NRC FORM 313 (3-2009)
10 CFR 30, 32, 33, 34, 35, 36, 39, and 40

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0120 EXPIRES: 3/31/2012

Estimated burden per response to comply with this mandatory collection request: 4.3 hours. Submittal of the application is necessary to determine that the applicant is qualified and that adequate procedures exist to protect the public health and safety. Send comments regarding burden estimate to the Records and FOIA/Privacy Services Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0120), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

APPLICATION FOR MATERIALS LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRLCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIEL BELOW.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

OFFICE OF FEDERAL & STATE MATERIALS AND
ENVIRONMENTAL MANAGEMENT PROGRAMS
DIVISION OF MATERIALS SAFETY AND STATE AGREEMENTS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS:

IF YOU ARE LOCATED IN:

ALABAMA, CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, FLORIDA, GEORGIA, KENTUCKY, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, NORTH CAROLINA, PENNSYLVANIA, PUERTO RICO, RHODE ISLAND, SOUTH CAROLINA, TENNESSEE, VERMONT, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

LICENSING ASSISTANCE TEAM
DIVISION OF NUCLEAR MATERIALS SAFETY
U.S. NUCLEAR REGULATORY COMMISSION, REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

ALASKA, ARIZONA, ARKANSAS, CALIFORNIA, COLORADO, HAWAII, IDAHO, KANSAS, LOUISIANA, MISSISSIPPI, MONTANA, NEBRASKA, NEVADA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, OREGON, PACIFIC TRUST TERRITORIES, SOUTH DAKOTA, TEXAS, UTAH, WASHINGTON, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
612 E. LAMAR BOULEVARD, SUITE 400
ARLINGTON, TX 76011-4125

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S.NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

A. NEW LICENSE

✓ B. AMENDMENT TO LICENSE NUMBER **24-00513-38**

C. RENEWAL OF LICENSE NUMBER

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include ZIP code)*

The Curators of the University of Missouri
University of Missouri - St. Louis
1 University Boulevard (102 PTB)
St. Louis, MO 63121

3. ADDRESS WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

University Of Missouri - St. Louis
8001 Natural Bridge Road
St. Louis, Missouri 63121

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Steven Struck

TELEPHONE NUMBER

(314) 516-6362

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL
a. Element and mass number; b. chemical and/or physical form; and c. maiximum amount which will be possessed at any one time.

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED.

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE.

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.

9. FACILITIES AND EQUIPMENT.

10. RADIATION SAFETY PROGRAM.

11. WASTE MANAGEMENT.

12. LICENSE FEES *(See 10 CFR 170 and Section 170.31)*

FEE CATEGORY **Exempt** AMOUNT ENCLOSED $ **0.00**

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, 36, 39, AND 40, AND THAT ALL INFORMATION CONTANED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

CERTIFYING OFFICER -- TYPED/PRINTED NAME AND TITLE

Steven D Struck

SIGNATURE

DATE **09/10/2010**

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
			$		
APPROVED BY				DATE	

PRINTED ON RECYCLED PAPER

Environmental Health and Safety

One University Boulevard
Saint Louis, MO 63121-4499
Telephone: 314-516-6363
314-516-6362

Materials Licensing Branch Chief
U.S. Nuclear Regulatory Commission
Region III
2443 Warrenville Road STE 210
Lisle, Illinois 60532-4352

September 10, 2010

Dear Sir or Ma'am,

The following is a request to amend the radioactive material license belonging to The Curators of the University of Missouri at the St. Louis Campus. The license number is 24-00513-38, amendment number 25, having the expiration date of January 31, 2013.

1) Please amend license condition 12A. and add the following authorized user for Phosphorus-32 and Sulpher-35 usage:

   a) Mindy Steiniger, Ph.D. Attachment 1 contains the "Application for Licensed Possession and Use of Radioactive Sources" with the University including relevant training and experience to the above materials. Maximum possession limits for this authorized user are 10 mCi for P-32 and 10 mCi for S-35. The purpose of this material is to construct radiolabeled probes for the detection of specific DNAs and RNAs and to radioactively label in-vitro proteins.

   b) The proposed radioactive materials usage and storage area is in the Research Building, laboratory R423. This laboratory was previously authorized for radioactive materials use under Colin MacDiarmid whom is no longer with the University.

2) Please amend license condition 12A and delete the following Authorized User who is no longer associated with the University of Missouri - St. Louis or no longer using licensed materials.

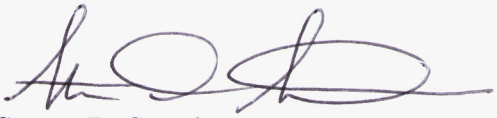
   a) Colin MacDiarmid, Ph.D.

3) Please amend the Radioactive Materials Use Areas In Science Complex Chart described in the License Application Item 9 dated February 28, 1992, the Facsimile dated January 15, 2003, and the application dated February 10, 2009 to match the attached chart (Attachment 2).

   a) Remove laboratories R-430. Close-out surveys dated November 24, 2009 (See Attachment 3 titled "Final Status Survey Report of Laboratory R-430").

   b) Change the "Person Responsible" for laboratory R-423 from Colin MacDiarmid to Mindy Steiniger.

Respectfully,



Steven D. Struck
Radiation Safety Officer
University of Missouri – St. Louis
(314)516-6362 phone
(314)516-6309 fax

Attachment 1 "Application for Licensed Possession and Use of Radioactive Sources".

Attachment 2 "Radioactive Materials Use Areas In Science Complex".

Attachment 3 "Final Status Survey Report of Laboratory R-430"

University of Missouri – St. Louis

APPLICATION FOR LICENSED POSSESSION AND USE OF RADIOACTIVE SOURCES

- Please Complete All 3 Pages -

1. Name of Applicant	2. Date of Application	3. Department of use
Mindy Steiniger	8-27-10	Biology

4. Building, Room and Telephone Number (For Communication)	5. Location(s) of Use and Storage
424 Research, 314-516-7013	423 Research

6. Sources To Be Used	7. Form Required	8. Requested Possession Limit
^{32}P, ^{35}S	^{32}P-nucleotides ^{35}S-amino acids	^{32}P-10mCi ^{35}S-10mCi

9. Proposed Use and Plan of Investigation

The radioactive materials applied for will be used to (1) construct radiolabeled probes for the detection of specific DNAs and RNAs, or (2) to radioactively label *in vitro* transcribed and translated proteins.

10. Plan of Personnel Monitoring and Radiation Protection

A hand-held GM counter, film badges and swipe tests will be used to monitor personnel, workspace and containers.

11. Plan for Disposing of Radioactive Wastes

Solid and liquid waste will be stored in separate, appropriately labeled containers located within the licensed area. Disposal protocols will follow the specifics of Section 4 of the "Handbook of Radiological Operations" regarding disposal through the RSO contractor.

12. Health Physics Evaluation	13. Campus Review	14. Signatures
Date Received: 9/9/10 Date Evaluated: 9/9/10 Risk-Level Classification:	Signature (Date):	Applicant
Signature – Radiation Safety Officer	Signature (Date):	Department Chairperson

University of Missouri – St. Louis

TRAINNING AND EXPERIENCE OF APPLICANT

Applicant
Mindy Steiniger

Training

Type of Training	Where Trained	Duration of Training	On the Job Check One		Formal Course	
			Yes	No	Yes	No
A. Principles and practices of radiation protection	University of Wisconsin-Madison University of North Carolina-Chapel Hill	4 h course online course		x	x	
B. Radioactivity measurement techniques and instruments	University of Wisconsin-Madison University of North Carolina-Chapel Hill	4 h course online course		x	x	
C. Mathematics basics to measurement of radioactivity	University of Wisconsin-Madison University of North Carolina-Chapel Hill	4 h course online course		x	x	
D. Biological effects of radiation	University of Wisconsin-Madison University of North Carolina-Chapel Hill	4 h course online course		x	x	

Experience With Radiation Sources: (Actual use or equivalent experience)

Source	Quantity	Where Gained	Duration	Type of Use
^{32}P	10mCi	University of Wisconsin-Madison	1997-1998	Actual use
^{32}P	10mCi	University of North Carolina-Chapel Hill	2006-2010	Actual use
^{35}S	10mCi	University of North Carolina-Chapel Hill	2006-2010	Actual use

Description of Equipment and Facilities for Radiation Safety

Radiation Detection Instruments: (Use supplemental sheets if necessary)

Type of instrument (Including make and model number of each)	Number Available	Radiation Detected	Sensitivity Range (mR/hr)	Window Thickness (mg/cm2)	Use (Monitoring, Surveying, Measuring)
Wm. B. Johnson & Assoc. Model GSM 110GP	1	α, β, γ	0-20	1.4-2.0	Monitoring, Surveying
Packard TRI-CARB 1600CA Liquid Scintillation Counter	1	α, β, γ			Monitoring, Surveying

Method, frequency, and standards used in calibrating instruments listed above:

Calibration will be performed by Health Physics or licensed companies.

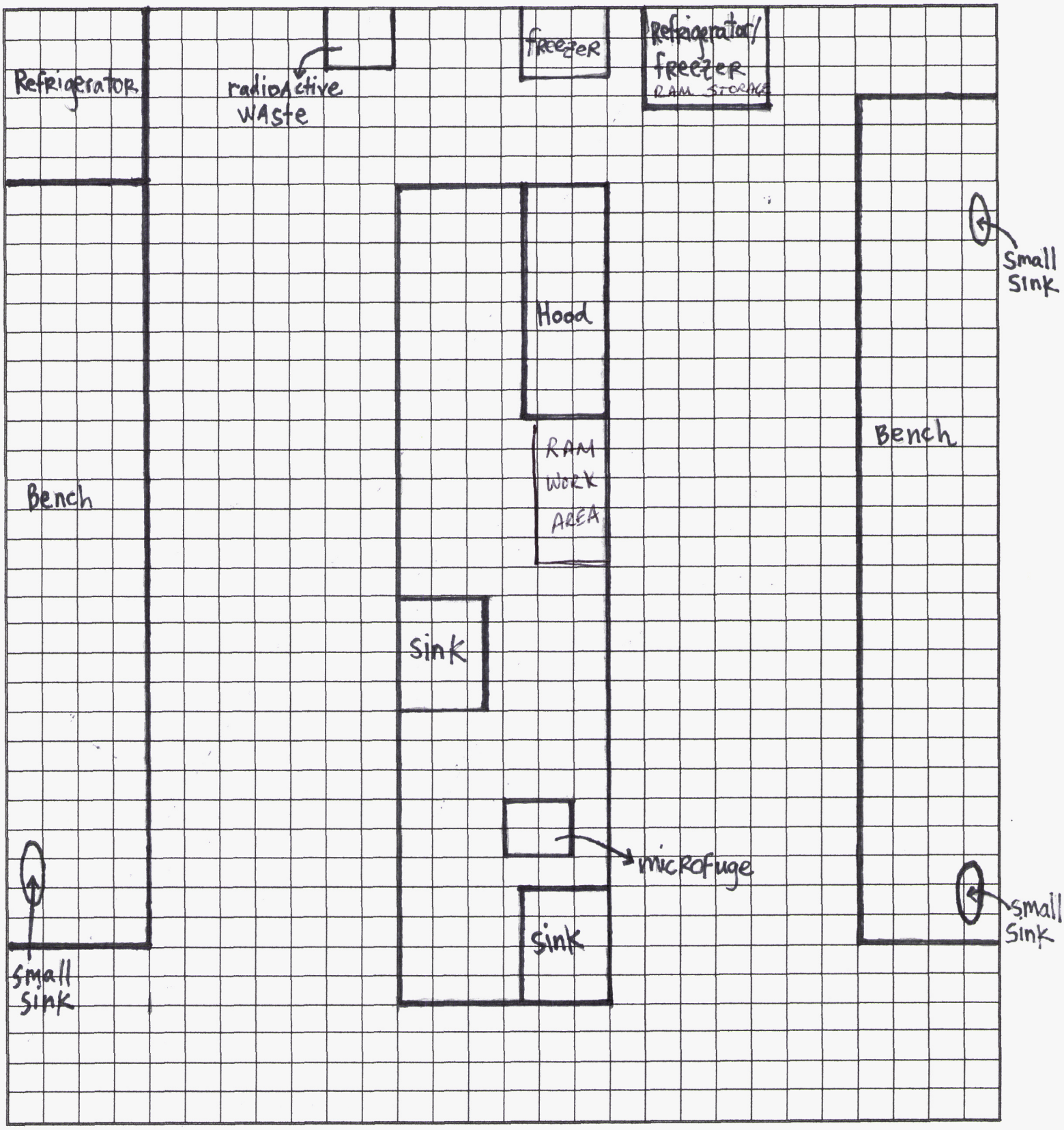
Special factilities:

Shield and storage containers in the laboratory are of 3/8" acrylic
S401-contains a liquid scintillation counter
There is a fume hood in R423 for radioactive use.

Applicant	Building/ Room
Mindy Steiniger	~~425~~ Research

423

Sketch laboratory facilities and show storage, fume hoods, sinks, refrigerators, and other pertinent equipment:



University of Missouri St. Louis

Environmental Health and Safety

One University Boulevard
Saint Louis, MO 63121-4499
Telephone: 314-516-6363
314-516-6362

Date: September 10, 2010

Attachment 2
University of Missouri – St. Louis
License amendment 25

Radioactive Materials Use Areas In Science Complex

Science Complex	Person Responsible	Intended Use
R335/7/9	Wang	Individual
R420	Schechter	Individual
R423	Steiniger	Individual
R438	Thiel	Individual
S302	Spingola	Individual
S402	Olivas	Individual
S455	Thiel	Common
S457	Thiel	Common Regular use by Kellogg, Parker Thiel and Wang
S459	Thiel	Common
S467	Thiel	Common
M315	Dupureur	Individual

COPY

2827.20091124.004

Final Status Survey Report of Laboratory R-430

University of Missouri St. Louis (UMSL) Radiation Safety Program

November 24, 2009

Prepared by
Science Applications International Corp. (SAIC)
8421 St. John Industrial Dr.
St. Louis, MO 63114

Under contract # W08-TS-010, Task Order #4

Prepared by:	*Eric Schrumpf (SAIC)*	11-24-09 / *Date*
Reviewed by:	*Steve Passig, CHP (SAIC)*	11/24/09 / *Date*
Approved by:	*S. Struck, RSO (UMSL)*	11/25/09 / *Date*

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EXECUTIVE SUMMARY

This report presents the results of a final status survey performed in laboratory room R-430 at the University of Missouri – St. Louis campus. All elements of the survey approach described in Section 3.0 were completed satisfactorily. No indications of residual radioactive materials from licensed activities were detected in the laboratory room R-430; therefore the room can be released for unrestricted use.

1.0 INTRODUCTION

This report presents the results of the survey performed in laboratory R-430 at the University of Missouri – St. Louis campus (UMSL). The final status survey was requested by the UMSL Radiation Safety Officer (RSO). Radiological survey information was collected to confirm that residual radioactive material from licensed activities present inside laboratory R-430 was less than the acceptable screening levels. The primary radiological contaminants of concern (COCs) are listed in Table 1. Radiological survey instrumentation was selected to maximize the ability to detect the gamma emissions from any Cobalt-57 (Co-57) that could be present. Co-57 decays by electron capture. During electron capture, a beta emission does not always take place. Sometimes, the energy is absorbed by the nucleus. A liquid scintillation counter was used to detect removable Co-57. A MARSSIM (Multiagency Radiation Survey and Site Investigation Manual) Class 2 Survey Approach was applied to the laboratory.

Table 1. Radionuclide Contaminant of Concern

Radionuclide	Half-life	Tenth Half-life	Principal Radiation
Co-57	271.8 days	7.5 years	Electron Capture (122 keV,136keV)

2.0 BACKGROUND

The use of the unsealed radionuclide Co-57 had been previously authorized in the laboratory R-430 under the UMSL US Nuclear Regulatory Commission (NRC) radioactive materials license in the recent past.

In October of 2009, the current UMSL RSO requested that a survey be performed to verify that no residual licensed radioactive material in excess of the screening limits provided in Table 2 are detected in laboratory R-430.

Laboratory R-430

Laboratory R-430 is located in the Research Building and is approximately 7 m^2. The room is approximately 12' X 6'. The laboratory is a research room with cabinets on both sides. There is a fume hood as well as a sink in the room. A history of usage is attached in Appendix A.

3.0 SUMMARY OF SURVEY APPROACH

The NRC pre-established screening criteria for license termination will be used for the purpose of removing the laboratory from the UMSL NRC License. One of the acceptable screening tools described in NUREG 1727, Appendix C, Section 2.3.3 was used for a screening analysis. The "Screening Values of Common Radionuclides for Building-Surface Contamination Levels," as defined in NUREG 5512 Volume 3, lists "Decommissioning and Demolition (D&D) Screening Values." The screening level Derived Concentration Guideline Level (DCGL) specified represented the 90th percentile of the output dose distribution equivalent to 25 mrem/yr for Co-57. The NRC staff acknowledged that there are several areas in which modeling used to develop screening level DCGL was overly conservative. One such area is in the selection of resuspension factors. Consequently, NRC issued guidance in "*Re-Evaluation of the Indoor Resuspension Factor for the Screening Analysis of the Building Occupancy Scenario for NRC's License Termination Rule - Draft Report*" (NUREG-1720) which recommends a resuspension factor of 1 x 10^{-6} m^{-1}. SAIC recalculated Co-57 screening level DCGL using D&D Version 2.1 with the only change being the modification of the value of the resuspension factor to the recommended

value of 1 x 10^{-6} m^{-1}. Using a 95 percent confidence level, this change resulted in derivation of the screening level DCGL as specified in Table 2.

Table 2. Acceptable Screening Level for Unconditional Release

Radionuclide	Symbol	Acceptable Screening Level DCGL (dpm/100 cm^2)
Cobalt-57	Co-57	2.3E+05

A SAIC health physics technician (HPT) set-up, tested, and performed quality control checks on radiological instrumentation using an UMSL radioactive check sources in the S-44 instrument calibration lab. Background measurements were taken in an adjacent laboratory with identical contents. The UMSL Liquid Scintillation Counter was set up by the UMSL RSO to detect the Co-57 gamma energy of 122 keV and 136 keV.

After arriving at the UMSL campus, a SAIC health physics technician (HPT) obtained a Cesium-137 (Cs-137) check source from the UMSL RSO and used that check source to verify the response of the survey instrument to Cs-137. The Cs-137 was used as a check source for initial check due to the energy of the source and the energy response curve for the instrumentation compared to the response of the instrument to Co-57. Refer to Appendix B for the energy response curve for the Ludlum 44-10.

The laboratory was surveyed in accordance with guidance from MARSSIM. A background reference area was selected to use in a preliminary MARSSIM survey. The preliminary MARSSIM survey of the background reference area resulted in a total number of 8 systematic samples for each class 2 area. This number was increased to 10 to ensure compliance with MARSSIM (SAIC 2008). For laboratory R-430, a MARSSIM Class 2 grid was placed over the area. Each systematic sample had a static measurement as well as a removable (e.g., "smear"). The static counts were able to detect the presence of Co-57. Smear samples were taken at each location to detect removable contamination. The smear samples were collected by the SAIC HPT, and then counted on a UMSL liquid scintillation counter by the RSO. The efficiency of the UMSL liquid scintillation counter was 71% for Co-57. This efficiency was used to calculate the removable activity of Co-57.

Laboratory R-430 was scanned with a Ludlum 44-10 NaI Detector. Based on the energy response curve of the instrument compared to the COC, it was determined that the instrumentation selected was adequate to detect Co-57. Refer to Appendix C for instrument information. The efficiency of the NaI Detector for Co-57 is approximately 78% (PKRD 1995)

Laboratory R-430

Ventilation screens and ducting were not within the scope of the survey effort. Horizontal and vertical surfaces above 6 feet in height were not within the scope of the survey. A 100% scan was performed on accessible areas on the floor and walls in the laboratory. Surveying concentrated on areas most likely to have contamination present.

The area was cleaned of all debris. The floor and walls were surveyed to a height of six feet. A 100% scan was performed in the areas most likely to have contamination present. The areas surveyed included all of the cabinets, sink, hood, floor, walls and horizontal surfaces.

Survey results were recorded on standard SAIC forms as provided in health physics procedure HP-11, "Radiological Monitoring". The survey forms included a sketch of the laboratory and indicated the areas surveyed.

4.0 SURVEY RESULTS

Survey forms, associated survey maps, and instrument minimum detectable concentration calculations are provided in Appendix C to this report.

All scans of accessible areas were below the screening limit. The scan of the accessible surfaces resulted in zero areas of elevated activity. Therefore, there were no biased measurements collected.

A total of 10 smear samples were collected from laboratory R-430 systematic locations. Due to the screening level for Co-57 in Table 2, it was assumed that the fraction of removable surface contamination is equal to 0.1. If the removable Co-57 results are multiplied by 10, the results are still below the acceptable screening level for Co-57 listed in Table 2.

5.0 CONCLUSIONS AND RECOMMENDATIONS

No unusual readings were obtained during scanning surveys. All removable contamination (smear) survey results were below the screening level of Co-57. Based on the area surveyed there is no contamination of Co-57 above the screening level DCGL listed in Table 2. The UMSL RSO may use this information to remove Laboratory R-430 from the NRC License (via license amendment request).

6.0 REFERENCES

NRC 2006 U.S. NRC Radioactive Materials License for UMSL, No. 24-00513-38, Amendment No. 25, dated February 10, 2009.

NRC 2000. *Consolidated NMSS Decommissioning Guidance*, NUREG-1727, US Nuclear Regulatory Commission, Volume 2, Final, September.

NRC 2000. *Multiagency Radiation Survey and Site Investigation Manual, (MARSSIM),* NUREG-1575, EPA 402-R-97-016, Revision 1, August.

NRC 2002. *Re-Evaluation of the Indoor Resuspension Factor for the Screening Analysis of the Building Occupancy Scenario for NRC's License Termination Rule-Draft Report,* NUREG-1720, US Nuclear Regulatory Commission, June.

NRC 1999. Residual Radioactive Contamination from Decommissioning. Parameter Analysis, NUREG-5512, US Nuclear Regulatory Commision, Volume 3, Final, October.

PKRD 1995. *Tricarb LS Analizers Model 2100 TR, 2300 TR,* Packard Information Inc., 1995, Chapter 3.

SAIC 2008. *Final Status Survey Report of Laboratories R-411, R-412, R-417, R-433, R-439, and S-466,* Science Applications International Corporation, July.

Appendix A

History of Radioactive Materials Use Areas

Environmental Health and Safety

One University Boulevard
Saint Louis, MO 63121-4499
Telephone: 314-516-6363
314-516-6362

Date: October 21, 2009

From: Steven Struck, UMSL RSO

Subject: History of Radioactive Materials Use in Lab R430

Memo NO.: RSM 09-01

On January 14, 2004, the University of Missouri- St. Louis sent a letter to the Nuclear Regulatory Commission requesting an amendment to its license, including the addition of laboratories R423 and R430 of the Research Building for the use and storage of radioactive materials by Dr. Colin MacDiarmid. After receiving NRC approval for this amendment Dr. MacDiarmid received 1mCi of cobalt 57 on May 9, 2006. The cobalt 57 was stored and used only in lab R430, no material was possessed in lab R423. On July 28, 2009, Dr. MacDiarmid informed the Radiation Safety Officer that he was leaving the University and would no longer need to use or store Co-57 in lab R430. On July 31, 2009, all radioactive materials were removed from R430 and placed in the radioactive waste storage facility.
Prior to the NRC authorization for the storage and use of radioactive materials in laboratory R430 the room was used as a common storage and utility room by the Department of Biology. No radioactive materials were stored or used in R430 prior to Dr. MacDiarmid's use.

Steven D. Struck
UMSL Radiation Safety Officer
516-6362

Appendix B

Radiological Survey Forms, Maps, and Calculations

SAIC RADIOLOGICAL SURVEY REPORT

SURVEY LOCATION: UMSL Lab R-430	HSWP: NA	Page 1 of 1
PURPOSE OF SURVEY: Smear Results for R-430	DATE: 10/4/09	TIME: 1145

Instrument Type(s):	Detector Area (cm²)	Serial Number: meter	Serial Number: detector	Cal. Due Date meter	Cal. Due Date detector	Background: (CPM) Alpha (α)	Background: (CPM) Beta (βγ)	Efficiency: (%) Alpha (α)	Efficiency: (%) Beta (βγ)
☒ Ludlum 2929 / 43-10-1 ___	100	UMSL	Liquid	Scintillation	Counter	NA	46	NA	71.0%
☐ Ludlum 2360 / 43-89 ___	125								
☐ Ludlum 2221 / 44-9 ___	15.5								
☐ Micro - R ___	N/A								

Contamination Limits: (dpm/100cm²)	Removable α _____	Removable βγ 230000	Total α _____	Total βγ _____
Instrument MDA: (dpm/100cm²)	α MDA _____	βγ MDA NA	α MDA _____	βγ MDA _____

Sample No.	Description / Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm² β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm² β Total	uR/hr
1	Floor by entrance				44	0	0							
2	Floor under table				50	4	6							
3	Floor by hood				44	0	0							
4	Floor by table				40	0	0							
5	Wall		N/A		56	10	14				N/A			
6	Wall				48	2	3							
7	Wall by hood				45	0	0							
8	Wall by hood				45	0	0							
9	Wall by shelf				40	0	0							
10	Wall by door				53	7	10							

REMARKS: UMSL Liquid Scintillation Counter used to count smears. See attached print out of sample results and sample locations.

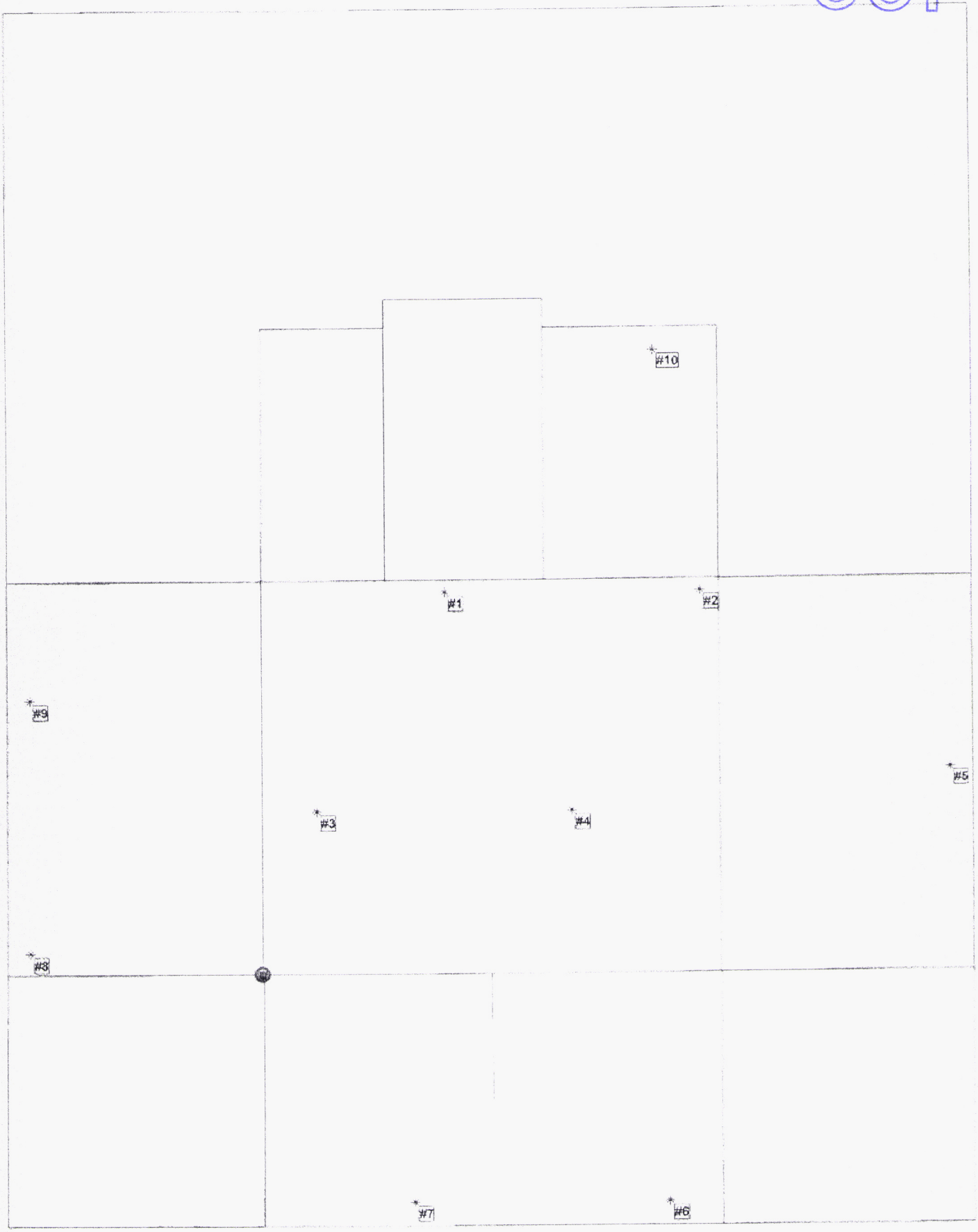
TECHNICIAN(S) SIGNATURE/ DATE: [signature] / 10/4/09 _____ / _____

REVIEWER SIGNATURE/ DATE: [signature] / 10/4/09 _____ / _____

Protocol #: 5 Name:Co-57 14-Oct-2009 11:45
Region A: LL-UL= 0.0-120. Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Region B: LL-UL= 0.0-136. Lcr= 0 Bkg= 0.00 %2 Sigma=0.00
Region C: LL-UL= 0.0-2000 Lcr= Bkg= 0.00 %2 Sigma=0.00
Time = 1.00 QIP = SIS

S#	TIME	CPMA	CPMA	CPMC	SIS	FLAG
1	1.00	36.00	36.00	46.00	55.016	
2	1.00	28.00	28.00	44.00	56.452	
3	1.00	30.00	30.00	50.00	77.842	
4	1.00	29.00	29.00	44.00	76.929	
5	1.00	23.00	23.00	40.00	37.124	
6	1.00	36.00	36.00	56.00	70.620	
7	1.00	27.00	27.00	48.00	130.95	
8	1.00	24.00	24.00	45.00	56.689	
9	1.00	26.00	26.00	45.00	119.70	
10	1.00	24.00	24.00	40.00	84.864	
11	1.00	33.00	33.00	53.00	42.897	

Background



Area: Area 1

X Coord	Y Coord	Z Coord	Label	Value	Type	Historical	Surface	LX	LY
61	8	0	#3	0	Systematic		Floor	1	4
67	8	0	#4	0	Systematic		Floor	7	4
64	13	0	#1	0	Systematic		Floor	4	9
70	13	0	#2	0	Systematic		Floor	10	9
63	4	5	#7	0	Systematic		Wall 4	7	5
70	4	5	#6	0	Systematic		Wall 4	1	5
71	9	5	#5	0	Systematic		Wall 3	5	5
69	13	5	#10	0	Systematic		Wall 2	9	5
60	10	5	#9	0	Systematic		Wall 1	7	5
60	4	5	#8	0	Systematic		Wall 1	1	5

SAIC - MINIMUM DETECTABLE CONCENTRATION (MDC) WORKSHEET [4]

Survey Number:	UMSL R-430	Date:	11/9/2009	Inst. Letter:	44-10

Alpha

$$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)\left(\frac{Probe\ Area}{100}\right)}$$

Alpha *Static MDC* =

#DIV/0!

(dpm/100cm^2)

$$P(n \geq 1) = 1 - e^{\frac{(-G)(\varepsilon_i)(d)}{(60)(v)}}$$

Alpha Scan Probability =

#DIV/0!

(should be ≥ 0.85)

Beta/Gamma

$$Static\ MDC = \frac{3 + 3.29\sqrt{(R_b)(t_g)\left(1+\frac{t_g}{t_b}\right)}}{(t_g)(\varepsilon_i)\left(\frac{Probe\ Area}{100}\right)}$$

Gamma *Static MDC* =

479

(dpm/100cm^2)

$$i = \frac{w}{s} \qquad MDCR = d'\sqrt{b*\left(\frac{i}{60}\right)} * \left(\frac{60}{i}\right)$$

$$MDC = \frac{MDCR}{(\sqrt{p})(\varepsilon_i)\left(\frac{Probe\ Area}{100}\right)}$$

i = 0.7

MDCR = 1040

Gamma Scan *MDC* =

1,333

(dpm/100cm^2)

Alpha Information		
Background count rate (R_b)		(cpm)
Background count time (t_b)		(minutes)
Sample count time (t_g)		(minutes)
Instrument efficiency (e_i)		(cpm/dpm)
-----	-----	-----
Probe area (PA)	125	(cm^2)
Width of the probe face (d) or (w)	7.6	(cm)
Scan speed (v) or (s)		(cm/sec)
-----	-----	-----
-----	-----	-----
Investigation level (G)	23000	(dpm/100cm^2)

Gamma Information		
Background count rate (R_b) or (b)	6349	(cpm)
Background count time (t_b)	1	(minutes)
Sample count time (t_g)	1	(minutes)
Instrument efficiency (e_i)	0.78	(cpm/dpm)
-----	-----	-----
Probe area (PA)	100	(cm^2)
Width of the probe face (w) or (d)	5.1	(cm)
Scan speed (s) or (v)	7.6	(cm/sec)
Index of detectability (d')	1.38	-----
Surveyor efficiency (p)	1	-----
-----	-----	-----

1 in/sec = 2.5 cm/sec 2 in/sec = 5.1 cm/sec 3 in/sec = 7.6 cm/sec : The width of the probe face for a Ludlum 44-10 is 5.1 cm

Appendix C

Survey Instrument Calibration and Quality Control Information

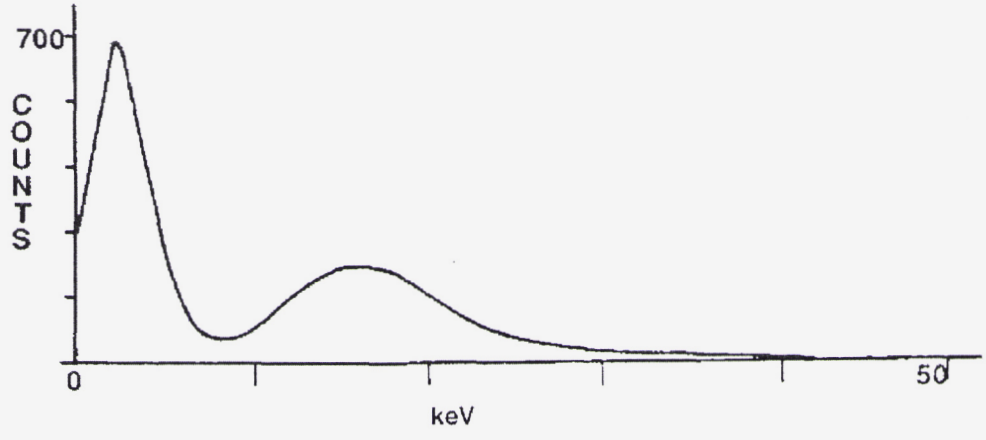


Figure 3–10. Spectrum Plot of ^{125}I Using LSC.

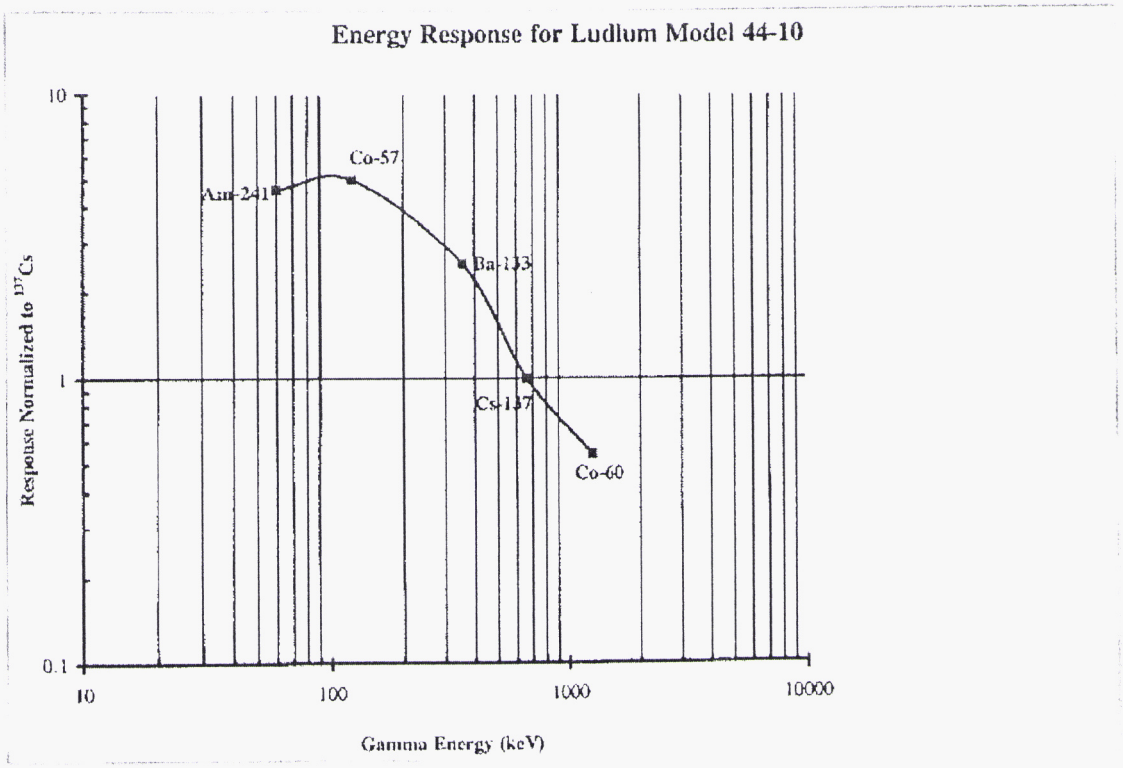
Spectrum Analysis can be successfully applied to quantify and qualify gamma radionuclides. Modern liquid scintillation analysis (LSA) techniques such as Spectrum Unfolding and Transformed Spectral Index (tSIE) calculations allow fast counting of gamma radionuclides, even for multilabel experiments involving beta and gamma emitters. Gamma–emitting radionuclides can often be counted with equal or higher counting efficiencies by a liquid scintillation analyzer than with a gamma counter. Table 3–1 compares the approximate counting efficiencies for a number of frequently used radionuclides.

Table 3–1 Approximate counting efficiencies for gamma radionuclides in a liquid scintillation analyzer (LSA) and a gamma counter.

Table 3–1. Approximate Counting Efficiencies.

Radionuclide	LSA Efficiency*	Gamma Counter Efficiency**
^{22}Na	96%	56%
^{51}Cr	34%	4 to 5%
^{57}Co	71%	78%
^{59}Fe	95%	25%
^{125}I	78%	78%

*Samples were counted in Packard Insta–Gel® cocktail.
**Measured with a 2–inch NaI (Tl) detector.


Energy Response for Ludlum Model 44-10
Response Normalized to ^{137}Cs
10
1
0.1
Am-241
Co-57
Ba-133
Cs-137
Co-60
10
100
1000
10000
Gamma Energy (keV)

2221 Scaler/Ratemeter Calibration Report

Date Calibrated: 05/05/2009 11:52:27 AM

Technician: B. French Customer: SAIC Order Number SAIC20090505-007

Temperature (F): 73 Humidity (%): 30 Altitude (asl): 660 Barametric Pressure ("Hg): 29.15

Repair Instrument

Serial Number: 149971 Manufacturer: Ludlum Model: 2221 Meterface: 202-159

Received: Within 10%

Last Calibrated: 4/29/2008 Calibration Interval: 1yr. Next Calibration Due: 5/5/2010

- [x] Mechanical OK
- [x] Meter Zeroed
- [x] Battery Ck. - Min. Volt.
- [x] Input Sens. Linearity
- [x] F/S Resp. OK
- [x] Reset OK
- [x] Geotropism
- [x] Window Operation
- [x] Audio OK
- [ ] Alarm Setting OK
- [ ] Background Subtract
- [x] Voltage Set 1300 V at 10 mV Det. Op. 1300 V at 10 mV Threshold Dial ratio 100 = 10
- [x] HV readout **Ref. 1** 500 Volts **Inst. 1** 500 Volts **Ref. 2** 2000 Volts **Inst. 2** 2000 Volts
- [x] Calibrated in accordance with ANSI N323A-1997 and the manufacturers procedure

CTV* Analog Reading

Multiplier	Ref. Cal Poin	Inst. As Found	Inst. As Left
X 1000	400 K cpm	400 K cpm	400 K cpm
X 1000	100 K cpm	100 K cpm	100 K cpm
X 100	40 K cpm	40 K cpm	40 K cpm
X 100	10 K cpm	10 K cpm	10 K cpm
X 10	4 K cpm	4 K cpm	4 K cpm
X 10	1 K cpm	1 K cpm	1 K cpm
X 1	400 cpm	400 cpm	400 cpm
X 1	100 cpm	100 cpm	100 cpm

- [x] Multimeter ser. # 93470436
- [ ] Oscilloscope ser. #
- [x] m500 ser. # 201462
- [ ] Other ser. #

CTV* Digital

Reference Pt.	Inst. as Found	Inst. as Left
400 K cpm	40010 (0) cpm	39995 (0) cpm
40 K cpm	3997 (0) cpm	4000 (0) cpm
4 K cpm	400 (0) cpm	400 (0) cpm
400 cpm	40 (0) cpm	40 (0) cpm
40 cpm	4 (0) cpm	4 (0) cpm

CTV* Log Scale

Reference Pt.	Inst. as Found	Inst. as Left
500 K cpm	450 K cpm	450 K cpm
50 K cpm	50 K cpm	50 K cpm
5 K cpm	5 K cpm	5 K cpm
500 cpm	500 cpm	500 cpm
50 cpm	50 cpm	50 cpm

*** Conventionally True Value** **** Uncertainty within +/- 10%** **All range(s) calibrated electronically**

Comments

Performed By: _____ Date: 5/5/09

Reviewed By: _____ Date: 5/6/09

44-10 Gamma Calibration Report

Date Calibrate 05/05/2009 Time: 12:03:56 PM Customer: SAIC

Technician: B. French Order Number: SAIC20090505-008

Repair Instrument

Serial Number 155593

Manufacture Ludlum Model: 44-10 Last Calibrated: 10/25/2006

Reason for recalibration: Due for Calibration

Calibration Instrument

Serial Number: 149971 Inst. Type: 2221 Calibration Due: 5/5/2010

Calibration Sources

Gamma Source ID: SAIC-0051

Isotope: Cs-137 Current Activity: 6.66 uCi Assay Date: 12/11/1998

Gamma as Found

Background 1 minute counts	Source 1 minute counts
NA	NA

Percent Efficiency: NA

Gamma as Left

Background 1 min. counts	Source 1 min. counts
6679	110762

Percent Efficiency: NA

Physical Condition: Sat High Voltage: 1300 Volts

Last Calibrated Efficiency: NA Gamma Threshold: 10 mv Next Calibration Due: 5/5/2010

No efficiency calculated, use for qualitative data only

Performed By: _____ Date: 5/5/09

Reviewed By: _____ Date: 5/7/09

PLATEAU CALIBRATION

Model #: 44-10 Source I.D.: SAIC-0051

Serial #: 155573 Attach. N/A

Calibration Points (Volts)	Background Counts	Source Counts
300		
350		
400		
450		
500		
550		
600		
650		
700		
750		
800		
850	4480	95582
900	5443	101040
950	6061	103347
1000	6058	105238
1050	6271	107823
1100	6578	108434
1150	6603	109648
1200	6554	109573
1250	6779	110127
1300	6879	110762
1350	6689	110470
1400	6864	111769
1450	6914	113269
1500	7557	121026

Determined HV Settings: 1300 V Determined Threshold Setting: 20mV

Reviewed By: [signature] Date: 5/4/09

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An Employee-Owned Company
500 Northwest Plaza
Suite 1250
St. Ann, MO 63074
(314) 209-2950 Phone

FROM: University of Missouri – St. Louis
1 University BLVD
St. Louis MO 63121

TO: MATERIALS LICENSING BRANCH
U.S. NUCLEAR REGULATORY COMMISION
2443 WARRENVILLE ROAD SUITE 210
LISLE, IL 60532-4352