhesive)	C-28			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-29			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-30			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-31			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-32			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (adhesive)	C-33			#VALUE!	43-68	126	0.036	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Concrete (bare)	C-34	248	232	16	43-68	126	0.036	353	OK	OK	OK

Survey# 040406-2
Pg 1

INSTRUMENT CALIBRATION: Maxi 4 APR 2006 15:44
Calibration successful

Calibrating Auto DPM
Counting Standard for 14C
Calibration Complete: 14C
Counting Standard for 3H
Calibration Complete: 3H
Calibration Successful

Survey # 040406-2
Pg 2

ID:7 4 APR 2006 15:51

USER: 7 COMMENT:

PRESET TIME : 1.00

DATA CALC :	DL DPM	H# :YES	SAMPLE REPEATS:	1	PRINTER	: STD
COUNT BLANK :	NO	IC# : NO	REPLICATES :	1	RS232	: STD
TWO PHASE :	NO	AQC :YES	CYCLE REPEATS :	1		
SCINTILLATOR:	LIQUID	LUMEX: NO	LOW SAMPLE REJ:	5		
LOW LEVEL :	NO	HALF LIFE CORRECTION DATE:			none	

ISOTOPE 1: 3H %ERROR: 2.00 FACTOR:1.0000 BKG. SUB: 0
ISOTOPE 2: 14C %ERROR: 2.00 FACTOR:1.0000 BKG. SUB: 0

BACKGROUND QUENCH CURVE: Off COLOR QUENCH CORRECTION: Off

Quench Limits Low:-0.163 High:302.08

SAM NO	POS	TIME MIN	H#	3H CPM	3H %ERROR	14C CPM	14C %ERROR	3H DPM	14C DPM	3H EFF-1	3H EFF-2	14C EFF-1	14C EFF-2	RATIO	LUMEX %	ELAPSED TIME
1	**-1	1.00	58.7	12.00	57.74	20.00	44.72	13.76	26.42	51.23	0.61	18.73	75.38	0.521	1.83	1.51
2	**-2	1.00	58.4	21.00	43.64	19.00	45.88	31.82	24.94	51.31	0.61	18.73	75.39	1.276	1.37	3.03

APPENDIX D

RADIOLOGICAL SURVEY PROTOCOLS

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D.1.0 Scope

D.1.1 Purpose

This procedure describes methods and techniques to be employed when performing surface contamination surveys and conducting smear sampling for the final status survey of Laboratory A3-367. The purposes of the described survey and sampling effort are:

- To determine the extent and magnitude of contamination on building and equipment surfaces
- To provide quality data for use in the License termination process
- To ensure that levels of personal protective equipment (PPE) worn during characterization and subsequent remediation activities are adequate for the protection of workers based on identified radiological conditions
- To ensure the establishment and maintenance of appropriate site controls, as required by the Aptuit Radiation Safety Program Manual based on identified radiological conditions.

D.1.2 Applicability

This procedure applies to final status survey activities being conducted at Aptuit by Shaw personnel and its subcontractors.

D.2.0 Responsibilities

D.2.1 Sample Coordinator

The Shaw Sample Coordinator is responsible for the supervision of data collection activities, including surveys and samples. Specific responsibilities include:

- Selecting proper equipment for the performance of defined data collection activities
- Ensuring properly calibrated and tested equipment is available for the performance of survey/sampling tasks
- Ensuring the proper establishment of reference and sample grids
- Assisting Survey/Sampling Technicians in determining locations for biased sample collection and direct measurement

- Reviewing collected data for accuracy and verifying the completion of data collection for each survey unit.

D.2.2 Survey/Sampling Technician

The Survey/Sample Technicians are responsible for the proper execution of survey and sampling activities. Specific responsibilities include:

- Ensuring all portable instrumentation properly calibrated and checked prior to use
- Establishing reference and sample grid systems for survey units and maintaining the integrity of the grid system during the performance of surveys
- Performing all data collection activities in full compliance with the established protocols
- Properly documenting all survey/sampling activities

D.3.0 Equipment and Materials

- Preprinted survey unit and laboratory survey maps and data forms (plan view of area, items or equipment to be surveyed)
- Roll of half-inch masking tape for marking survey and sample grids
- Minimum 10-foot metal rule tape measure
- Fine and super-fine tip "Sharpie" permanent markers (black ink)
- Soluble fiber liquid scintillation smears
- Metal or plastic laboratory tweezers
- Properly prepared liquid scintillation vials containing 5 mL of scintillation coctail (Approximately 60 for each survey unit).
- Gloves, safety glasses
- Ludlum Model 239/1F floor monitor (or equivalent) if available
- Ludlum Model 2224 scaler with 43-68 probe

D.4.0 Prerequisites

Ensure that all instrumentation is properly calibrated and operating properly in accordance with

Aptuit or manufacturer procedures.

Ensure Survey/Sampling Technicians have proper PPE for area to be surveyed based on area postings and site control requirements.

Ensure the activity hazardous analysis (AHA) has been conducted for the survey/sampling activities and that all workers are properly briefed on the hazards anticipated.

Survey/Sampling Technicians have reviewed any previous surveys of the survey unit conducted by Shaw, if available, to determine radiological conditions within the survey unit prior to entry.

Survey/Sampling Technicians will be instructed regarding the quality control (QC) measure/sample requirements prior to performing any survey or sampling activity.

Survey/Sampling Technicians will be instructed on the potential radiological hazards that may be present in the survey units. If the Aptuit RSO deems it necessary, the survey/sampling technicians will also receive documented training from the Aptuit radiation safety officer (RSO) regarding the Aptuit Radiation Safety Program Manual and applicable radiation protection procedures defined in the Radiation Safety Program Manual.

NOTE: Minimum PPE for performance of survey/sampling activities will be latex or nitrile gloves, and safety glasses. Any survey measurement that indicates the presence of contamination greater than half the removable DCGL will require survey/sampling technicians to immediately report that condition to the Sample Coordinator and exit the survey unit pending further evaluation of site controls and PPE requirements by the Aptuit RSO and the project CHP.

D.5.0 Instructions

D.5.1 Survey Unit Reference Grid System Preparation

Using the preprinted survey unit and laboratory maps as a reference, establish the 1-meter-by-1-meter square reference grid system for the survey unit to be surveyed/sampled. This is accomplished by starting at a location referenced on the preprinted map, mark the corner of each square reference grid by using masking tape to form a cross delineating the corners of each reference grid. Verify spacing of grids using the metal rule tape measurer. The grid system will include the floors, horizontal counter surfaces, and walls and vertical fixed furniture to a height of two meters above the floor.

D.5.2 Scan Surveys

The scan survey will include 100 percent of floors and countertops and 100 percent of the exposed wall surfaces and other exterior fixed furniture surfaces. Interior surfaces of the fixed furniture will be scanned on a judgmental basis. Prior to performing the survey, the minimum detectable count rate for the surveyor must be established.

When detection depends on the ability of the surveyor to recognize events above the minimum count rate, then a surveyor efficiency must be taken into consideration and the $MDCR_{surveyor}$ is calculated as follows:

$$MDCR_{surveyor} = \frac{MDCR}{\sqrt{p}}$$

Where p is the surveyor efficiency. Typically a value of 0.5 is selected for p. For example, if the instrument background is 9,400 counts per minute (cpm), then b_i is 9,400/60, or 157 counts per second. For d' a value of 2.48 is used and p is 0.5. This yields a $MDCR_{surveyor}$ of 2,640 cpm above background, or a gross count rate of 12,040 (9,400 + 2,640). This means that, for a background count of 9,400 cpm, a count of 12,040 cpm indicates, with a 95 percent true positive and 20 percent false positive rate, that activity is present above background. Other values of d', b_i, and p may be selected based on project-specific needs. The $MDCR_{surveyor}$ must be less than half of the DCGL.

This survey will be performed as follows:

Verify the instrument has been calibrated and has been set up in accordance with the Aptuit or manufacturer's technical manual prior to use.

With the instrument in operation, at a rate of approximately 0.5 meters/second and a height of approximately 6 to 10 centimeters (cm) above the surface, move the detector over 100 percent of the exposed surfaces. Using the audible response of the instrument, locate the area of maximum count rate for each reference grid and document the instrument reading at that location on the preprinted laboratory map.

For walls, the same survey technique will be used over 100 percent of the wall and exterior fixed furniture surface. This is accomplished by moving the detector in a back-and-forth pattern horizontally across each grid, spacing the back-and-forth pattern such that 100 percent of the

surface of each grid is covered by the survey. Using the audible response of the instrument, locate the area of maximum count rate for each reference grid and document the instrument reading at that location on the preprinted laboratory map.

Any location where the detector reading is twice background or greater will be flagged with a small piece of masking tape marked with the word "SCAN," the meter reading in counts per minute (cpm), the background reading in cpm, and the initials of the person performing the survey. The anomalous reading will also be noted field paperwork.

D.5.3 Determining Systematic Sample Points

Prior to performing systematic direct measurement surveys and smear sampling in each survey unit, a triangular sample grid will be established spacing the systematic sample points as follows:

$$L = \sqrt{\frac{A}{0.866n}}$$

where:

$L =$ Spacing between sample points
$A =$ Area of the survey unit in square meters (cannot exceed 100 m^2)
$n =$ number of sample points (always equal to 32).

Calculated grid spacing will be noted on the preprinted survey map for each systematic survey. After calculating the grid spacing (L), a starting sample point will be randomly selected on the preprinted map and additional sample points defined on an evenly spaced triangular grid radiating from the initial sample point, each sample point being spaced at a distance of L from the adjacent points until all sample points for the survey unit are identified and noted on the preprinted survey unit and laboratory maps. For any defined sample point that is inaccessible or where accurate measurements are impractical due to instrument configuration, an alternate sample point will be selected.

D.5.4 Direct Measurement Surveys

A minimum of 32 systematically located direct measurements for alpha or beta surface contamination will be performed in each survey unit at sample locations determined by the pre-established triangular grid system. Additionally, biased direct measurements will be conducted on a judgmental basis. These direct measurements will be performed as follows:

Verify that the required instrument/detector combination has been calibrated and has been set up in accordance with the Aptuit or manufacturer's technical manual prior to use.

Place the detector directly on the surface to be surveyed at the desired location. With the instrument operating in "Scaler" mode, take a measurement at the selected sample point for count time determined during instrument setup required to meet static MDC requirements for the parameter being measured. MDCs will be no greater than 50 percent of the applicable derived concentration guideline level (DCGL). Document the direct surface contamination reading measured at the location on the survey data forms and identify the sample location with a small piece of masking tape marked with the word "DIRECT" , a unique measurement number corresponding to a measurement number designated for that location, and the initials of the person performing the survey.

NOTE: Any survey measurement that indicates the presence of contamination greater than half the DCGL will require survey/sample technicians to immediately report that condition to the Sample Coordinator and exit the survey unit pending further evaluation of site controls and PPE requirements by the Aptuit RSO and the project CHP.

D.5.5 Wipe Surveys

Wipe sampling will be conducted at the same sample locations as the direct measurement surveys. These samples will be taken and then transported to the on-site laboratory for sample preparation and analysis. The sample method for beta contamination smears will be a strofoam smear technique performed in accordance with current Aptuit procedures. A common procedure is presented as follows:

- Survey/Sampling Technician will change into new gloves at the start of work at each new survey unit, at a minimum, and as needed thereafter.
- Obtain prepared scintillation vials with 1 milliliter of scintillation coctail added to each vial by the on-site laboratory.
- At each sample point, remove a single smear from the plastic bag and wipe the smear over an area of approximately 100 cm^2 (wipe a square area of approximately 4 inches by 4 inches or an "S" pattern approximately 16 inches long).
- Once the wipe is performed, quickly place smear into an individual prepped scintillation vial. The smear must be placed into the vial as quickly as possible to prevent loss from evaporation.
- The lid of the scintillation vial containing the smear will be marked with a unique number identifying the sample location and the survey unit. The vials will be transported to the laboratory for counting and activity determination.

NOTE: Any survey measurement that indicates the presence of contamination greater than half the DCGL will require survey/sample technicians to immediately report that condition to the Sample Coordinator and exit the survey unit pending further evaluation of site controls and PPE requirements by the Aptuit RSO and the project CHP.

D.5.6 Quality Control Measurements/Samples

Quality control measurements and samples will be performed/collected in a manner consistent with the protocols of prescribed by this document. The survey/sampling technician performing each survey will be given instruction regarding the QC sample requirements for the sampling activity being conducted.

D.5.7 Waste Management

Waste streams associated with survey and sampling activities include used PPE (gloves). If not suspected of being contaminated, these items will be disposed as trash. If contamination is suspect, based on survey data, PPE will be bagged as potentially radioactive waste and turned over to the Aptuit RSO for disposition.

D.5.8 Documentation of Surveys and Smear Samples

Once a survey is completed, all survey data forms and field paperwork will be provided to the Sample Coordinator for review. Upon completion of the review, each individual survey package, one for each survey unit, will be placed in an individual file unique to the relevant survey unit.

APPENDIX E

DIRECT MEASUREMENT AND WIPE SAMPLE RESULTS

Radiation/Contamination Survey Report

CONTAMINATION / RADIATION SURVEY REPORT

LOCATION: Aptuit A3-367

PROJECT NUMBER: 120089

SURVEYOR: Anthony Martinez

SURVEY NUMBER: 032206-1

MAP ID:

DATE: 3/22/06 TIME START: 0900 TIME COMPLETE: 1130 PAGE 1 OF 2

ACCEPTABLE SURFACE CONTAMINATION LEVELS — FSS limits (DCGL)

Loose N/A dpm/100cm² Alpha 200 dpm/100cm² Beta-Gamma ~~3.5E5~~ RTO 3.7E5 dpm/100cm²

Total N/A dpm/100cm² Alpha 2000 dpm/100cm² Beta-Gamma 3.7E6 dpm/100cm²

Source Check Data	Contamination Surveys				Radiation Surveys
	α (LOOSE)	α (TOTAL)	β-γ (LOOSE)	β-γ (TOTAL)	Beta-Gamma
Instrument	N/A	N/A	LSC 6000	2360/43-68	N/A
Source Type and ID			C-14, H³	Ni-63	
Source Strength in dpm			SADS	65900	μCi
Efficiency (instrument)				0.145	
MDA in dpm/100 cm²				1302	Sat. ☐ Unsat. ☐
Background in cpm				131	mrem/hr or μrem/hr

REASON FOR SURVEY: ☐ PROCEDURE NO ____ ✓ SPECIAL Final Status Survey ☐ ROUTINE ____

Contamination ☐ By Shift ☐ Daily ☐ Weekly ☐ Monthly ☐

Radiation ☐ By Shift ☐ Daily ☐ Weekly ☐ Monthly ☐

COMMENTS: Sample location C-34 was added to survey as a Bias location Based off elevated scan reading, then remediation. Referance Backgrounds use to calculate Net cpm values Total Efficiency used to calculate dpm/100cm² Values.

Contamination Survey INSTRUMENT / SERIAL #	ALPHA (LOOSE) N/A	BETA-GAMMA (LOOSE) LSC6000 / 7060380
	ALPHA (TOTAL) N/A	BETA-GAMMA (TOTAL) 2360/43-68 / 185781/PR1020
Radiation Survey INSTRUMENT / SERIAL #	BETA-GAMMA N/A	BETA-GAMMA N/A

THE KNOWING & WILLFUL RECORDING OF FALSE, FICTITIOUS, OR FRAUDULENT STATEMENTS OR ENTRIES ON THIS DOCUMENT MAY BE PUNISHABLE AS A FELONY UNDER FEDERAL STATUTES.

Item #	Alpha Loose dpm/100cm²	Alpha Total dpm/100cm²	Beta-Gamma Loose dpm/100cm²	Beta-Gamma Total dpm/100cm²	Beta-Gamma ☐ mrem/hr ☐ micro rem/hr ☐ Beta mrad/hr ☐	Item or Location
1	N/A	N/A	SADS	SADS	N/A	See Attached Map for Sample locations
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

RCS REVIEW: [illegible] DATE: 3-24-06

* SADS - See Attached Data Sheet

Radiation/Contamination Survey Report Continuation

CONTAMINATION / RADIATION SURVEY REPORT (CONTINUATION SHEET)

PROJECT NUMBER: 120089 | DATE: 3/22/06 | PAGE 2 OF 2

LOCATION: Aptuit A3-367

SURVEYOR: Anthony Martinez

SURVEY NUMBER: 032206-1

MAP ID: N/A

COMMENTS: SADS - See Attached Data Sheet

RCS REVIEW [illegible] DATE 3-29-06

[redacted]	Alpha		Beta-Gamma		Beta-Gamma ☐ mrem/hr ☐ microrem/hr ☐ Bet mrads/hr ☐	Item or Location
Item #	LOOSE dpm/100cm²	TOTAL dpm/100cm²	LOOSE dpm/100cm²	TOTAL dpm/100cm²		
26	N/A	N/A	SADS	SADS	N/A	See Attached Maps.
27	↓	↓	↓	↓	↓	↓
28	↓	↓	↓	↓	↓	↓
29	↓	↓	↓	↓	↓	↓
30	↓	↓	↓	↓	↓	↓
31	↓	↓	↓	↓	↓	↓
32	↓	↓	↓	↓	↓	↓
33	↓	↓	↓	↓	↓	↓
34	↓	↓	↓	↓	↓	↓

N A

[redacted]	Alpha		Beta-Gamma		Beta-Gamma ☐ mrem/hr ☐ micro rem/hr ☐ Beta mrads/hr ☐	Item or Location
Item #	LOOSE dpm/100cm²	TOTAL dpm/100cm²	LOOSE dpm/100cm²	TOTAL dpm/100cm²		

N A

THE KNOWING & WILLFUL RECORDING OF FALSE, FICTITIOUS, OR FRAUDULENT STATEMENTS OR ENTRIES ON THIS DOCUMENT MAY BE PUNISHABLE AS A FELONY UNDER FEDERAL STATUTES.

Final Status Survey A3-367 conducted 3/22/06

area description	Sample Location	gross cpm	Reference bkg cpm	net cpm	Instrument Probe Model	Probe area cm^2	Total efficiency cpm/dpm	net dpm/100 cm^2	DCGL dpm/100 cm^2 3.70E+06	1.86 dpm/100 cm^2 5.00E+03	Aptuit dpm/100 cm^2 2.00E+03
Wall (Drywall)	C-1	139	146	-7	43-68	126	0.036	-154	OK	OK	OK
Wall (Drywall)	C-2	116	146	-30	43-68	126	0.036	-661	OK	OK	OK
Wall (Drywall)	C-3	122	146	-24	43-68	126	0.036	-529	OK	OK	OK
Wall (Drywall)	C-4	125	146	-21	43-68	126	0.036	-463	OK	OK	OK
Wall (Drywall)	C-5	154	146	8	43-68	126	0.036	176	OK	OK	OK
Wall (Drywall)	C-6	150	146	4	43-68	126	0.036	88	OK	OK	OK
Wall (Drywall)	C-7	122	146	-24	43-68	126	0.036	-529	OK	OK	OK
Wall (Drywall)	C-8	137	146	-9	43-68	126	0.036	-198	OK	OK	OK
Door (wood)	C-9	147	139	8	43-68	126	0.036	176	OK	OK	OK
Wall (Drywall)	C-10	148	146	2	43-68	126	0.036	44	OK	OK	OK
Wall (Drywall)	C-11	142	146	-4	43-68	126	0.036	-88	OK	OK	OK
Wall (Drywall)	C-12	134	146	-12	43-68	126	0.036	-265	OK	OK	OK
Wall (Drywall)	C-13	130	146	-16	43-68	126	0.036	-353	OK	OK	OK
Wall (Drywall)	C-14	144	146	-2	43-68	126	0.036	-44	OK	OK	OK
Wall (Drywall)	C-15	142	146	-4	43-68	126	0.036	-88	OK	OK	OK
Wall (Drywall)	C-16	145	146	-1	43-68	126	0.036	-22	OK	OK	OK
Wall (Drywall)	C-17	146	146	0	43-68	126	0.036	0	OK	OK	OK
Wall (Drywall)	C-18	140	146	-6	43-68	126	0.036	-132	OK	OK	OK
Wall (Drywall)	C-19	150	146	4	43-68	126	0.036	88	OK	OK	OK
Concrete (adhesive)	C-20	150	164	-14	43-68	126	0.036	-309	OK	OK	OK
Concrete (bare)	C-21	236	232	4	43-68	126	0.036	88	OK	OK	OK
Concrete (adhesive)	C-22	185	164	21	43-68	126	0.036	463	OK	OK	OK
Concrete (adhesive)	C-23	179	164	15	43-68	126	0.036	331	OK	OK	OK
Concrete (adhesive)	C-24	171	164	7	43-68	126	0.036	154	OK	OK	OK
Concrete (adhesive)	C-25	181	164	17	43-68	126	0.036	375	OK	OK	OK
Concrete (adhesive)	C-26	171	164	7	43-68	126	0.036	154	OK	OK	OK
Concrete (adhesive)	C-27	164	164	0	43-68	126	0.036	0	OK	OK	OK
Concrete (adhesive)	C-28	170	164	6	43-68	126	0.036	132	OK	OK	OK
Concrete (adhesive)	C-29	221	164	57	43-68	126	0.036	1257	OK	OK	OK
Concrete (adhesive)	C-30	170	164	6	43-68	126	0.036	132	OK	OK	OK
Concrete (adhesive)	C-31	171	164	7	43-68	126	0.036	154	OK	OK	OK
Concrete (adhesive)	C-32	175	164	11	43-68	126	0.036	243	OK	OK	OK
Concrete (adhesive)	C-33	173	164	9	43-68	126	0.036	198	OK	OK	OK
Concrete (bare)	C-34	277	232	45	43-68	126	0.036	992	OK	OK	OK

INSTRUMENT CALIBRATION: Maxi 23 MAR 2006 07:38
Calibration successful

Calibrating Auto DPM
Counting Standard for 14C
Calibration Complete: 14C
Counting Standard for 3H
Calibration Complete: 3H
Calibration Successful

ID:7 23 MAR 2006 07:44

USER: 7		COMMENT:					
PRESET TIME :	1.00						
DATA CALC :	DL DPM	H#	:YES	SAMPLE REPEATS:	1	PRINTER	: STD
COUNT BLANK :	NO	IC#	: NO	REPLICATES :	1	RS232	: STD
TWO PHASE :	NO	AQC	:YES	CYCLE REPEATS :	1		
SCINTILLATOR:	LIQUID	LUMEX:	NO	LOW SAMPLE REJ:	5		
LOW LEVEL :	NO	HALF LIFE CORRECTION DATE:				none	

ISOTOPE 1:	3H	%ERROR: 2.00	FACTOR:1.0000	BKG. SUB:	0
ISOTOPE 2:	14C	%ERROR: 2.00	FACTOR:1.0000	BKG. SUB:	0

BACKGROUND QUENCH CURVE: Off COLOR QUENCH CORRECTION: Off

SAM NO	POS	TIME MIN	H#	3H CPM	3H %ERROR	14C CPM	14C %ERROR	3H DPM	14C DPM	3H EFF-1	3H EFF-2	14C EFF-1	14C EFF-2	RATIO	LUMEX %	ELAPSED TIME
1	**-1	1.00	58.1	23.00	41.70	12.00	57.74	39.08	15.60	51.38	0.61	18.73	75.40	2.506	0.82	1.51
2	**-2	1.00	60.7	16.00	50.00	11.00	60.30	26.21	14.39	50.76	0.61	18.74	75.31	1.821	1.75	3.04
3	**-3	1.00	59.5	18.00	47.14	14.00	53.45	28.53	18.35	51.04	0.61	18.73	75.35	1.555	1.39	4.58
4	**-4	1.00	59.4	16.00	50.00	15.00	51.64	24.10	19.71	51.08	0.61	18.73	75.36	1.223	1.63	6.10
5	**-5	1.00	58.1	13.00	55.47	13.00	55.47	19.07	17.09	51.39	0.61	18.73	75.41	1.116	1.37	7.64
6	**-6	1.00	58.9	19.00	45.88	14.00	53.45	30.41	18.33	51.19	0.61	18.73	75.37	1.659	1.23	9.17
7	**-7	1.00	58.4	18.00	47.14	6.00	81.65	32.26	7.70	51.33	0.61	18.73	75.40	4.192	1.05	10.72
8	**-8	1.00	58.1	16.00	50.00	11.00	60.30	25.89	14.38	51.40	0.61	18.73	75.41	1.801	2.09	12.26
9	**-9	1.00	58.1	17.00	48.51	13.00	55.47	26.88	17.02	51.38	0.61	18.73	75.40	1.579	1.59	13.81
10	**-10	1.00	57.9	17.00	48.51	24.00	40.82	21.53	31.65	51.43	0.61	18.73	75.41	0.680	1.23	15.34
11	**-11	1.00	58.6	12.00	57.74	12.00	57.74	17.64	15.77	51.26	0.61	18.73	75.39	1.119	1.90	16.89
12	**-12	1.00	57.7	21.00	43.64	17.00	48.51	32.69	22.28	51.48	0.61	18.73	75.42	1.467	1.27	18.42
13	**-1	1.00	59.5	23.00	41.70	36.00	33.33	27.60	47.55	51.06	0.61	18.73	75.35	0.580	0.82	20.09
14	**-2	1.00	58.1	18.00	47.14	15.00	51.64	27.86	19.67	51.39	0.61	18.73	75.41	1.416	1.54	21.64
15	**-3	1.00	58.1	13.00	55.47	7.00	75.59	21.98	9.10	51.38	0.61	18.73	75.40	2.414	2.38	23.21
16	**-4	1.00	57.7	19.00	45.88	12.00	57.74	31.20	15.66	51.50	0.61	18.73	75.42	1.993	1.99	24.74
17	**-5	1.00	58.5	12.00	57.74	21.00	43.64	13.26	27.75	51.29	0.61	18.73	75.39	0.478	1.30	26.31
18	**-6	1.00	58.9	19.00	45.88	12.00	57.74	31.39	15.67	51.19	0.61	18.73	75.37	2.003	1.85	27.84
19	**-7	1.00	60.0	14.00	53.45	11.00	60.30	22.19	14.42	50.91	0.61	18.73	75.33	1.539	2.20	29.41
20	**-8	1.00	58.6	18.00	47.14	11.00	60.30	29.87	14.35	51.26	0.61	18.73	75.39	2.082	1.45	30.96
21	**-9	1.00	58.9	19.00	45.88	18.00	47.14	28.46	23.65	51.19	0.61	18.73	75.37	1.204	1.12	32.51
22	**-10	1.00	60.5	19.00	45.88	15.00	51.64	30.14	19.67	50.81	0.61	18.73	75.32	1.532	1.28	34.04
23	**-11	1.00	59.1	28.00	37.80	9.00	66.67	50.53	11.53	51.14	0.61	18.73	75.37	4.382	1.51	35.61
24	**-12	1.00	57.1	19.00	45.88	9.00	66.67	32.56	11.66	51.64	0.61	18.73	75.44	2.792	1.48	37.14
25	**-1	1.00	61.4	19.00	45.88	14.00	53.45	30.77	18.35	50.58	0.61	18.74	75.28	1.677	1.78	38.81
26	**-2	1.00	60.2	12.00	57.74	14.00	53.45	16.79	18.45	50.89	0.61	18.73	75.33	0.910	2.04	40.34
27	**-3	1.00	59.1	23.00	41.70	14.00	53.45	38.28	18.26	51.14	0.61	18.73	75.37	2.096	1.67	41.91
28	**-4	1.00	58.7	16.00	50.00	10.00	63.25	26.46	13.05	51.23	0.61	18.73	75.38	2.027	2.25	43.44
29	**-5	1.00	59.8	12.00	57.74	14.00	53.45	16.76	18.45	50.98	0.61	18.73	75.34	0.909	2.66	45.01
30	**-6	1.00	58.8	26.00	39.22	10.00	63.25	46.05	12.89	51.22	0.61	18.73	75.38	3.572	1.36	46.56
31	**-7	1.00	58.3	20.00	44.72	13.00	55.47	32.77	16.98	51.33	0.61	18.73	75.40	1.930	1.30	48.12
32	**-8	1.00	60.3	21.00	43.64	7.00	75.59	37.99	8.98	50.85	0.61	18.73	75.32	4.228	1.84	49.66
33	**-9	1.00	59.0	18.00	47.14	21.00	43.64	25.05	27.66	51.17	0.61	18.73	75.37	0.906	1.60	51.21
34	**-10	1.00	58.3	21.00	43.64	12.00	57.74	35.20	15.63	51.34	0.61	18.73	75.40	2.252	1.35	52.76