

**General Narrative  
for  
BRC  
Tuscani GW  
SDG: 244697**

**January 18, 2010**

**Laboratory Identification:**

GEL Laboratories LLC  
2040 Savage Road  
Charleston, South Carolina 29407  
(843) 556-8171

**Summary**

**Sample receipt**

The sample(s) arrived at GEL Laboratories, LLC, Charleston, South Carolina on January 14, 2010, for analysis. The samples were delivered with proper chain of custody documentation and signatures. All sample containers arrived without any visible signs of tampering or breakage. There are no additional comments concerning sample receipt.

**Sample Identification**

The laboratory received the following samples:

<b><u>Laboratory Identification</u></b>	<b><u>Sample Description</u></b>
244697001	DBMW-13
244697002	MW-WS1-14

**Case Narrative**

Sample analyses were conducted using methodology as outlined in GEL Laboratories, LLC (GEL) Standard Operating Procedures. Any technical or administrative problems during analysis, data review, and reduction are contained in the analytical case narratives in the enclosed data package.

**Data Package**

The enclosed data package contains the following sections: General Narrative, Chain of Custody and Supporting Documentation, and data from the following fractions: Radiochemistry. This package, to the best of my knowledge, is in compliance with technical and administrative requirements.

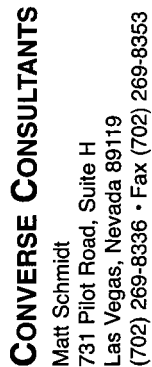
GEL Laboratories, LLC appreciates this opportunity to provide you with analytical results and trusts that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate in contacting me at (843) 556-8171.



Ann Skradski

Project Manager

# Chain of Custody

CHAIN  
244697

**GEL LABORATORIES, LLC**  
Contact: Amanda Raslo  
2040 Savage Road  
Charleston, SC 29407  
(843) 556-8171

# CHAIN OF CUSTODY FORM

[illegible]

**Note:** By relinquishing samples to Converse Consultants, client agrees to pay for the services requested on this chain of custody form and any additional analysis performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

## SAMPLE RECEIPT &amp; REVIEW FORM

Client: BromSDG/ARCOC/Work Order: 244697Received By: RM6Date Received: 1/14/10

Suspected Hazard Information	Yes	No	*If Counts > x2 area background on samples not marked "radioactive", contact the Radiation Safety Group of further investigation.
COC/Samples marked as radioactive?		<input checked="" type="checkbox"/>	Maximum Counts Observed*: <u>30cpm</u>
Classified Radioactive II or III by RSO?		<input checked="" type="checkbox"/>	
COC/Samples marked containing PCBs?		<input checked="" type="checkbox"/>	
Shipped as a DOT Hazardous?		<input checked="" type="checkbox"/>	Hazard Class Shipped: UN#:
Samples identified as Foreign Soil?		<input checked="" type="checkbox"/>	

Sample Receipt Criteria		Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	<input checked="" type="checkbox"/>			Circle Applicable: seals broken    damaged container    leaking container    other (describe)
2	Samples requiring cold preservation within $0 \leq 6$ deg. C?	<input checked="" type="checkbox"/>			Preservation Method: <u>ice bags</u> blue ice    dry ice    none    other (describe) <u>3°C</u>
3	Chain of custody documents included with shipment?	<input checked="" type="checkbox"/>			
4	Sample containers intact and sealed?	<input checked="" type="checkbox"/>			Circle Applicable: seals broken    damaged container    leaking container    other (describe)
5	Samples requiring chemical preservation at proper pH?		<input checked="" type="checkbox"/>		Sample ID's, containers affected and observed pH: If Preservation added, Lot#:
6	VOA vials free of headspace (defined as < 6mm bubble)?	<input checked="" type="checkbox"/>			Sample ID's and containers affected:
7	Are Encore containers present?			<input checked="" type="checkbox"/>	(If yes, immediately deliver to Volatiles laboratory)
8	Samples received within holding time?	<input checked="" type="checkbox"/>			Id's and tests affected:
9	Sample ID's on COC match ID's on bottles?	<input checked="" type="checkbox"/>			Sample ID's and containers affected:
10	Date & time on COC match date & time on bottles?	<input checked="" type="checkbox"/>			Sample ID's affected:
11	Number of containers received match number indicated on COC?	<input checked="" type="checkbox"/>			Sample ID's affected:
12	COC form is properly signed in relinquished/received sections?	<input checked="" type="checkbox"/>			

Comments:

Fax: 8659 4851 5233PM (or PMA) review: Initials RM6Date: 1/14/10

# **Laboratory Certifications**

**List of current GEL Certifications as of 18 January 2010**

<b>State</b>	<b>Certification</b>
Arizona	AZ0668
Arkansas	88-0651
CLIA	42D0904046
California – NELAP	01151CA
Colorado	GEL
Connecticut	PH-0169
Dept. of Navy	NFESC 413
EPA Region 5	WG-15J
Florida – NELAP	E87156
Georgia	E87156 (FL/NELAP)
Georgia DW	967
Hawaii	N/A
ISO 17025	2567.01
Idaho	SC00012
Illinois – NELAP	200029
Indiana	C-SC-01
Kansas – NELAP	E-10332
Kentucky	90129
Louisiana – NELAP	03046
Maryland	270
Massachusetts	M-SC012
Nevada	SC00012
New Jersey – NELAP	SC002
New Mexico	FL NELAP E87156
New York – NELAP	11501
North Carolina	233
North Carolina DW	45709
Oklahoma	9904
Pennsylvania – NELAP	68-00485
South Carolina	10120001/10120002
Tennessee	TN 02934
Texas – NELAP	T104704235-07B-TX
U.S. Dept. of Agriculture	S-52597
Utah – NELAP	GEL
Vermont	VT87156
Virginia	00151
Washington	C1641

# RADIOLOGICAL ANALYSIS

**Radiochemistry Case Narrative  
BRC (BRCM)  
SDG 244697**

**Method/Analysis Information**

**Product:** Liquid Scint Rn222, Liquid

Analytical Method: SM 7500 Rn B

Analytical Batch Number: 941700

<b>Sample ID</b>	<b>Client ID</b>
244697001	DBMW-13
244697002	MW-WS1-14
1202015593	Method Blank (MB)
1202015594	244697001(DBMW-13) Sample Duplicate (DUP)
1202015595	244697001(DBMW-13) Matrix Spike (MS)
1202015596	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

**SOP Reference**

Procedure for preparation, analysis and reporting of analytical data are controlled by GEL Laboratories LLC as Standard Operating Procedure (SOP). The data discussed in this narrative has been analyzed in accordance with GL-RAD-A-007 REV# 11.

**Calibration Information:**

**Calibration Information**

All initial and continuing calibration requirements have been met.

**Standards Information**

Standard solution(s) for these analyses are NIST traceable and used before the expiration date(s).

**Sample Geometry**

All counting sources were prepared in the same geometry as the calibration standards.

**Quality Control (QC) Information:**

**Blank Information**

The blank volume is representative of the sample volume in this batch.

**Designated QC**



The following sample was used for QC: 244697001 (DBMW-13).

**QC Information**

All of the QC samples met the required acceptance limits.

**Technical Information:****Holding Time**

All sample procedures for this sample set were performed within the required holding time.

**Sample Re-prep/Re-analysis**

None of the samples in this sample set required reprep or reanalysis.

**Miscellaneous Information:****Data Exception (DER) Documentation**

Data exception reports are generated to document any procedural anomalies that may deviate from referenced SOP or contractual documents. A data exception report (DER) was not generated for this SDG.

**Additional Comments**

Additional comments were not required for this sample set.

**Qualifier information**

Manual qualifiers were not required.

**Certification Statement**

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

**Review Validation:**

GEL requires all analytical data to be verified by a qualified data validator. In addition, all data designated for CLP or CLP-like packaging will receive a third level validation upon completion of the data package.

**The following data validator verified the information presented in this case narrative:**

Reviewer/Date: \_\_\_\_\_



# SAMPLE DATA SUMMARY

## GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

### Certificate of Analysis Report for

BRCM001 BRC

Client SDG: 244697 GEL Work Order: 244697

**The Qualifiers in this report are defined as follows:**

\* A quality control analyte recovery is outside of specified acceptance criteria

\*\* Analyte is a surrogate compound

U Analyte was analyzed for, but not detected above the MDL, MDA, or LOD.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the Certificate of Analysis.

The designation ND, if present, appears in the result column when the analyte concentration is not detected above the detection limit.

This data report has been prepared and reviewed in accordance with GEL Laboratories LLC standard operating procedures. Please direct any questions to your Project Manager, Ann Skradski.

Reviewed by



# GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

## Certificate of Analysis

Company : BRC  
Address : 875 W. Warm Springs Road  
Henderson, Nevada 89011

Report Date: January 18, 2010

Contact: Mr. Ron Sahu  
Project: **Tuscani GW**

Client Sample ID: DBMW-13  
Sample ID: 244697001  
Matrix: Water  
Collect Date: 12-JAN-10 10:20  
Receive Date: 14-JAN-10  
Collector: Client

Project: BRCM00136  
Client ID: BRCM001

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
<b>Rad Liquid Scintillation Analysis</b>											
<i>Liquid Scint Rn222, Liquid "As Received"</i>											
Radon-222		223	+/-58.1	82.3	200	pCi/L		KXK2 01/15/10 0801	941700	1	

### The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SM 7500 Rn B	

# GEL LABORATORIES LLC

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## Certificate of Analysis

Company : BRC  
Address : 875 W. Warm Springs Road  
Henderson, Nevada 89011

Report Date: January 18, 2010

Contact: Mr. Ron Sahu  
Project: **Tuscani GW**

Client Sample ID: MW-WS1-14  
Sample ID: 244697002  
Matrix: Water  
Collect Date: 12-JAN-10 13:00  
Receive Date: 14-JAN-10  
Collector: Client

Project: BRCM00136  
Client ID: BRCM001

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
<b>Rad Liquid Scintillation Analysis</b>											
<i>Liquid Scint Rn222, Liquid "As Received"</i>											
Radon-222		435	+/-66.5	80.8	200	pCi/L		KXK2 01/15/10 0817	941700	1	

### The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SM 7500 Rn B	

# QUALITY CONTROL DATA

# GEL LABORATORIES LLC

2040 Savage Road Charleston, SC 29407 - (843) 556-8171 - www.gel.com

## QC Summary

Report Date: January 18, 2010

Page 1 of 2

BRC

875 W. Warm Springs Road  
Henderson, Nevada

Contact: Mr. Ron Sahu

Workorder: 244697

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
Rad Liquid Scintillation											
Batch	941700										
QC1202015594	244697001	DUP									
Radon-222			223	260	pCi/L	15.5		(0% - 100%)	KXK2	01/15/10	08:49
			+/-58.1	+/-60.2							
QC1202015596	LCS										
Radon-222	10900			11000	pCi/L		102	(75%-125%)		01/18/10	07:31
				+/-278							
QC1202015593	MB										
Radon-222			U	-17.3	pCi/L					01/15/10	08:33
				+/-34.1							
QC1202015595	244697001	MS									
Radon-222	10900		223	11400	pCi/L		103	(75%-125%)		01/18/10	07:15
			+/-58.1	+/-283							

### Notes:

The Qualifiers in this report are defined as follows:

- \*\* Analyte is a surrogate compound
- < Result is less than value reported
- > Result is greater than value reported
- A The TIC is a suspected aldol-condensation product
- B For General Chemistry and Organic analysis the target analyte was detected in the associated blank.
- BD Results are either below the MDC or tracer recovery is low
- C Analyte has been confirmed by GC/MS analysis
- D Results are reported from a diluted aliquot of the sample
- F Estimated Value
- H Analytical holding time was exceeded
- J Value is estimated
- M M if above MDC and less than LLD
- M Matrix Related Failure
- N/A RPD or %Recovery limits do not apply.
- ND Analyte concentration is not detected above the detection limit
- NJ Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- R Sample results are rejected
- U Analyte was analyzed for, but not detected above the MDL, MDA, or LOD.
- UI Gamma Spectroscopy--Uncertain identification
- X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

# GEL LABORATORIES LLC

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## QC Summary

Workorder: 244697

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Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time
Y	QC Samples were not spiked with this compound										
^	RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.										
h	Preparation or preservation holding time was exceeded										

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more.

^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.

\* Indicates that a Quality Control parameter was not within specifications.

For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.



**RAW DATA**

# Radiochemistry Batch Checklist, Rev10

Batch# 941700 Product: Radon 222 Date: 1-18-10

Criteria:	Yes	No	Comments
Sample Solids are less than or equal to 100 mg for GAB.			NA
Samples have been blank corrected (if required)			NA
If activity less 10* MDA/ MDC, error is 150% or less of sample activity. If greater 10* MDA/ MDC, error is 40% or less. If below the MDA/ MDC, error is okay.	✓		
Instrument source check is within limits.	✓		
Instrument bkg check is within limits.	✓		
Method RDL/ LLD has been met.	✓		
If duplicate activities are less 5* MDA/ MDC, then RPD is 100% or less. If greater 5* MDA/ MDC, then RPD 20% or less. If below the MDA/ MDC, the RPD is 0%.	✓		
Or meets the client's required RER acceptance criteria.			
Tracer yield is 15-125% . Carrier yield 25-125%.			NA
Or meets the client's contract acceptance criteria.			
Method blank is less than the RDL/ LLD.	✓		
(If rad samples, < 5% of lowest activity)			
Sample was run within hold time.	✓		
Sample was correctly preserved if required.	✓		
Smears Taken for Radioactive batches.			NA
Method Spike and LCS are within 75-125% or meets the client's contract acceptance criteria.	✓		
No blank spaces on data forms.			
All line outs initialed and dated.	✓		
No transcription errors are apparent.			
Aux data is correct.			NA
Client Special requirements page has been checked.	✓		
Raw Data and/ or spectrum are included and properly statused.	✓		
QC data entered into QC database and batch is in REVW	✓		
Hit notification complete (if necessary)			NA
Batch entered into Case Narrative.	✓		
Batch Data Exception Reports (DER) completed, if applicable.			NA
Batch Data Exception Reports (DER) second reviewed and disposition verified to be completed.			NA
Aliquot Correction completed if required.			NA
Review sample historical results if available (If REMP, results above MDC have been verified by historical results, recount or re-analysis.)	✓		

GEL Laboratories, LLC

RADchecklistrev10, revised 1/13/2010

Primary Review Performed By: [Signature]

Secondary Review Performed By: [Signature] 1/18/10

NSFI  
BRCM 1-28-10

# Radon 222 Que Sheet

01/14/2010

Batch #: 941700

Analyst: KKK2

First Client Due Date: 01/28/2010

Internal Due Date: 01/24/2010

Spike Isotope: Radium-226 Spike Code: 0638-E Expiration Date: 4/9/10 Vol: 0.1

LCS Isotope: Radium-226 LCS Code: 0638-E Expiration Date: 4/9/10 Vol: 0.1

Comments

Prep Date: 1/14/10 Pipet ID: 2970968 Initials: YK Witness: MCB 1-14-10

Sample ID	Client Description	Type	Hazard Code	Min CRDL	Matrix	Client	Collection Date	Label	Sample Mass (g/ml)	LSC Rack #	Time Spike Added
244664001-1	S-0000722604	SAMPLE	2 pCi/mL	2 pCi/mL	DRINKING WATNSFI001		12-JAN-10 12:00 PM	1	16	60-2	
244697001-1	DBMW-13	SAMPLE	2 pCi/mL	2 pCi/mL	WATER	BRCM001	12-JAN-10 10:20 AM	2	10	60-3	
244697002-1	MW-WSI-14	SAMPLE	2 pCi/mL	2 pCi/mL	WATER	BRCM001	12-JAN-10 01:00 PM	3	10	60-4	
1202015593-1	MB for batch 941700	MB	2 pCi/mL	2 pCi/mL	WATER	QC ACCOUNT		4	10	60-5	
1202015594-1	DBMW-13(244697001DUP)	DUP	2 pCi/mL	2 pCi/mL	WATER	QC ACCOUNT	12-JAN-10 10:20 AM	5	10	60-6	
1202015595-1	DBMW-13(244697001MS)	MS	2 pCi/mL	2 pCi/mL	WATER	QC ACCOUNT	12-JAN-10 10:20 AM	6	10	45-2	16:40
1202015596-1	LCS for batch 941700	LCS	2 pCi/mL	2 pCi/mL	WATER	QC ACCOUNT		7	10	45-3	16:40

Bkg Rack #: 60-1 / 45-1

dailes ✓

Comments:

Data Reviewed By: JN 1-18-10

Instrument Used: LS6000 (Red) 7065155, LS6500 (Black) 7069123, LS6500 (Blue) 7067083, LS6500 (Green) 7067404  
Wallac (Yellow) 4040127, Wallac (Pink) 2200082, Purple 7069123, Silver 7060656

GEL Laboratories LLC, Radiochemistry Division

## Radon-222 Liquid

Filename : RN222.XLS  
File type : Excel  
Version # : 1.2.5

Batch : 941700  
Analyst : KXK2  
Prep Date : 1/14/2010

Rn-222 Abundance : 1  
Rn-222 Method Uncertainty : 0.1111  
Geometry : 10ML MINERAL OIL/10ML  
SAMPLE

Spike S/N : 0638-E  
Spike Exp Date : 4/9/2010  
Spike Activity (dpm/ml): 2409.55  
Spike Volume Added: 0.10  
Spike Date/Time: 1/14/2010 16:40

LCS S/N : 0638-E  
LCS Exp Date : 4/9/2010  
LCS Activity (dpm/ml): 2409.55  
LCS Volume Added: 0.10

Procedure Code : LSC22RNL  
Parmname : Radon-222  
Required MDA : 200  
Half-life of Radon-222 : 3.8235  
pCi/L  
days

Pipet, 0.1 ml Stdev : +/- 0.000701 ml  
Pipet, 0.5 ml Stdev : +/- 0.002564 ml

Sample Characteristics				Count raw Data									
Pos.	Sample ID	Sample Aliquot L	Sample Aliquot StDev. L	Sample Date/Time	Rack Position #	Counting Time (min.)	Quench#	Gross cpm	Background cpm	Background Count Time (min.)	Count Start Date/Time	Sample Decay	
1	244664001.1	0.0100	4.2391E-06	1/12/2010 12:00	60-2	15	45.8	16.13	9.20	15	1/15/2010 7:45	0.599	
2	244697001.1	0.0100	4.2391E-06	1/12/2010 10:20	60-3	15	47.4	19.6	9.20	15	1/15/2010 8:01	0.590	
3	244697002.1	0.0100	4.2391E-06	1/12/2010 13:00	60-4	15	50.1	29.87	9.20	15	1/15/2010 8:17	0.601	
4	1202015593.1	0.0100	4.2391E-06	1/14/2010 0:00	60-5	15	43	8.13	9.20	15	1/15/2010 8:33	0.781	
5	1202015594.1	0.0100	4.2391E-06	1/12/2010 10:20	60-6	15	49.8	21.27	9.20	15	1/15/2010 8:49	0.587	
6	1202015595.1	0.0100	4.2391E-06	1/12/2010 10:20	45-2	15	43.8	442.4	9.27	15	1/18/2010 7:15	0.345	
7	1202015596.1	0.0100	4.2391E-06	1/14/2010 0:00	45-3	15	46.2	429.67	9.27	15	1/18/2010 7:31	0.457	

Calibration Data				Backgrounds				Correction Factors			Net Sample Activity for MS pCi/L
Pos.	Counted on	Calibration Date	Calibration Due Date	Detector Efficiency (cpm/dpm)	Detector Efficiency Error (cpm/dpm)	Rack Position #	Count Start Date/Time	Spike Date/Time	Rn-222 Ingrowth	Rn-222 Count Correction	
1	LSCRED	7/28/2009	7/31/2010	3.5654	0.00792	60-1	1/15/2010 7:29	NA	NA	0.599	159.623
2	LSCRED	7/28/2009	7/31/2010	3.5654	0.00792	60-1	1/15/2010 7:29	NA	NA	0.590	
3	LSCRED	7/28/2009	7/31/2010	3.5654	0.00792	60-1	1/15/2010 7:29	NA	NA	0.601	
4	LSCRED	7/28/2009	7/31/2010	3.5654	0.00792	60-1	1/15/2010 7:29	NA	NA	0.781	
5	LSCRED	7/28/2009	7/31/2010	3.5654	0.00792	60-1	1/15/2010 7:29	NA	NA	0.587	
6	LSCRED	7/28/2009	7/31/2010	3.5654	0.00792	45-1	1/18/2010 6:59	1/14/2010 16:40	0.481	0.481	
7	LSCRED	7/28/2009	7/31/2010	3.5654	0.00792	45-1	1/18/2010 6:59	1/14/2010 16:40	0.482	0.482	

- 1 - Results are decay corrected to Sample Date/Time
- 2 - Reference date for Spike Activity (dpm/ml) is the batch Prep Date
- 3 - Spike Nominals are decay corrected to Sample Date/Time

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ID#RN-222

15 JAN 2010 07:36

USER:12 COMMENT:RED

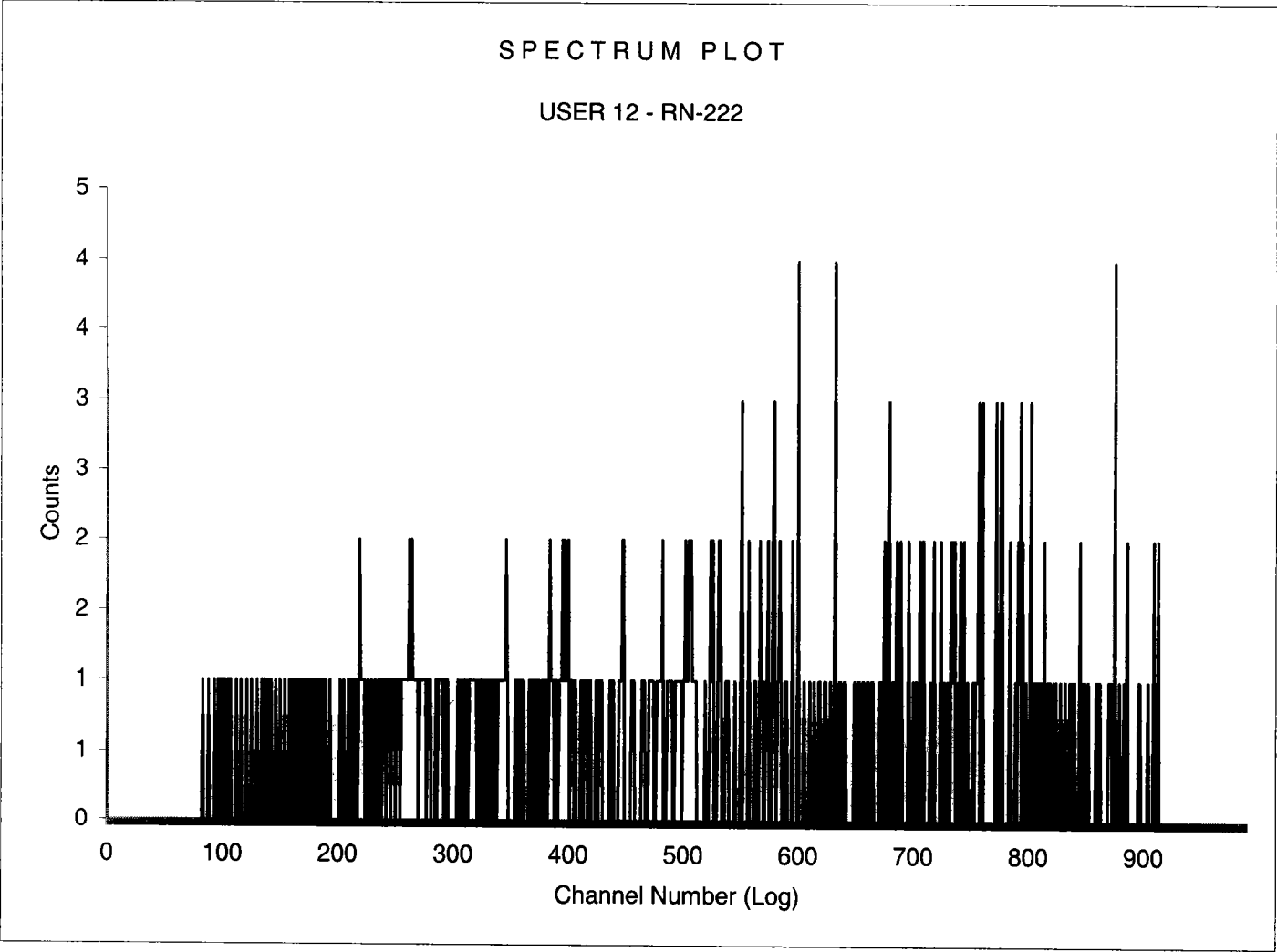
PRESET TIME : 15.00  
 DATA CALC : CPM HH :YES SAMPLE REPEATS: 1 PRINTER :EDIT  
 COUNT BLANK : NO IC# : NO REPLICATES : 1 RS232 :EDIT  
 TWO PHASE : NO AOC : NO CYCLE REPEATS : 1 DISK : OFF  
 SCINTILLATOR: LIQUID LUMEX: NO LOW SAMPLE REJ: 0  
 LOW LEVEL : YES HALF LIFE CORRECTION DATE: none

CHAN: 600.0 - 875.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0  
 CHAN: 0.0 - 900.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	HH	WIND1 RAW CPM	WIND2 RAW CPM	WIND1 CPM %ERROR		WIND2 CPM %ERROR		LUMEX %	ELAPSED TIME
1	60-1	15.00	45.4	9.20	29.27	9.20	17.03	29.27	9.55	0.80	15.62
2	60-2	15.00	45.8	16.13	37.07	16.13	12.86	37.07	8.48	0.56	31.70
3	60-3	15.00	47.4	19.60	41.07	19.60	11.66	41.07	8.06	0.57	47.78
4	60-4	15.00	50.1	29.87	52.73	29.87	9.45	52.73	7.11	0.46	63.87
5	60-5	15.00	43.0	8.13	27.73	8.13	18.11	27.73	9.81	0.92	79.97
6	60-6	15.00	49.8	21.27	45.47	21.27	11.20	45.47	7.66	0.74	96.05

Sample Count Start Time:	15 Jan 2010 07:29:04		
Data Capture Date	15 Jan 2010 07:44:26		
User Filename	S12011560-1A.XLS		
	U12011560-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	1	60-1	15.00
H#, Total Counts:	45.4	445	
Win1: Rn-222 - Start, End, Counts:	600	875	138
Win2: - Start, End, Counts:	0	990	445

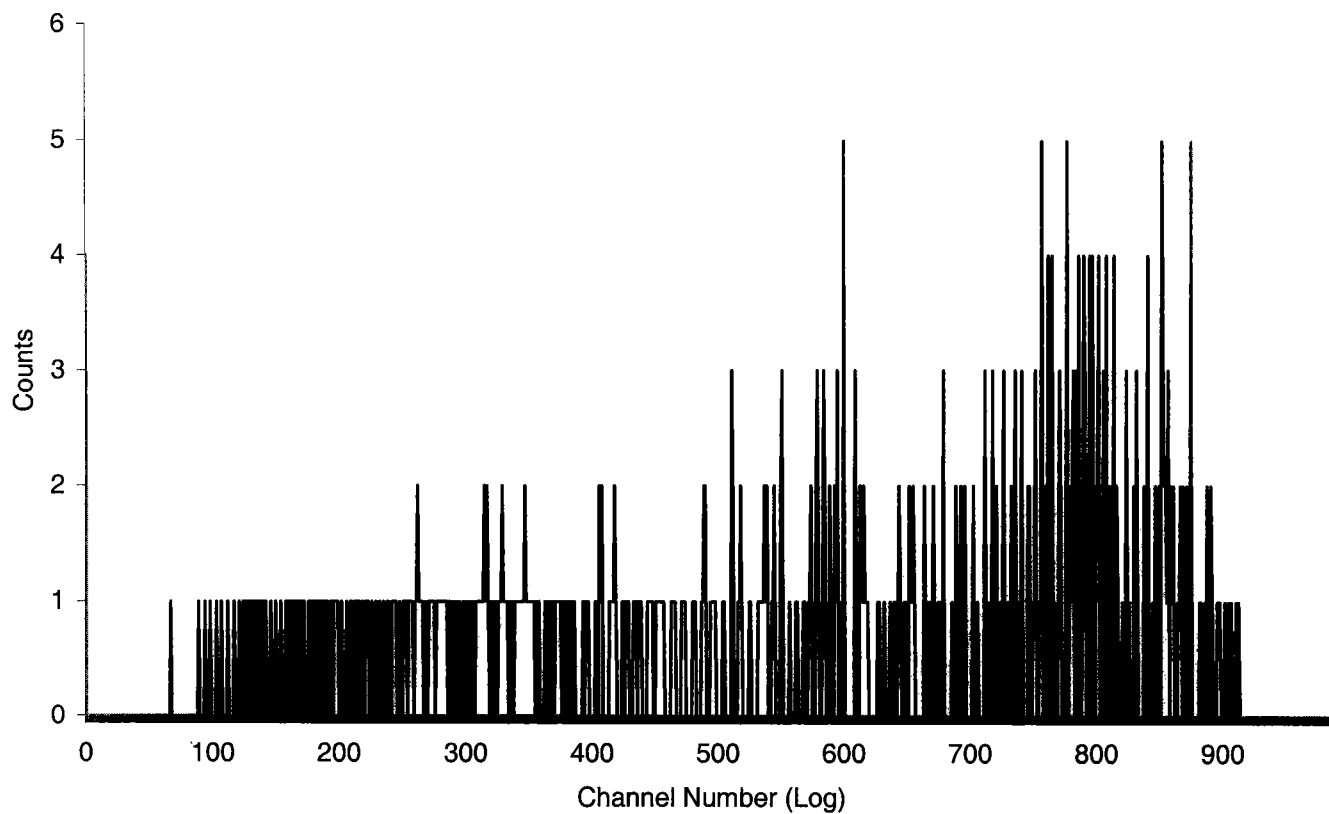




Sample Count Start Time:	15 Jan 2010 07:45:09		
Data Capture Date	15 Jan 2010 08:00:31		
User Filename	S12011560-2A.XLS		
	U12011560-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	2	60-2	15.00
H#, Total Counts:	45.8	561	
Win1: Rn-222 - Start, End, Counts:	600	875	242
Win2: - Start, End, Counts:	0	990	561

# SPECTRUM PLOT

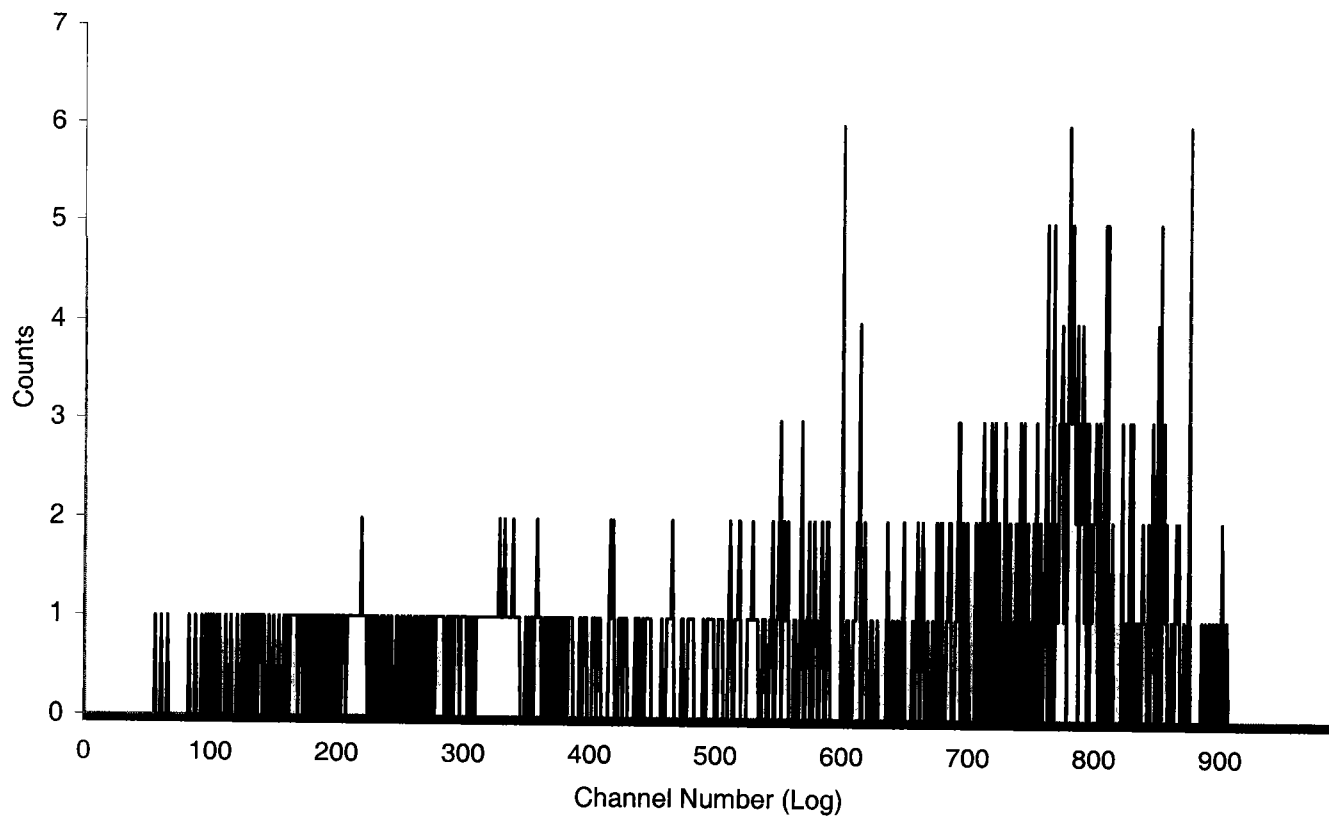
USER 12 - RN-222



Sample Count Start Time:	15 Jan 2010 08:01:14		
Data Capture Date	15 Jan 2010 08:16:36		
User Filename	S12011560-3A.XLS		
	U12011560-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	3	60-3	15.00
H#, Total Counts:	47.4	621	
Win1: Rn-222 - Start, End, Counts:	600	875	294
Win2: - Start, End, Counts:	0	990	621

# SPECTRUM PLOT

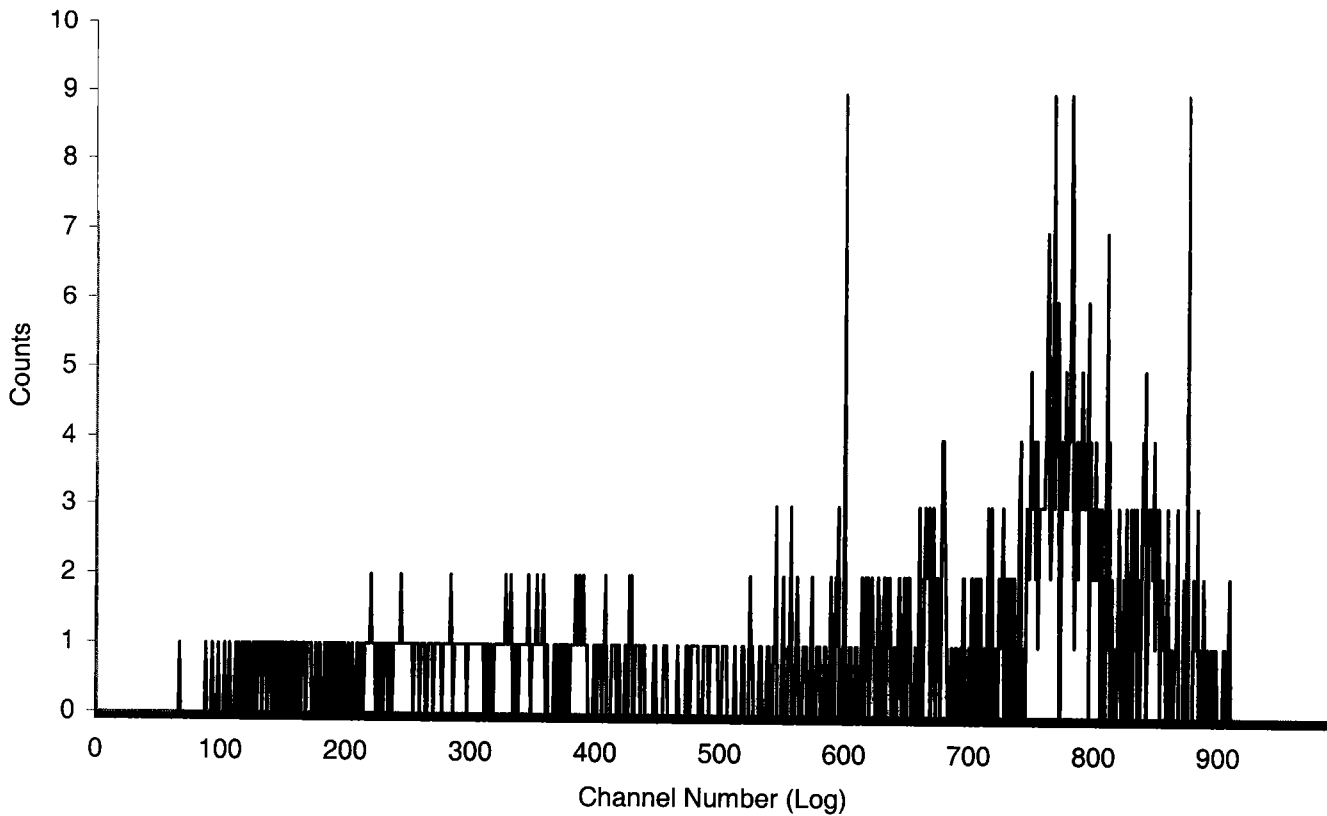
USER 12 - RN-222



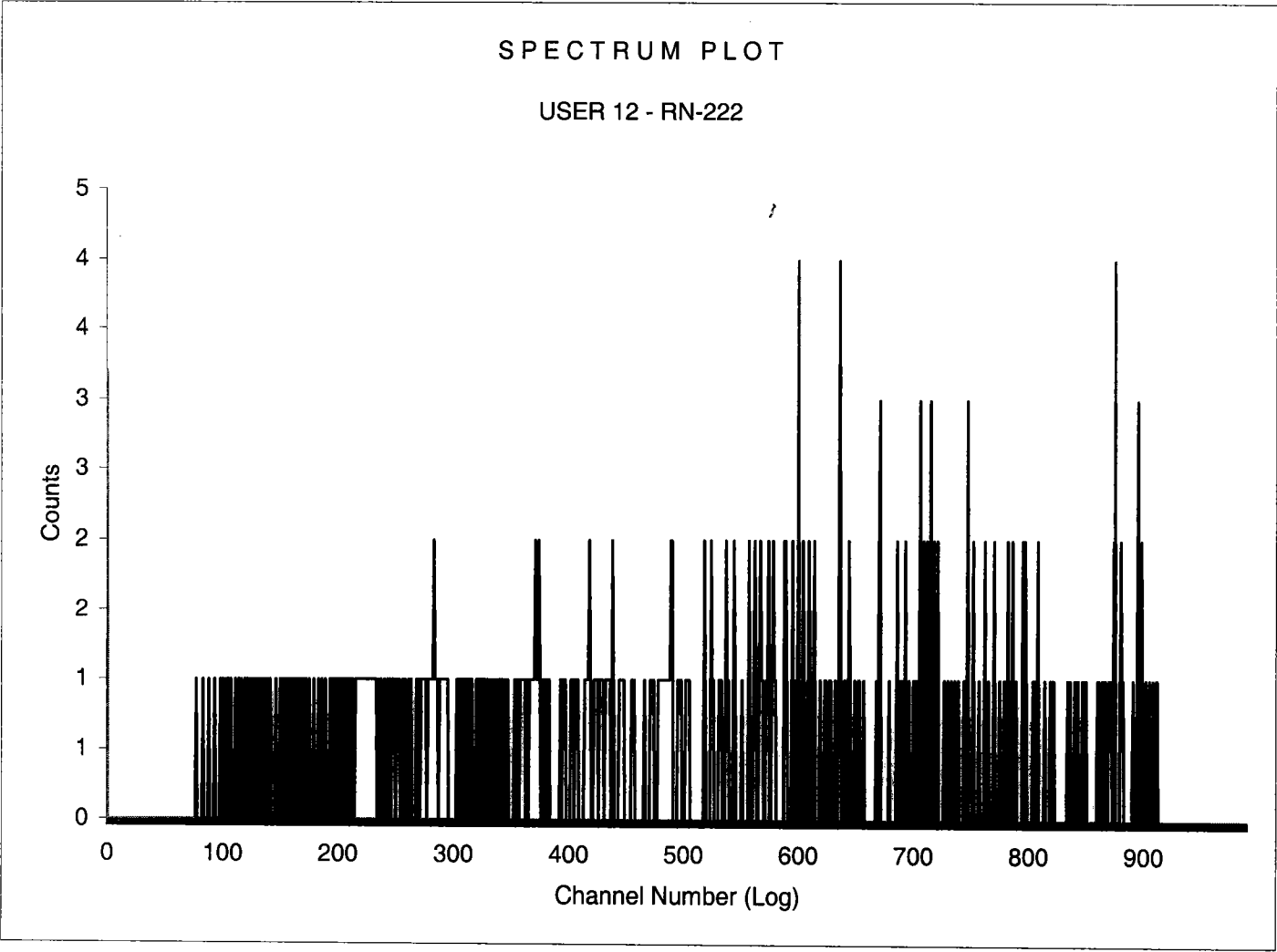
Sample Count Start Time:	15 Jan 2010 08:17:19		
Data Capture Date	15 Jan 2010 08:32:42		
User Filename	S12011560-4A.XLS		
	U12011560-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	4	60-4	15.00
H#, Total Counts:	50.1	796	
Win1: Rn-222 - Start, End, Counts:	600	875	448
Win2: - Start, End, Counts:	0	990	796

# SPECTRUM PLOT

USER 12 - RN-222



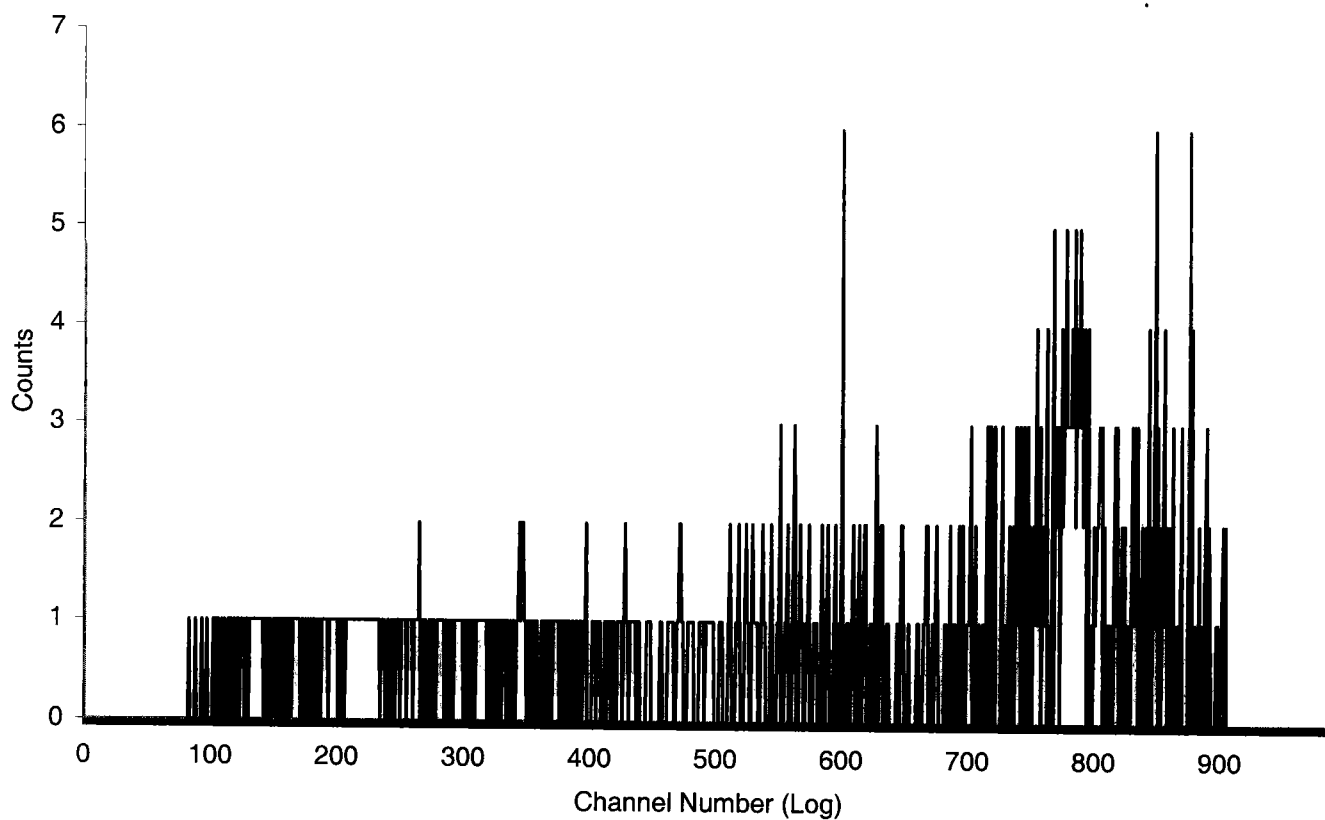
Sample Count Start Time:	15 Jan 2010 08:33:25		
Data Capture Date	15 Jan 2010 08:48:47		
User Filename	S12011560-5A.XLS		
	U12011560-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	5	60-5	15.00
H#, Total Counts:	43.0	421	
Win1: Rn-222 - Start, End, Counts:	600	875	122
Win2: - Start, End, Counts:	0	990	421



Sample Count Start Time:	15 Jan 2010 08:49:30		
Data Capture Date	15 Jan 2010 09:04:53		
User Filename	S12011560-6A.XLS		
	U12011560-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	6	60-6	15.00
H#, Total Counts:	49.8	687	
Win1: Rn-222 - Start, End, Counts:	600	875	319
Win2: - Start, End, Counts:	0	990	687

# SPECTRUM PLOT

USER 12 - RN-222



Instrument Type LS 6000  
 Data Capture Date 18 Jan 2010 06:58:55  
 User Filename C:\SCCAPTURE\RED\USER12\UN011801.BSF

User Number 12  
 User Id RN-222  
 User Comments RED

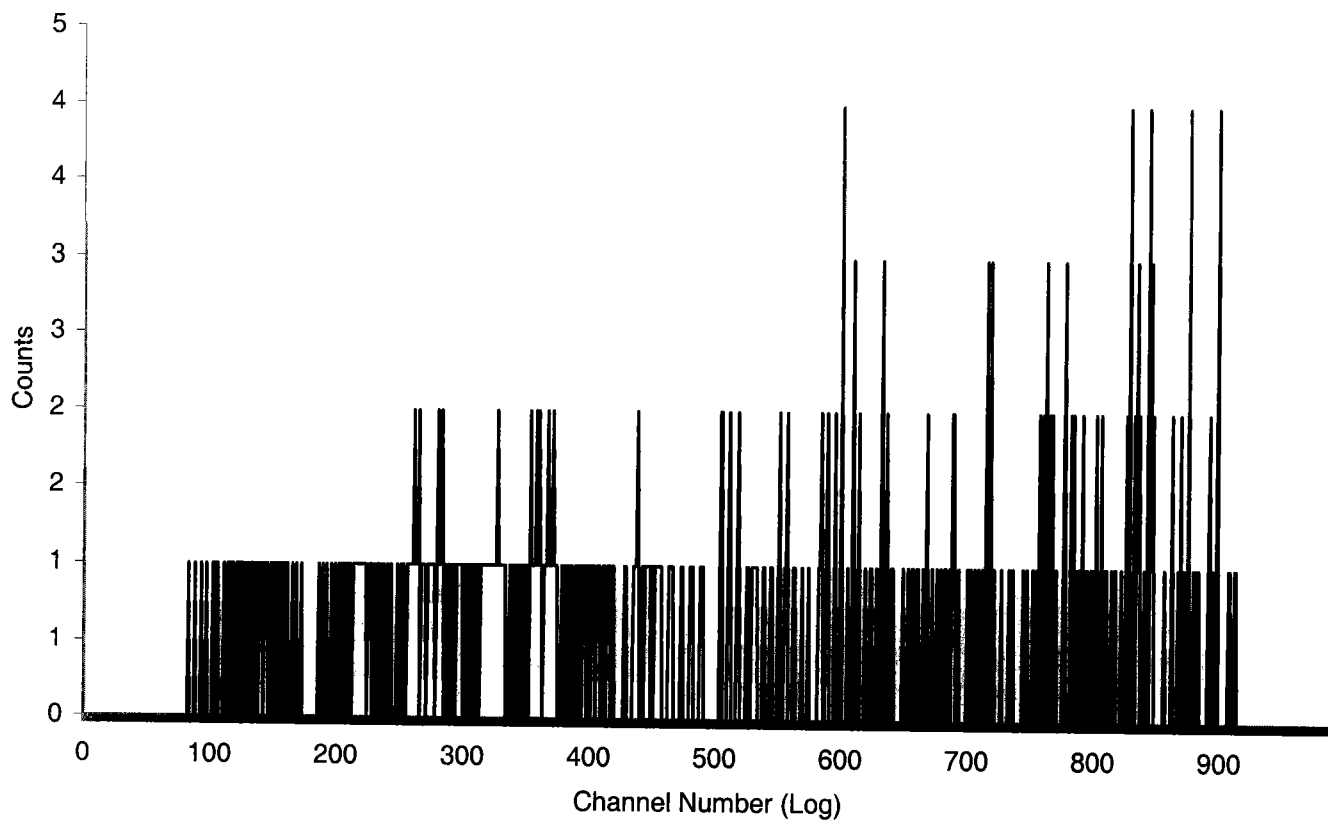
Scintillator Choice: LIQUID

Sam	Rack	Time	H#	Raw CPM1	Raw CPM2	CPM Iso1	%Err1	CPM Iso2	%Err2	LumEx	ElTime
1	45-1	15.00	43.9	9.27	29.00	9.27	16.96	29.00	9.59	0.53	15.72
2	45-2	15.00	43.8	442.40	558.00	442.40	2.46	558.00	2.19	0.03	31.78
3	45-3	15.00	46.2	429.67	531.67	429.67	2.49	531.67	2.24	0.03	47.89

Sample Count Start Time:	18 Jan 2010 06:59:38		
Data Capture Date	18 Jan 2010 07:14:59		
User Filename	S12011845-1A.XLS		
	U12011845-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	1	45-1	15.00
H#, Total Counts:	43.9	439	
Win1: Rn-222 - Start, End, Counts:	600	875	139
Win2: - Start, End, Counts:	0	990	439

# SPECTRUM PLOT

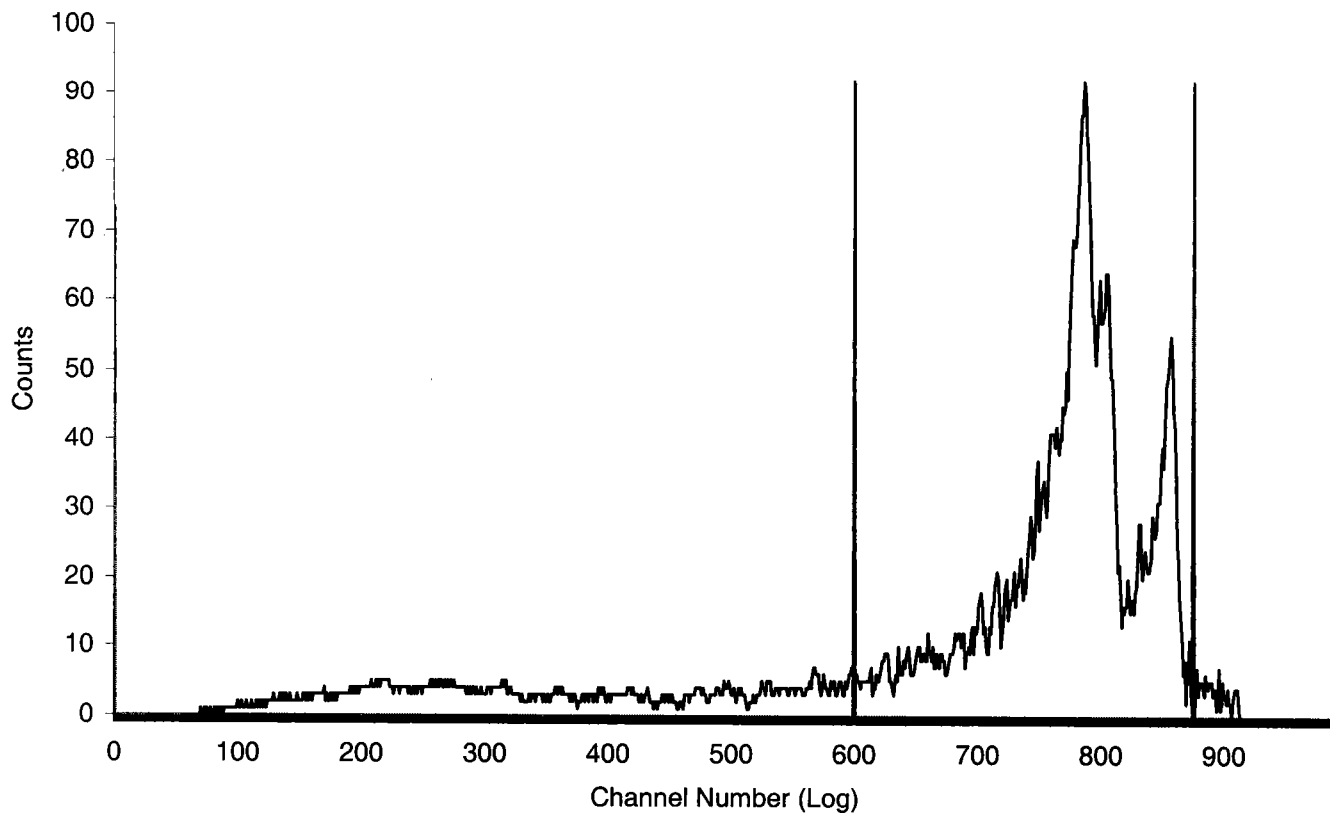
USER 12 - RN-222



Sample Count Start Time:	18 Jan 2010 07:15:42		
Data Capture Date	18 Jan 2010 07:31:06		
User Filename	S12011845-2A.XLS		
	U12011845-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	2	45-2	15.00
H#, Total Counts:	43.8	8401	
Win1: Rn-222 - Start, End, Counts:	600	875	6636
Win2: - Start, End, Counts:	0	990	8401

# SPECTRUM PLOT

USER 12 - RN-222

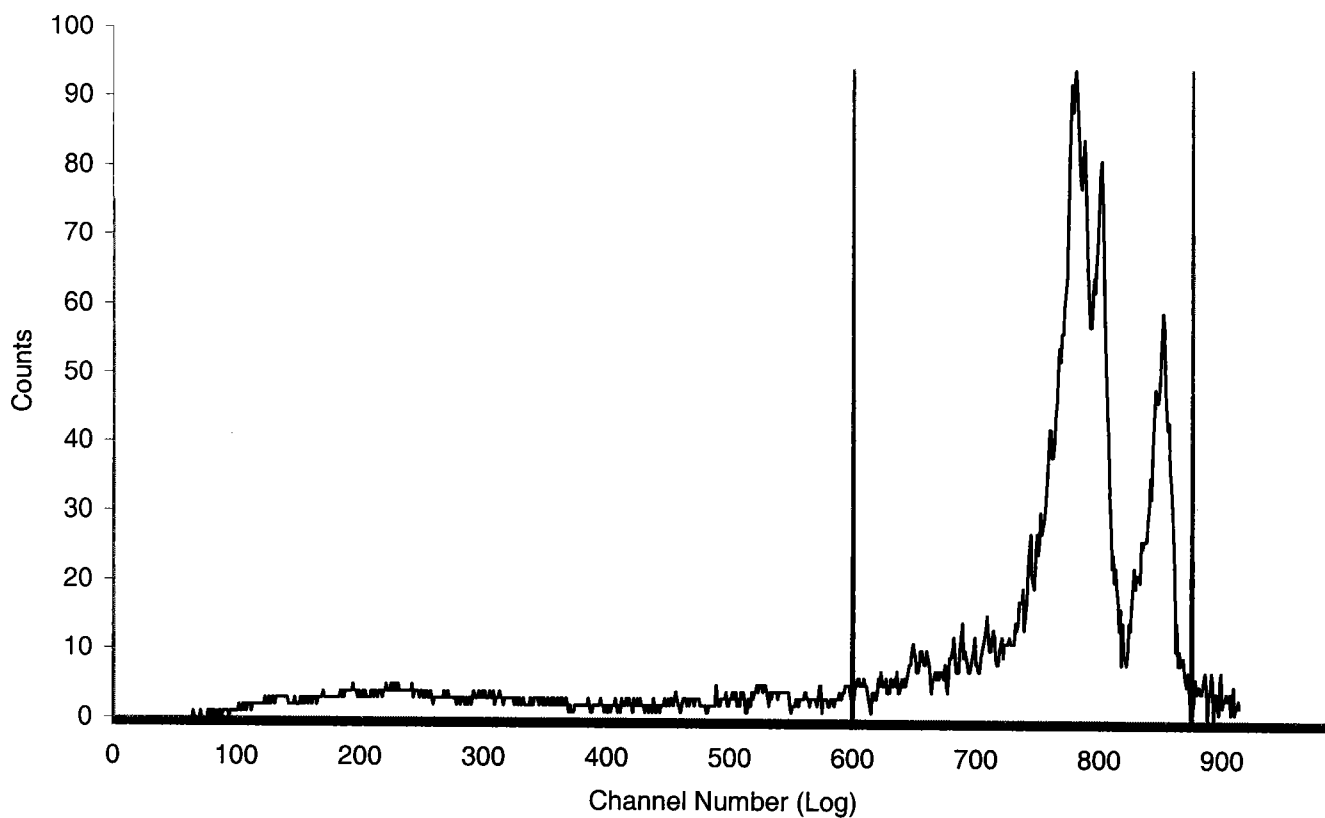




Sample Count Start Time:	18 Jan 2010 07:31:48		
Data Capture Date	18 Jan 2010 07:47:12		
User Filename	S12011845-3A.XLS		
	U12011845-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	3	45-3	15.00
H#, Total Counts:	46.2	8013	
Win1: Rn-222 - Start, End, Counts:	600	875	6445
Win2: - Start, End, Counts:	0	990	8013

### SPECTRUM PLOT

USER 12 - RN-222



# METHOD CALIBRATION DATA

GEL Laboratories

2040 Savage Road, Charleston, SC 29407

(843)556-8171

Liquid Scintillation Counter Calibration Package

Method: Rn 222

Instrument Color Code: Red

**Part 1: Efficiency determination**

- 1 Efficiency spreadsheet (eff pts, graph, trendline equation)
- 2 Verification Spreadsheet (recoveries 90%-110%)
- 3 Applicable portion of Machines.XLS
- 4 Raw Data and spectra
- 5 Window, Low Level and Lumex settings

Included/ Acceptable	Comments
✓	
✓	
✓	
✓	
✓	

**Part 2. Documentation for Calibration Source**

- 1 Vendor Certificate
- 2 Standard Traceability Log (from LIMS)
- 3 Verification of Source
- 4 Source preparation sheet
- 5 Efficiency standard precision check

✓	
✓	
✓	
✓	
NA	

**Part 3. Documentation for Verification Source**

- 1 Vendor Certificate
- 2 Standard Traceability Log (from LIMS)
- 3 Verification of Source
- 4 Source preparation sheet
- 5 Efficiency standard precision check

✓	
✓	
✓	
✓	
NA	

**Part 4. Enter into LIMS**

- 1 Alpha LIMS instrument calibration updated

✓	
---	--

Primary Review of Package

L. Anderson 8/4/09

Secondary Review of Package

[Signature] 8/5/09

Effective Date:

7/28/09

**Radon 222 Calibration**

Instrument      Red

## Standard Information from prep sheet

Isotope	Ra-226
Serial Number	0024-A
Isotope Half-life (days)	584400
Reference Date	9/10/1997
Ref. Act. (DPM/mL)	131439.80
Amount of Std. (mL)	0.1

Std #	Start Count Time	Quench Number	RAW CPM	BKG	RAW CPM-BKG	Nominal DPM	EFF.
1	7/28/09 8:40	50.00	46572.00	8.73	46563.27	13076.50356	3.56083
2	7/28/09 8:42	49.30	47740.00	8.73	47731.27	13076.50355	3.65016
3	7/28/09 8:43	50.30	45272.00	8.73	45263.27	13076.50354	3.46142
4	7/28/09 8:44	49.40	47800.00	8.73	47791.27	13076.50352	3.65474
5	7/28/09 8:45	50.80	46324.00	8.73	46315.27	13076.50351	3.54187
6	7/28/09 8:47	50.70	44828.00	8.73	44819.27	13076.5035	3.42747
7	7/28/09 8:48	50.20	47660.00	8.73	47651.27	13076.50348	3.64404
8	7/28/09 8:49	50.30	45392.00	8.73	45383.27	13076.50347	3.47060
9	7/28/09 8:51	50.20	47560.00	8.73	47551.27	13076.50345	3.63639
10	7/28/09 8:52	50.00	46604.00	8.73	46595.27	13076.50344	3.56328
11	7/28/09 8:53	50.80	47200.00	8.73	47191.27	13076.50343	3.60886

## Copy into Machines.xls

Cal Date	07/28/09
Min H#	0.0
Max H#	0.0
A0	3.56542328E+00
A1	0.00000000E+00
A2	0.00000000E+00
A3	0.00000000E+00
A4	0
A5	0
Geometry	MINERAL OIL/10ML SAMPLE
Exp Date	07/31/10
Low Level	y
Eff Error	0.007920
Window1 LL	600
Window1 UL	875
Window2 LL	0
Window2 UL	900

# Radon 222 Verification

Standard Information from prep sheet	
Isotope	Ra-226
Serial Number	0299-G
Isotope Halflife (days)	584400
Reference Date	12/15/1999
Ref. Act. (DPM/mL)	2446.35
Amount of Std. (mL)	0.1

	Start	Quench	Raw		BKG Corrected	Calculated	Standard	Measured	Recovery
Std #	Count Time	Number	CPM	BKG	CPM	EFF.	DPM	DPM	%
1	7/28/09 9:12	51.50	952.89	8.73	944.16	3.5654	243.62	264.81	108.70%
2	7/28/09 9:23	49.90	942.35	8.73	933.62	3.5654	243.62	261.85	107.49%
3	7/28/09 9:35	50.80	924.06	8.73	915.33	3.5654	243.62	256.72	105.38%
4	7/28/09 9:47	49.60	926.48	8.73	917.75	3.5654	243.62	257.40	105.66%
5	7/28/09 9:59	50.30	944.06	8.73	935.33	3.5654	243.62	262.33	107.68%
6	7/28/09 10:10	49.20	958.47	8.73	949.74	3.5654	243.62	266.38	109.34%
7	7/28/09 10:22	51.00	928.15	8.73	919.42	3.5654	243.62	257.87	105.85%
8	7/28/09 10:34	50.90	959.33	8.73	950.60	3.5654	243.62	266.62	109.44%
9	7/28/09 10:46	51.40	937.29	8.73	928.56	3.5654	243.62	260.43	106.90%
10	7/28/09 10:57	52.80	924.42	8.73	915.69	3.5654	243.62	256.83	105.42%

	Calibration Coeffs
a0	3.56542328E+00
a1	0.00000000E+00
a2	0.00000000E+00
a3	0.00000000E+00

*AL 8/4/09*

# RED-RAD

<b>Red</b>	<b>Rn-222</b>	
<b>Cal Date</b>		07/28/2009
<b>Min H#</b>		0.00
<b>Max H#</b>		0.00
<b>A0</b>		3.56542328129873E+00
<b>A1</b>		0.00000000000000E+00
<b>A2</b>		0.00000000000000E+00
<b>A3</b>		0.00000000000000E+00
<b>A4</b>		0.00000000000000E+00
<b>A5</b>		0.00000000000000E+00
<b>Geometry</b>	10ML MINERAL OIL/10ML SAMPLE	
<b>Exp Date</b>		07/31/2010
<b>Low Level</b>	y	
<b>Eff Error</b>		0.007920
<b>Window1 LL</b>	600	
<b>Window1 UL</b>	875	
<b>Window2 LL</b>	0	
<b>Window2 UL</b>	900	

*Handwritten signature*

Machines

ID: RN222 DONT USE

28 JUL 2009 08:57

USER:12

COMMENT:RED

PRESET TIME : 15.00

DATA CALC : CPM HH : YES SAMPLE REPEATS: 1 PRINTER : EDIT

COUNT BLANK : NO IC# : NO REPLICATES : 1 RS232 : EDIT

TWO PHASE : NO ABC : NO CYCLE REPEATS : 1 DISK : OFF

SCINTILLATOR: LIQUID LUMEX: NO LOW SAMPLE REJ: 0

LOW LEVEL : YES HALF LIFE CORRECTION DATE: none

CHAN: 600.0 - 875.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

CHAN: 0.0 - 900.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	HH	WIND1 RAW CPM	WIND2 RAW CPM	WIND1		WIND2		LUMEX %	ELAPSED TIME
						CPM	%ERROR	CPM	%ERROR		
1	**1	0.25	50.0	46572.00	52956.00	46572.00	1.85	52956.00	1.74	0.00	0.73
2	**2	0.25	49.3	47740.00	54180.00	47740.00	1.83	54180.00	1.72	0.00	1.97
3	**3	0.25	50.3	45272.00	51812.00	45272.00	1.88	51812.00	1.76	0.00	3.18
4	**4	0.25	49.4	47800.00	54724.00	47800.00	1.83	54724.00	1.71	0.00	4.55
5	**5	0.25	50.8	46324.00	53004.00	46324.00	1.86	53004.00	1.74	0.00	5.78
6	**6	0.25	50.7	44828.00	51016.00	44828.00	1.89	51016.00	1.77	0.00	7.00
7	**7	0.25	50.2	47660.00	54128.00	47660.00	1.83	54128.00	1.72	0.00	8.37
8	**8	0.25	50.3	45392.00	51364.00	45392.00	1.88	51364.00	1.76	0.00	9.60
9	**9	0.25	50.2	47560.00	54088.00	47560.00	1.83	54088.00	1.72	0.00	10.96
10	**10	0.25	50.0	46604.00	53176.00	46604.00	1.85	53176.00	1.73	0.00	12.20
11	**11	0.25	50.8	47200.00	53668.00	47200.00	1.84	53668.00	1.73	0.00	13.56
12	**12	15.00	50.1	8.73	31.13	8.73	17.47	31.13	9.25	0.84	29.68

ID:RN222 DONT USE

28 JUL 2009 09:27

USER:12

COMMENT:RED

PRESET TIME : 15.00

DATA CALC : CPM H# :YES SAMPLE REPEATS: 1 PRINTER :EDIT

COUNT BLANK : NO IC# : NO REPLICATES : 1 RS232 :EDIT

TWO PHASE : NO AQC : NO CYCLE REPEATS : 1 DISK : OFF

SCINTILLATOR: LIQUID LUMEX: NO LOW SAMPLE REJ: 0

LOW LEVEL : YES HALF LIFE CORRECTION DATE: none

CHAN: 600.0 - 875.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

CHAN: 0.0 - 900.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	H#	WIND1 RAW CPM	WIND2 RAW CPM	WIND1		WIND2		LUMEX %	ELAPSED TIME
						CPM	%ERROR	CPM	%ERROR		
1	57-1	10.55	51.5	952.89	1099.34	952.89	1.99	1099.34	1.86	0.03	11.15
2	57-2	10.65	49.9	942.35	1095.12	942.35	2.00	1095.12	1.85	0.02	22.86
3	57-3	10.85	50.8	924.06	1074.93	924.06	2.00	1074.93	1.85	0.02	34.78
4	57-4	10.80	49.6	926.48	1076.39	926.48	2.00	1076.39	1.85	0.02	46.78
5	57-5	10.60	50.3	944.06	1096.42	944.06	2.00	1096.42	1.86	0.02	58.44
6	57-6	10.45	49.2	958.47	1105.74	958.47	2.00	1105.74	1.86	0.02	69.98
7	57-7	10.80	51.0	928.15	1077.22	928.15	2.00	1077.22	1.85	0.02	81.97
8	57-8	10.45	50.9	959.33	1111.96	959.33	2.00	1111.96	1.86	0.02	93.50
9	57-9	10.70	51.4	937.29	1090.65	937.29	2.00	1090.65	1.85	0.03	105.29
10	57-10	10.85	52.8	924.42	1081.84	924.42	2.00	1081.84	1.85	0.02	117.34



Instrument Type LS 6000  
 Data Capture Date 28 Jul 2009 08:40:27  
 User Filename C:\LSCCAPTURE\BROWN\USER12\UN072801.BSF

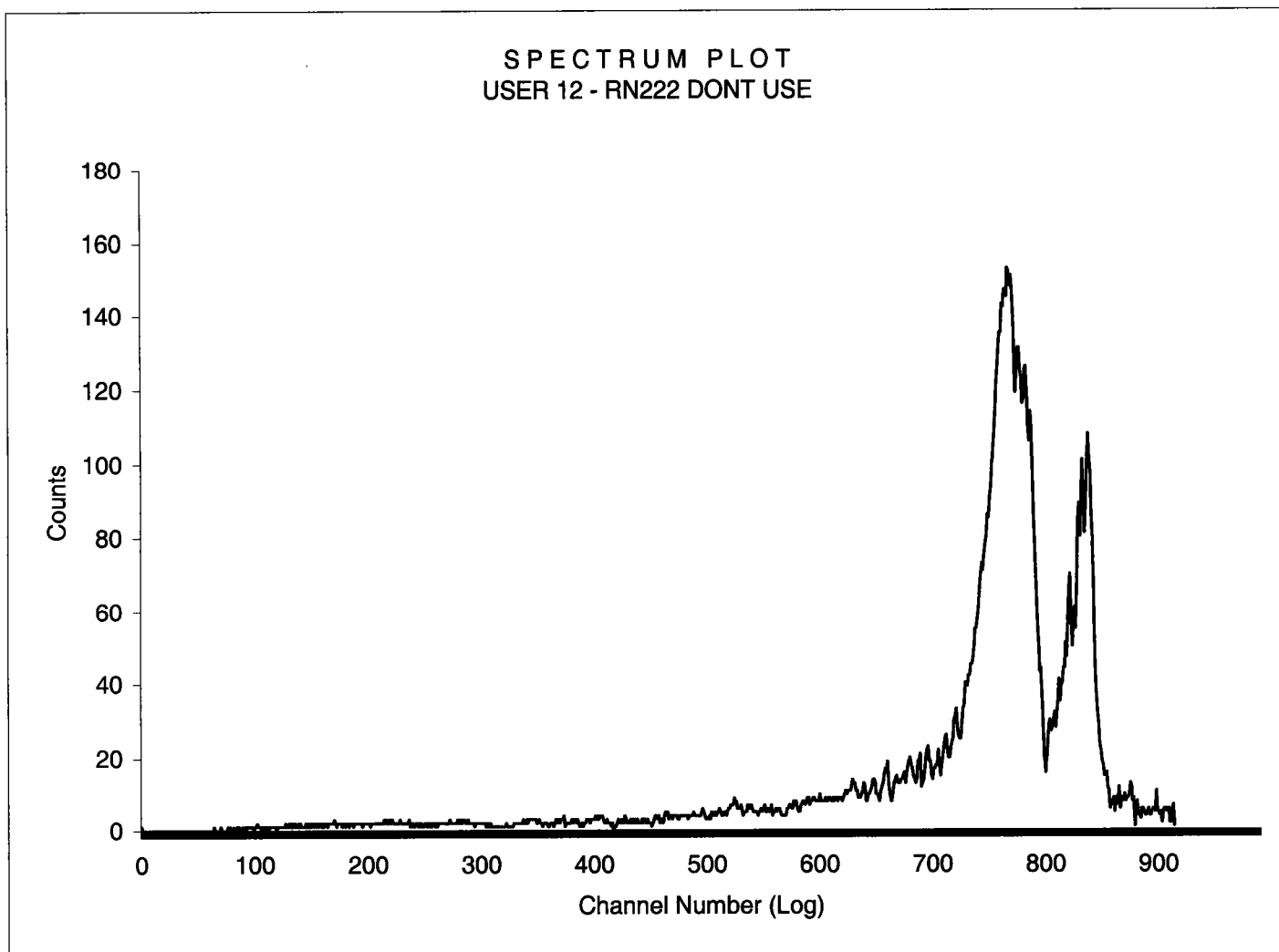
User Number 12  
 User Id RN222  
 User Comments RED

Scintillator Choice: LIQUID

Sam	Rack	Time	H#	Raw CPM1	Raw CPM2	CPM Iso1	%Err1	CPM Iso2	%Err2	LumEx
1	**1	0.25	50.0	46572.00	52956.00	46572.00	1.85	52956.00	1.74	0.00
2	**2	0.25	49.3	47740.00	54180.00	47740.00	1.83	54180.00	1.72	0.00
3	**3	0.25	50.3	45272.00	51812.00	45272.00	1.88	51812.00	1.76	0.00
4	**4	0.25	49.4	47800.00	54724.00	47800.00	1.83	54724.00	1.71	0.00
5	**5	0.25	50.8	46324.00	53004.00	46324.00	1.86	53004.00	1.74	0.00
6	**6	0.25	50.7	44828.00	51016.00	44828.00	1.89	51016.00	1.77	0.00
7	**7	0.25	50.2	47660.00	54128.00	47660.00	1.83	54128.00	1.72	0.00
8	**8	0.25	50.3	45392.00	51364.00	45392.00	1.88	51364.00	1.76	0.00
9	**9	0.25	50.2	47560.00	54088.00	47560.00	1.83	54088.00	1.72	0.00
10	**10	0.25	50.0	46604.00	53176.00	46604.00	1.85	53176.00	1.73	0.00
11	**11	0.25	50.8	47200.00	53668.00	47200.00	1.84	53668.00	1.73	0.00
12	**12	15.00	50.1	8.73	31.13	8.73	17.47	31.13	9.25	0.84

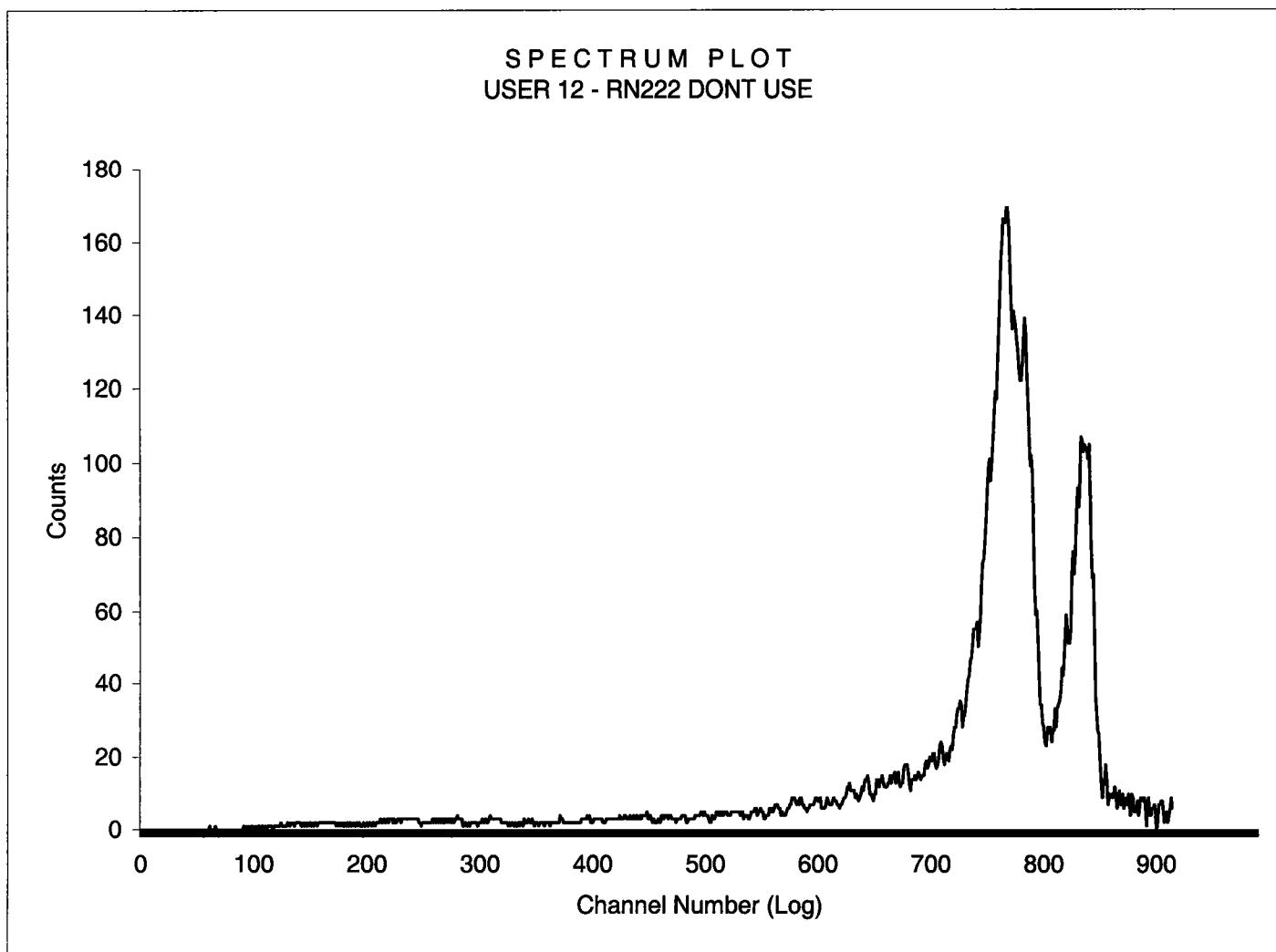
*Handwritten signature*

Sample Count Start Time:	28 Jul 2009 08:40:56		
Data Capture Date	28 Jul 2009 08:41:35		
User Filename	S120728---1A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	1	** -1	0.25
H#, Total Counts:	50.0	13302	
Start, End, X-Axis:	0	990	Channel Number



*Handwritten signature*  
28/7/09

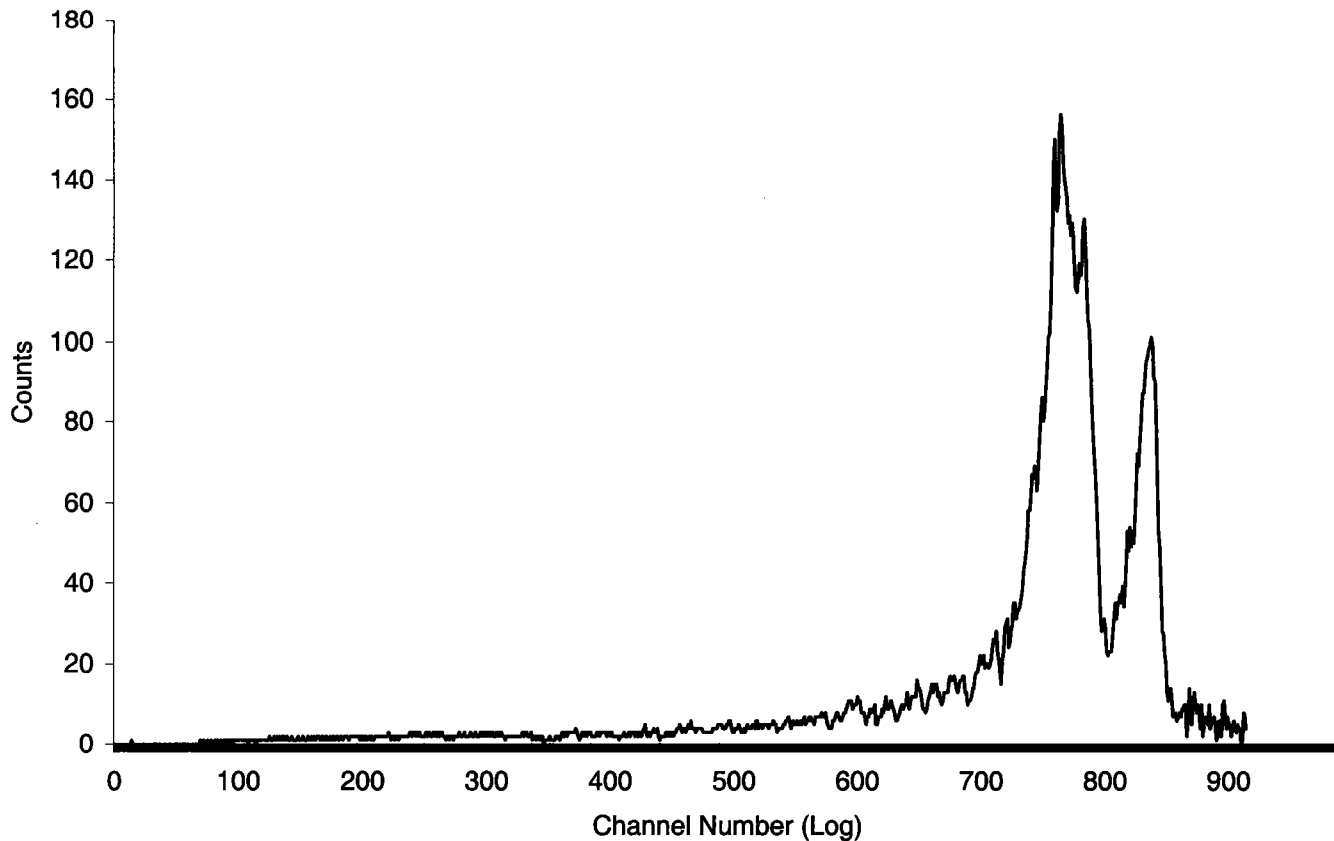
Sample Count Start Time:	28 Jul 2009 08:42:10		
Data Capture Date	28 Jul 2009 08:42:58		
User Filename	S120728---2A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	2	** -2	0.25
H#, Total Counts:	49.3	13619	
Start, End, X-Axis:	0	990	Channel Number



*Handwritten signature*

Sample Count Start Time:	28 Jul 2009 08:43:23		
Data Capture Date	28 Jul 2009 08:44:11		
User Filename	S120728---3A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	3	** -3	0.25
H#, Total Counts:	50.3	13010	
Start, End, X-Axis:	0	990	Channel Number

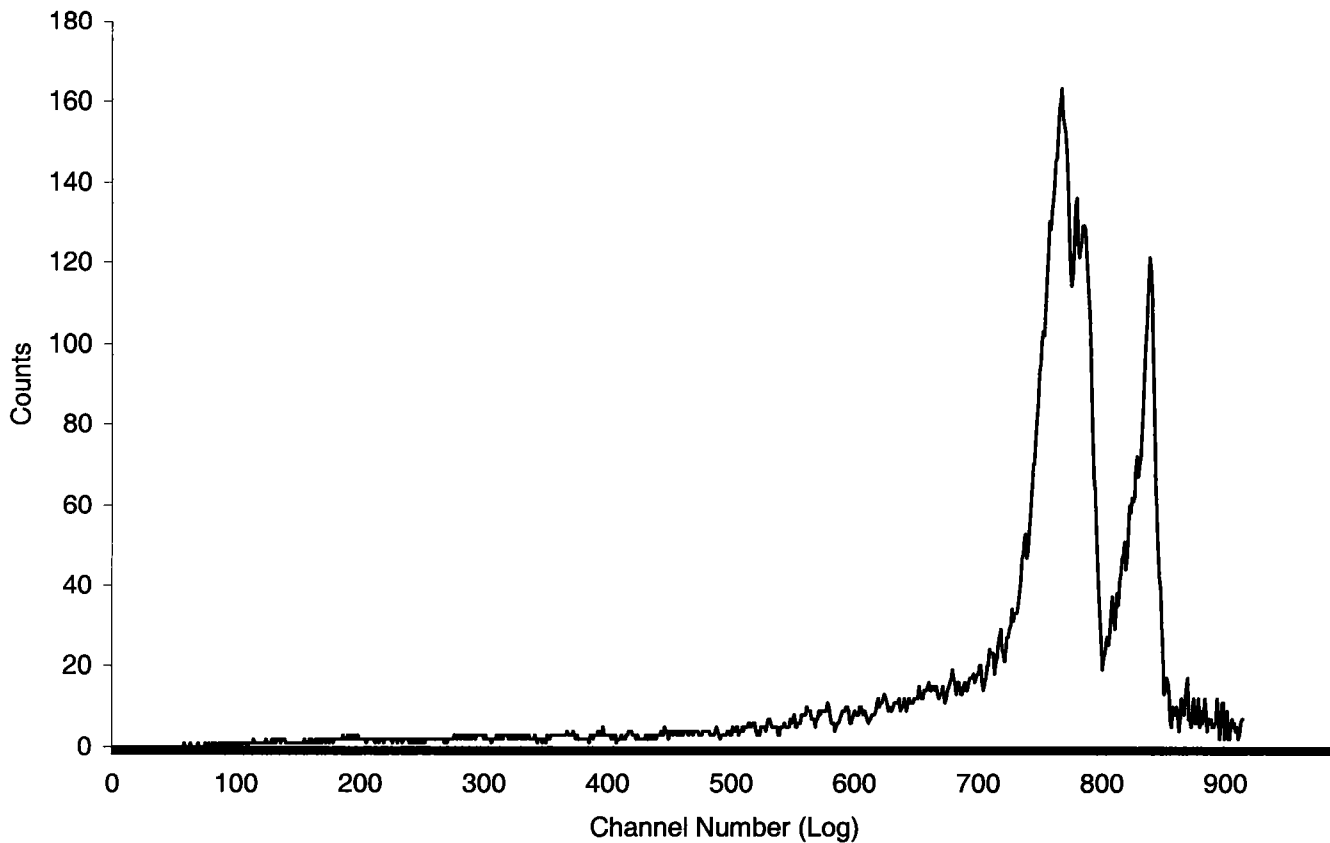
SPECTRUM PLOT  
USER 12 - RN222 DONT USE



*28/7/09*

Sample Count Start Time:	28 Jul 2009 08:44:45		
Data Capture Date	28 Jul 2009 08:45:25		
User Filename	S120728---4A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	4	** -4	0.25
H#, Total Counts:	49.4	13752	
Start, End, X-Axis:	0	990	Channel Number

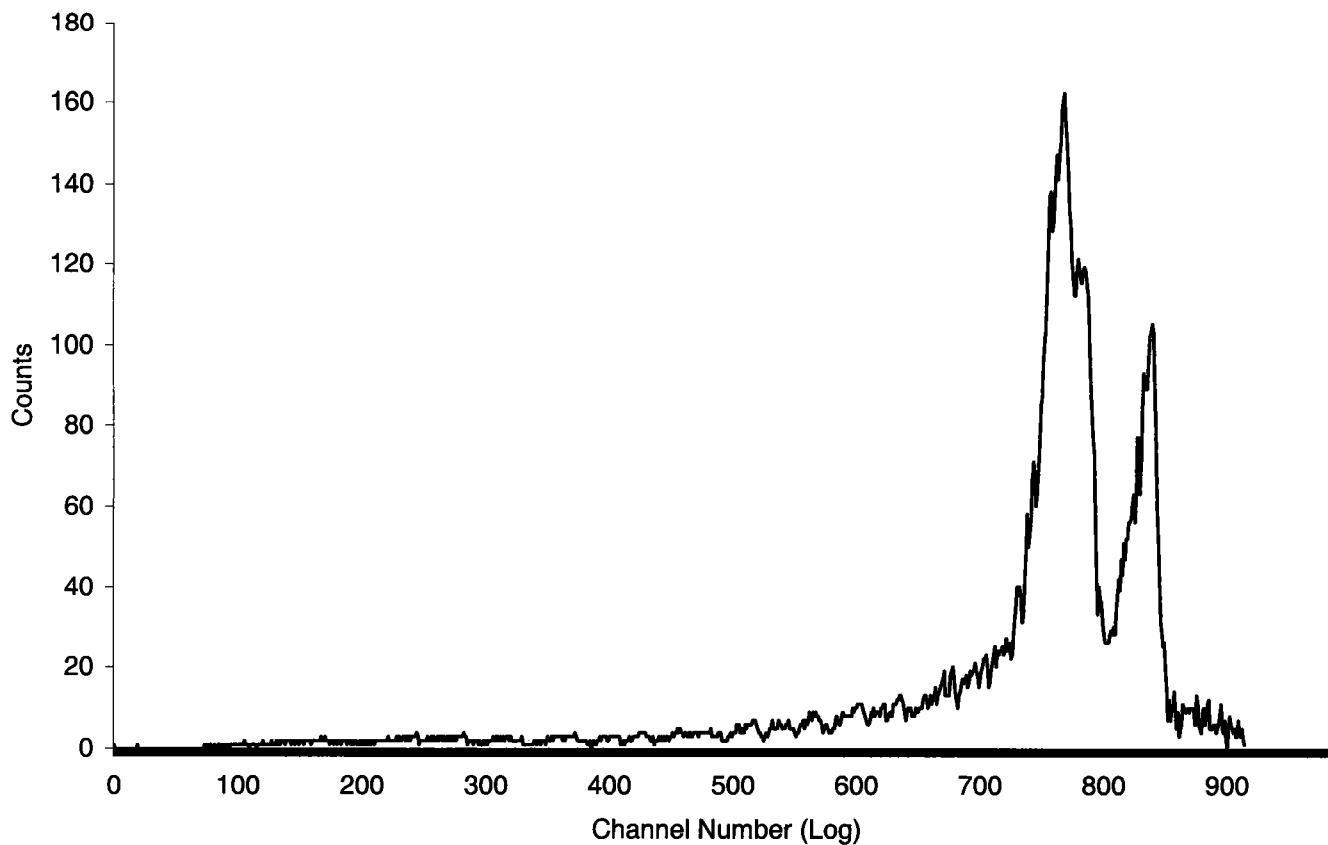
SPECTRUM PLOT  
USER 12 - RN222 DONT USE



*28/7/09*

Sample Count Start Time:	28 Jul 2009 08:45:59		
Data Capture Date	28 Jul 2009 08:46:42		
User Filename	S120728---5A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	5	**5	0.25
H#, Total Counts:	50.8	13312	
Start, End, X-Axis:	0	990	Channel Number

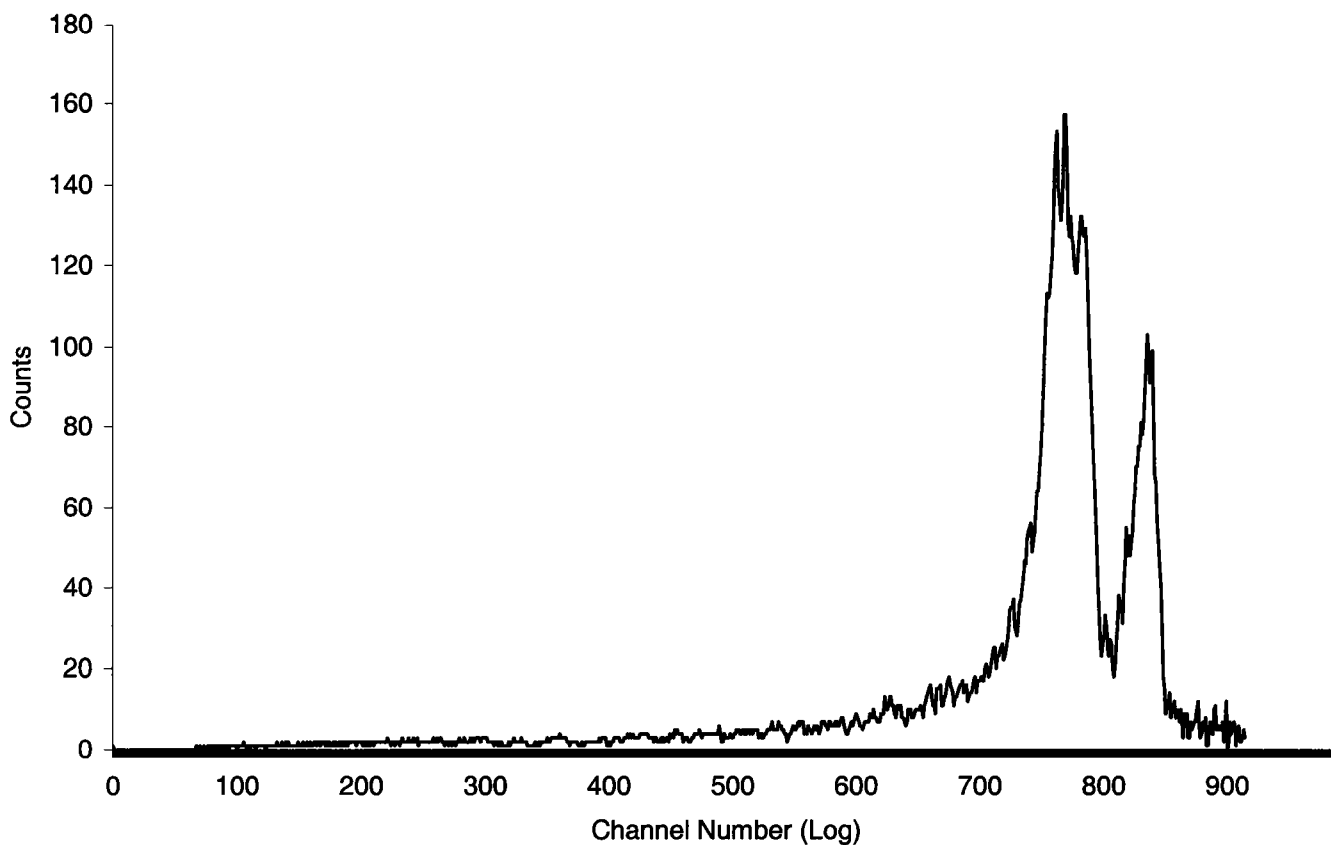
SPECTRUM PLOT  
USER 12 - RN222 DONT USE



*Handwritten signature/initials*

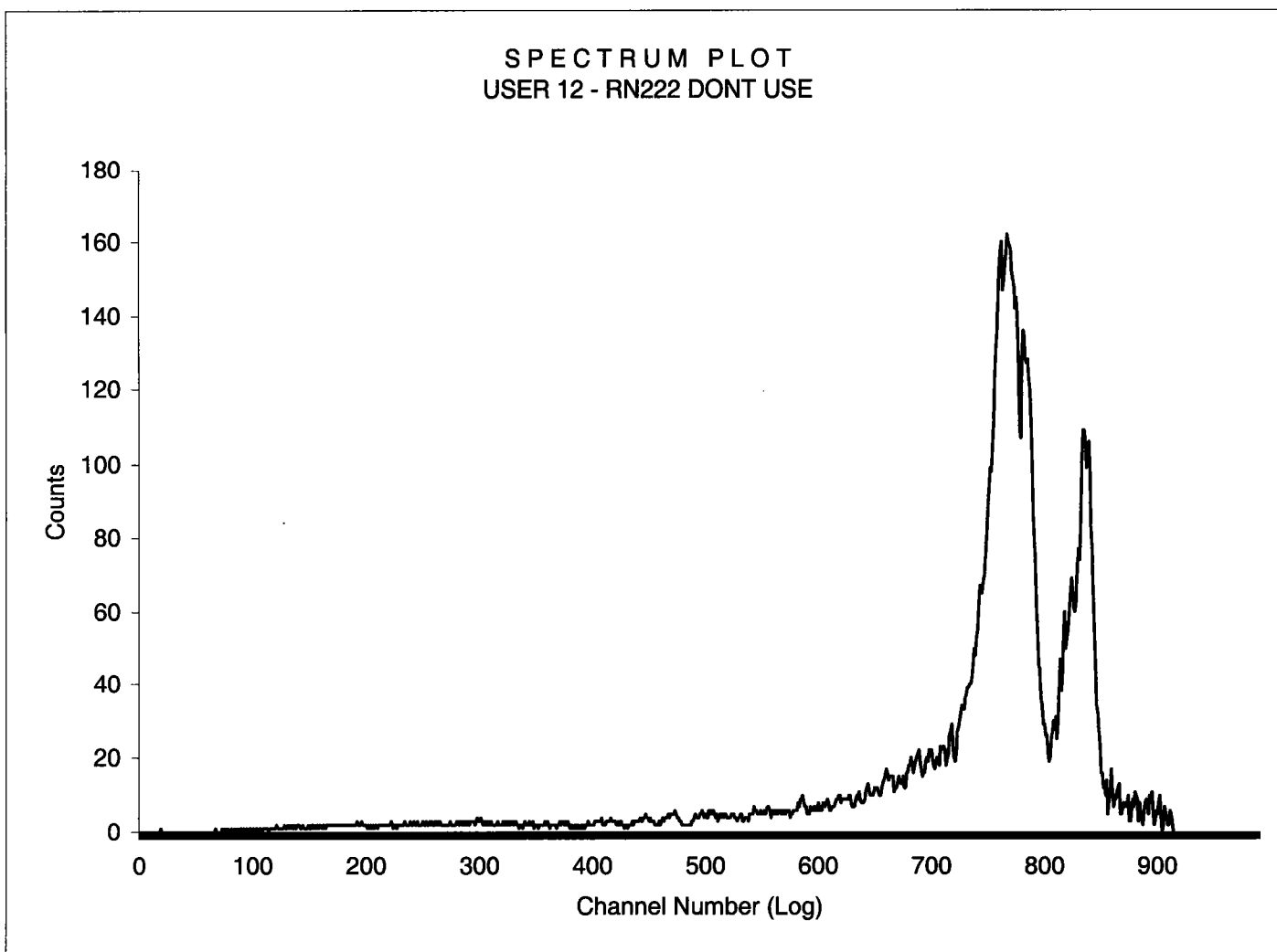
Sample Count Start Time:	28 Jul 2009 08:47:12		
Data Capture Date	28 Jul 2009 08:47:56		
User Filename	S120728---6A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	6	** -6	0.25
H#, Total Counts:	50.7	12813	
Start, End, X-Axis:	0	990	Channel Number

SPECTRUM PLOT  
USER 12 - RN222 DONT USE



*Handwritten signature*

Sample Count Start Time:	28 Jul 2009 08:48:34		
Data Capture Date	28 Jul 2009 08:49:13		
User Filename	S120728---7A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	7	**7	0.25
H#, Total Counts:	50.2	13592	
Start, End, X-Axis:	0	990	Channel Number

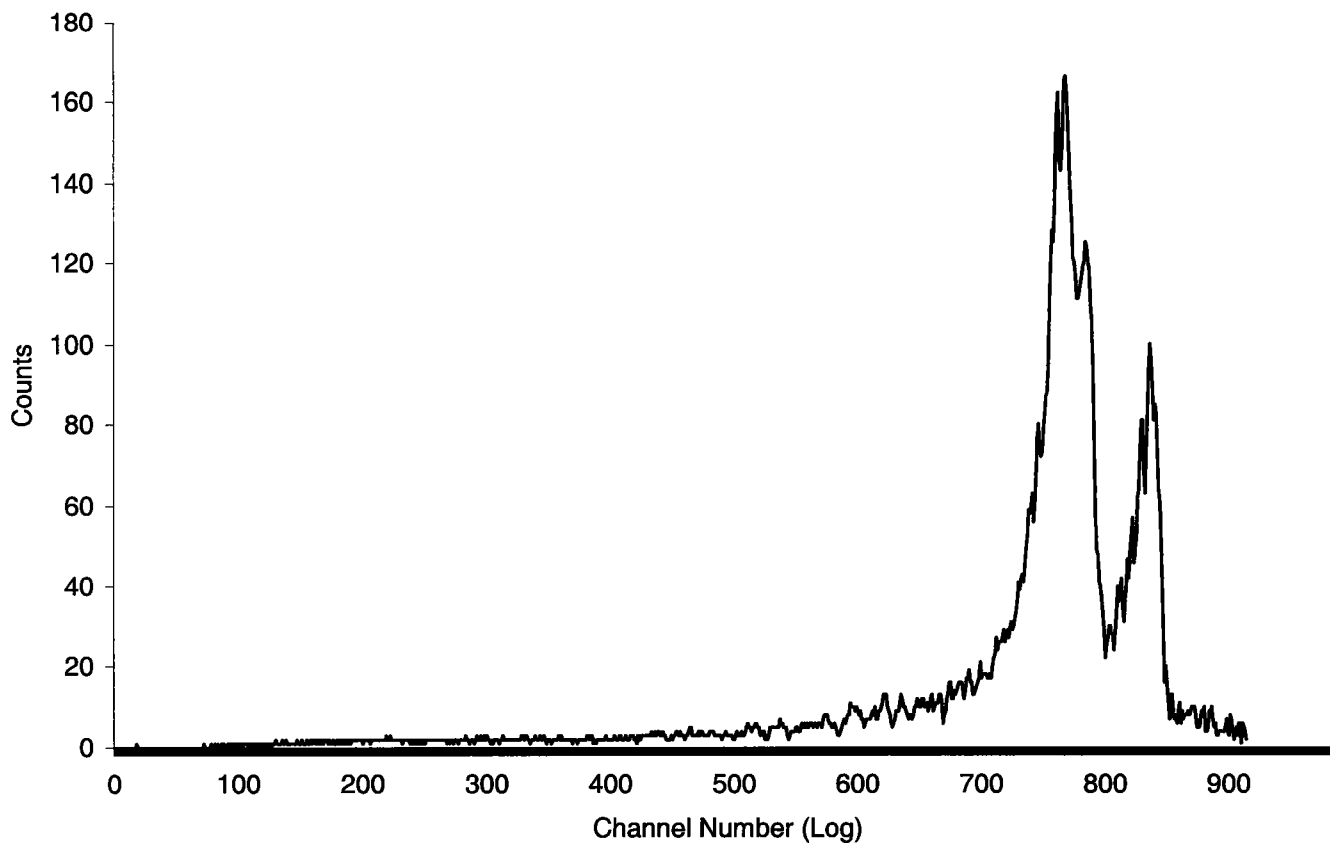


*2008/4/09*



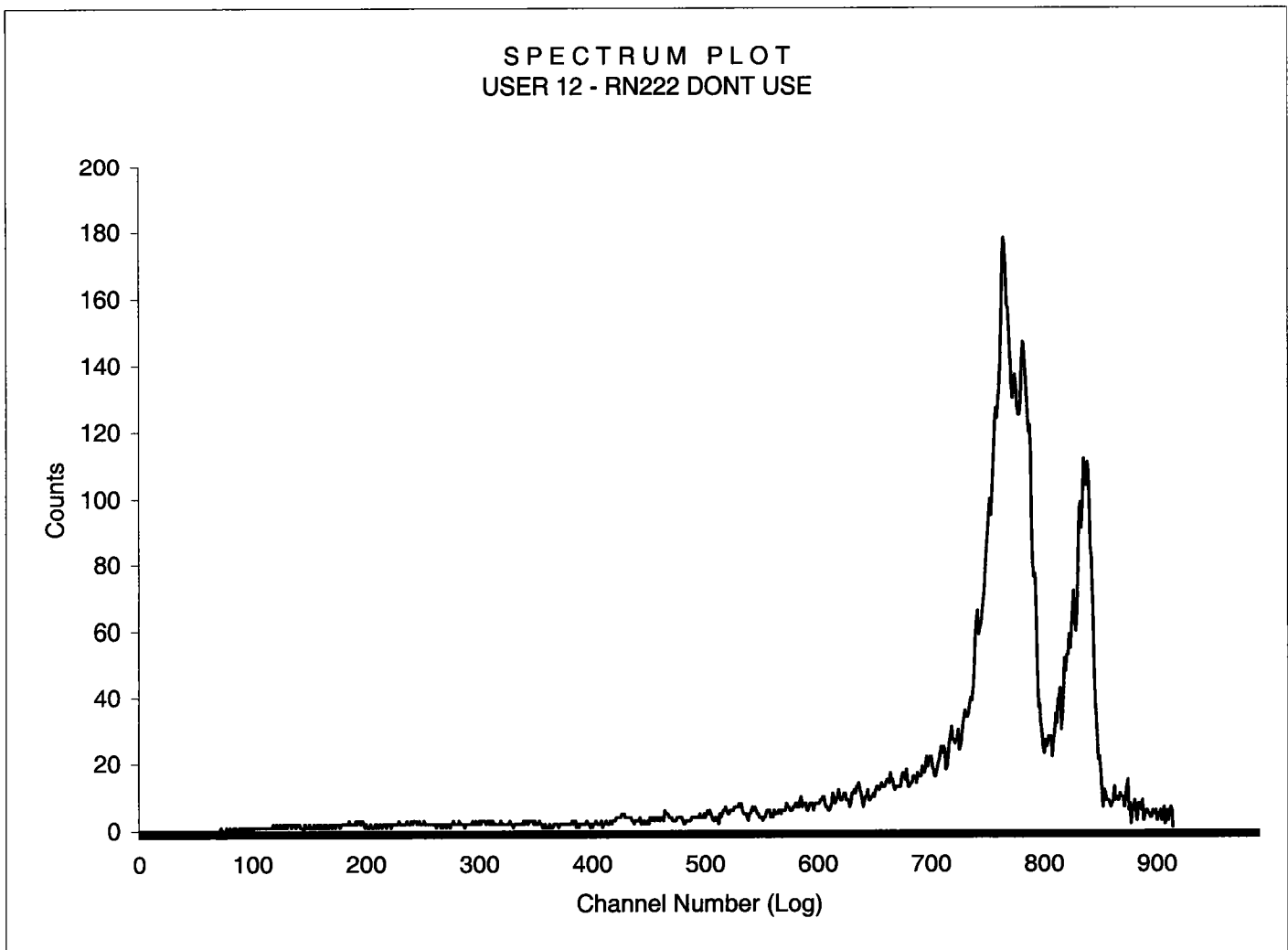
Sample Count Start Time:	28 Jul 2009 08:49:48		
Data Capture Date	28 Jul 2009 08:50:27		
User Filename	S120728---8A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	8	** -8	0.25
H#, Total Counts:	50.3	12904	
Start, End, X-Axis:	0	990	Channel Number

SPECTRUM PLOT  
USER 12 - RN222 DONT USE



*28/7/09*

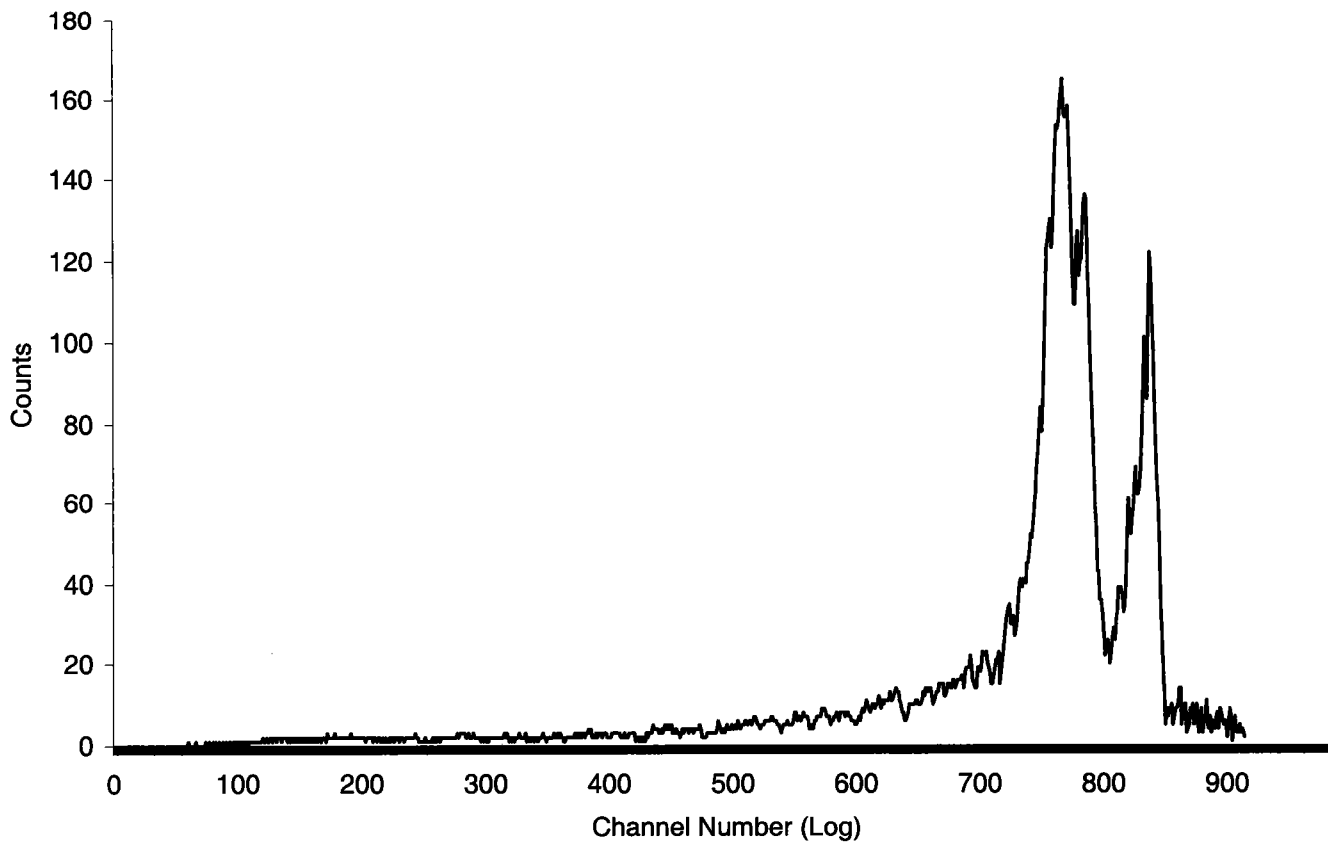
Sample Count Start Time:	28 Jul 2009 08:51:10		
Data Capture Date	28 Jul 2009 08:51:49		
User Filename	S120728---9A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	9	** -9	0.25
H#, Total Counts:	50.2	13586	
Start, End, X-Axis:	0	990	Channel Number



*Lhs/4/09*

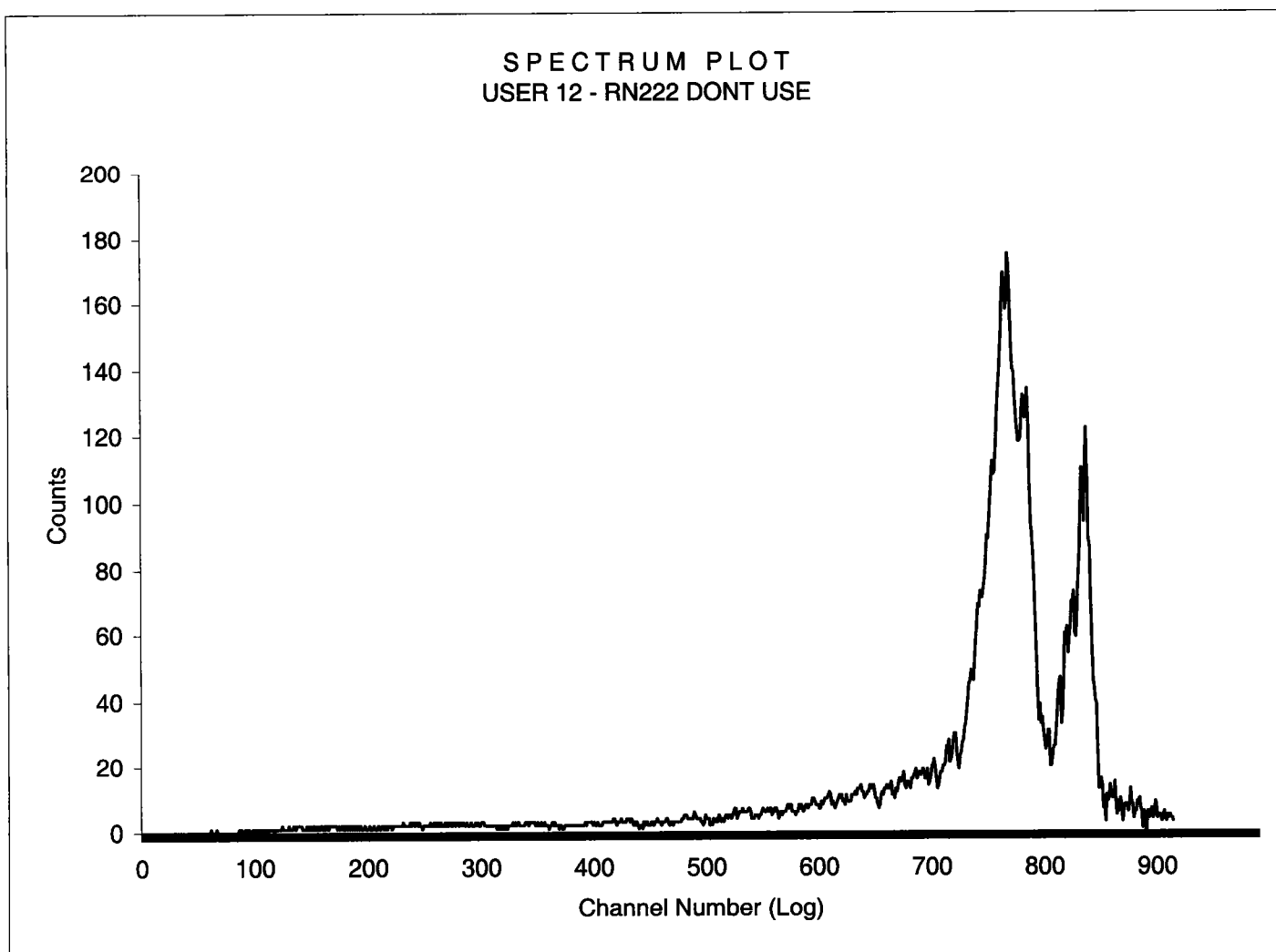
Sample Count Start Time:	28 Jul 2009 08:52:24		
Data Capture Date	28 Jul 2009 08:53:18		
User Filename	S120728---10A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	10	** -10	0.25
H#, Total Counts:	50.0	13354	
Start, End, X-Axis:	0	990	Channel Number

SPECTRUM PLOT  
USER 12 - RN222 DONT USE



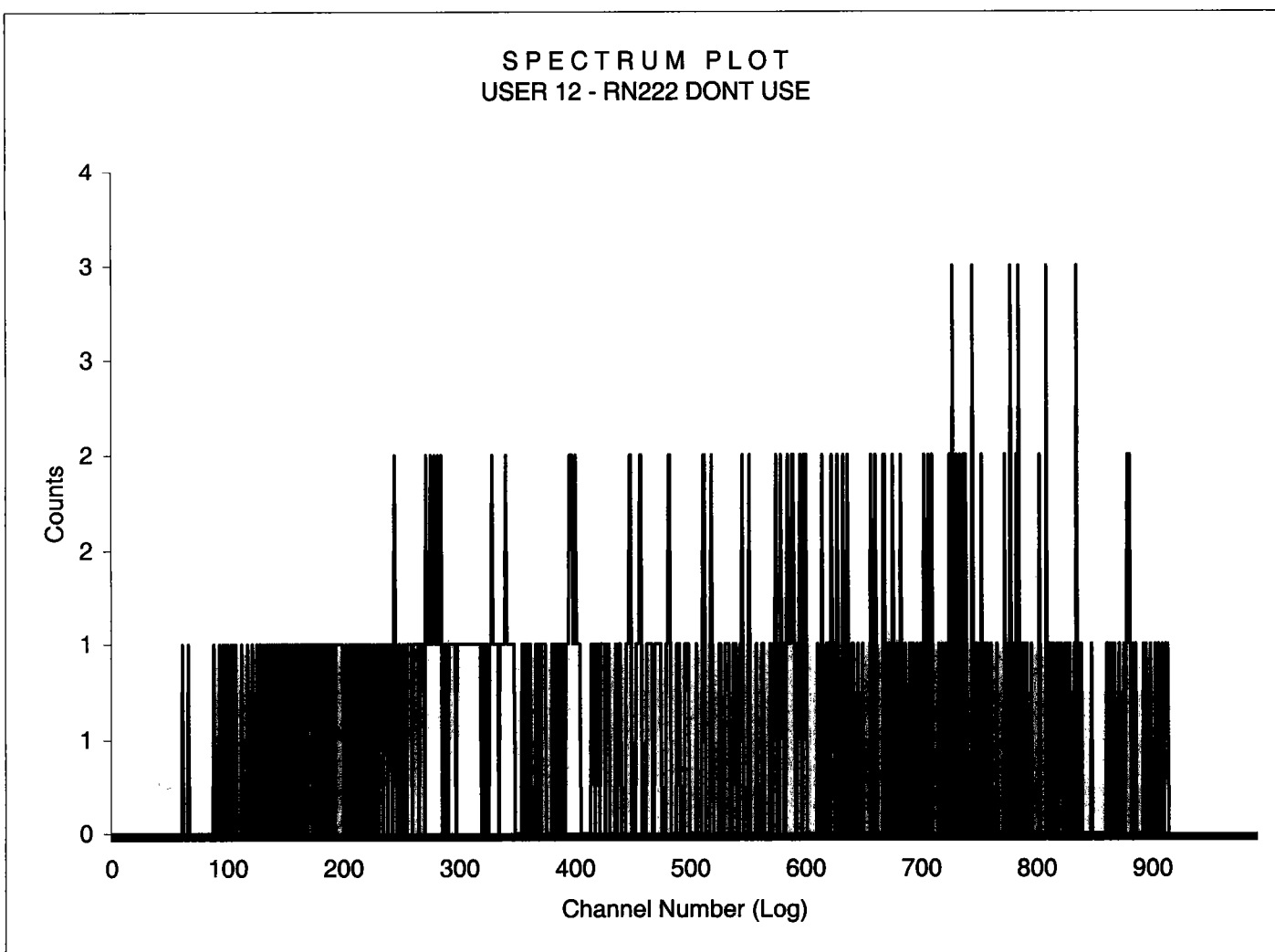
*28-8/4/09*

Sample Count Start Time:	28 Jul 2009 08:53:46		
Data Capture Date	28 Jul 2009 08:54:31		
User Filename	S120728---11A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	11	**11	0.25
H#, Total Counts:	50.8	13477	
Start, End, X-Axis:	0	990	Channel Number



*28/7/09*

Sample Count Start Time:	28 Jul 2009 08:55:08		
Data Capture Date	28 Jul 2009 09:10:30		
User Filename	S120728---12A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	12	**12	15.00
H#, Total Counts:	50.1	474	
Start, End, X-Axis:	0	990	Channel Number



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Instrument Type LS 6000  
 Data Capture Date 28 Jul 2009 09:11:25  
 User Filename C:\LSCCAPTURE\BROWN\USER12\UN072801.BSF

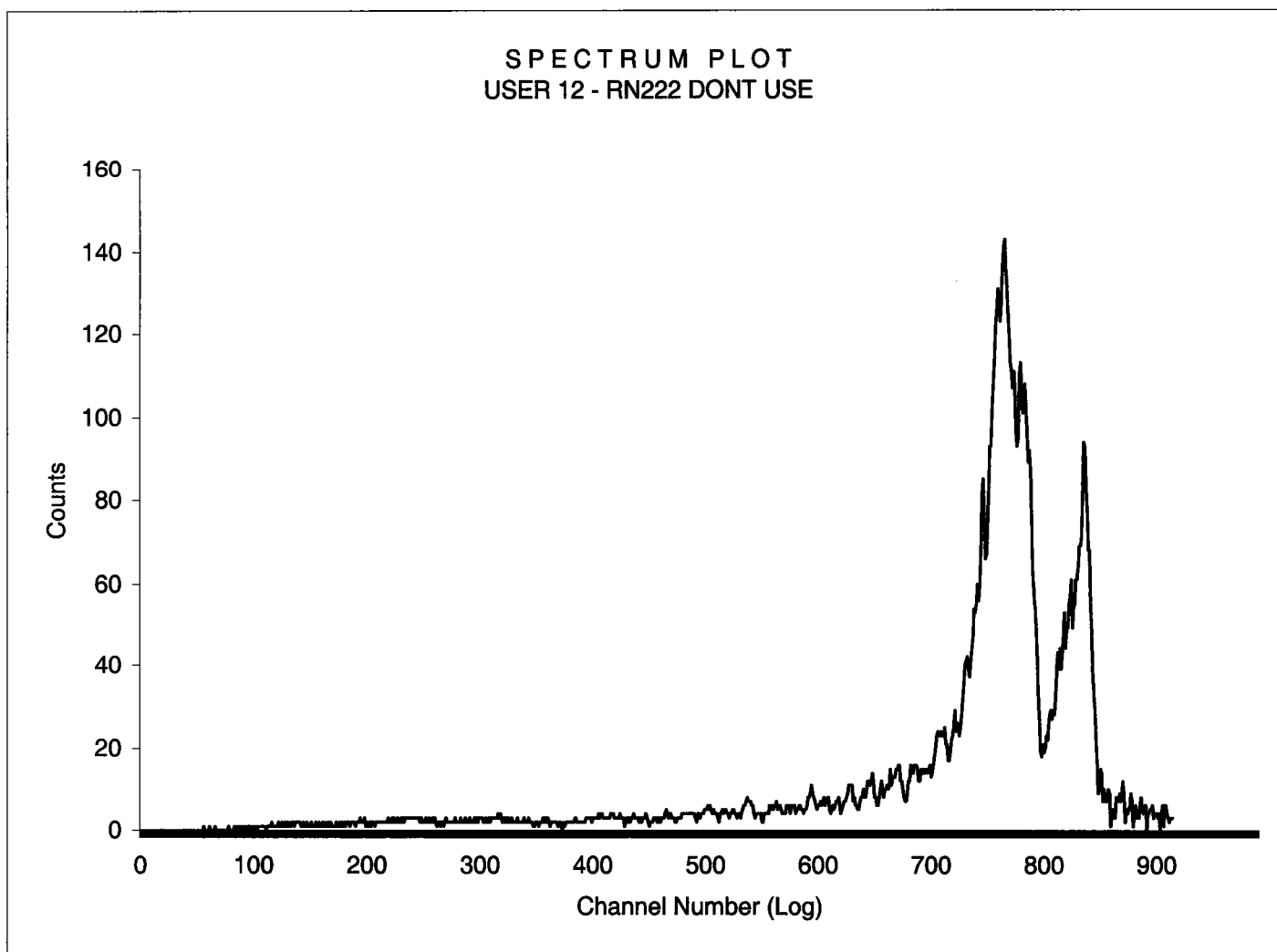
User Number 12  
 User Id RN222  
 User Comments RED

Scintillator Choice: LIQUID

Sam	Rack	Time	H#	Raw CPM1	Raw CPM2	CPM Iso1	%Err1	CPM Iso2	%Err2	LumEx
1	57-1	10.55	51.5	952.89	1099.34	952.89	1.99	1099.34	1.86	0.03
2	57-2	10.65	49.9	942.35	1095.12	942.35	2.00	1095.12	1.85	0.02
3	57-3	10.85	50.8	924.06	1074.93	924.06	2.00	1074.93	1.85	0.02
4	57-4	10.80	49.6	926.48	1076.39	926.48	2.00	1076.39	1.85	0.02
5	57-5	10.60	50.3	944.06	1096.42	944.06	2.00	1096.42	1.86	0.02
6	57-6	10.45	49.2	958.47	1105.74	958.47	2.00	1105.74	1.86	0.02
7	57-7	10.80	51.0	928.15	1077.22	928.15	2.00	1077.22	1.85	0.02
8	57-8	10.45	50.9	959.33	1111.96	959.33	2.00	1111.96	1.86	0.02
9	57-9	10.70	51.4	937.29	1090.65	937.29	2.00	1090.65	1.85	0.03
10	57-10	10.85	52.8	924.42	1081.84	924.42	2.00	1081.84	1.85	0.02

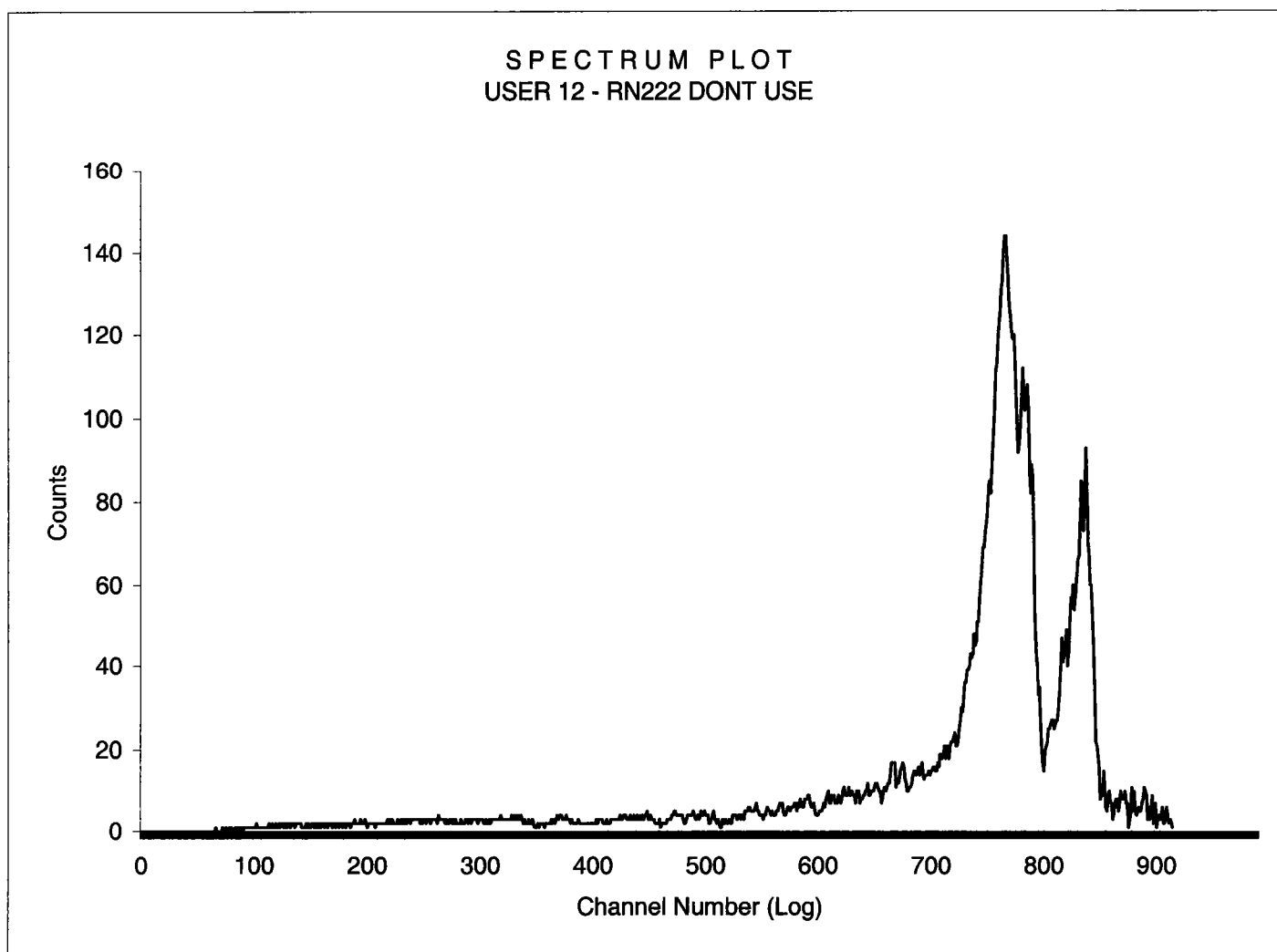
*Handwritten signature*  
 8/4/09

Sample Count Start Time:	28 Jul 2009 09:12:01		
Data Capture Date	28 Jul 2009 09:22:17		
User Filename	S12072857-1A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	1	57-1	10.55
H#, Total Counts:	51.5	11646	
Start, End, X-Axis:	0	990	Channel Number



*Y. D. 7/28/09*

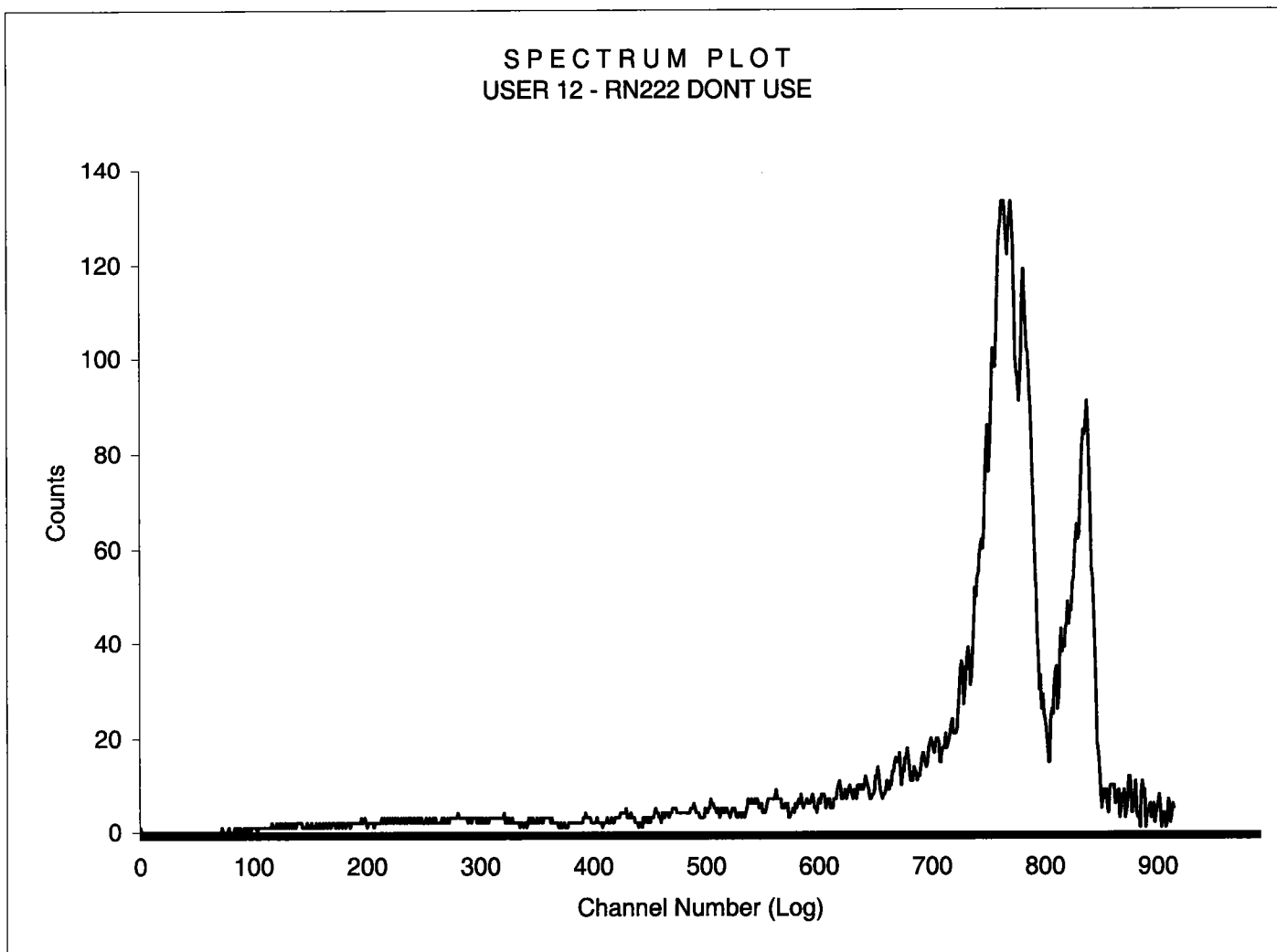
Sample Count Start Time:	28 Jul 2009 09:23:38		
Data Capture Date	28 Jul 2009 09:34:01		
User Filename	S12072857-2A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	2	57-2	10.65
H#, Total Counts:	49.9	11708	
Start, End, X-Axis:	0	990	Channel Number



20-8/4/09

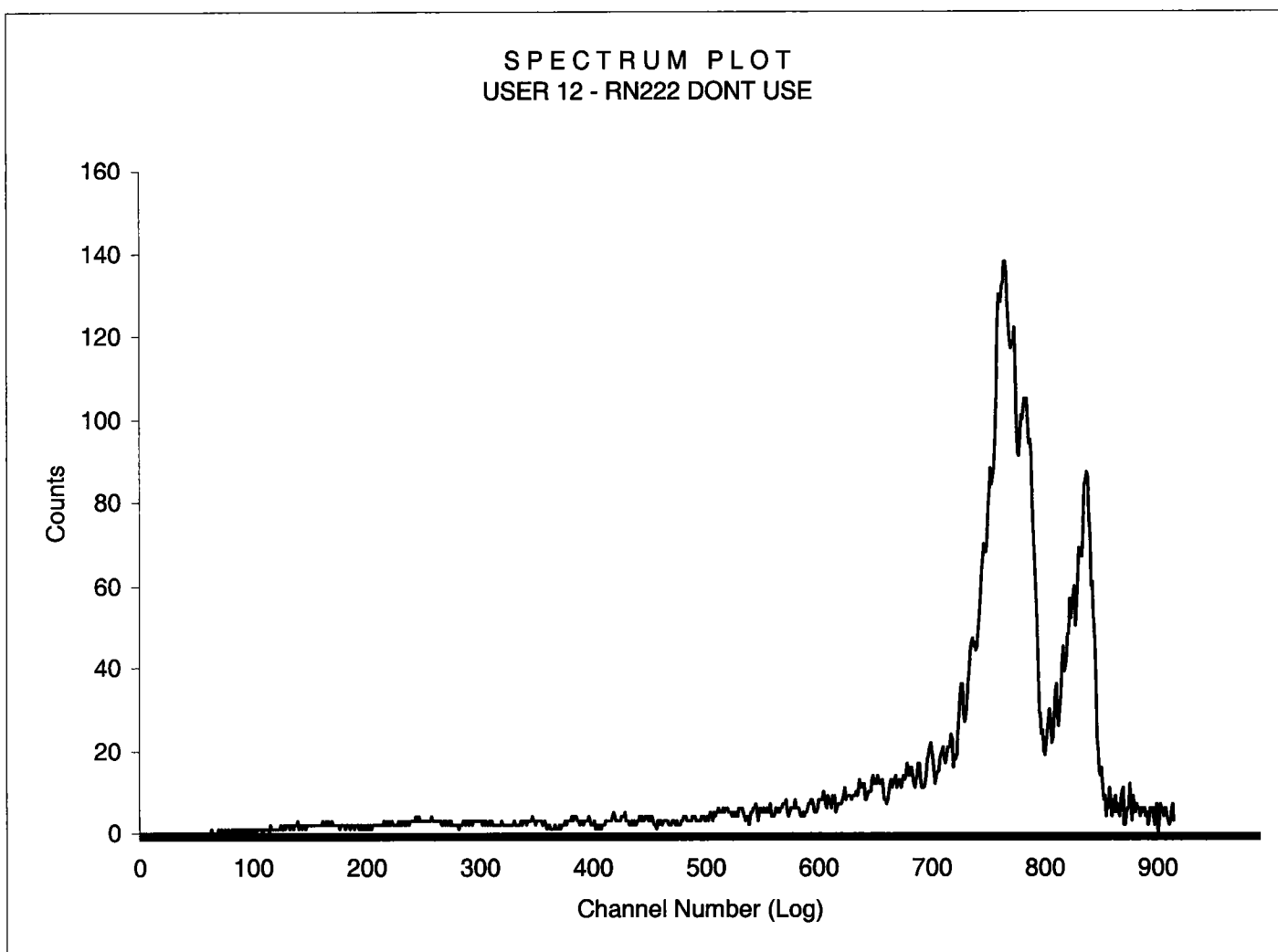


Sample Count Start Time:	28 Jul 2009 09:35:21		
Data Capture Date	28 Jul 2009 09:46:26		
User Filename	S12072857-3A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	3	57-3	10.85
H#, Total Counts:	50.8	11720	
Start, End, X-Axis:	0	990	Channel Number



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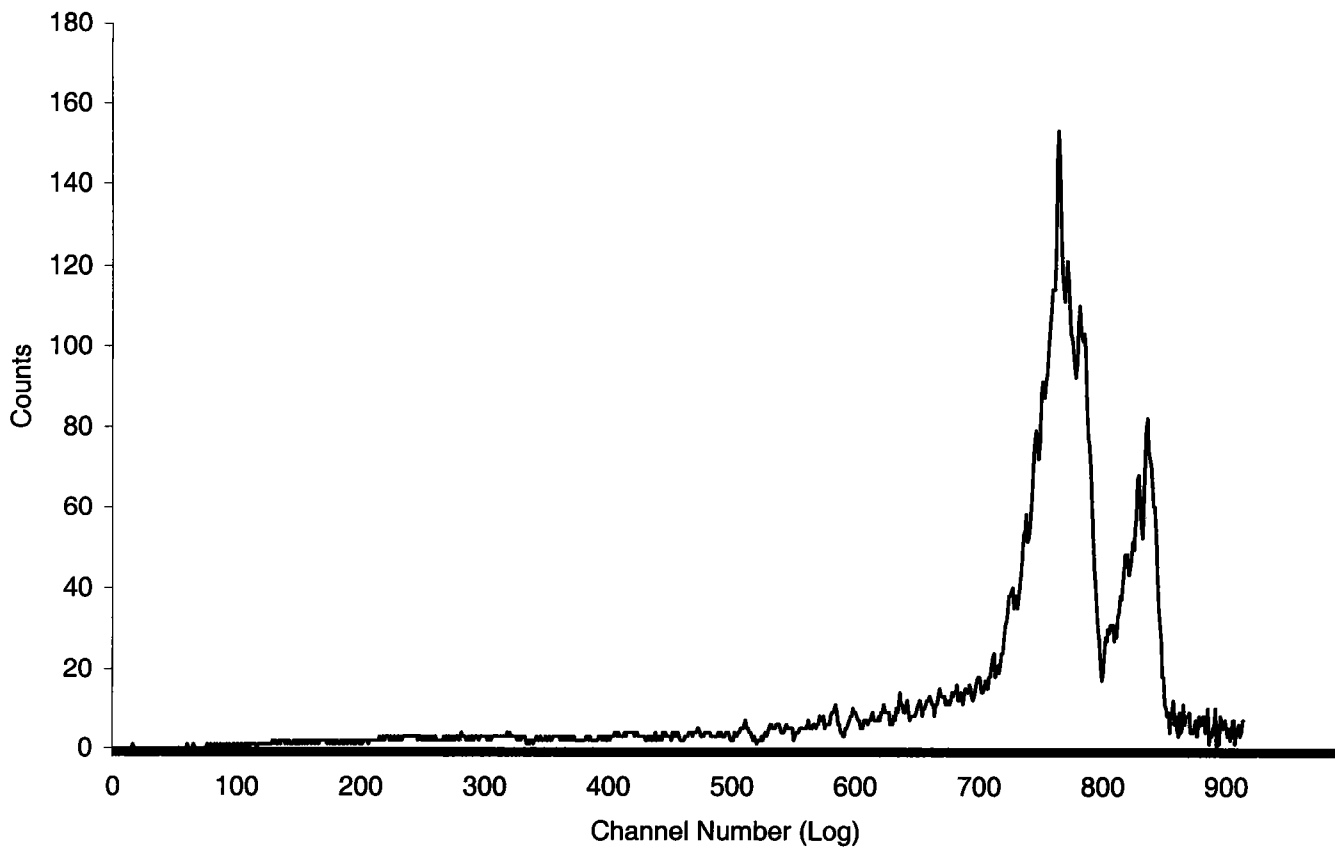
Sample Count Start Time:	28 Jul 2009 09:47:24		
Data Capture Date	28 Jul 2009 09:57:56		
User Filename	S12072857-4A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	4	57-4	10.80
H#, Total Counts:	49.6	11690	
Start, End, X-Axis:	0	990	Channel Number



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Sample Count Start Time:	28 Jul 2009 09:59:15		
Data Capture Date	28 Jul 2009 10:09:36		
User Filename	S12072857-5A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	5	57-5	10.60
H#, Total Counts:	50.3	11687	
Start, End, X-Axis:	0	990	Channel Number

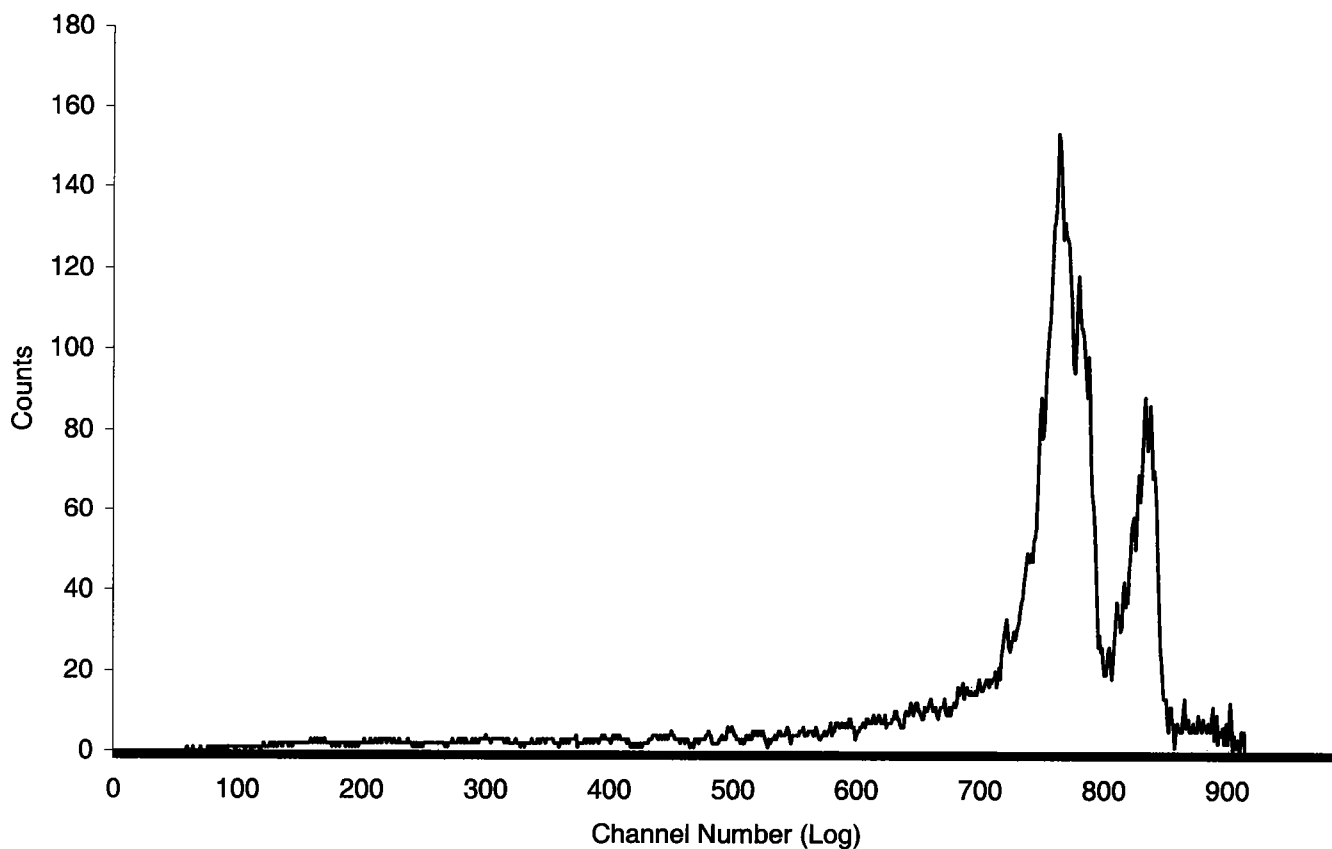
SPECTRUM PLOT  
USER 12 - RN222 DONT USE



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28 Jul 2009

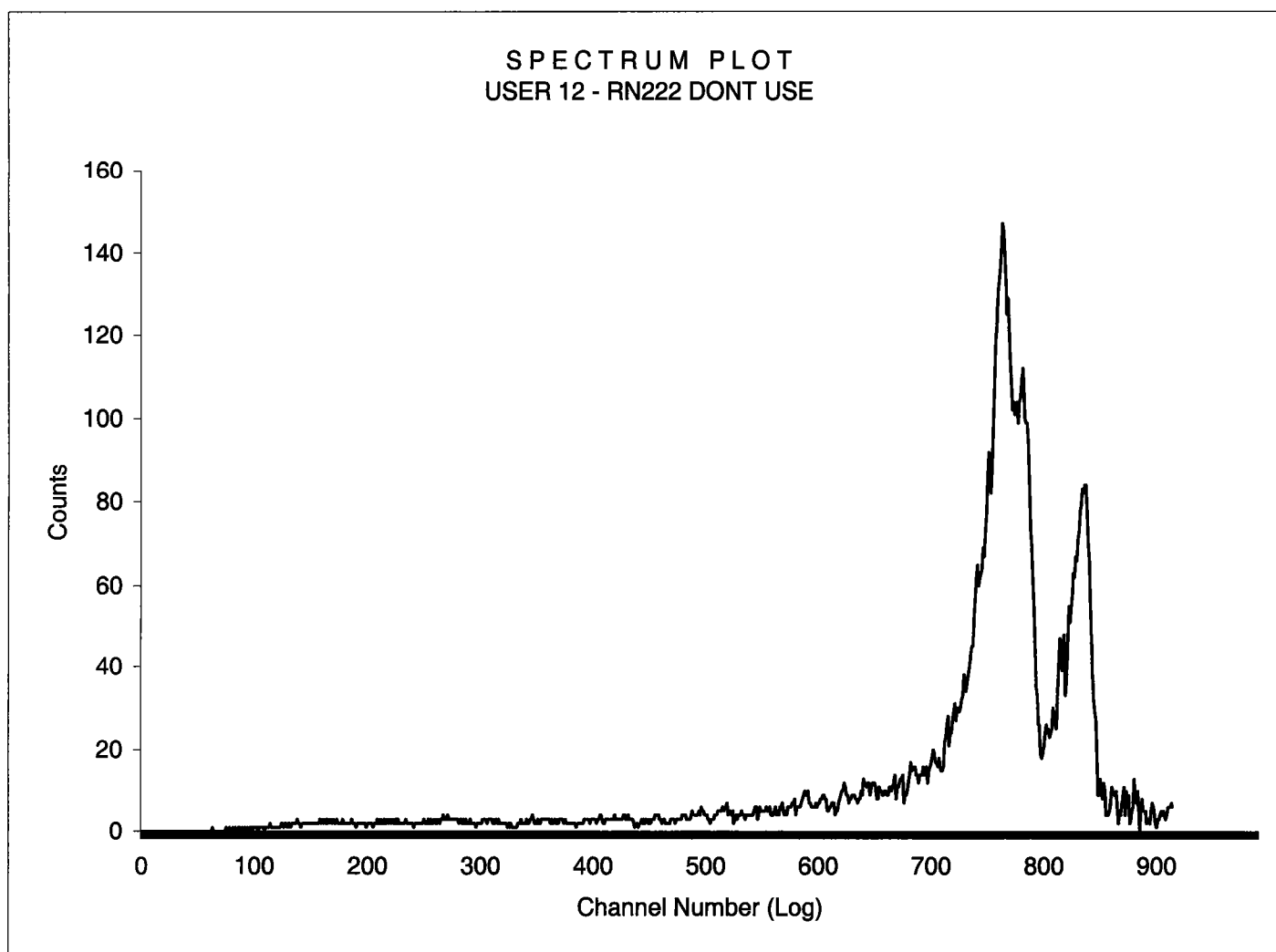
Sample Count Start Time:	28 Jul 2009 10:10:57		
Data Capture Date	28 Jul 2009 10:21:07		
User Filename	S12072857-6A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	6	57-6	10.45
H#, Total Counts:	49.2	11606	
Start, End, X-Axis:	0	990	Channel Number

SPECTRUM PLOT  
USER 12 - RN222 DONT USE



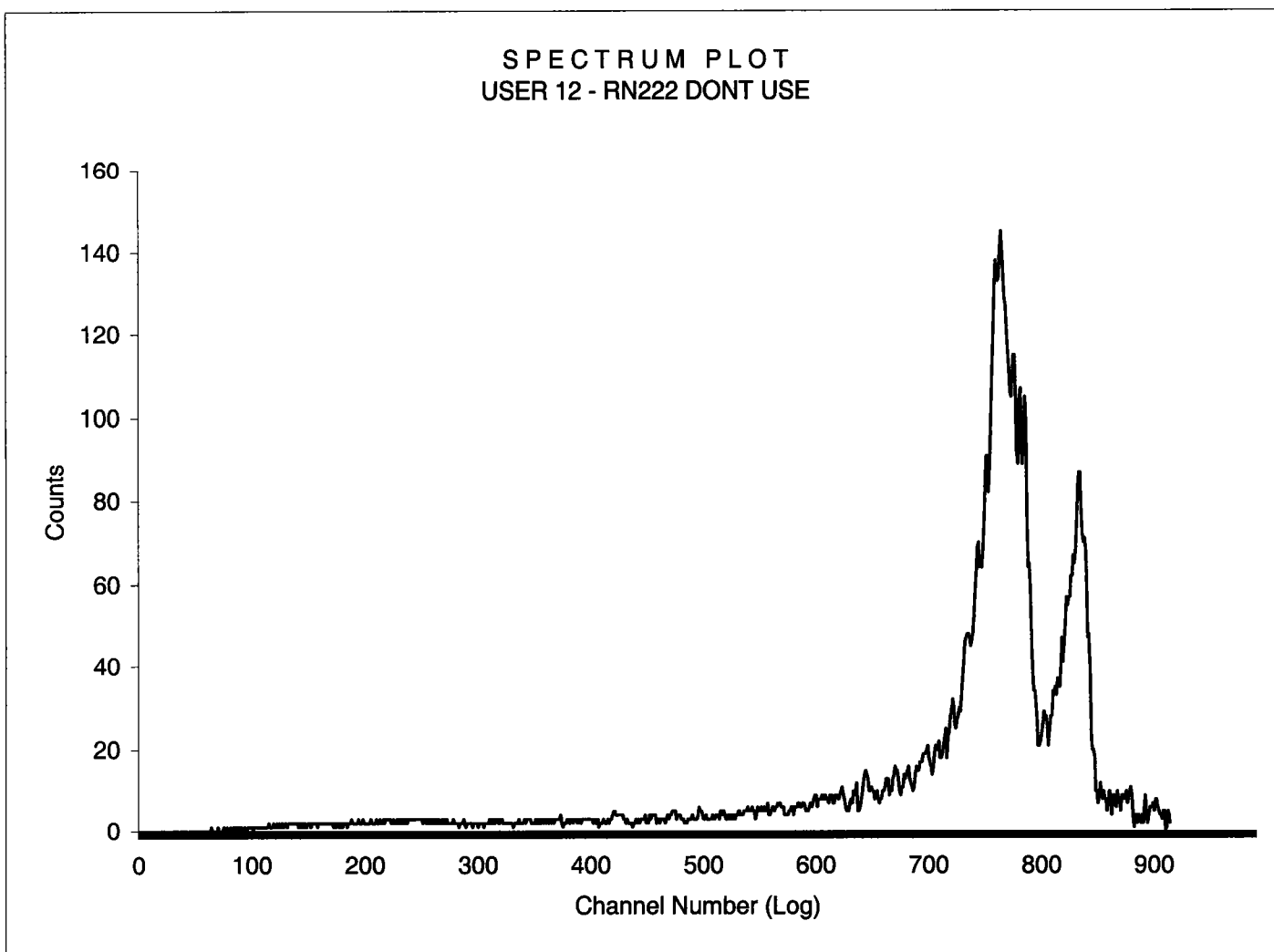
*Handwritten signature/initials*

Sample Count Start Time:	28 Jul 2009 10:22:35		
Data Capture Date	28 Jul 2009 10:33:08		
User Filename	S12072857-7A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	7	57-7	10.80
H#, Total Counts:	51.0	11700	
Start, End, X-Axis:	0	990	Channel Number



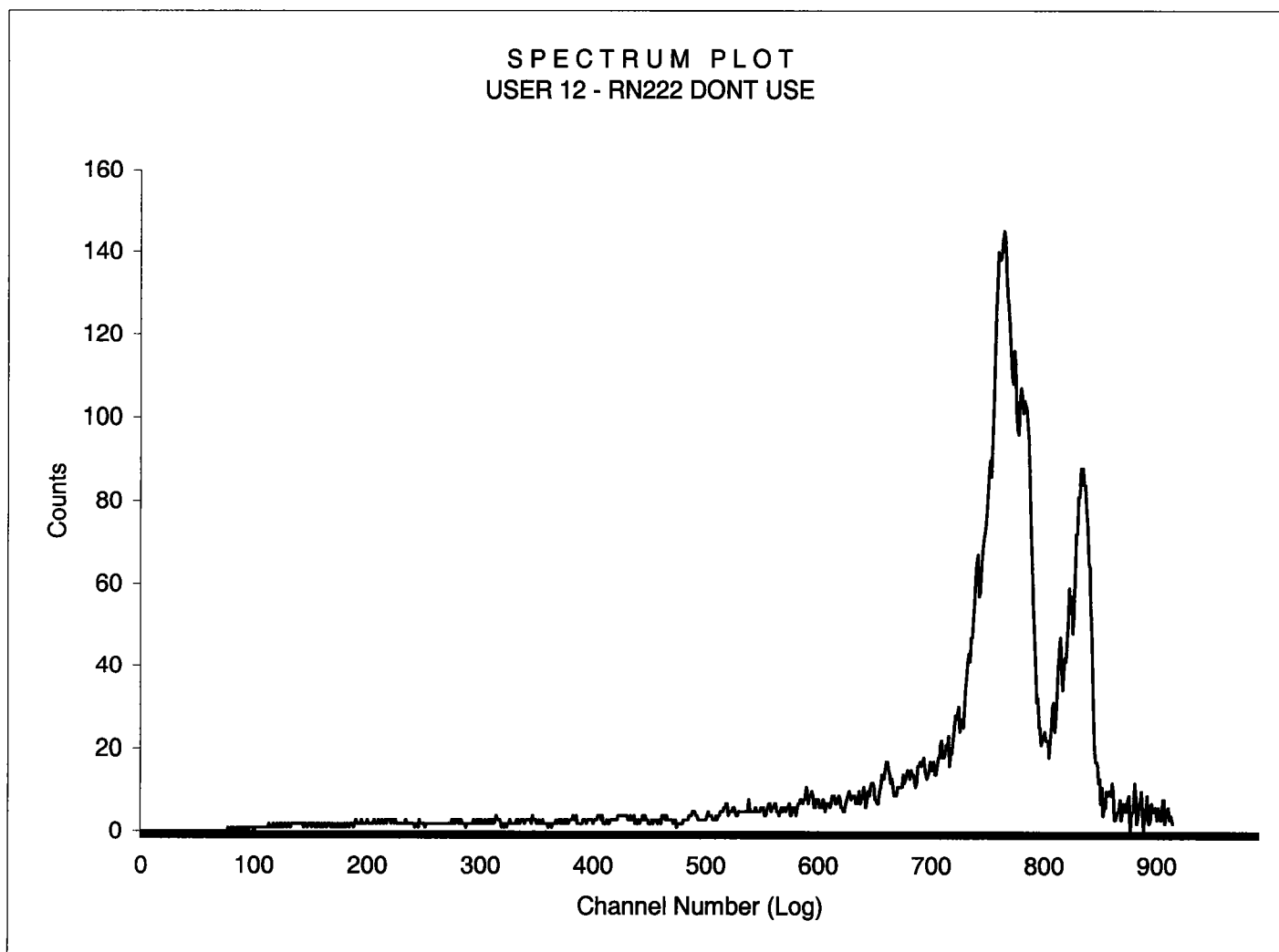
*JD 8/4/09*

Sample Count Start Time:	28 Jul 2009 10:34:28		
Data Capture Date	28 Jul 2009 10:44:39		
User Filename	S12072857-8A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	8	57-8	10.45
H#, Total Counts:	50.9	11680	
Start, End, X-Axis:	0	990	Channel Number



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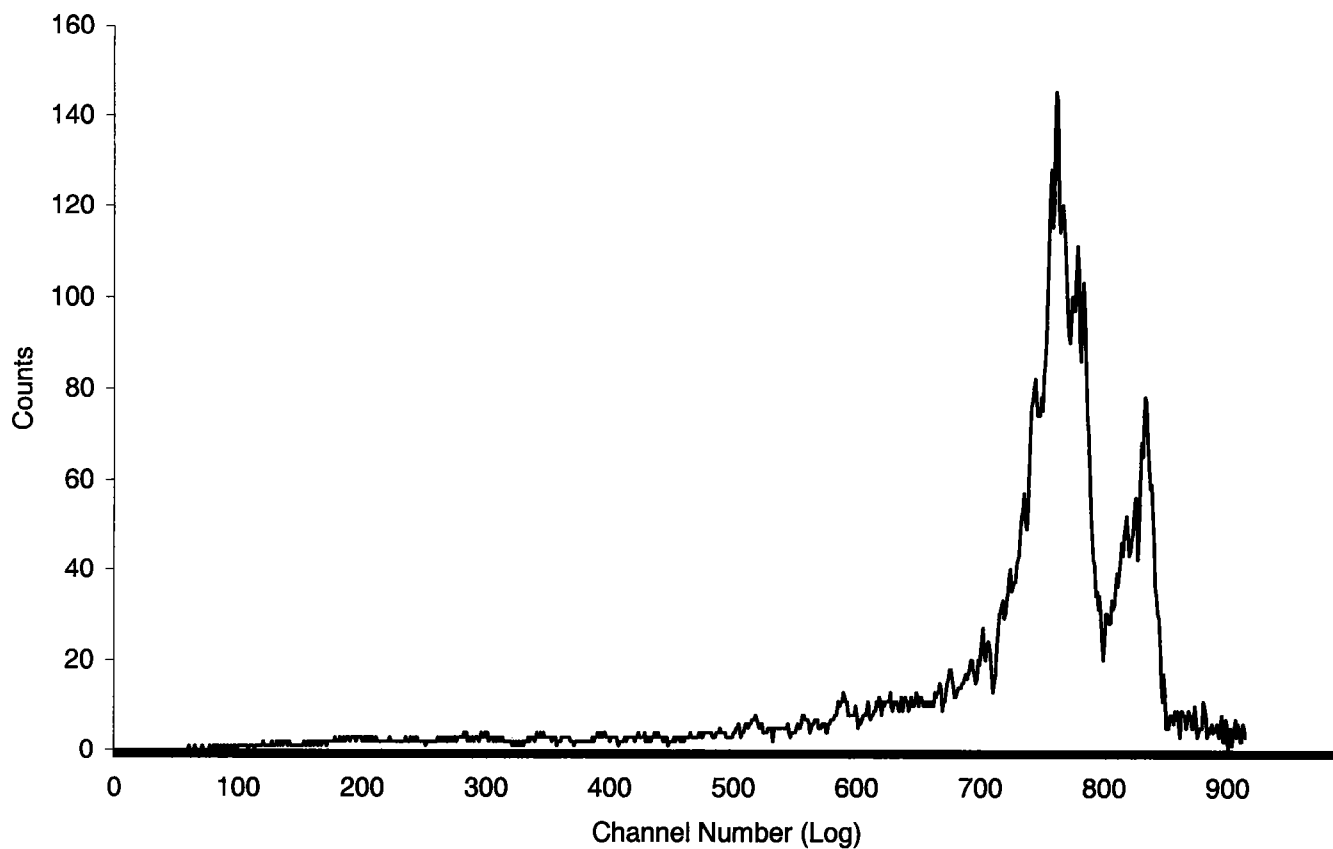
Sample Count Start Time:	28 Jul 2009 10:46:00		
Data Capture Date	28 Jul 2009 10:56:26		
User Filename	S12072857-9A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	9	57-9	10.70
H#, Total Counts:	51.4	11732	
Start, End, X-Axis:	0	990	Channel Number



*28/7/09*

Sample Count Start Time:	28 Jul 2009 10:57:54		
Data Capture Date	28 Jul 2009 11:08:32		
User Filename	S12072857-10A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	10	57-10	10.85
H#, Total Counts:	52.8	11797	
Start, End, X-Axis:	0	990	Channel Number

SPECTRUM PLOT  
USER 12 - RN222 DONT USE



28/8/09



0024



CALIBRATION  
No 0146

Description Principal radionuclide: Radium-226 Product code: RAY.44  
Solution number: R4/131/58

Measurement Reference time: 1200 GMT on 10 September 1997

Radioactive concentration of radium-226: 43.85 kilobecquerels per gram of solution  
which is equivalent to: 1.185 microcuries per gram of solution

Mass of solution: 5.0357 grams

Total activity of radium-226: 220.8 kilobecquerels  
which is equivalent to: 5.968 microcuries

Recommended half life: 1600.00 years

Method of measurement:  
The activity of the solution was measured in a high pressure re-entrant ionisation chamber calibrated with a large number of absolutely standardised solutions.

Accuracy Overall uncertainty in the radioactive concentration quoted above:  $\pm 3.7 \%$   
Random uncertainty:  $\pm 0.7 \%$  Systematic uncertainty:  $\pm 3.0 \%$

The limits of overall uncertainty were taken as the arithmetic sum of the uncertainty due to random variations, calculated at the 99.7% confidence level, and the estimated systematic uncertainties in the measurement.

Radionuclidic Purity The estimated activities of any radioactive impurities found by high-resolution gamma ray spectrometry, or in any other examination of the solution, are listed below expressed as percentages of the activity of the principal radionuclide at the reference time.

Chemical Composition. Carrier free in 0.5M HCl

Remarks At the reference date radium-226 was shown to be in radioactive equilibrium with its daughter nuclides down the decay chain to polonium-214 and thallium-210, the precursors of lead-210. The ionisation chamber was calibrated using a standard supplied by the National Institute of Standards and Technology, Washington DC, USA.

This product meets the quality assurance requirements of the NRC Regulatory Guide 4.15 for achieving implicit NIST traceability as defined in NCRP 58 (1985).

Approved  
Signatory

*[Signature]*

20-5-021-097



# Standard Traceability Log Rad

Source Material Info		A Solution Material Info	
Parent Code:	0024	Isotope:	Radium-226
Prepared By:	Richard Kinney	Prepared By:	Angela Johnson
Carrier Conc:	0.5 M HCL	Prep Date:	01/22/1999
Reference Date:	09/10/1997	Verification Date:	01/23/2008
Ampoule Mass (g):	5.0357 g	Expiration Date:	04/09/2010
Uncertainty:	+/- 3.7 %	Primary Code:	0024-A
LogBook No:	RC S 021 097	Dilution(mL):	100 mL
		Mass of Parent(g):	4.9958 g
		Density(g/mL):	1.0044
		Balance ID:	38080204

**Calculations Converting parent activity to dpm/mL|dpm/g**

$$(\text{Mass of parent(g)}) * (\text{Parent Activity (kBq/g)}) * (\text{conversion dpm to kBq}) / (\text{Dilution Vol}) = \text{Parent Activity (dpm/mL)}$$


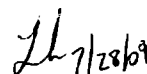
$$(\text{Mass of parent(g)}) * (\text{Parent Activity (kBq/g)}) * (\text{conversion dpm to kBq}) / \text{Density (g/mL)} / (\text{Dilution Vol}) = \text{Parent Activity (dpm/g)}$$

$$(4.9958 \text{ g}) * (43.85 \text{ kBq/g}) * (60000 \text{ dpm/kBq}) / (100 \text{ mL}) = 131439.4980 \text{ dpm/mL}$$

$$(4.9958 \text{ g}) * (43.85 \text{ kBq/g}) * (60000 \text{ dpm/kBq}) / (1.0044 \text{ g/mL}) / (100 \text{ mL}) = 130865.9326 \text{ dpm/g}$$
**Secondary Standards**

Prep Date	Preparer	Mass Primary	Dilution (mL)	Code	Conc dpm/mL	Verification Date	Expiration Date
03/02/2000	Angela Johnson	10.5724	100	0024-D	13834.1 dpm/mL	02/10/2005	02/10/2006
08/23/2002	Angela Johnson	8.0371	100	0024-G	10516.626 dpm/mL	02/10/2004	02/10/2005

GEL Laboratories LLC  
Version 1.0 9/18/2000

## Verification for Ra-226 Standard 0024-A 09

M. Aders 4/13/2009	Isotope	Value	Uncertainty
	0024-A	5930.765	106.9965
	0024-A	5563.022	98.7976
	0024-A	5699.674	104.7832
Mean Value (Counting) =	5731.153	97.29	Pass
Stdev =	185.8813485		Rule 3 (Pass/Fail)
Target =	5891.04		
Lower Limit =	5359.390736		
Upper Limit =	6102.91613		
Rule 1 Pass/Fail	Pass		
Two sigma =	371.762697		
10 % of Mean =	573.1153433		
Rule 2 (Pass/Fail)	Pass		

Rule 1 = The certificate value (NOT including any uncertainty) shall lie within the 95% confidence interval determined from the mean and two sigma standard deviation of the three measurements

Rule 2 = The two sigma value used for the 95% confidence interval shall not exceed 10% of the mean value of the three verification measurements.

Rule 3 = The determined mean value shall be within 5% of the certificate value.

The analyst prepared three standard verification sources for Ra-226 source 0024-A by transferring portions of the degassed standard into tared glass liquid scintillation vials. Ten mL of DI Water and 10 mL mineral oil was added to each vial and the vials were shaken to mix. A Blank vial was prepared in a similar fashion using 10 mL of DI water and 10 mL of mineral oil. The standard verification vials and Background source were dark adapted for two hours and counted on LSC Green using source standard verification. Each verification source calculation was performed as follows:

$$\text{Source dpm/g} = (A - B)/(C)(D)$$

where:

- A = Ver. source cpm,
- B = BKG cpm,
- C = System efficiency, (cpm/dpm), and
- D = mass used for standard verification.

Reference RAD SOP M-001

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*Handwritten signature: M. Aders 4/14/09*

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## Radon-222 Liquid

Filename : RN222.XLS  
File type : Excel  
Version # : 1.2.3

Spike S/N : N/A  
Spike Exp Date : N/A  
Spike Activity (dpm/ml): N/A  
Spike Volume Added: N/A  
Spike Date/Time: 4/9/2009 14:45

LCS S/N : 0024-A  
LCS Exp Date : 7/23/2009  
LCS Activity (dpm/ml): 130781.16  
LCS Volume Added: 0.10

Batch : 856389  
Analyst : AF1  
Prep Date : 4/9/2009

Procedure Code : LSC22RNL  
Parname : Radon-222  
Required MDA : 200  
Half-life of Radon-222 : 3.823

pCi/L  
days

Rn-222 Abundance : 1

Rn-222 Method Uncertainty : 0.1111

Geometry : 10ML MINERAL OIL/10ML

SAMPLE

Pipet, 0.1 ml Sidev : +/- 0.000701 ml  
Pipet, 0.5 ml Sidev : +/- 0.002564 ml

Sample Characteristics				Count raw Data							Background		Count		Sample	
Sample ID	Sample Aliquot L	Sample Aliquot StDev. L	Sample Date/Time	Rack Position #	Counting Time (min.)	Quench#	Gross cpm	cpm	Count Time (min.)	Date/Time	Start	Decay				
1201812586.1	1.0000	2.0399E-05	4/9/2009 14:45	29-2	0.5	51.1	23650	21.60	15	4/13/2009 16:30		0.478				
1201812587.1	1.0000	2.0399E-05	4/9/2009 14:45	29-3	0.55	48.9	22189.09	21.60	15	4/13/2009 16:32		0.478				
1201812588.1	1.0000	2.0399E-05	4/9/2009 14:45	29-4	0.5	50.2	22738	21.60	15	4/13/2009 16:34		0.478				
1201812589.1	1.0000	2.0399E-05	4/9/2009 14:45	29-5	4.3	50.2	2636.28	21.60	15	4/13/2009 16:35		0.477				
1201812590.1	1.0000	2.0399E-05	4/9/2009 14:45	29-6	4.45	49.7	2562.25	21.60	15	4/13/2009 16:41		0.477				
1201812591.1	1.0000	2.0399E-05	4/9/2009 14:45	29-7	4.55	49.3	2521.76	21.60	15	4/13/2009 16:46		0.477				
1201812592.1	1.0000	2.0399E-05	4/9/2009 14:45	29-8	15	49.6	477.4	21.60	15	4/13/2009 16:52		0.476				
1201812593.1	1.0000	2.0399E-05	4/9/2009 14:45	29-9	15	50.3	486.73	21.60	15	4/13/2009 17:09		0.475				
1201812594.1	1.0000	2.0399E-05	4/9/2009 14:45	29-10	15	48.5	501.67	21.60	15	4/13/2009 17:25		0.474				

1201812586.1

Calibration Data				Backgrounds			Correction Factors		Net Sample Activity for MS	
Counted on	Calibration Date	Calibration Due Date	Detector Efficiency (cpm/dpm)	Detector Efficiency Error (cpm/dpm)	Rack Position #	Count Start Date/Time	Spike Date/Time	Rn-222 Ingrowth	Rn-222 Count Correction	pCi/L
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.522	0.522	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.522	0.522	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.522	0.522	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.523	0.523	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.523	0.523	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.523	0.523	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.524	0.524	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.525	0.525	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.526	0.526	

4/14/10  
4/14/10  
4/14/10

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RN856389rr

Notes:

- Results are decay corrected to Sample Date/Time
- Reference date for Spike Activity (dpm/ml) is the batch Prep Date
- Spike Nominals are decay corrected to Sample Date/Time

Results Decision Level pCi/L	Critical Level pCi/L	MDA pCi/L	Sample Act. Conc. pCi/L	Sample Act. Error pCi/L	Net Count Rate CPM	Net Count Rate Error CPM	2 SIGMA		Sample QC	Sample Type	RPD	RER	Nominal pCi/L	Recovery
							Counting Uncertainty pCi/L	Total Prop. Uncertainty pCi/L						
3.9075	2.7587	7.0234	5930.7645	0.0121	23628.4000	217.4889	106.9965	1299.1505		LCS			5891.0434	100.7%
3.7309	2.6341	6.6370	5563.0219	0.0120	22167.4900	200.8612	98.7976	1218.4676		LCS			5891.0434	94.4%
3.9060	2.7576	7.0207	5699.6739	0.0123	22716.4000	213.2544	104.8732	1248.6996		LCS			5891.0434	96.8%
1.4856	1.0489	2.2727	655.7702	0.0124	2614.6800	24.7897	12.1860	143.6780		LCS			612.8784	107.0%
1.4651	1.0344	2.2377	636.7951	0.0123	2540.6500	24.0255	11.8028	139.5180		LCS			612.8784	103.9%
1.4517	1.0249	2.2150	626.2343	0.0123	2500.1600	23.5727	11.5727	137.2013		LCS			612.8784	102.2%
0.9892	0.6984	1.4467	114.0215	0.0149	455.8000	5.7677	2.8280	25.0520		LCS			108.5740	105.0%
0.9873	0.6970	1.4440	116.1380	0.0148	465.1300	5.8214	2.8489	25.5135		LCS			108.5740	107.0%
0.9855	0.6957	1.4413	119.6448	0.0146	480.0700	5.9063	2.8851	26.2784		LCS			108.5740	110.2%

REC'D  
11/17/13

Table 1. *Salmonella* serotypes and their associated diseases

[illegible]

$\chi^2 = 1.0$ ,  $df = 1$ ,  $p = .32$ . The  $\chi^2$  test for the interaction of the two variables was not significant ( $\chi^2 = 0.00$ ,  $df = 1$ ,  $p = .99$ ).

[illegible]

$\frac{1}{2} \left( \frac{1}{2} \right) = \frac{1}{4}$

INDEX OF AUTHORS

[illegible]

13

2007  
4/14/09

Sample Count Start Time:

13 Apr 2009 16:14:45

Data Capture Date:

13 Apr 2009 16:30:02

User Filename:

S16041329-1A.WK1

U16041329-1A.WK1

Spectrum Type

Log Counts

User Number:

16

User Id:

RN-222

User Comment:

GREEN

Isotope Name:

$^{14}\text{C}$

Scintillator:

LIQUID

Sample, Rack-Pos, Time:

1 29-1 15.00

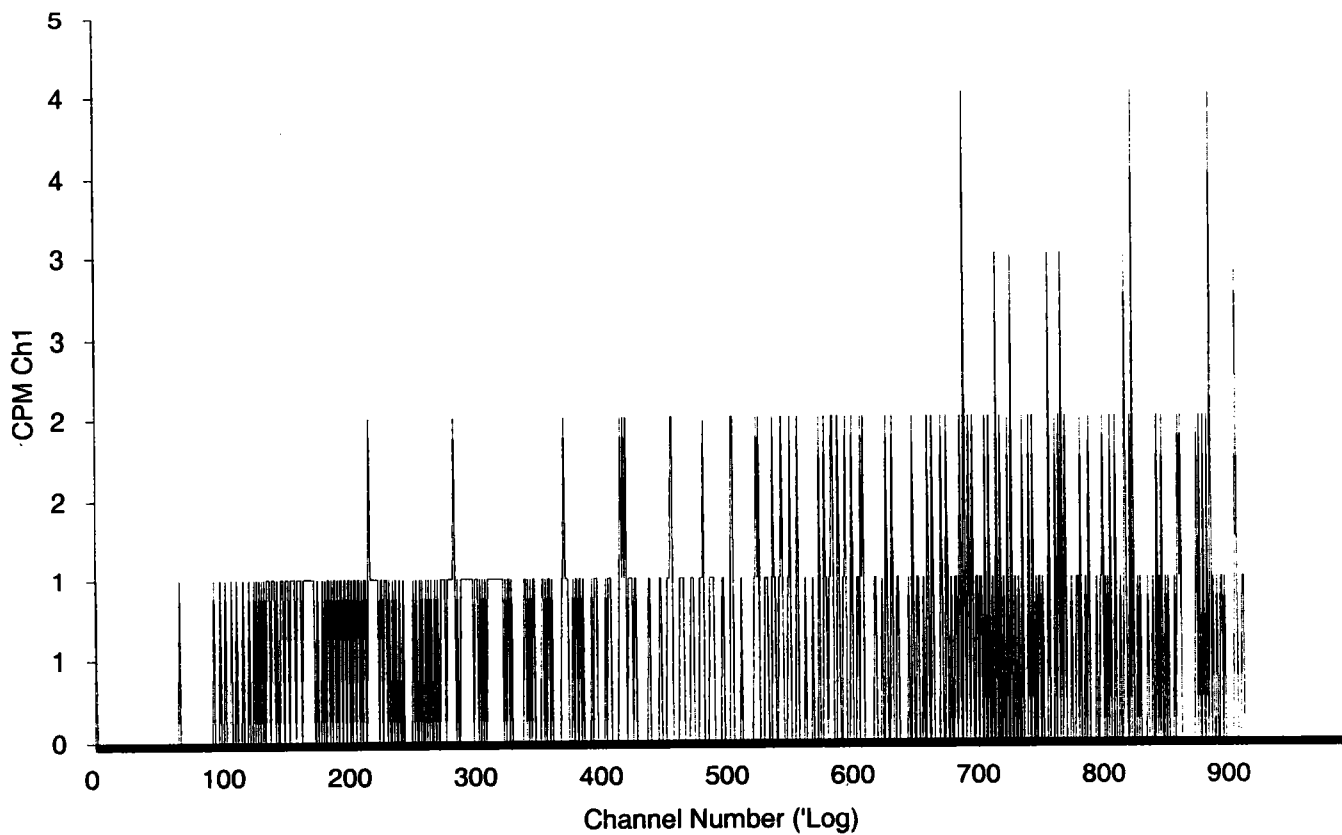
H#, Total Counts:

48.1 450

Start, End, X-Axis:

0 990 Channel Number

SPECTRUM PLOT  
USER 16 - RN-222

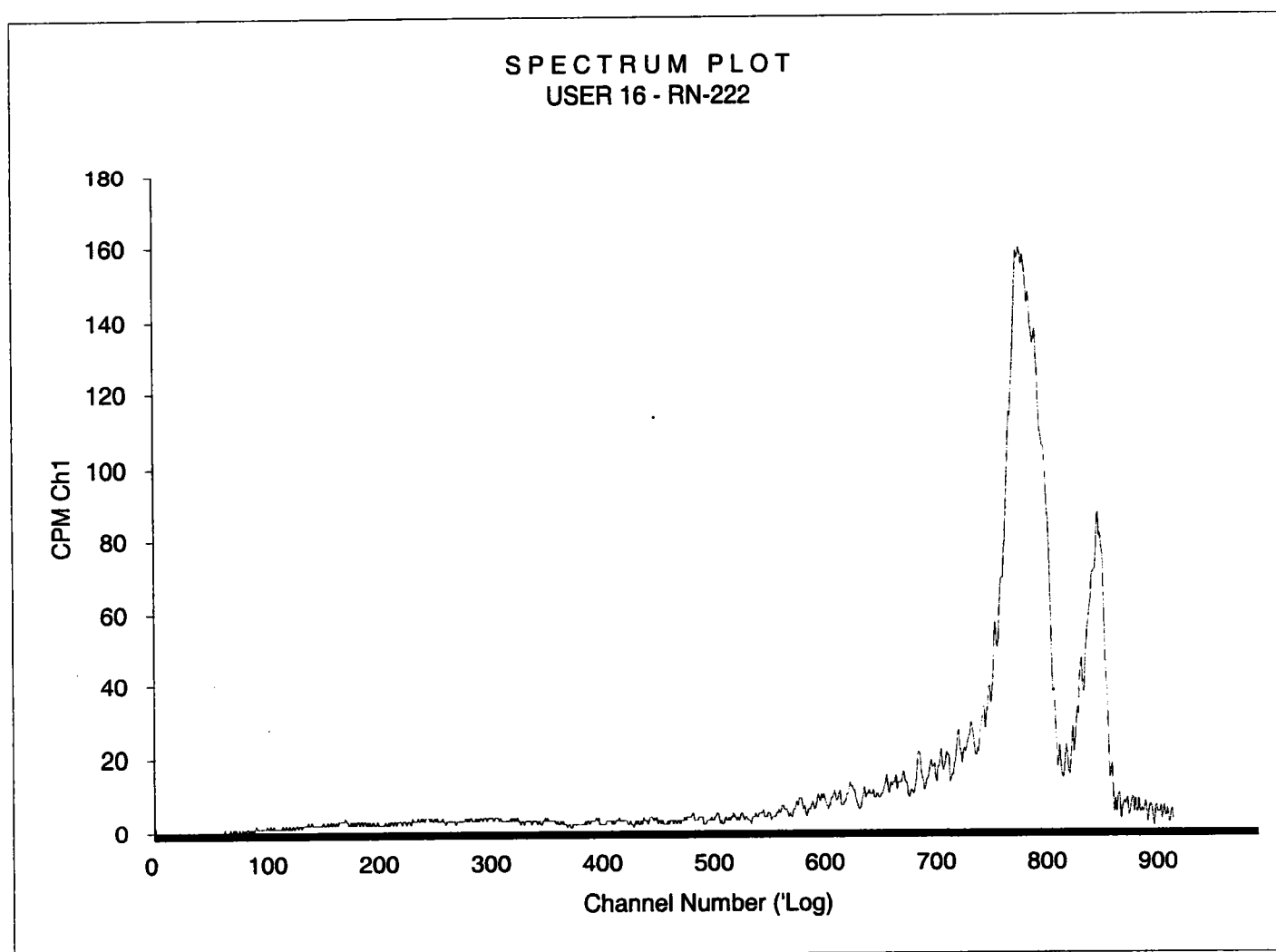


*2/8/4/9*

*2/8/4/9*



Sample Count Start Time:	13 Apr 2009 16:30:50		
Data Capture Date:	13 Apr 2009 16:31:39		
User Filename:	S16041329-2A.WK1		
	U16041329-1A.WK1		
Spectrum Type	Log Counts		
User Number:	16		
User Id:	RN-222		
User Comment:	GREEN		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	2	29-2	0.50
H#, Total Counts:	51.1	12433	
Start, End, X-Axis:	0	990	Channel Number



*Handwritten signature*  
4/8/09

*Handwritten text*  
4/11/09

Sample Count Start Time:  
Data Capture Date:  
User Filename:

13 Apr 2009 16:32:27  
13 Apr 2009 16:33:19  
S16041329-3A.WK1  
U16041329-1A.WK1

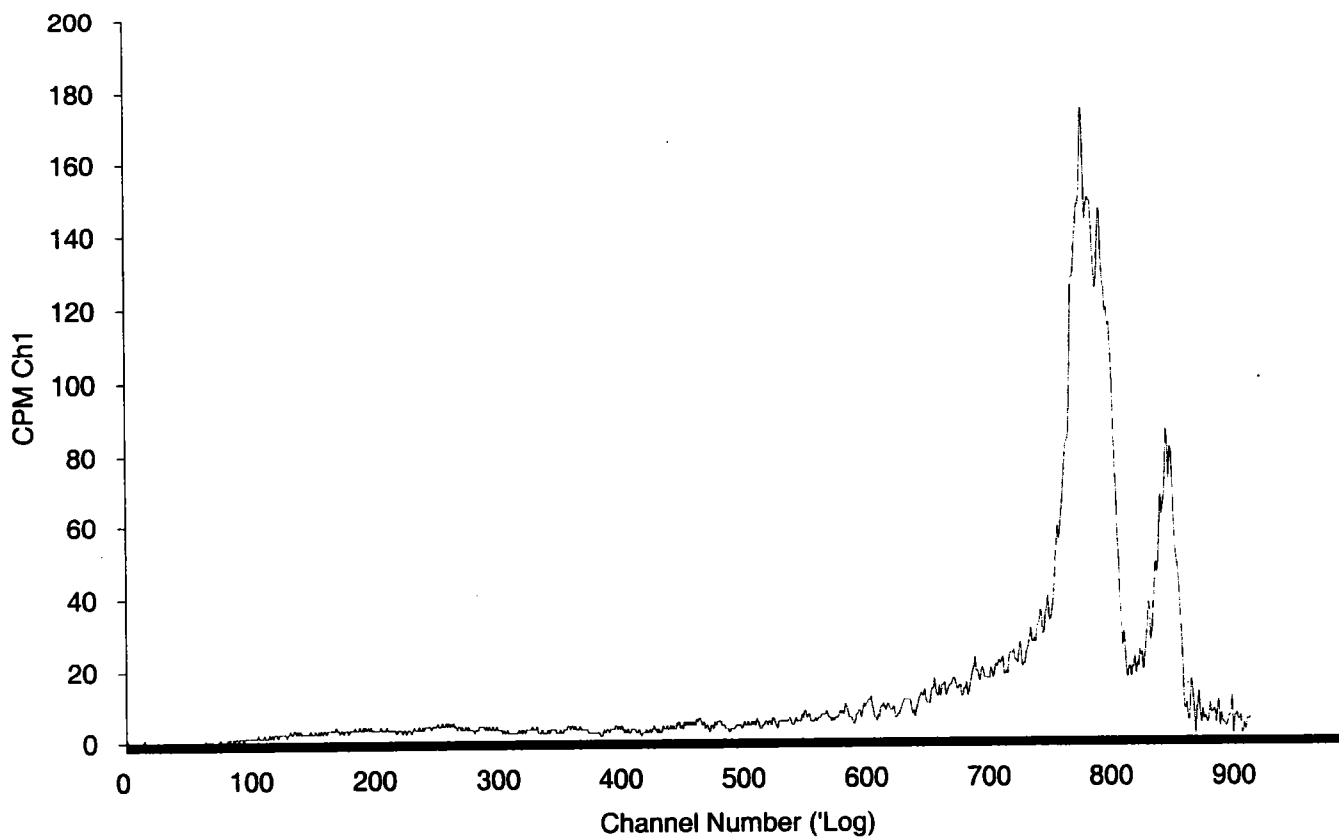
Spectrum Type  
User Number:  
User Id:  
User Comment:  
Isotope Name:

Log Counts  
16  
RN-222  
GREEN  
14C  
LIQUID

Sample, Rack-Pos, Time:  
H#, Total Counts:  
Start, End, X-Axis:

3            29-3            0.55  
48.9        12867  
0            990            Channel Number

SPECTRUM PLOT  
USER 16 - RN-222



Lh 3/4/09

11/11/09

Sample Count Start Time:

13 Apr 2009 16:34:09

Data Capture Date:

13 Apr 2009 16:34:57

User Filename:

S16041329-4A.WK1

U16041329-1A.WK1

Spectrum Type

Log Counts

User Number:

16

User Id:

RN-222

User Comment:

GREEN

Isotope Name:

$^{14}\text{C}$

Scintillator:

LIQUID

Sample, Rack-Pos, Time:

4 29-4 0.50

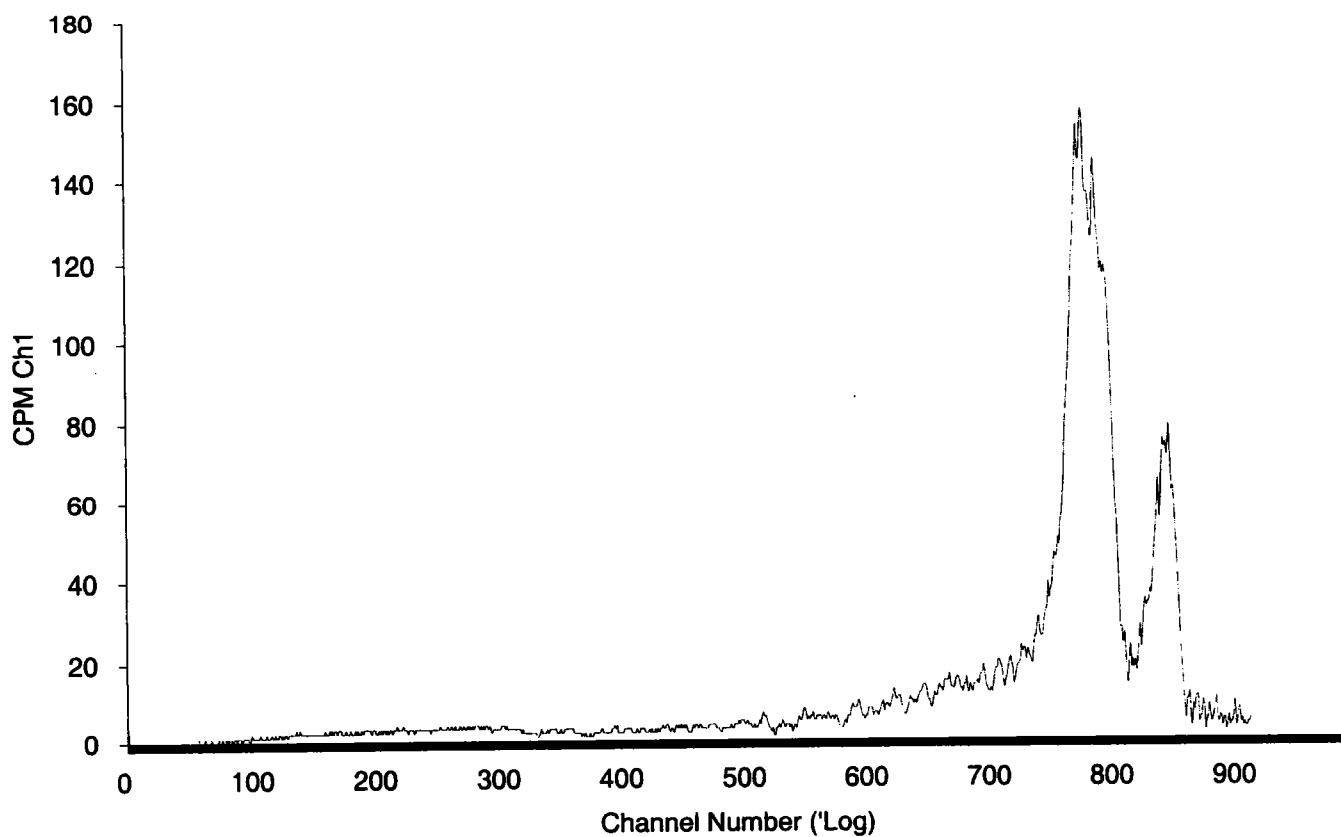
H#, Total Counts:

50.2 11972

Start, End, X-Axis:

0 990 Channel Number

SPECTRUM PLOT  
USER 16 - RN-222



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4/14/09

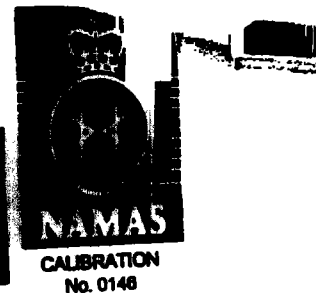
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4/14/09

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lec'd

8-21-00  
Nycomed Amersham plc  
Amersham Laboratories

0299



ISSUED

Nycomed Amersham plc  
Radiation & Radioactivity  
Calibration Laboratory  
Amersham Laboratories  
White Lion Road  
Amersham  
Buckinghamshire  
HP7 9LL

ISSUED  
FOR:

AEA Technology plc  
Isotrak  
Amersham Laboratories  
White Lion Road  
Amersham  
Buckinghamshire  
HP7 9LL

Description Principal radionuclide: Radium-226

Product code: RAY44  
Solution number: R4/131/89

Measurement Reference time: 1200 GMT on 15 December 1999

Nuclear data Nuclear data quoted on this certificate are taken from the Joint European File, Version 2.2.

Expression of The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor  $k = 2.00$ , which  
uncertainties for a  $t$ -distribution with  $v_{eff} = \infty$  effective degrees of freedom corresponds to a coverage probability of approximately  
95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Unless indicated, all other uncertainties are expressed at the confidence level associated with one standard  
uncertainty.

The format used for the uncertainties in the values of radionuclidic purity is illustrated in the following examples;

6.5(21)	=	$6.5 \pm 2.1$
6.54(21)	=	$6.54 \pm 0.21$
6.543(21)	=	$6.543 \pm 0.021$

*[Handwritten signature]*  
22/8/99

17<sup>th</sup> December 1999



## Standard Traceability Log Rad

Source Material Info		A Solution Material Info	
Parent Code:	0299	Isotope:	Radium-226
Prepared By:	Angela Johnson	Prepared By:	Angela Johnson
Carrier Conc:	0.5 M HCL	Prep Date:	09/15/2000
Reference Date:	12/15/1999	Verification Date:	01/23/2008
Ampoule Mass (g):	5.0368 g	Expiration Date:	01/23/2009
Uncertainty:	+/- 2.5 %	Primary Code:	0299-A
LogBook No:	RC S 027 128	Dilution(mL):	100 mL
		Mass of Parent(g):	4.6634 g
		Density(g/mL):	1.0012
		Balance ID:	

## Calculations Converting parent activity to dpm/mL dpm/g

$(\text{Mass of parent(g)}) * (\text{Parent Activity (kBq/g)}) * (\text{conversion dpm to kBq}) / (\text{Dilution Vol}) = \text{Parent Activity (dpm/mL)}$
$(\text{Mass of parent(g)}) * (\text{Parent Activity (kBq/g)}) * (\text{conversion dpm to kBq}) / \text{Density (g/mL)} / (\text{Dilution Vol}) = \text{Parent Activity (dpm/g)}$
$(4.6634 \text{ g}) * (43.75 \text{ kBq/g}) * (60000 \text{ dpm/kBq}) / (100 \text{ mL}) = 122414.2500 \text{ dpm/mL}$
$(4.6634 \text{ g}) * (43.75 \text{ kBq/g}) * (60000 \text{ dpm/kBq}) / (1.0012 \text{ g/mL}) / (100 \text{ mL}) = 122273.3377 \text{ dpm/g}$

## Secondary Standards

Prep Date	Preparer	Mass Primary	Dilution (mL)	Code	Conc dpm/mL	Verification Date	Expiration Date
08/26/2003	Angela Johnson	1.9909	100	0299-E	2434.34 dpm/mL	11/04/2004	11/04/2005
08/26/2003	Angela Johnson	1.9872	100	0299-F	2429.82 dpm/mL	08/26/2004	08/26/2005
04/05/2005	Amanda Fehr	5.0018	250	0299-G	2446.3471 dpm/mL	04/02/2008	04/02/2009

GEL Laboratories LLC  
Version 1.0 9/18/2000

2/8/4/09

# Verification for Ra-226 Standard 0299-G

4/2/2008		Isotope		Standard	
D. Roy					
		D. Roy			
		0299-G N1	2536.9600	52.4000	2484.5600
		0299-G N2	2520.2500	52.4000	2467.8500
		0299-G N3	2532.5000	52.4000	2480.1000
Mean Value (Counting) =		2558.093715			
Stdev =		10.63610098			
Certificate Value =		2437.6	dpm/mL		
Lower Limit =		2536.821513	dpm/mL		
Upper Limit =		2579.365917	dpm/mL		
Rule 1 Pass/Fail		Fail	*exception taken due to full recovery of standard		
Two sigma =		21.27220197	dpm/mL		
10 % of Mean =		255.8093715	dpm/mL		
Rule 2 (Pass/Fail)		Pass			
				NET CPM	Detector Eff
				2484.5600	1.917186
				2467.8500	1.917186
				2480.1000	1.917186
					0.5057
					0.5056
					0.5042
					Average =
					2558.093715

## Verification Rules

- Rule 1 = The certificate value (NOT including any uncertainty) shall lie within the 95% confidence interval determined from the mean and two sigma standard deviation of the three measurements
- Rule 2 = The two sigma value used for the 95% confidence interval shall not exceed 10% of the mean value of the three verification measurements.
- Rule 3 = The determined mean value shall be within 10% of the certificate value.

The analyst prepared three standard verification sources for Ra-226 source 0299-G by transferring portions of the standard into tared glass liquid scintillation vials. One mL of DI Water and ten mLs of Ready Gel liquid scintillation cocktail was added to each vial and the vials were shaken to mix. A Blank vial was prepared in a similar fashion using 1 mL of DI water and 10 mL of Ready Gel cocktail. The standard verification vials and Background source were dark adapted for two hours and counted on LSC Gold for Radium source standard verification. The Ra-226 efficiency calibration which was used for verification calculations was performed on 4/02/08 using source 0024-A (Ra-226). Calibration data is recorded in this logbook under Ra-226 0024. Each verification source calculation was performed as follows:

$$\text{Source dpm/g} = (A - B)/(C)(D)$$

where:

- A = Ver. source cpm,  
B = BKG cpm,  
C = System efficiency, (cpm/dpm), and  
D = mass used for standard verification.

RAD SOP M-001

Henry E. St. John 4/19/08  
David Roy 4/10/08

4/8/08

## ID: TOTAL ACTIVITY

2 APR 2008 22:17

USER:11

COMMENT:GOLD

PRESET TIME : 5.00

DATA CALC : CPM H# : YES SAMPLE REPEATS: 1 PRINTER : STD

COUNT BLANK : NO IC# : NO REPLICATES : 1 RS232 : EDIT

TWO PHASE : NO AQC : NO CYCLE REPEATS : 1 DISK : OFF

SCINTILLATOR: LIQUID LUMEX: YES LOW SAMPLE REJ: 0

LOW LEVEL : NO HALF LIFE CORRECTION DATE: none

CHAN: 0.0 - 990.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

CHAN: 0.0 - 1000.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

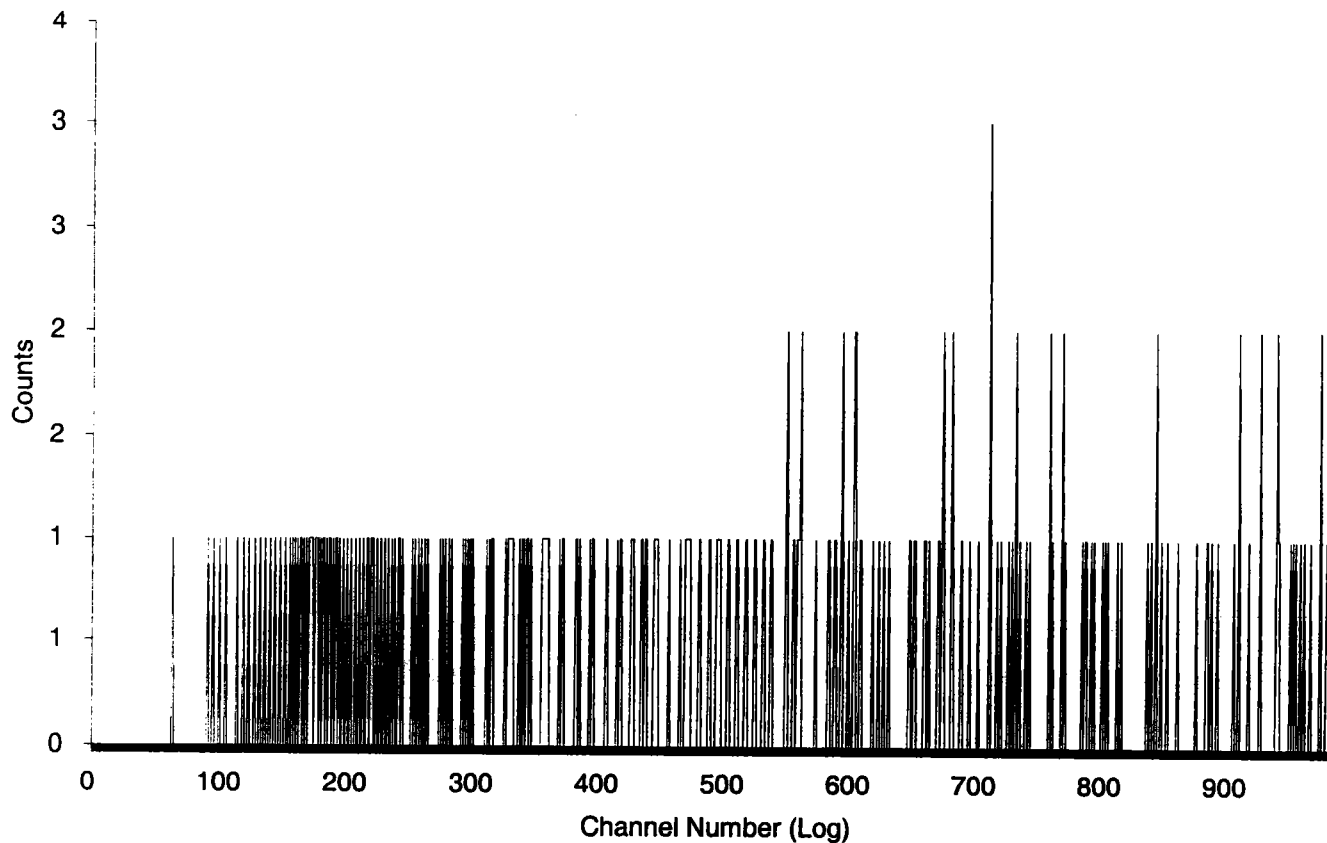
SAM NO	POS	TIME MIN	H#	WIND1		WIND2		LUMEX %	ELAPSED TIME	
				CPM	%ERROR	CPM	%ERROR			
0299-G-0024-A	1	13-1	5.00	111.9	48.60	12.86	51.60	12.48	0.89	5.59
	2	13-2	0.40	114.1	25475.00	1.98	25475.00	1.98	0.00	6.94
	3	13-3	0.40	114.3	25432.50	1.98	25432.50	1.98	0.00	8.34
	4	13-4	0.45	114.1	24786.67	1.89	24786.67	1.89	0.00	9.80
	5	13-5	5.00	112.3	52.40	12.36	54.80	12.08	0.57	15.89
	6	13-6	3.95	121.6	2536.96	2.00	2538.23	2.00	0.07	20.89
	7	13-7	4.00	120.4	2520.25	1.99	2523.00	1.99	0.05	25.97
	8	13-8	4.00	120.0	2532.50	1.99	2534.25	1.99	0.05	31.04

Lhs/4/09



Sample Count Start Time:	2 Apr 2008 22:28:46		
Data Capture Date:	4/2/2008 22:34:01		
User Filename:	S11040213-5A.WK1		
	U11040213-1A.WK1		
Spectrum Type	Log Counts		
User Number:	11		
User Id:	TOTAL ACTIVITY		
User Comment:	GOLD		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	5	13-5	5.00
H#, Total Counts:	112.3	66	
Start, End, X-Axis:	0	990	Channel Number

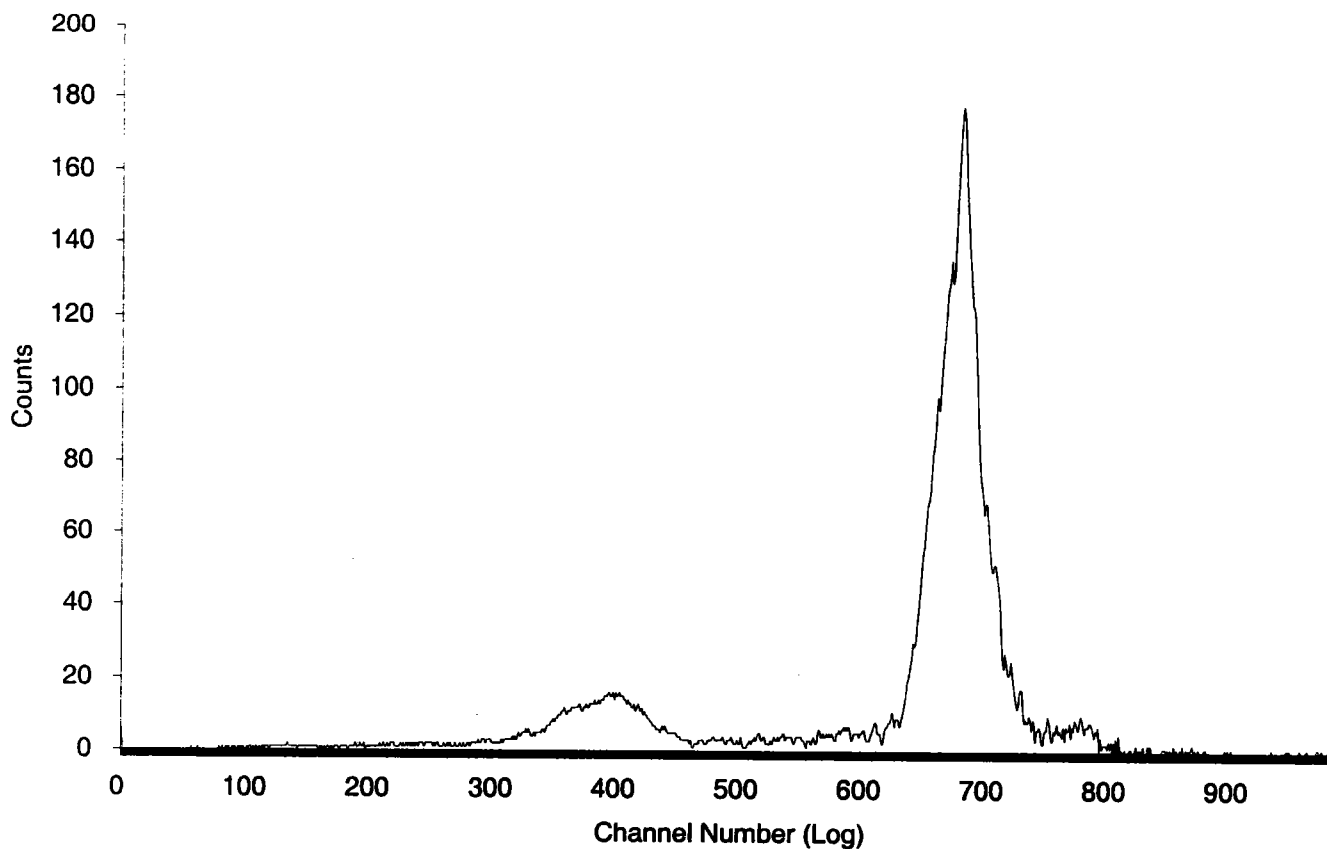
SPECTRUM PLOT  
USER 11 - TOTAL ACTIVITY



*Handwritten signature/initials*

Sample Count Start Time:	2 Apr 2008 22:34:49		
Data Capture Date:	4/2/2008 22:39:04		
User Filename:	S11040213-6A.WK1		
	U11040213-1A.WK1		
Spectrum Type	Log Counts		
User Number:	11		
User Id:	TOTAL ACTIVITY		
User Comment:	GOLD		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	6	13-6	3.95
H#, Total Counts:	121.6	7906	
Start, End, X-Axis:	0	990	Channel Number

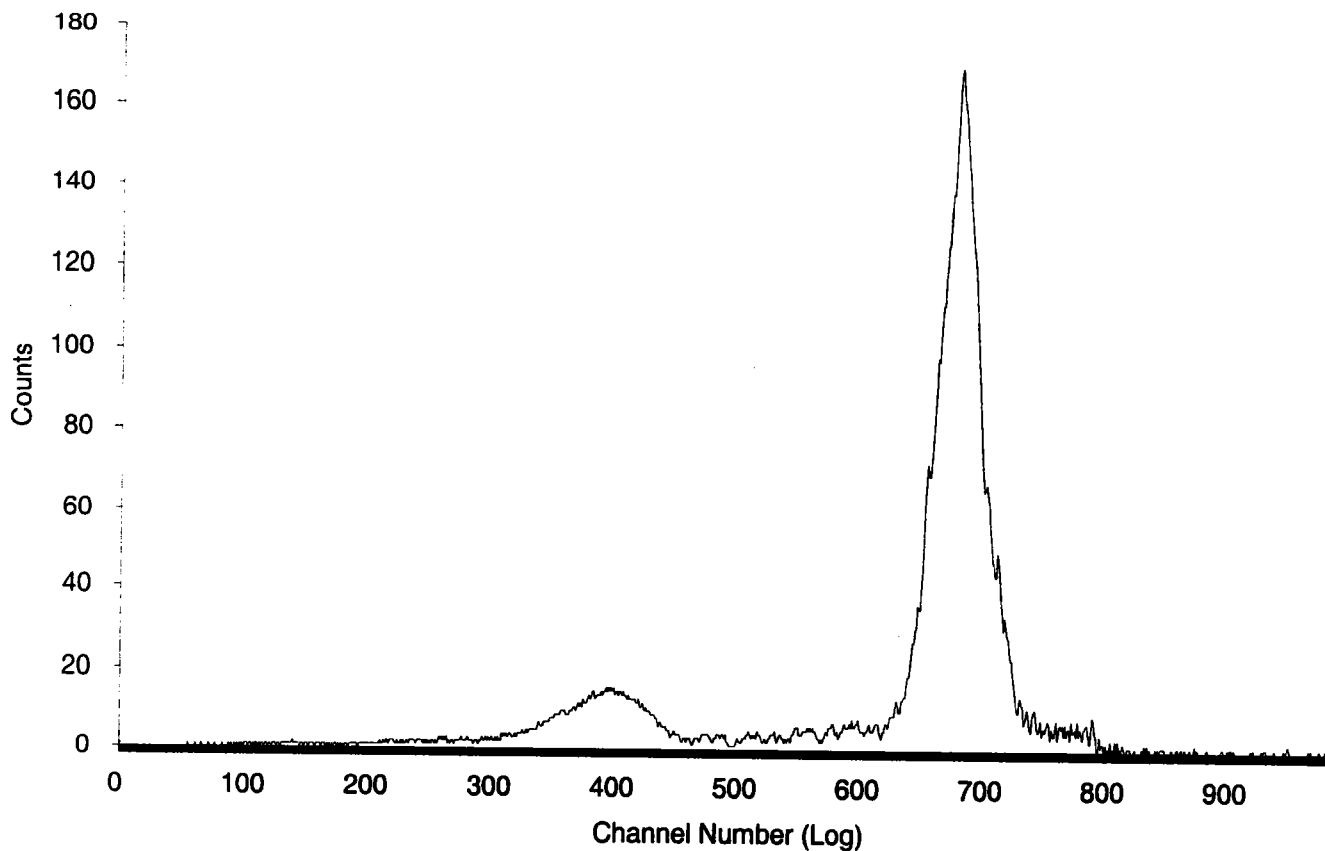
**SPECTRUM PLOT  
USER 11 - TOTAL ACTIVITY**



*Handwritten signature*  
4/14/08

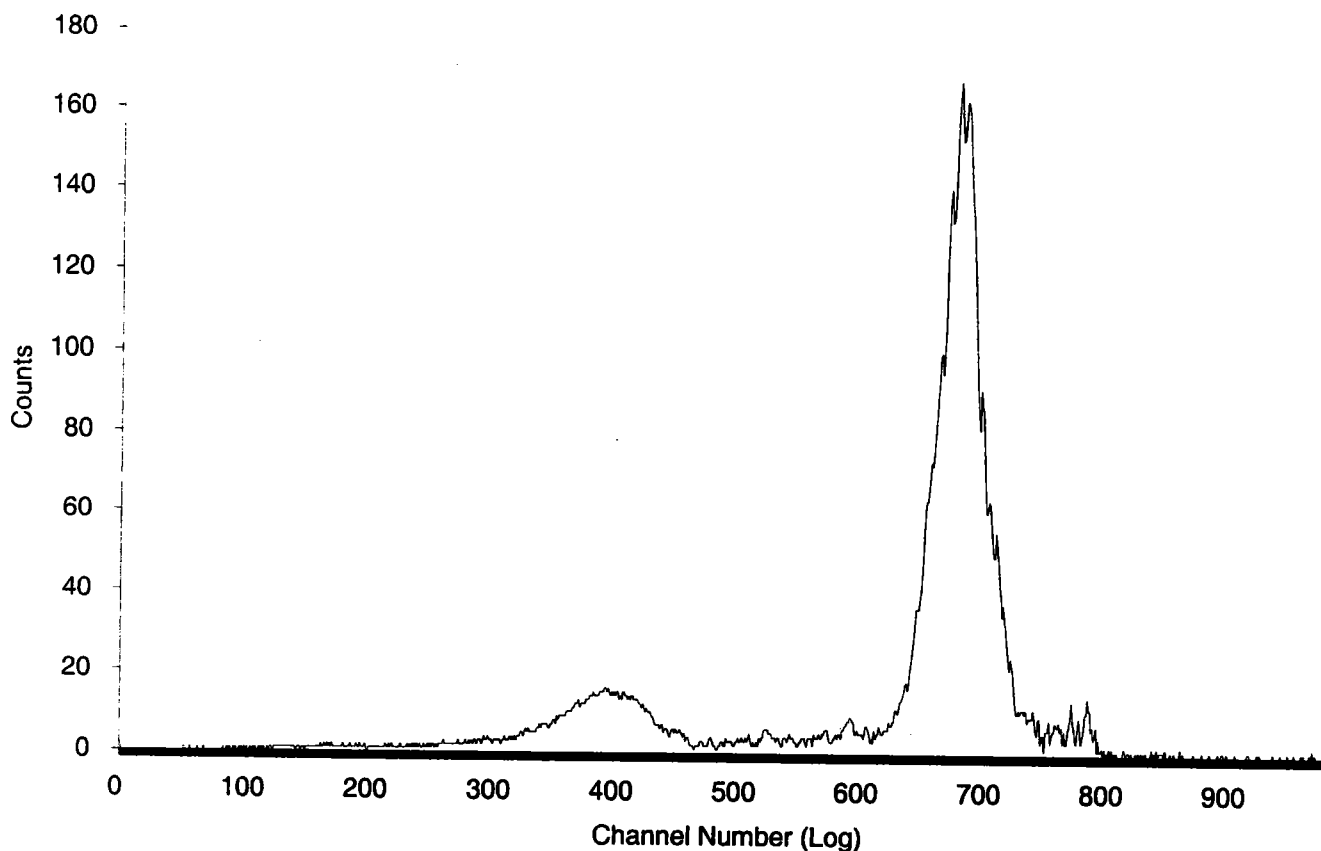
Sample Count Start Time:	2 Apr 2008 22:39:51		
Data Capture Date:	4/2/2008 22:44:07		
User Filename:	S11040213-7A.WK1		
	U11040213-1A.WK1		
Spectrum Type	Log Counts		
User Number:	11		
User Id:	TOTAL ACTIVITY		
User Comment:	GOLD		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	7	13-7	4.00
H#, Total Counts:	120.4	7901	
Start, End, X-Axis:	0	990	Channel Number

SPECTRUM PLOT  
USER 11 - TOTAL ACTIVITY



Sample Count Start Time:	2 Apr 2008 22:44:55		
Data Capture Date:	4/2/2008 22:49:12		
User Filename:	S11040213-8A.WK1		
	U11040213-1A.WK1		
Spectrum Type	Log Counts		
User Number:	11		
User Id:	TOTAL ACTIVITY		
User Comment:	GOLD		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	8	13-8	4.00
H#, Total Counts:	120.0	7908	
Start, End, X-Axis:	0	990	Channel Number

**SPECTRUM PLOT  
USER 11 - TOTAL ACTIVITY**



*Handwritten signature/initials*

**General Engineering Laboratories  
Verification Source Preparation Sheet**

Applicable SOP Number GL-RAD-A-007 Isotope Pn222

Date Standards Prepared 2/22/06 Cocktail Type Used Mineral Oil Scintillator

Standard ID 0299-G Matrix of Vial/Planchett 10 mL DI water  
10 mL Mineral Oil

Amount Used (g or mL) ~~0.5 g~~ 0.1

Standard Activity (DPM/g or mL) 2446.3471 Type of Scintillation Vial glass

Reference Date 12/15/99 Pipette ID Used 3158763

Expiration Date 12/15/06 Balance ID Used N/A

Residue/Carrier Agent N/A Quenching Agent N/A

	Standard Number	Quenching Vol (uL)/ Residue Volume (mL)	Initial Wt. (g)	Final Wt. (g)	Net Wt. (mg)
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				

Prepared By: Amanda D. Lehe Date: 2/22/06

Reviewed By: [Signature] Date: 2/30/06

Rev 1 RLM 9/10/97

2/23/09

# CONTINUING CALIBRATION DATA



# Liquid Scintillation Counter Checks for 15-JAN-2010

Short Name	Parmname	Run Time	Count Time	Counts	CPM	Stdev	Status	Comments
LSCBLUE	Carbon-14	04:51	1		41800	-1.6		
	Carbon-14	04:52	.95		42400	1.11		
	Tritium	04:54	.8		63100	-0.28		
	Tritium	04:55	.8		62900	-0.77		
	BKG	04:57	30		20.9	0.05		
	BKG	05:27	30		22	0.38		
LSCBROWN	Carbon-14	02:49	.95		42300	-0.01		
	Carbon-14	02:50	.95		42400	0.3		
	Tritium	02:52	.8		62100	-1.6		
	Tritium	02:54	.8		62200	-1.1		
	BKG	02:56	30		25.6	4.48	Outside Three Sigma	
	BKG	03:26	30		22.7	-0.15		
	Carbon-14	12:33	.95		42200	-0.81		
	Carbon-14	12:34	.95		42300	-0.31		
	Tritium	12:36	.8		62400	-0.43		
	Tritium	12:37	.8		61600	-3.3	Outside Three Sigma	
	BKG	12:39	30		21.4	-2.4		
	BKG	13:10	30		22.8	-0.03		
	Carbon-14	17:25	.95		42100	-0.93		
	Carbon-14	17:27	.95		42700	1.66		
	Tritium	17:28	.8		62000	-2.1		
	Tritium	17:30	.8		62600	0.21		
	BKG	17:32	30		23.1	0.41		
	BKG	18:03	30		24.7	3.06	Outside Three Sigma	
	Carbon-14	18:49	.95		42300	-0.37		
	Carbon-14	18:50	.95		42300	-0.13		
	Tritium	18:52	.8		62700	0.38		
	Tritium	18:54	.8		62200	-1.1		
	BKG	18:56	30		23.4	0.99		
	BKG	19:27	30		23.9	1.71		
LSCGOLD	Carbon-14	05:29	.95		43200	-1.5		
	Carbon-14	05:30	.95		43000	-2.1		

JP 1/18/10

cleared by renn

	Tritium	05:32	.7	86600	-0.41	
	Tritium	05:33	.7	85600	-2.1	
	BKG	05:35	30	20.2	-1.4	
	BKG	06:05	30	21.7	0.19	
LSCGREEN	Carbon-14	05:02	.95	42300	0.13	
	Carbon-14	05:04	1	41900	-1.6	
	Tritium	05:05	.85	60000	-1.8	
	Tritium	05:07	.85	59900	-2	
	BKG	05:09	30	20	-1	
	BKG	05:39	30	20.5	-0.45	
LSCORANGE	Carbon-14	05:27	1.012433	98500	-1	
	Tritium	05:30	1.012433	132000	-3.9	Outside Three Sigma
	BKG	06:03	30.01243	10.8	-1.9	
	Carbon-14	06:04	1.012433	97900	-2.9	
	Tritium	06:05	1.012333	132000	-5	Outside Three Sigma
	BKG	06:36	30.01243	10.6	-2.2	
	Carbon-14	07:45	1.012433	98200	-1.9	
	Tritium	07:48	1.012433	132000	-4.2	Outside Three Sigma
	BKG	08:21	30.01243	12.2	0.23	
	Carbon-14	08:22	1.012433	98200	-1.9	
	Tritium	08:24	1.012333	133000	-3	
	BKG	08:54	30.01243	11.1	-1.4	
LSCPINK	Carbon-14	05:11	1.012433	94800	1.98	
	Tritium	05:14	1.012433	56900	-1.4	
	BKG	05:47	30.01243	11.8	-1	
	Carbon-14	05:48	1.012433	93700	-1.3	
	Tritium	05:50	1.012433	57000	-0.99	
	BKG	06:20	30.01243	10.9	-1.2	
LSCPURPLE	Carbon-14	01:31	.55	94500	-0.53	
	Carbon-14	01:32	.55	94800	0.06	
	Tritium	01:33	.95	66300	-3.4	Outside Three Sigma
	Tritium	01:34	.9	66900	-1.9	
	BKG	01:36	30	28.9	-0.34	
	BKG	02:07	30	26.9	-1.9	
	Carbon-14	11:51	.55	94600	-0.28	
	Carbon-14	11:52	.55	95300	1.53	
	Tritium	11:53	.9	66900	-1.9	
	Tritium	11:54	.95	66400	-3.1	Outside Three Sigma

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Outside Three Sigma

Outside Three Sigma

Outside Three Sigma

cleared by rerun

JP 1/18/10

Outside Three Sigma

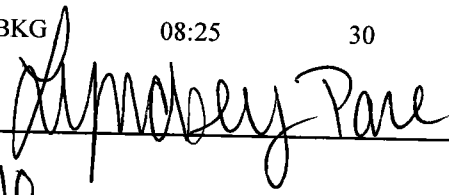
Outside Three Sigma

cleared by rerun



	BKG	11:56	30	29.5	0.14
	BKG	12:26	30	26.2	-2.4
	Carbon-14	14:50	.55	94900	0.35
	Carbon-14	14:51	.55	94600	-0.44
	Tritium	14:52	.95	66700	-2.5
	Tritium	14:53	.95	66500	-3
	BKG	14:55	30	29	-0.23
	BKG	15:26	30	28.7	-0.45
LSCRED	Carbon-14	03:07	.95	42400	-0.21
	Carbon-14	03:08	.95	42200	-0.87
	Tritium	03:10	.75	65800	-0.46
	Tritium	03:11	.75	65700	-0.76
	BKG	03:13	30	22.5	-0.81
	BKG	03:43	30	21.9	-1.2
LSCSILVER	Carbon-14	05:14	.45	95300	-0.05
	Carbon-14	05:14	.45	95800	1.09
	Tritium	05:16	.75	68300	-1.8
	Tritium	05:17	.75	67700	-3
	BKG	05:18	30	23.3	-0.85
	BKG	05:49	30	24.5	0.22
LSCYELLOW	Carbon-14	07:43	1.717	97900	0.34
	Carbon-14	07:46	1.717	98000	0.88
	Tritium	07:48	2.017	131000	-3
	Tritium	07:51	2	132000	-1.1
	BKG	07:54	30	13.3	-1.9
	BKG	08:25	30	13.3	-1.9

Reviewed by



Date

1/18/10

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# Liquid Scintillation Counter Checks for 18-JAN-2010

Short Name	Parmname	Run Time	Count Time	Counts	CPM	Stdev	Status	Comments
LSCBLUE	Carbon-14	07:03	.95		42200	0.56	← = locked out	
	Carbon-14	07:05	.95		42100	0.03		
	Tritium	07:06	.8		62500	-1.9		
	Tritium	07:07	.8		63900	2.43		
	BKG	07:09	30		22.4	0.49		
	BKG	07:40	30		21.1	0.1		
LSCBROWN	Carbon-14	05:43	.95		42200	-0.57		
	Carbon-14	05:44	.95		42200	-0.71		
	Tritium	05:46	.8		62500	-0.04		
	Tritium	05:48	.8		62100	-1.5		
	BKG	05:50	30		22.8	-0.08		
	BKG	06:21	30		23.5	1.16		
LSCGOLD	Carbon-14	05:47	.95		43400	-0.57		
	Carbon-14	05:49	.95		43100	-1.5		
	Tritium	05:50	.7		85900	-1.5		
	Tritium	05:51	.7		85700	-1.9		
	BKG	05:53	30		21.5	-0.03		
	BKG	06:24	30		18.9	-2.8		
LSCGREEN	Carbon-14	05:41	.95		42500	1.13		
	Carbon-14	05:42	.95		42200	-0.13		
	Tritium	05:44	.85		60500	-0.17		
	Tritium	05:45	.85		60300	-0.76		
	BKG	05:47	30		20.4	-0.53		
	BKG	06:18	30		20.4	-0.56		
<u>LSCORANGE</u>	Carbon-14	09:07	1.012433		98400	-1.4		
	Tritium	09:10	1.012433		133000	-3.2	Outside Three Sigma	
	BKG	09:43	30.01243		11.9	-0.23		
	Carbon-14	09:44	1.012433		98700	-0.16		
	Tritium	09:45	1.012333		132000	-3.7	Outside Three Sigma	
	BKG	10:16	30.01243		12.3	0.33		
	Carbon-14	13:54	1.012433		98300	-1.6		
	Tritium	13:57	1.012433		132000	-3.6	Outside Three Sigma	

	BKG	14:30	30.01243	10.8	-1.9	
	Carbon-14	14:31	1.012433	98400	-1.2	
	Tritium	14:32	1.012333	133000	-3.1	Outside Three Sigma
	BKG	15:03	30.01243	12.5	0.62	
LSCPINK	Carbon-14	07:07	1.012433	94700	1.58	
	Tritium	07:10	1.01235	57300	0.26	
	BKG	07:43	30.01243	10.7	-1.3	
	Carbon-14	07:44	1.012433	94600	1.35	
	Tritium	07:46	1.012433	56700	-2.2	
	BKG	08:16	30.01243	10.7	-1.3	
LSCPURPLE	Carbon-14	04:40	.55	94900	0.32	
	Carbon-14	04:41	.55	94900	0.45	
	Tritium	04:42	.9	67000	-1.6	
	Tritium	04:43	.9	66800	-2.2	
	BKG	04:45	30	28.2	-0.9	
	BKG	05:16	30	28.3	-0.77	
LSCRED	Carbon-14	05:48	.95	42400	0.01	
	Carbon-14	05:49	1	42100	-1.6	
	Tritium	05:51	.75	65800	-0.41	
	Tritium	05:52	.8	65300	-1.8	
	BKG	05:54	30	20.9	-1.8	
	BKG	06:24	30	22.3	-0.94	
LSCSILVER	Carbon-14	05:52	.45	95400	0.16	
	Carbon-14	05:52	.45	95800	1.16	
	Tritium	05:54	.75	67900	-2.6	
	Tritium	05:55	.75	68300	-1.8	
	BKG	05:56	30	24.7	0.41	
	BKG	06:27	30	23.4	-0.76	
LSCYELLOW	Carbon-14	05:48	1.733	98200	1.49	
	Carbon-14	05:50	1.717	98200	1.64	
	Tritium	05:53	1.967	132000	-2	
	Tritium	05:56	2	132000	-1.6	
	BKG	05:59	30	13.6	-1.4	
	BKG	06:30	30	13.4	-1.7	

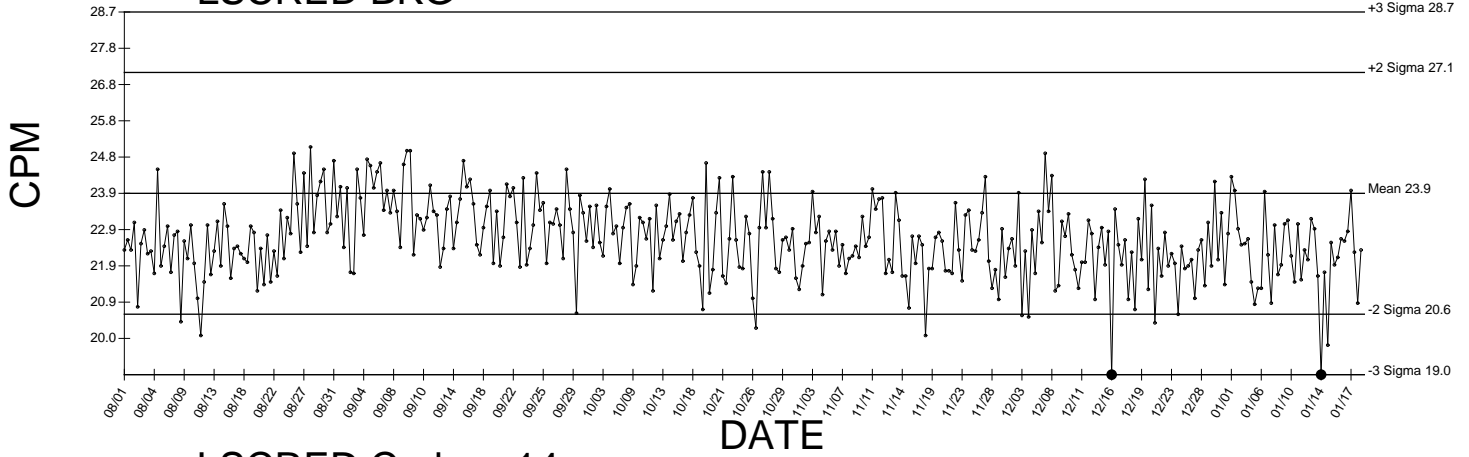
Reviewed by Date 1/18/10

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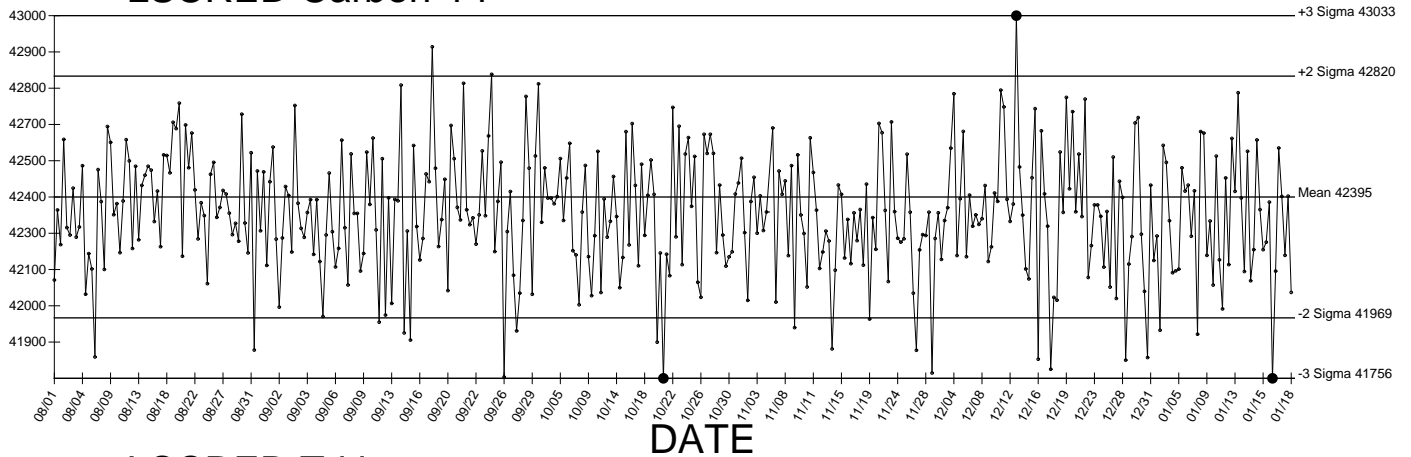
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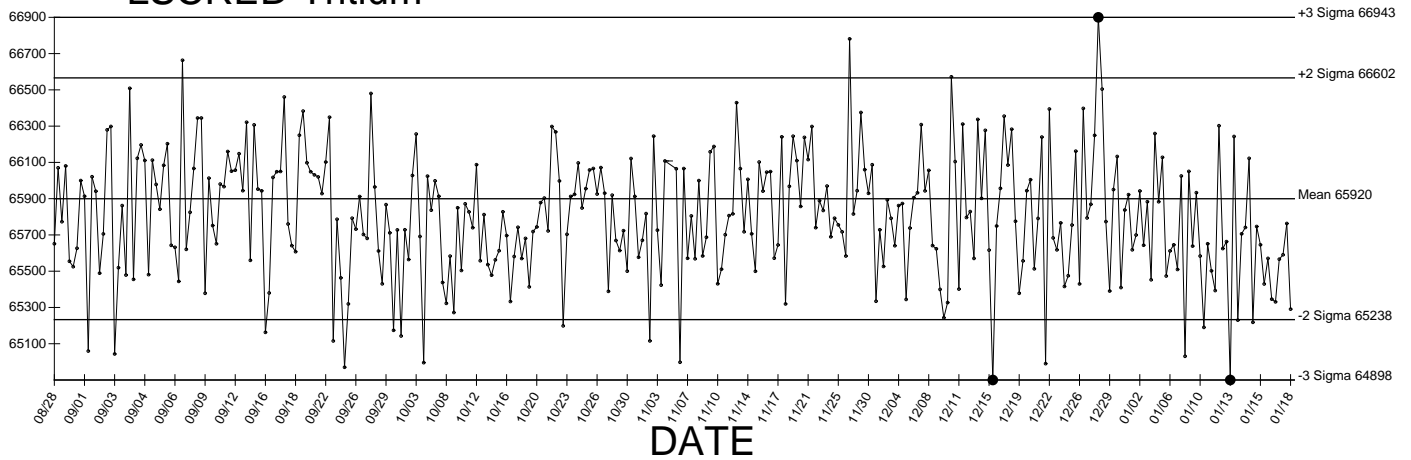
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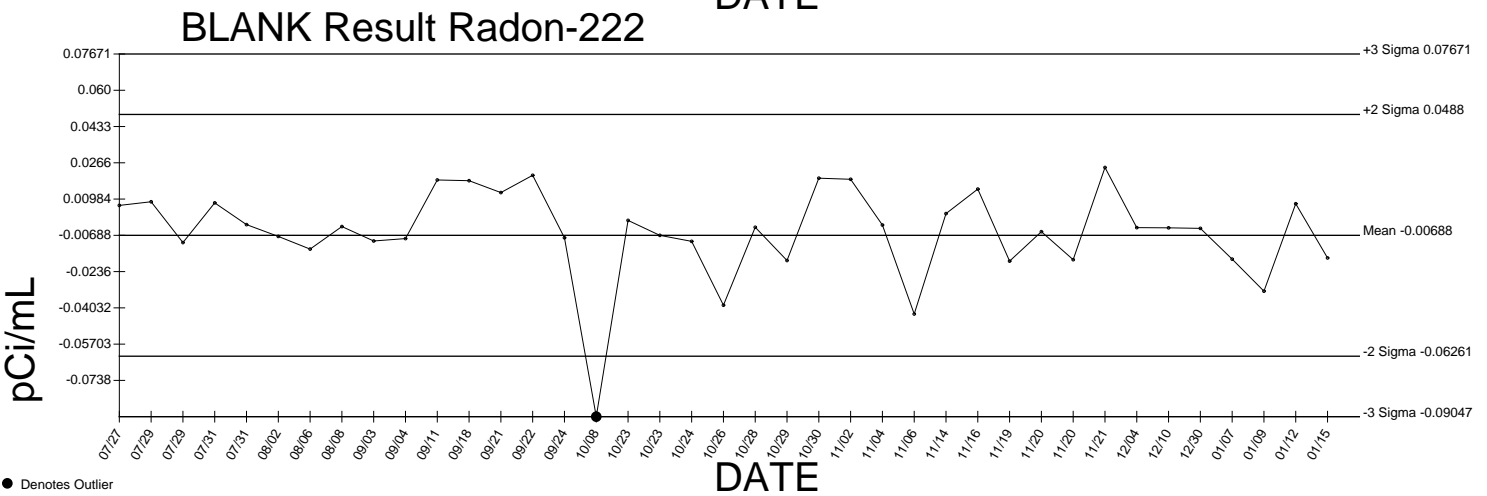
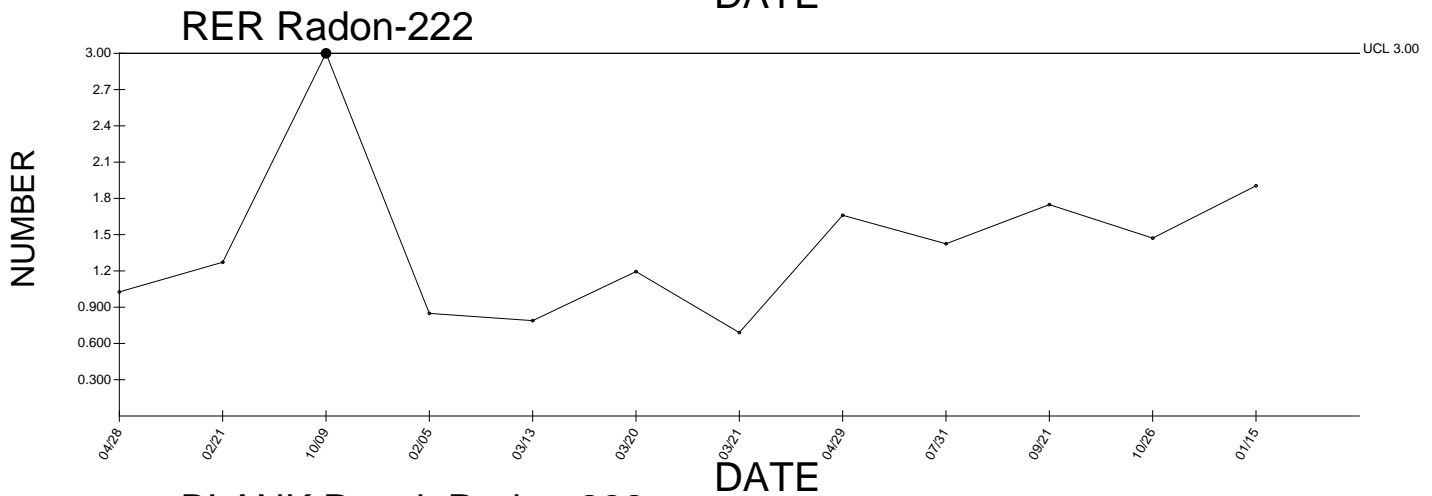
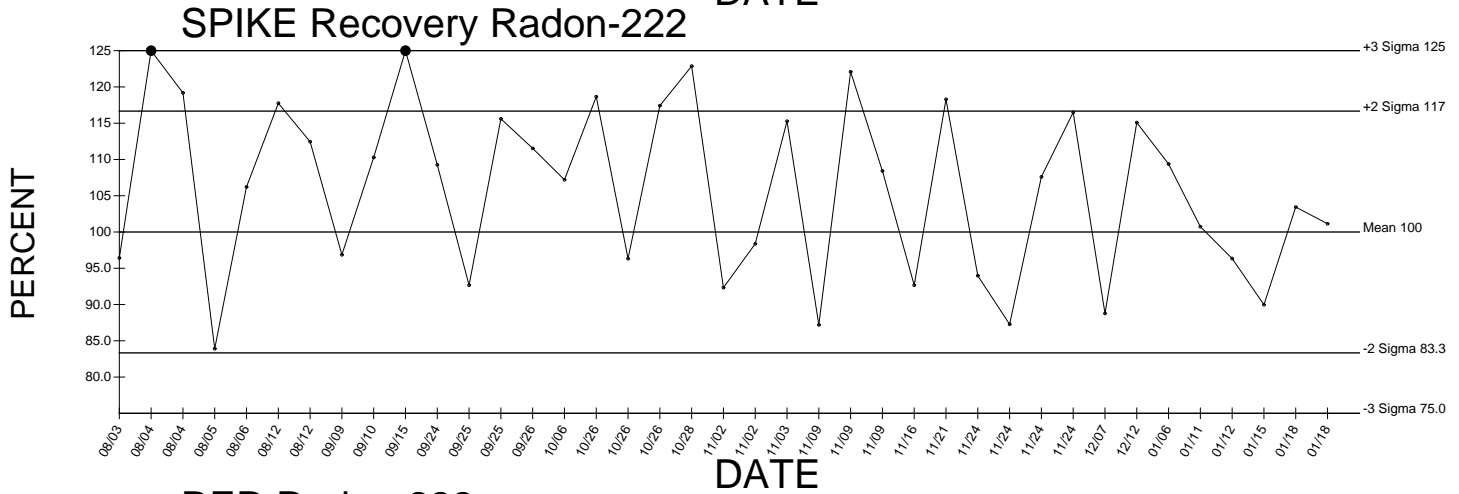
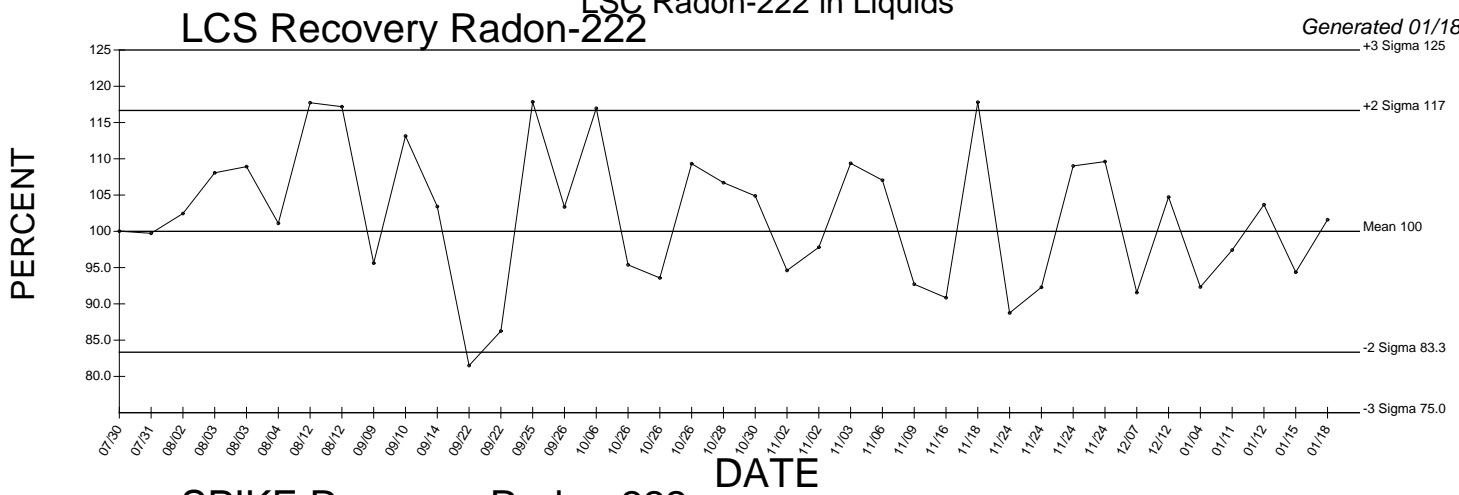


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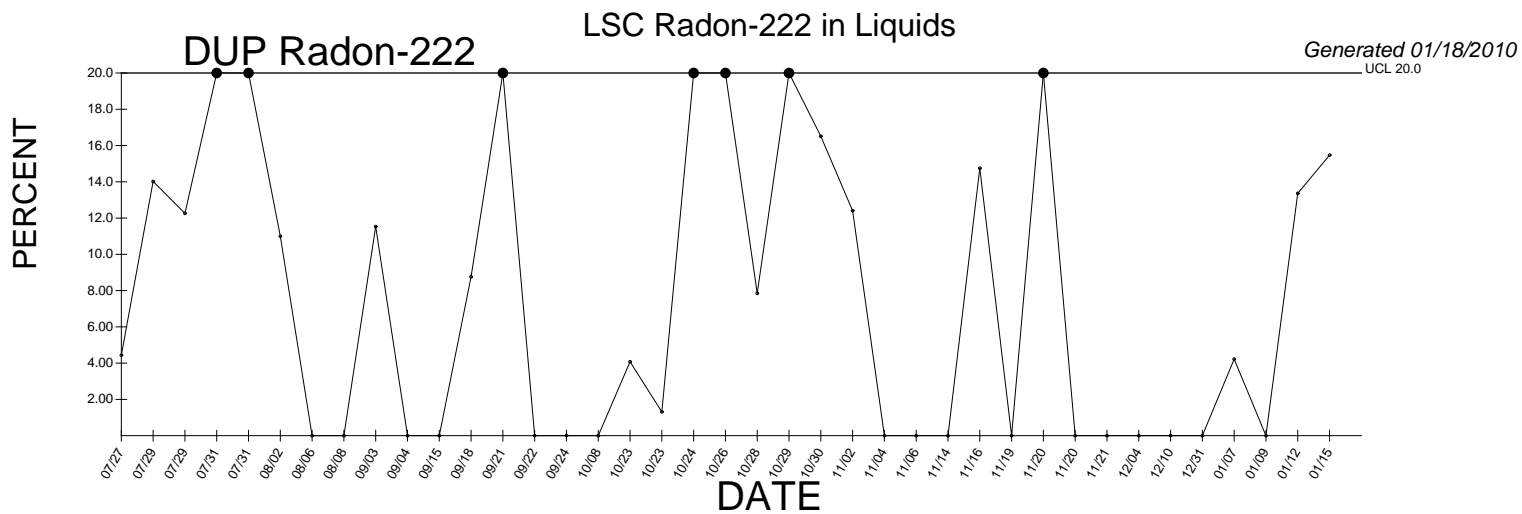


● Denotes Outlier

# QUALITY CONTROL CHARTS







● Denotes Outlier

# Data used for LSC Radon-222 in Liquids 18-JAN-2010

Radon-222 BLANK: Limits LCL = -.1 UCL = .1

Batch ID	Samp ID	Run Date	Status	Value	Deviation	Units	Mean	LCL	LWL	UWL	UCL	Stdev
888296	1201888688	27-JUL-2009 15:08	DONE	0	0.5	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
888866	1201890198	29-JUL-2009 04:05	DONE	0	0.56	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
889213	1201890949	29-JUL-2009 19:49	DONE	0	-0.12	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
889592	1201891830	31-JUL-2009 11:38	DONE	0	0.54	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
890056	1201892805	31-JUL-2009 17:27	DONE	0	0.18	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
890128	1201892968	02-AUG-2009 21:18	DONE	0	-0.02	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
891180	1201895534	06-AUG-2009 07:19	DONE	0	-0.23	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
891966	1201897339	08-AUG-2009 15:27	DONE	0	0.14	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
899920	1201917167	03-SEP-2009 15:52	DONE	0	-0.09	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
900305	1201918118	04-SEP-2009 13:07	DONE	0	-0.05	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
902162	1201922458	11-SEP-2009 20:43	DONE	0	0.92	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
904049	1201927060	18-SEP-2009 07:38	DONE	0	0.9	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
904317	1201927694	21-SEP-2009 23:35	DONE	0	0.71	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
905111	1201929785	22-SEP-2009 22:02	DONE	0	0.99	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
905356	1201930389	24-SEP-2009 09:10	DONE	0	-0.04	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
907808	1201936292	08-OCT-2009 16:09	DONE	0	-5	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
914941	1201953542	23-OCT-2009 15:19	DONE	0	0.25	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
914890	1201953426	23-OCT-2009 16:56	DONE	0	-0	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
915321	1201954382	24-OCT-2009 07:58	DONE	0	-0.1	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
915492	1201954779	26-OCT-2009 08:01	DONE	0	-1	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
916231	1201956685	28-OCT-2009 05:53	DONE	0	0.13	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
916704	1201957861	29-OCT-2009 08:29	DONE	0	-0.42	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
917227	1201959116	30-OCT-2009 01:23	DONE	0	0.95	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
917559	1201959903	02-NOV-2009 09:31	DONE	0	0.93	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
918656	1201962495	04-NOV-2009 08:42	DONE	0	0.17	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
920046	1201965737	06-NOV-2009 20:09	DONE	0	-1	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
922512	1201971563	14-NOV-2009 04:34	DONE	0	0.36	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
922709	1201971997	16-NOV-2009 09:34	DONE	0	0.77	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
924119	1201975500	19-NOV-2009 12:07	DONE	0	-0.43	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
924558	1201976467	20-NOV-2009 00:17	DONE	0	0.06	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
925021	1201977554	20-NOV-2009 23:21	DONE	0	-0.4	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
925100	1201977706	21-NOV-2009 00:42	DONE	0	1.1	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
928999	1201986696	04-DEC-2009 10:37	DONE	0	0.13	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
931048	1201991400	10-DEC-2009 14:39	DONE	0	0.12	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
937719	1202006634	30-DEC-2009 22:50	DONE	0	0.12	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
939320	1202010158	07-JAN-2010 19:57	DONE	0	-0.39	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
939964	1202011491	09-JAN-2010 15:20	DONE	0	-0.92	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
940747	1202013417	12-JAN-2010 18:07	DONE	0	0.52	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03
941700	1202015593	15-JAN-2010 08:33	DONE	0	-0.37	pCi/mL	-0.007	-0.09	-0.063	0.05	0.08	0.03

Radon-222 DUP: Limits LCL = 0 UCL = 20

Batch ID	Samp ID	Run Date	Status	Value	Deviation	Units	Mean	LCL	LWL	UWL	UCL	Stdev
888296	1201888689	27-JUL-2009 15:24	DONE	4	-0.39	percent	13.3	0	-32	58.3	20.0	22.5
888866	1201890199	29-JUL-2009 04:21	DONE	14	0.03	percent	13.3	0	-32	58.3	20.0	22.5
889213	1201890950	29-JUL-2009 20:06	DONE	12	-0.04	percent	13.3	0	-32	58.3	20.0	22.5
889592	1201891831	31-JUL-2009 11:55	DONE	27	0.59	percent	13.3	0	-32	58.3	20.0	22.5

890056	1201892806	31-JUL-2009 17:43	DONE	75	2.7	percent	13.3	0	-32	58.3	20.0	22.5
890128	1201892969	02-AUG-2009 21:34	DONE	11	-0.1	percent	13.3	0	-32	58.3	20.0	22.5
891180	1201895535	06-AUG-2009 07:36	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
891966	1201897340	08-AUG-2009 15:43	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
899920	1201917168	03-SEP-2009 16:09	DONE	12	-0.08	percent	13.3	0	-32	58.3	20.0	22.5
900305	1201918119	04-SEP-2009 13:24	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
902162	1201922459	15-SEP-2009 06:45	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
904049	1201927061	18-SEP-2009 07:54	DONE	9	-0.2	percent	13.3	0	-32	58.3	20.0	22.5
904317	1201927695	21-SEP-2009 23:51	DONE	104	4	percent	13.3	0	-32	58.3	20.0	22.5
905111	1201929786	22-SEP-2009 22:19	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
905356	1201930390	24-SEP-2009 09:26	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
907808	1201936293	08-OCT-2009 16:25	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
914941	1201953543	23-OCT-2009 15:35	DONE	4	-0.41	percent	13.3	0	-32	58.3	20.0	22.5
914890	1201953427	23-OCT-2009 17:12	DONE	1	-0.53	percent	13.3	0	-32	58.3	20.0	22.5
915321	1201954383	24-OCT-2009 08:14	DONE	44	1.3	percent	13.3	0	-32	58.3	20.0	22.5
915492	1201954780	26-OCT-2009 08:17	DONE	27	0.6	percent	13.3	0	-32	58.3	20.0	22.5
916231	1201956686	28-OCT-2009 06:09	DONE	8	-0.24	percent	13.3	0	-32	58.3	20.0	22.5
916704	1201957862	29-OCT-2009 08:45	DONE	29	0.71	percent	13.3	0	-32	58.3	20.0	22.5
917227	1201959117	30-OCT-2009 01:39	DONE	17	0.14	percent	13.3	0	-32	58.3	20.0	22.5
917559	1201959904	02-NOV-2009 09:47	DONE	12	-0.04	percent	13.3	0	-32	58.3	20.0	22.5
918656	1201962496	04-NOV-2009 08:58	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
920046	1201965738	06-NOV-2009 20:25	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
922512	1201971564	14-NOV-2009 04:51	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
922709	1201971998	16-NOV-2009 09:51	DONE	15	0.07	percent	13.3	0	-32	58.3	20.0	22.5
924119	1201975501	19-NOV-2009 12:23	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
924558	1201976468	20-NOV-2009 02:19	DONE	60	2.1	percent	13.3	0	-32	58.3	20.0	22.5
925021	1201977555	20-NOV-2009 23:37	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
925100	1201977707	21-NOV-2009 00:58	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
928999	1201986697	04-DEC-2009 10:53	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
931048	1201991401	10-DEC-2009 14:56	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
937719	1202006635	31-DEC-2009 00:52	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
939320	1202010159	07-JAN-2010 20:13	DONE	4	-0.4	percent	13.3	0	-32	58.3	20.0	22.5
939964	1202011492	09-JAN-2010 15:36	DONE	0	-0.59	percent	13.3	0	-32	58.3	20.0	22.5
940747	1202013418	12-JAN-2010 18:24	DONE	13	00	percent	13.3	0	-32	58.3	20.0	22.5
941700	1202015594	15-JAN-2010 08:49	DONE	15	0.1	percent	13.3	0	-32	58.3	20.0	22.5

**Radon-222 LCS: Limits LCL = 75 UCL = 125**

Batch ID	Samp ID	Run Date	Status	Value	Deviation	Units	Mean	LCL	LWL	UWL	UCL	Stdev
888296	1201888691	30-JUL-2009 10:41	DONE	100	00	percent	100	75.0	83.3	117	125	8.33
888866	1201890201	31-JUL-2009 09:44	DONE	100	-0.03	percent	100	75.0	83.3	117	125	8.33
889213	1201890952	02-AUG-2009 20:11	DONE	102	0.29	percent	100	75.0	83.3	117	125	8.33
889592	1201891833	03-AUG-2009 08:37	DONE	108	0.97	percent	100	75.0	83.3	117	125	8.33
890056	1201892808	03-AUG-2009 09:26	DONE	109	1.1	percent	100	75.0	83.3	117	125	8.33
890128	1201892971	04-AUG-2009 02:01	DONE	101	0.13	percent	100	75.0	83.3	117	125	8.33
891180	1201895537	12-AUG-2009 03:38	DONE	118	2.1	percent	100	75.0	83.3	117	125	8.33
891966	1201897342	12-AUG-2009 21:41	DONE	117	2.1	percent	100	75.0	83.3	117	125	8.33
899920	1201917170	09-SEP-2009 00:34	DONE	96	-0.53	percent	100	75.0	83.3	117	125	8.33
900305	1201918121	10-SEP-2009 06:57	DONE	113	1.6	percent	100	75.0	83.3	117	125	8.33
902162	1201922461	14-SEP-2009 09:23	DONE	103	0.41	percent	100	75.0	83.3	117	125	8.33
904049	1201927063	22-SEP-2009 01:14	DONE	81	-2	percent	100	75.0	83.3	117	125	8.33

904317	1201927697	22-SEP-2009 23:08	DONE	86	-2	percent	100	75.0	83.3	117	125	8.33
905111	1201929788	25-SEP-2009 17:33	DONE	118	2.1	percent	100	75.0	83.3	117	125	8.33
905356	1201930392	26-SEP-2009 08:36	DONE	103	0.4	percent	100	75.0	83.3	117	125	8.33
907808	1201936295	06-OCT-2009 13:47	DONE	117	2	percent	100	75.0	83.3	117	125	8.33
914941	1201953545	26-OCT-2009 10:18	DONE	95	-0.55	percent	100	75.0	83.3	117	125	8.33
914890	1201953429	26-OCT-2009 11:07	DONE	94	-0.77	percent	100	75.0	83.3	117	125	8.33
915321	1201954385	26-OCT-2009 17:11	DONE	109	1.1	percent	100	75.0	83.3	117	125	8.33
915492	1201954782	28-OCT-2009 10:27	DONE	107	0.81	percent	100	75.0	83.3	117	125	8.33
916231	1201956688	30-OCT-2009 12:13	DONE	105	0.59	percent	100	75.0	83.3	117	125	8.33
916704	1201957864	02-NOV-2009 10:36	DONE	95	-0.65	percent	100	75.0	83.3	117	125	8.33
917227	1201959119	02-NOV-2009 11:25	DONE	98	-0.26	percent	100	75.0	83.3	117	125	8.33
917559	1201959906	03-NOV-2009 20:37	DONE	109	1.1	percent	100	75.0	83.3	117	125	8.33
918656	1201962498	06-NOV-2009 19:20	DONE	107	0.85	percent	100	75.0	83.3	117	125	8.33
920046	1201965740	09-NOV-2009 09:03	DONE	93	-0.87	percent	100	75.0	83.3	117	125	8.33
922512	1201971566	16-NOV-2009 14:31	DONE	91	-1	percent	100	75.0	83.3	117	125	8.33
922709	1201972000	18-NOV-2009 06:54	DONE	118	2.1	percent	100	75.0	83.3	117	125	8.33
925021	1201977557	24-NOV-2009 04:01	DONE	89	-1	percent	100	75.0	83.3	117	125	8.33
925100	1201977709	24-NOV-2009 04:50	DONE	92	-0.93	percent	100	75.0	83.3	117	125	8.33
924119	1201975503	24-NOV-2009 08:23	DONE	109	1.1	percent	100	75.0	83.3	117	125	8.33
924558	1201976470	24-NOV-2009 09:11	DONE	110	1.2	percent	100	75.0	83.3	117	125	8.33
928999	1201986699	07-DEC-2009 09:10	DONE	92	-1	percent	100	75.0	83.3	117	125	8.33
931048	1201991403	12-DEC-2009 10:17	DONE	105	0.57	percent	100	75.0	83.3	117	125	8.33
937719	1202006637	04-JAN-2010 08:03	DONE	92	-0.92	percent	100	75.0	83.3	117	125	8.33
939320	1202010161	11-JAN-2010 12:40	DONE	97	-0.31	percent	100	75.0	83.3	117	125	8.33
939964	1202011494	12-JAN-2010 03:33	DONE	104	0.44	percent	100	75.0	83.3	117	125	8.33
940747	1202013420	15-JAN-2010 08:26	DONE	94	-0.68	percent	100	75.0	83.3	117	125	8.33
941700	1202015596	18-JAN-2010 07:31	DONE	102	0.19	percent	100	75.0	83.3	117	125	8.33

**Radon-222 RER:** Limits LCL = 0 UCL = 3

Batch ID	Samp ID	Run Date	Status	Value	Deviation	Units	Mean	LCL	LWL	UWL	UCL	Stdev
629264	1201324245	28-APR-2007 11:39	DONE	1.03	-0.51	dec	1.54	0	-0.47	3.56	3.00	1.01
728723	1201519907	21-FEB-2008 19:51	DONE	1.27	-0.27	dec	1.54	0	-0.47	3.56	3.00	1.01
803128	1201688653	09-OCT-2008 04:13	DUSE	4.49	2.9	dec	1.54	0	-0.47	3.56	3.00	1.01
838729	1201770251	05-FEB-2009 00:33	DONE	0.85	-0.69	dec	1.54	0	-0.47	3.56	3.00	1.01
849481	1201796264	13-MAR-2009 02:07	DONE	0.79	-0.75	dec	1.54	0	-0.47	3.56	3.00	1.01
852451	1201802857	20-MAR-2009 10:53	DONE	1.19	-0.35	dec	1.54	0	-0.47	3.56	3.00	1.01
852725	1201803521	21-MAR-2009 17:19	DONE	0.69	-0.85	dec	1.54	0	-0.47	3.56	3.00	1.01
862433	1201826997	29-APR-2009 14:04	DONE	1.66	0.12	dec	1.54	0	-0.47	3.56	3.00	1.01
889592	1201891831	31-JUL-2009 11:55	DONE	1.42	-0.12	dec	1.54	0	-0.47	3.56	3.00	1.01
904317	1201927695	21-SEP-2009 23:51	DONE	1.75	0.2	dec	1.54	0	-0.47	3.56	3.00	1.01
915492	1201954780	26-OCT-2009 08:17	DONE	1.47	-0.07	dec	1.54	0	-0.47	3.56	3.00	1.01
942156	1202016820	15-JAN-2010 16:58	DONE	1.9	0.36	dec	1.54	0	-0.47	3.56	3.00	1.01

**Radon-222 SPIKE:** Limits LCL = 75 UCL = 125

Batch ID	Samp ID	Run Date	Status	Value	Deviation	Units	Mean	LCL	LWL	UWL	UCL	Stdev
890056	1201892807	03-AUG-2009 09:10	DONE	96	-0.43	percent	100	75.0	83.3	117	125	8.33
888866	1201890200	04-AUG-2009 07:39	DONE	125	3	percent	100	75.0	83.3	117	125	8.33
887360	1201886413	04-AUG-2009 08:10	DONE	119	2.3	percent	100	75.0	83.3	117	125	8.33
890128	1201892970	05-AUG-2009 15:41	DONE	84	-2	percent	100	75.0	83.3	117	125	8.33
889592	1201891832	06-AUG-2009 17:46	DONE	106	0.75	percent	100	75.0	83.3	117	125	8.33

891180	1201895536	12-AUG-2009 03:23	DONE	118	2.1	percent	100	75.0	83.3	117	125	8.33
891966	1201897341	12-AUG-2009 21:25	DONE	112	1.5	percent	100	75.0	83.3	117	125	8.33
899920	1201917169	09-SEP-2009 00:17	DONE	97	-0.38	percent	100	75.0	83.3	117	125	8.33
900305	1201918120	10-SEP-2009 06:41	DONE	110	1.2	percent	100	75.0	83.3	117	125	8.33
902162	1201922460	15-SEP-2009 08:47	DONE	144	5.3	percent	100	75.0	83.3	117	125	8.33
904317	1201927696	24-SEP-2009 21:39	DONE	109	1.1	percent	100	75.0	83.3	117	125	8.33
904049	1201927062	25-SEP-2009 11:49	DONE	93	-0.88	percent	100	75.0	83.3	117	125	8.33
905111	1201929787	25-SEP-2009 17:16	DONE	116	1.9	percent	100	75.0	83.3	117	125	8.33
905356	1201930391	26-SEP-2009 08:20	DONE	112	1.4	percent	100	75.0	83.3	117	125	8.33
907808	1201936294	06-OCT-2009 13:31	DONE	107	0.86	percent	100	75.0	83.3	117	125	8.33
914941	1201953544	26-OCT-2009 10:02	DONE	119	2.2	percent	100	75.0	83.3	117	125	8.33
914890	1201953428	26-OCT-2009 10:51	DONE	96	-0.44	percent	100	75.0	83.3	117	125	8.33
915321	1201954384	26-OCT-2009 16:55	DONE	117	2.1	percent	100	75.0	83.3	117	125	8.33
915492	1201954781	28-OCT-2009 22:58	DONE	123	2.7	percent	100	75.0	83.3	117	125	8.33
916704	1201957863	02-NOV-2009 10:20	DONE	92	-0.92	percent	100	75.0	83.3	117	125	8.33
917227	1201959118	02-NOV-2009 11:09	DONE	98	-0.2	percent	100	75.0	83.3	117	125	8.33
916231	1201956687	03-NOV-2009 19:49	DONE	115	1.8	percent	100	75.0	83.3	117	125	8.33
920046	1201965739	09-NOV-2009 08:46	DONE	87	-2	percent	100	75.0	83.3	117	125	8.33
917559	1201959905	09-NOV-2009 11:12	DONE	122	2.7	percent	100	75.0	83.3	117	125	8.33
918656	1201962497	09-NOV-2009 13:10	DONE	108	1	percent	100	75.0	83.3	117	125	8.33
922512	1201971565	16-NOV-2009 14:15	DONE	93	-0.88	percent	100	75.0	83.3	117	125	8.33
922709	1201971999	21-NOV-2009 21:47	DONE	118	2.2	percent	100	75.0	83.3	117	125	8.33
925021	1201977556	24-NOV-2009 03:45	DONE	94	-0.72	percent	100	75.0	83.3	117	125	8.33
925100	1201977708	24-NOV-2009 04:33	DONE	87	-2	percent	100	75.0	83.3	117	125	8.33
924119	1201975502	24-NOV-2009 08:06	DONE	108	0.91	percent	100	75.0	83.3	117	125	8.33
924558	1201976469	24-NOV-2009 08:55	DONE	116	2	percent	100	75.0	83.3	117	125	8.33
928999	1201986698	07-DEC-2009 08:54	DONE	89	-1	percent	100	75.0	83.3	117	125	8.33
931048	1201991402	12-DEC-2009 10:01	DONE	115	1.8	percent	100	75.0	83.3	117	125	8.33
937719	1202006636	06-JAN-2010 12:16	DONE	109	1.1	percent	100	75.0	83.3	117	125	8.33
939320	1202010160	11-JAN-2010 12:24	DONE	101	0.09	percent	100	75.0	83.3	117	125	8.33
939964	1202011493	12-JAN-2010 03:17	DONE	96	-0.44	percent	100	75.0	83.3	117	125	8.33
940747	1202013419	15-JAN-2010 08:10	DONE	90	-1	percent	100	75.0	83.3	117	125	8.33
941700	1202015595	18-JAN-2010 07:15	DONE	103	0.41	percent	100	75.0	83.3	117	125	8.33
942156	1202016821	18-JAN-2010 08:04	DONE	101	0.14	percent	100	75.0	83.3	117	125	8.33

# STANDARDS DATA

0638

**CERTIFICATE OF CALIBRATION**  
**Standard Radionuclide Source**

67519-278

Ra-226 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated using a germanium gamma spectrometer system.

Radionuclide purity and calibration were checked using a germanium gamma spectrometer system. The nuclear decay rate and assay date for this source are given below.

Analytics maintains traceability to the National Institute of Standards and Technology through participation in a Measurements Assurance Program as described in USNRC Reg. Guide 4.15, Revision 1, February 1979.

ISOTOPE:	Ra-226
ACTIVITY (dps):	2.353 E4
HALF-LIFE:	1.600 E3 years
CALIBRATION DATE:	January 23, 2004 12:00 EST
RELATIVE EXPANDED UNCERTAINTY (k=2):	3.3%

Impurities:  $\gamma$ -impurities (other than decay products) <0.1%

5.01065 grams 0.1M HCl solution with 50  $\mu\text{g/g}$  Ba carrier.

P O NUMBER 3231RD, Item 5

SOURCE PREPARED BY:

M. D. Currie  
M. D. Currie, Radiochemist

Q A APPROVED:

RCM 1/26/04

2C-S-037-037a



## Standard Traceability Log Rad

Source Material Info	
Parent Code:	0638
Prepared By:	Amanda Fehr
Carrier Conc:	0.1M HCl
Reference Date:	01/23/2004
Ampoule Mass (g):	5.01065 g
Uncertainty:	+/- 3.3 %
LogBook No:	RC-S-037-037

A Solution Material Info	
Isotope:	Radium-226
Prepared By:	Amanda Fehr
Prep Date:	01/16/2006
Verification Date:	04/09/2009
Expiration Date:	04/09/2010
Primary Code:	0638-A
Dilution(mL):	100 mL
Mass of Parent(g):	4.8398 g
Density(g/mL):	1.0266
Balance ID:	38080204

## Calculations Converting parent activity to dpm/mL|dpm/g

$$(\text{Mass of parent(g)}) * (\text{Parm Activity (dps)}) * (\text{conversion dpm to dps}) / (\text{Ampoule Mass(g)} * (\text{Dilution Vol})) = \text{Parent Activity (dpm/mL)}$$

$$(\text{Mass of parent(g)}) * (\text{Parm Activity (dps)}) * (\text{conversion dpm to dps}) / \text{Density} / (\text{Ampoule Mass (g)} * (\text{Dilution Vol})) = \text{Parent Activity (dpm/g)}$$

$$(4.8398 \text{ g}) * (23530 \text{ dps}) * (60 \text{ dpm/dps}) / (5.01065 \text{ g} * 100 \text{ mL}) = 13636.6133 \text{ dpm/mL}$$

$$(4.8398 \text{ g}) * (23530 \text{ dps}) * (60 \text{ dpm/dps}) / (1.0266 \text{ g/mL}) / (5.01065 \text{ g} * 100 \text{ mL}) = 13282.9676 \text{ dpm/g}$$

## Secondary Standards

Prep Date	Preparer	Mass Primary	Dilution (mL)	Code	Conc dpm/mL	Verification Date	Expiration Date
01/17/2006	Amanda Fehr	2.1041	100	0638-B	279.0211 dpm/mL	01/17/2007	01/17/2008
07/17/2006	Mary Aders	2.1313	100	0638-C	282.6281 dpm/mL	07/26/2006	07/26/2007
03/28/2007	Daniel Roy	2.1025	100	0638-D	279.2744 dpm/ml	04/08/2007	04/08/2008
03/28/2007	Daniel Roy	45.468	250	0638-E	2415.7999 dpm/ml	04/09/2009	04/09/2010
12/18/2007	Daniel Roy	2.014	100	0638-F	267.519 dpm/ml	02/02/2009	02/02/2010
02/12/2008	Daniel Roy	.5004	100	0638-G	66.468 dpm/ml	03/02/2009	03/02/2010
07/23/2008	Daniel Roy	5.0607	250	0638-H	268.8845 dpm/ml	07/17/2009	07/17/2010
09/28/2009	Angela Johnson	4.052	200	0638-I	269.113 dpm/mL	09/28/2009	09/28/2010

GEL Laboratories LLC  
Version 1.0 9/18/2000



## Verification for Ra-226 Standard 0638-E 09

M. Aders 4/13/2009	Isotope	Value	Uncertainty
	0638-E	100.063	2.5965
	0638-E	103.307	2.6336
	0638-E	106.718	2.6721
Mean Value (Counting) =	103.362	95.20	Pass
Stdev =	3.327800466	Rule 3 (Pass/Fail)	
Target =	108.57		
Lower Limit =	96.70666573		
Upper Limit =	110.0178676		
Rule 1 Pass/Fail	Pass		
Two sigma =	6.655600933		
10 % of Mean =	10.33622667		
Rule 2 (Pass/Fail)	Pass		

Rule 1 = The certificate value (NOT including any uncertainty) shall lie within the 95% confidence interval determined from the mean and two sigma standard deviation of the three measurements

Rule 2 = The two sigma value used for the 95% confidence interval shall not exceed 10% of the mean value of the three verification measurements.

Rule 3 = The determined mean value shall be within 5% of the certificate value.

The analyst prepared three standard verification sources for Ra-226 source 0638-E by transferring portions of the degassed standard into tared glass liquid scintillation vials. Ten mL of DI Water and 10 mL mineral oil was added to each vial and the vials were shaken to mix. A Blank vial was prepared in a similar fashion using 10 mL of DI water and 10 mL of mineral oil. The standard verification vials and Background source were dark adapted for two hours and counted on LSC Green using source standard verification. Each verification source calculation was performed as follows:

$$\text{Source dpm/g} = (A - B)/(C)(D)$$

where:

- A = Ver. source cpm,
- B = BKG cpm,
- C = System efficiency, (cpm/dpm), and
- D = mass used for standard verification.

Reference RAD SOP M-001

*W. G. Adams 4/14/09*  
*Amanda A. Felt 4/14/09*

# RUNLOGS

# Instrument Run Log

**Instrument Type: LSC**

**Batch ID: 941700**

Sample ID	Sample Type	Analyst	Instrument	Run Date	Status	Geometry	Calibration Date
244664001	SAMPLE	KXK2	LSCRED	15-JAN-10 07:45	DONE	10ML MINERAL OIL/10ML SAMPLE	28-JUL-09 00:00
244697001	SAMPLE	KXK2	LSCRED	15-JAN-10 08:01	DONE	10ML MINERAL OIL/10ML SAMPLE	28-JUL-09 00:00
244697002	SAMPLE	KXK2	LSCRED	15-JAN-10 08:17	DONE	10ML MINERAL OIL/10ML SAMPLE	28-JUL-09 00:00
1202015593	MB	KXK2	LSCRED	15-JAN-10 08:33	DONE	10ML MINERAL OIL/10ML SAMPLE	28-JUL-09 00:00
1202015594	DUP	KXK2	LSCRED	15-JAN-10 08:49	DONE	10ML MINERAL OIL/10ML SAMPLE	28-JUL-09 00:00
1202015595	MS	KXK2	LSCRED	18-JAN-10 07:15	DONE	10ML MINERAL OIL/10ML SAMPLE	28-JUL-09 00:00
1202015596	LCS	KXK2	LSCRED	18-JAN-10 07:31	DONE	10ML MINERAL OIL/10ML SAMPLE	28-JUL-09 00:00