ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

December 30, 2009

Mr. Mike Barsa
Cabrera Services, Inc.
103 E Mount Royal Ave. Ste. 2B
Baltimore, MD 21202

Re: ALS Workorder: 09-12-056
Project Name: Forest Glen Rad Scoping Survey
Project Number: 08-3800.04

Dear Mr. Barsa:

Two wipe samples were received from Cabrera Services, Inc. on December 7, 2009. The samples were scheduled for the following analysis:

Tritium pages 1-86

The results for this analysis are contained in the enclosed reports.

Thank you for your confidence in ALS Laboratory Group. Should you have any questions, please call.

Sincerely,

ALS Laboratory Group
Lance Steere
Senior Project Manager

LRS/mh
Enclosure (s): Report

ALS Laboratory Group -- FC

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 0912056
Client Name: Cabrera Services Inc.
Client Project Name: Forest Glen Rad Scoping Survey
Client Project Number: 08-3800.04
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
SU03-BIAS-02	0912056-1		WIPE	18-Nov-09	12:50
SU03-BIAS-03	0912056-2		WIPE	18-Nov-09	12:55

225 Commerce Drive Fort Collins, CO 80524
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Accession Number (LAB ID) 0912056

ALS Laboratory Group

Chain-of-Custody

Date 12/04/09 Page 1 of 1

Project Name / No.: Forest Glen Rad Scoping Survey Sampler(s): KK, AC, MB, AW (circle one) Turnaround: Standard or ~~Rush (Due-_____)~~ Dispose or Return to Client

Report To: Michael Barsa
Phone: 410-332-8177
Fax: 410-332-8183
Company: Cabrera Services
Address: 103 E. Mount Royal Ave, Suite 2B, Baltimore, MD 21202

circle method or specify under comments

Sample ID	Date	Time *	Lab ID	Matrix	No. of Containers	H-3 via Liquid Scintillation E906.0
SU03-BIAS-02	11/18/09	12:50	1	SM	1	X
SU03-BIAS-03	11/18/09	12:55	2	SM	1	X
						X
						X
						X
						X
						X
						X
						X
						X

Comments:
08-3800.04, Task 2
WRAMC Forest Glen Annex Radiological Survey
SM=Smear
Additional bias samples collected 11/18, held until necessity of analysis was determined
Submitted to lab -
12/4/2009

Total number of containers: 2

Form 202r4.xls (1/3/01)

	(1)	(2)
Relinquished By:		
Signature	Michael Barsa	
Printed Name	Michael Barsa	
Date	12/4/09	
Time	1400	
Company	Cabrera	
Received By:		
Signature	Cheryl Trimble	
Printed Name	Cheryl Trimble	
Date	12-7-09	
Time	1140	
Company	ALS	

* Time Zone (circle one): EDT CDT MDT PDT

** Indicate specific analytes under comments.

Distribution: white / yellow (Paragon); pink retained by originator.

CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Cabrera Workorder No: 0912056

Project Manager: LS Initials: CDT Date: 12-7-09

1. Does this project require any **special handling** in addition to standard Paragon procedures?		YES	(NO)
2. Are custody **seals** on **shipping containers** intact?	NONE	(YES)	NO
3. Are Custody seals on **sample containers** intact?	(NONE)	YES	NO
4. Is there a **COC (Chain-of-Custody) present** or other representative documents?		(YES)	NO
5. Are the **COC and bottle labels complete and legible**?		(YES)	NO
6. Is the **COC in agreement** with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were **airbills / shipping documents** present and/or removable?	DROP OFF	(YES)	NO
8. Are all aqueous **samples requiring preservation preserved correctly?** (excluding volatiles)	(N/A)	YES	NO
9. Are all aqueous **non-preserved samples pH 4-9**?	(N/A)	YES	NO
10. Is there **sufficient sample** for the requested analyses?		(YES)	NO
11. Were all samples placed in the **proper containers** for the requested analyses?		(YES)	NO
12. Are all samples within **holding times** for the requested analyses?		(YES)	NO
13. Were all sample containers received **intact**? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring **no** headspace (**VOC, GRO, RSK/MEE, Rx CN/S, radon**) headspace free? **Size of bubble**: ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do perchlorate LCMS-MS samples **have** headspace? (at least 1/3 of container required)	(N/A)	YES	NO
16. Were samples checked for and free from the presence of **residual chlorine?** (Applicable when PM has indicated samples are from a chlorinated water source; note if field preservation with sodium thiosulfate was not observed.)	(N/A)	YES	NO
17. Were the samples **shipped on ice**?		YES	(NO)
18. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: #2 #4	RAD ONLY	YES	(NO)

Cooler #:	1							
Temperature (°C):	CDT 12-7-09 +8 11.2							
No. of custody seals on cooler:	1							
DOT Survey/ Acceptance Information — External µR/hr reading:	12							
Background µR/hr reading:	12							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? (YES) / NO / NA (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16

If applicable, was the client contacted? YES / NO / NA Contact: _____ Date/Time: _____

Project Manager Signature / Date: 12/7/09

*IR Gun #2: Oakton, SN 29922500201-0066 *IR Gun #4: Oakton, SN 2372220101-0002

0912056

From: Origin ID: ODMA (410) 332-8177
Mike Barsa
CABRERA SERVICES
103 E. Mount Royal Ave
Ste 2B
Baltimore, MD 21202

FedEx Express

J09300907312023

Ship Date: 04DEC09
ActWgt: 2.0 LB
CAD: 4239785/INET9090
Account#: S *********

Delivery Address Bar Code

Ref # 08-3800.04, Task 200
Invoice #
PO #
Dept #

12
1

SHIP TO: (970) 490-1511 BILL SENDER

Lance Steere
ALS-Paragon
225 COMMERCE DR

FORT COLLINS, CO 80524

MON - 07DEC A2
STANDARD OVERNIGHT

TRK# 0201 7981 9299 5533

80524
CO-US
DEN

XH FTCA

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ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division
Fort Collins, Colorado

Tritium

Case Narrative

Cabrera Services, Inc.

Forest Glen Rad Scoping Survey -- 08-3800.04

Work Order Number: 0912056

1. This report consists of the analytical results and supporting documentation for two wipe samples received by ALS on 12/07/2009.

2. These samples were prepared according to procedure SOP700R10, with procedure modifications outlined in QASS 379412.

3. The samples were analyzed for the presence of tritium according to procedure SOP704R9. The analyses were completed on 12/25/2009.

4. Upon analysis of these samples, it was noted that the quench factor (H#) was outside of the current usable calibration range for the associated QC. Thus, an approximate volume of 10 µL of nitro-methane was added to the associated QC to bring them into the usable calibration range.

5. The analysis results for these samples are reported on an 'As Received' basis in units of pCi/sample.

6. Sample volume was insufficient to allow preparation of a duplicate and matrix spike. A laboratory control sample duplicate (LCSD) was prepared in lieu of a client sample duplicate.

7. Sample 0912056-1 had a "Window 2" count rate of 27.17 cpm, below the lower control limit of 27.30 cpm, determined from calibration on 12/24/2009 through 12/25/2009. For this analysis, "Window 2" is monitored for high-energy beta contamination, therefore no contamination is observed and the data quality is not believed to be affected.

8. No further anomalous situations were encountered during the preparation or analysis of these samples. All remaining quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Jean Anderson
Radiochemistry Primary Data Reviewer

12/30/09
Date

Radiochemistry Final Data Reviewer

12-30-09
Date

Section 1

CHAIN OF CUSTODY

ALS Laboratory Group -- FC

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 0912056
Client Name: Cabrera Services Inc.
Client Project Name: Forest Glen Rad Scoping Survey
Client Project Number: 08-3800.04
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
SU03-BIAS-02	0912056-1		WIPE	18-Nov-09	12:50
SU03-BIAS-03	0912056-2		WIPE	18-Nov-09	12:55

225 Commerce Drive Fort Collins, CO 80524
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Accession Number (LAB ID) 0912056

ALS Laboratory Group

Chain-of-Custody

Date 12/04/09 Page 1 of 1

Project Name / No.: Forest Glen Rad Scoping Survey Sampler(s): KK, AC, MB, AW (circle one) Turnaround: Standard or ~~Rush (Due~~) Dispose or Return to Client

Report To: Michael Barsa
Phone: 410-332-8177
Fax: 410-332-8183
Company: Cabrera Services
Address: 103 E. Mount Royal Ave, Suite 2B
Baltimore, MD 21202

circle method or specify under comments

Sample ID	Date	Time *	Lab ID	Matrix	No. of Containers	H-3 via Liquid Scintillation E906.0
SU03-BIAS-02	11/18/09	12:50	1	SM	1	X
SU03-BIAS-03	11/18/09	12:55	2	SM	1	X
						X
						X
						X
						X
						X
						X
						X
						X

Comments:
08-3800.04, Task 2
WRAMC Forest Glen Annex Radiological Survey
SM=Smear
Additional bias samples collected 11/18, held until necessity of analysis was determined
Submitted to lab -
12/4/2009

Total number of containers: 2

Form 202r4.xls (1/3/01)

Relinquished By: (1)	Relinquished By: (2)
Signature [signature]	Signature
Printed Name Michael Barsa	Printed Name
Date 12/4/09 Time 1400	Date Time
Company Cabrera	Company

Received By: (1)	Received By: (2)
Signature Cheryl Trimble	Signature
Printed Name Cheryl Trimble	Printed Name
Date 12-7-09 Time 1140	Date Time
Company ALS	Company

* Time Zone (circle one): EDT CDT MDT PDT

** Indicate specific analytes under comments.

Distribution: white / yellow (Paragon); pink retained by originator.

CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Cabrera Workorder No: 0912056

Project Manager: LS Initials: CDT Date: 12-7-09

1. Does this project require any **special handling** in addition to standard Paragon procedures?		YES	(NO)
2. Are custody **seals** on **shipping containers** intact?	NONE	(YES)	NO
3. Are Custody seals on **sample containers** intact?	(NONE)	YES	NO
4. Is there a **COC (Chain-of-Custody) present** or other representative documents?		(YES)	NO
5. Are the **COC and bottle labels complete and legible**?		(YES)	NO
6. Is the **COC in agreement** with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were **airbills / shipping documents** present and/or removable?	DROP OFF	(YES)	NO
8. Are all aqueous **samples requiring preservation preserved correctly**? (excluding volatiles)	(N/A)	YES	NO
9. Are all aqueous **non-preserved samples pH 4-9**?	(N/A)	YES	NO
10. Is there **sufficient sample** for the requested analyses?		(YES)	NO
11. Were all samples placed in the **proper containers** for the requested analyses?		(YES)	NO
12. Are all samples within **holding times** for the requested analyses?		(YES)	NO
13. Were all sample containers received **intact**? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring **no** headspace (**VOC, GRO, RSK/MEE, Rx CN/S, radon**) headspace free? **Size of bubble:** ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do perchlorate LCMS-MS samples **have** headspace? (at least 1/3 of container required)	(N/A)	YES	NO
16. Were samples checked for and free from the presence of **residual chlorine**? (Applicable when PM has indicated samples are from a chlorinated water source; note if field preservation with sodium thiosulfate was not observed.)	(N/A)	YES	NO
17. Were the samples **shipped on ice**?		YES	(NO)
18. Were cooler temperatures measured at 0.1-6.0°C? **IR gun used*:** #2 #4	RAD ONLY	YES	(NO)

Cooler #:	1
Temperature (°C):	CDT 12-7-09 +6 11.2
No. of custody seals on cooler:	1
DOT Survey/ Acceptance Information — External µR/hr reading:	12
DOT Survey/ Acceptance Information — Background µR/hr reading:	12

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? (YES) / NO / NA (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16

If applicable, was the client contacted? YES / NO / NA Contact: _____ Date/Time: _____

Project Manager Signature / Date: 12/7/09

*IR Gun #2: Oakton, SN 29922500201-0066 *IR Gun #4: Oakton, SN 2372220101-0002

0912056 Page 1 of 1

From: Origin ID: ODMA (410) 332-8177
Mike Barsa
CABRERA SERVICES
103 E. Mount Royal Ave
Ste 2B
Baltimore, MD 21202

FedEx Express

Ship Date: 04DEC09
ActWgt: 2.0 LB
CAD: 4239785/INET9090
Account#: S *********

Delivery Address Bar Code

12
1-

SHIP TO: (970) 490-1511 BILL SENDER
Lance Steere
ALS-Paragon
225 COMMERCE DR

FORT COLLINS, CO 80524

Ref # 08-3800.04, Task 200
Invoice #
PO #
Dept #

MON - 07DEC A2
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CO-US
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Section 2

SAMPLE RESULTS SUMMARY

Tritium Analysis By Liquid Scintillation Sample Results Summary

Client Name: Cabrera Services Inc.
Client Project Name: Forest Glen Rad Scoping Survey
Client Project Number: 08-3800.04

Laboratory Name: ALS Laboratory Group -- FC
PAI Work Order: 0912056

Reported on: Wednesday, December 30, 2009 7:43:14 AM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0912056-1	SU03-BIAS-02	Sample	H-3	0.5 +/- 1.8	3.0	pCi/sample	WIPE	3H091209-2	12/24/2009	U
0912056-2	SU03-BIAS-03	Sample	H-3	0.7 +/- 1.8	3.0	pCi/sample	WIPE	3H091209-2	12/24/2009	U

Comments:

Data Package ID: *H30912056-1*

Qualifiers/Flags:
U - Result is less than the sample specific MDC.
LT - Result is less than Requested MDC, greater than sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:
TPU - Total Propagated Uncertainty
MDC - Minimum Detectable Concentration
BDL - Below Detection Limit

Section 3

QC RESULTS SUMMARY 3

Tritium Analysis By Liquid Scintillation

PAI 704 Rev 9

Method Blank Results

Lab Name: ALS Laboratory Group -- FC
Work Order Number: 0912056
Client Name: Cabrera Services Inc.
ClientProject ID: Forest Glen Rad Scoping Survey 08-3800.04

Lab ID: 3H091209-2MB

Sample Matrix: WIPE
Prep SOP: PAI 700 Rev 10
Date Collected: 09-Dec-09
Date Prepared: 09-Dec-09
Date Analyzed: 24-Dec-09

Prep Batch: 3H091209-2
QCBatchID: 3H091209-2-1
Run ID: 3H091209-2A
Count Time: 60 minutes

Final Aliquot: 1.00 sample
Result Units: pCi/sample
File Name: B60_04_122401

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
10028-17-8	H-3	1.3 +/- 2.0	3.2	20	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

BDL - Below Detection Limit

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Data Package ID: *H30912056-1*

Tritium Analysis By Liquid Scintillation

PAI 704 Rev 9

Laboratory Control Sample(s)

Lab Name: ALS Laboratory Group -- FC
Work Order Number: 0912056
Client Name: Cabrera Services Inc.
ClientProject ID: Forest Glen Rad Scoping Survey 08-3800.04

Lab ID: 3H091209-2LCS

Sample Matrix: WIPE
Prep SOP: PAI 700 Rev 10
Date Collected: 09-Dec-09
Date Prepared: 09-Dec-09
Date Analyzed: 25-Dec-09

Prep Batch: 3H091209-2
QCBatchID: 3H091209-2-1
Run ID: 3H091209-2A
Count Time: 60 minutes

Final Aliquot: 1.00 sample
Result Units: pCi/sample
File Name: B60_04_122401

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
10028-17-8	H-3	114 +/- 18	3	113	101	85 - 115	P

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS Recovery within control limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

Data Package ID: *H30912056-1*

Tritium Analysis By Liquid Scintillation

PAI 704 Rev 9

Laboratory Control Sample(s)

Lab Name: ALS Laboratory Group -- FC
Work Order Number: 0912056
Client Name: Cabrera Services Inc.
ClientProject ID: Forest Glen Rad Scoping Survey 08-3800.04

Lab ID: 3H091209-2LCSD

Sample Matrix: WIPE
Prep SOP: PAI 700 Rev 10
Date Collected: 09-Dec-09
Date Prepared: 09-Dec-09
Date Analyzed: 25-Dec-09

Prep Batch: 3H091209-2
QCBatchID: 3H091209-2-1
Run ID: 3H091209-2A
Count Time: 60 minutes

Final Aliquot: 1.00 sample
Result Units: pCi/sample
File Name: B60_04_122401

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
10028-17-8	H-3	114 +/- 18	3	113	101	85 - 115	P

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS Recovery within control limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

Data Package ID: *H30912056-1*

Tritium Analysis By Liquid Scintillation

PAI 704 Rev 9

Duplicate Sample Results (DER)

Lab Name: ALS Laboratory Group -- FC
Work Order Number: 0912056
Client Name: Cabrera Services Inc.
ClientProject ID: Forest Glen Rad Scoping Survey 08-3800.04

Field ID:
Lab ID: 3H091209-2LCSD

Sample Matrix: WIPE
Prep SOP: PAI 700 Rev 10
Date Collected: 09-Dec-09
Date Prepared: 09-Dec-09
Date Analyzed: 25-Dec-09

Prep Batch: 3H091209-2
QCBatchID: 3H091209-2-1
Run ID: 3H091209-2A
Count Time: 60 minutes

Final Aliquot: 1.00 sample
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/sample
File Name: B60_04_122401

CASNO	Analyte	Sample			Duplicate			DER	DER Lim
		Result +/- 2 s TPU	MDC	Flags	Result +/- 2 s TPU	MDC	Flags		
10028-17-8	H-3	114 +/- 18	3	P	114 +/- 18	3	P	0.00078	2.13

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13
LT - Result is less than Request MDC, greater than sample specific MDC
M - Requested MDC not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits

Abbreviations:

TPU - Total Propagated Uncertainty
DER - Duplicate Error Ratio
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *H30912056-1*

Section 4

INDIVIDUAL SAMPLE RESULTS

Tritium Analysis By Liquid Scintillation

PAI 704 Rev 9

Sample Results

Lab Name: ALS Laboratory Group -- FC
Work Order Number: 0912056
Client Name: Cabrera Services Inc.
ClientProject ID: Forest Glen Rad Scoping Survey 08-3800.04

Field ID: SU03-BIAS-02
Lab ID: 0912056-1

Sample Matrix: WIPE
Prep SOP: PAI 700 Rev 10
Date Collected: 18-Nov-09
Date Prepared: 09-Dec-09
Date Analyzed: 24-Dec-09

Prep Batch: 3H091209-2
QCBatchID: 3H091209-2-1
Run ID: 3H091209-2A
Count Time: 60 minutes
Report Basis: As Received

Final Aliquot: 1.00 sample
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/sample
File Name: B60_04_122401

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
10028-17-8	H-3	0.5 +/- 1.8	3.0	20	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

BDL - Below Detection Limit

Data Package ID: *H30912056-1*

Tritium Analysis By Liquid Scintillation

PAI 704 Rev 9

Sample Results

Lab Name: ALS Laboratory Group -- FC
Work Order Number: 0912056
Client Name: Cabrera Services Inc.
ClientProject ID: Forest Glen Rad Scoping Survey 08-3800.04

Field ID: SU03-BIAS-03
Lab ID: 0912056-2

Sample Matrix: WIPE
Prep SOP: PAI 700 Rev 10
Date Collected: 18-Nov-09
Date Prepared: 09-Dec-09
Date Analyzed: 24-Dec-09

Prep Batch: 3H091209-2
QCBatchID: 3H091209-2-1
Run ID: 3H091209-2A
Count Time: 60 minutes
Report Basis: As Received

Final Aliquot: 1.00 sample
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/sample
File Name: B60_04_122401

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
10028-17-8	H-3	0.7 +/- 1.8	3.0	20	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

BDL - Below Detection Limit

Data Package ID: *H30912056-1*

Section 5

RAW DATA

5

Tritium Analysis By Liquid Scintillation Raw Data Report

Laboratory Name: ALS Laboratory Group -- FC
PAI Work Order: 0912056

Prep SOP: PAI 700
Analytical SOP: PAI 704

Reported on: Monday, December 28, 2009 1:36:14 PM

Sample ID / QC Type	Nuclide / Type	Sample Date/Time	Prep Batch / QCBatchID	Ingrowth Date /Time	Quench Factor / %Lum	Matrix / %Moist.	Samp Alq / Analy Alq	Inst ID / Det ID	AnRunID / File Name	Count Date/Time	GrossCPM / BkgCPM	BaseEff / ProgEff	CntDur(min) / Yield	Activity +/- 2 s TPU	MDC / DecLev	ReportUnits / ReportBasis	DER RPD	%Spk. Recov / Flags
0912056-1	H-3	11/18/2009	3H091209-2	NA	115.8	WIPE	1 S	LS6000	3H091209-2A	12/24/2009	7.070	24.14%	60	0.5	3.0	pCi/sample	NA	
SMP	Trg. Analyte	12:50:00 PM	3H091209-2-1	NA	0.37	NA	1 S	36-2	B60_04_122401	8:01 PM	6.829	NA	NA	1.8	NA	As Received	NA	U
0912056-2	H-3	11/18/2009	3H091209-2	NA	117.1	WIPE	1 S	LS6000	3H091209-2A	12/24/2009	7.230	23.99%	60	0.7	3.0	pCi/sample	NA	
SMP	Trg. Analyte	12:55:00 PM	3H091209-2-1	NA	0.32	NA	1 S	36-3	B60_04_122401	9:02 PM	6.838	NA	NA	1.8	NA	As Received	NA	U
3H091209-2	H-3	12/9/2009	3H091209-2	NA	127.8	WIPE	1 S	LS6000	3H091209-2A	12/24/2009	7.580	22.79%	60	1.3	3.2	pCi/sample	NA	
MB	Trg. Analyte	10:51:38 AM	3H091209-2-1	NA	0.43	NA	1 S	36-4	B60_04_122401	10:03 PM	6.912	NA	NA	2.0	NA	As Received	NA	U
3H091209-2	H-3	12/9/2009	3H091209-2	NA	126.3	WIPE	1 S	LS6000	3H091209-2A	12/25/2009	64.930	22.96%	60	114	3	pCi/sample	NA	101
LCS	Trg. Analyte	10:51:38 AM	3H091209-2-1	NA	0.21	NA	1 S	36-6	B60_04_122401	12:05 AM	6.902	NA	NA	18	NA	As Received	NA	P
3H091209-2	H-3	12/9/2009	3H091209-2	NA	126.3	WIPE	1 S	LS6000	3H091209-2A	12/25/2009	64.920	22.96%	60	114	3	pCi/sample	0.00	101
LCSD	Trg. Analyte	10:51:38 AM	3H091209-2-1	NA	0.22	NA	1 S	36-7	B60_04_122401	1:07 AM	6.902	NA	NA	18	NA	As Received	NA	P

Comments:

Data Package ID: *H30912056-1*

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

+ - Duplicate RPD not within limits.

LT - Result is less than Request MDC, greater than sample specific MDC

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.

- Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'

M - Requested MDC not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Notes:

1) The Tracer results are not yield corrected (i.e. activity measured not activity added).

2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

Abbreviations:

TR- Tracer TA - Target Analyte

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

DER - Duplicate Error Ratio

BDL - Below Detection Limit

ID: CSH 5 PHL, LO PHL 24 DEC 2009 18:57
USER: 4 COMMENT: LS6000

PRESET TIME :	60.00				
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		
SCINTILLATOR:	LIQUID	LUMEX:	NO	LOW SAMPLE REJ:	0		
LOW LEVEL :	YES	HALF LIFE CORRECTION DATE:			none		

CHAN: 50.0 - 250.0 %ERROR: 1.75 FACTOR: 1.000000 BKG. SUB: 0
CHAN: 450.0 - 900.0 %ERROR:20.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	H#	WIND1 CPM	WIND1 %ERROR	WIND2 CPM	WIND2 %ERROR	LUMEX %	ELAPSED TIME
1	36-1	60.00	129.8	6.58	10.06	30.27	4.69	0.48	61.11
2	36-2	60.00	115.8	7.07	9.71	27.17[K]	4.95	0.37	122.30
3	36-3	60.00	117.1	7.23	9.60	27.90	4.89	0.32	183.45
4	36-4	60.00	127.8	7.58	9.38	28.80	4.81	0.43	244.65
5	36-5	60.00	129.7	6.75	9.94	29.78	4.73	0.44	305.84
6	36-6	60.00	126.3	64.93	3.20	28.10	4.87	0.21	367.02
7	36-7	60.00	126.3	64.92	3.20	27.52	4.92	0.22	428.20
8	36-8	60.00	130.0	7.45	9.46	28.15	4.87	0.48	489.41

060-04-122401
mdc 12-28-09

K < LCL of 27.30

B60_04_122401

BSF Version	: 3
Instrument Type	: LS 6000
Data Capture Date	: 24 Dec 2009 18:58:48
User Filename	: C:\...\LS WINCONNECTION\DATA\USER04\UN122401.BSF
User Number	: 4
User Id	: 3H:5-ML,10-ML
User Comments	: LS6000
Preset Count Time	: 60.00
Calculation Mode	: CPM
H# Selected	: YES
Sample Repeats	: 1
Printer Output Mode	: STD
Blank Count	: NO
IC# or SCR Selected	: NO
Replicates	: 1
RS232 Output Mode	: EDIT
Two-Phase Selected	: NO
AQC Choice	: NO
Cycle Repeats	: 1
Scintillator Choice	: LIQUID
Lumex Selected	: NO
Low Sample Reject Count	: 0
Low Level Selection	: YES
Half Life Correction Date	: none
Window Limits Window 1	: 50.00
Preset %Error Iso1	: 1.75
Norm Multiplier Iso1	: 1.00000
Background CPM 1	: 0.00
Window Limits Window 2	: 450.00
Preset %Error Iso2	: 20.00
Norm Multiplier Iso2	: 1.00000
Background CPM 2	: 0.00
Alpha/Beta Discrimination	: NO

Sam	Rack	Time	H#	CPM Iso1	%Err1	CPM Iso2	%Err2	LumEx	ElTime
1	36-1	60.00	129.8	6.58	10.06	30.27	4.69	0.48	61.11
2	36-2	60.00	115.8	7.07	9.71	27.17	4.95	0.37	122.30
3	36-3	60.00	117.1	7.23	9.60	27.90	4.89	0.32	183.45
4	36-4	60.00	127.8	7.58	9.38	28.80	4.81	0.43	244.65
5	36-5	60.00	129.7	6.75	9.94	29.78	4.73	0.44	305.84
6	36-6	60.00	126.3	64.93	3.20	28.10	4.87	0.21	367.02
7	36-7	60.00	126.3	64.92	3.20	27.52	4.92	0.22	428.20
8	36-8	60.00	130.0	7.45	9.46	28.15	4.87	0.48	489.41

MP 12-28-09

379857

LSC Run Log

Instrument ID: LS6000

ALS Laboratory Group - Fort Collins

	Date	Sample ID	CountTime (min.)	Rack & Position	Test	User #	Batch ID	Position Check	Initials	Comments
1	12-21-09	0911170-63	70	6 - 2	H3 Sm1	8	3H091123-4	MR	MR	NA
2	↓	-63D	↓	- 3	↓	↓	↓	↓	↓	↓
3		-64		- 4						
4		-65		- 5						
5	↓	3H091123-4CD2	↓	↓ - 6	↓	↓	↓	↓	↓	↓
6	12-22-09	Daily QC	10	1,3 - 1-3, 1-4	—	1,3	—	MR	MR	NA
7	12-22-09	0924008-1	46.05	47 - 1	H3 10ml	4	3H091122-1			Cocktail Verification
8		-2	↓	- 2						
9		-3	45.75	- 3						
10		-4	47.80	- 4						
11		-5	47.75	- 5						
12		-6	48	- 6						
13		3H091122-1BLMB	180	- 7						
14		-1BL2 MB		- 8						
15		-1BL3 MB		- 9						
16		-1BL4 MB		- 10						
17		-1BL5 MB		- 11						
18	↓	-1BL6 MB	↓	↓ - 12	↓	↓	↓	↓	↓	↓
19	12-23-09	0911170-66	70	8 - 7	H3 5ml	8	3H091123-4	MR	MR	NA
20		-67		- 8						
21		-68		- 9						
22		-69		- 10						
23		-70		- 11						
24		3H091123-4MB	↓	↓ - 12						
25		4LCS	38.80	40 - 1						
26	↓	-4CB3	70	↓ - 2	↓	↓	↓	↓	↓	↓
27	12-23-09	Daily QC	10	1,3 - 1-3, 1-4	—	1,3	—	MR	MR	NA
28	12-23-09	3H091218-5CB1	120	32 - 1	H3 10ml	2	3H091218-5			
29		0912143-1		- 2						
30	↓	↓ -2	↓	↓ - 3	↓	↓	↓	↓	↓	↓

MR 12-26-09

Analyst / Date MR 12-28-09

FORM 762r6.xls (3/7/09)

Note: Each page is copied as completed and included with the workorder/run documentation reviewed subsequently.

LSC Run Log

Instrument ID: LS6000 **379858** **ALS Laboratory Group - Fort Collins**

	Date	Sample ID	CountTime (min.)	Rack & Position	Test	User #	Batch ID	Position Check	Initials	Comments
1	12-23-09	09120443-3	120	32 - 4	H3 10ml	2	3H091218-S	MLK	MLK	NA
2		-S		- 5						
3		3H091218-SCB2		- 6						
4		-SMB		- 7						
5		-SLCS		- 8						
6		-SLCSD		- 9						
7		-SCB3		- 10						
8	12-24-09	3H091209-2 CB1	60	36 - 1	H3 5ml	4	3H091209-2	MLK	MLK	NA
9		09120056-1		- 2						
10		-2		- 3						
11		3H091209-2MB		- 4						
12		-2CB2		- 5						
13		-2LCS		- 6						
14		-2LCSD		- 7						
15		-2CB3		- 8						
16	12-25-09	3H091117-2CB1	60	42 - 1	H3 5ml	4	3H091117-2	MLK	MLK	
17		09125008-1		- 2						
18		-2		- 3						
19		-3		- 4						
20		-4		- 5						
21		-5		- 6						
22		3H091117-2 CB2		- 7						
23		09125008-6		- 8						
24		3H091117-2MB		- 9						
25		-2LCS		- 10						
26		-2LCSD		- 11						
27		-2CB3		- 12						MLK 12-28-09
28	12-25-09	3H091216-1 CB1	120	56 - 1	H3 10ml	2	3H091216-1	MLK	MLK	NA
29		09120902-1		- 2						
30		-10		- 3						

Analyst / Date MLK 12-28-09

FORM 762r6.xls (3/7/09)

Note: Each page is copied as completed and included with the workorder/run documentation; reviewed subsequently.

LSC Run Log

Instrument ID: LS6000 **379859** **ALS Laboratory Group - Fort Collins**

	Date	Sample ID	CountTime (min.)	Rack & Position	Test	User #	Batch ID	Position Check	Initials	Comments
1	12-25-09	091209 2-3	120	56 - 4	H3 10ml	2	3H091216-1	MK	MK	NA
2		↓ -3MS		- 5						
3		091210 6-9		- 6						
4		3H091216-1CD2		- 7						
5		091210 6-13		- 8						
6		-17	↓	- 9						
7		↓ -21	27.00	- 10						
8		3H091216-1MB	120	- 11						
9		↓ -1LCS	↓	↓ - 12						
10	↓	↓ -1CB3	↓	4 - 1	↓	↓	↓	↓	↓	↓
11	12-26-09	Daily QC	10	1,3 - 1-3, 1-4	—	1,3	—	MK	MK	NA
12				-						
13				-						
14				-						
15				-						
16				-						
17				-						
18				-						
19				-						
20				-						
21				-						
22				-						
23				-						
24				-						
25				-						
26				-						
27				-						
28				-						
29				-						
30				-						MK 12-28-09

Analyst / Date MK 12-28-09

FORM 762r6.xls (3/7/09)

Note: Each page is copied as completed and included with the workorder/run documentation; reviewed subsequently.

Section 6

QUALITY ASSURANCE SUMMARY REPORTS

6

ALS Laboratory Group - Fort Collins

QUALITY ASSURANCE SUMMARY SHEET

PAR W.O. # / BATCH 3H091209-2
TEST 3H
METHOD Prep
SOP/REV (PREP) 700.10
SOP/REV (ANAL) _____

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

GDW 12/09/09

Samples in work order 0912056 consisted of swipes in a liquid scintillation vial with 5 ml of water. 15ml of UG LLT were added directly to the original vials, all stickers were removed and vials cleaned with methanol before submitting.
Due to limited sample volume, no sample duplicate or MS were prepared; for additional quality control a LCS duplicate was prepared.
The CB, MB, LCS and LCS duplicate were made using swipes folded in half and placed into a liquid scintillation vial. 5 ml of DI water were pipetted into the vial using a calibrated pipette and 15 ml of UG LLT added. For the Tritium LCS and LCSD, 0.1 ml of water was removed with a pipette and 0.1ml of Tritium spike was added.

GDW 12/09/09

GDW 12/09/09

GDW 12/09/09

GDW
12-09-09

TECHNICIAN/ANALYST Gabriel Wes DATE 12-09-09

DEPARTMENT MANAGER Crystal Shaffer DATE 12/9/09

379412

FORM 302r6b.doc (4/22/04)

Section 7

LABORATORY BENCH SHEETS

7

1-4

Radiochemistry Instrument Worksheet

ALS Laboratory Group -- FC

Prep Batch: 3H091209-2

Prep Procedure: H3 swipes 30 min

Analytical QASS / NCR? Y / N NA

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Report Units	Cnt 1 File/Inst	Cnt 1 Rack-Pos	Cnt 1 Pos Chk By	Cnt 2 File/Inst	Cnt 2 Rack-Pos	Cnt 2 Pos Chk By	Cnt 3 File/Inst	Cnt 3 Rack-Pos	Cnt 3 Pos Chk By	Notes
1	0912056-1	SMP	1	1	sample	pCi/sample	156000	36-2	MH							
1	0912056-2	SMP	1	1	sample	pCi/sample		-3								MH 12-28-09
1	3H091209-2CB1	MB	1	1	sample	pCi/sample		-1								10µL nitro added
1	3H091209-2CB2	MB	1	1	sample	pCi/sample		-5								
1	3H091209-2CB3	MB	1	1	sample	pCi/sample		-8								
1	3H091209-2	MB	1	1	sample	pCi/sample		-4								
1	3H091209-2	LCS	1	1	sample	pCi/sample		-6								
1	3H091209-2	LCSD	1	1	sample	pCi/sample		-7								MH 12-28-09

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	H-3	648.3610.44	2,517.810	DPM/ml	12/09/09	0.1	ml	RS-013

Reporting Units

LabID:	TstGrbNatNte:	RptUnits:
0912056-1	H3_Edgewood_smears_20pCi	pCi/samp
0912056-2	H3_Edgewood_smears_20pCi	pCi/samp

Sample Barcodes

0912056-1
3H091209-2PS1

0912056-2
3H091209-2PS2

3H091209-2CB1MB
3H091209-2PS3

3H091209-2CB2MB
3H091209-2PS4

3H091209-2CB3MB
3H091209-2PS5

3H091209-2MB
3H091209-2PS6

3H091209-2LCS
3H091209-2PS7

3H091209-2LCSD
3H091209-2PS8

Radiochemistry Prep Worksheet

ALS Laboratory Group -- FC

Prep Batch: 3H091209-2

Prep Procedure: H3

Reviewed By: GDW GDW Review Date: 12/9/2009

Non-Routine Pre-Treatment? Y / (N) Batch: N/A Re-Prep? Y / (N) Batch: N/A Prep QASS / NCR? (Y) / N 379412

Prep SOP: PAI 700 Rev: 10
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Gabriel D. Wagner GDW
Prep Date: 12/9/2009
Prep Dept: RS

Balance: 21
Balance:

Cocktail: UG LLT
Cocktail Pipet: T-002
Aliquot Pipet: RS-015

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq sample	Fin Alq sample	Prep Basis	Water Added(ml)	Moisture(%)	Analysis Vol.(ml)	Standards	Prep Notes
1	1	0912056-1	SMP		1	1	As Received					
2	1	0912056-2	SMP		1	1	As Received					
3	1	3H091209-2CB1	MB		1	1	As Received					
4	1	3H091209-2CB2	MB		1	1	As Received					
5	1	3H091209-2CB3	MB		1	1	As Received					
6	1	3H091209-2	MB		1	1	As Received					
7	1	3H091209-2	LCS		1	1	As Received				S1	
8	1	3H091209-2	LCSD		1	1	As Received				S1	

GDW 12-09-09 GDW 12-09-09 GDW 12-09-09 GDW 12-09-09

Comments
UG LLT #97-090301// DUE TO LIMITED VOLUME A DUPLICATE AND MS WERE NOT PREPARED FOR THIS BATCH. A LCSD WAS PREPARED INSTEAD.

Spiked By: Gabriel D. Wagner GDW Date: 12/9/2009

Witnessed By: Peter Workman Date: 12/9/2009

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	H-3	648.3610.44	2,517.810	DPM/ml	12/09/09	0.1	ml	RS-013

ALS Laboratory Group -- FC

Radiochemistry Prep Worksheet

Prep Batch: 3H091209-2

Prep Procedure: H3

Prep Batch Not Validated!!!

Reviewed By: Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 700 Rev: 10
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Gabriel D. Wagner GDW
Prep Date: 12/9/2009
Prep Dept: RS

Balance: 21
Balance:

Cocktail: UG LLT
Cocktail Pipet: T-002
Aliquot Pipet: RS-015

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq sample	Fin Alq sample	Prep Basis	Water Added(ml)	Moisture(%)	Analysis Vol.(ml)	Standards	Prep Notes
1	1	0912056-1	SMP		1	1	As Received					
2	1	0912056-2	SMP		1	1	As Received					
3	1	3H091209-2CB1	MB		1	1	As Received					
4	1	3H091209-2CB2	MB		1	1	As Received					
5	1	3H091209-2CB3	MB		1	1	As Received					
6	1	3H091209-2	MB		1	1	As Received					
7	1	3H091209-2	LCS		1	1	As Received				S1	
8	1	3H091209-2	LCSD		1	1	As Received				S1	

Comments 97-090301 CDW 12-09-09

UG LLT ~~#97-090701~~ // DUE TO LIMITED VOLUME A DUPLICATE AND MS WERE NOT PREPARED FOR THIS BATCH. A LCSD WAS PREPARED INSTEAD.

Spiked By: Gabriel D. Wagner GDW Date: 12-09-09

Witnessed By: PJW Date: 12/9/09

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	H-3	648.3610.44	2,517.810	DPM/ml	12/09/09	0.1	ml	RS-013

exp. 10/21/10

SAMPLE CONDITION FORM (SOLIDS)

ANALYST: GDW

ANALYSIS DATE: 12-09-2009 METHOD: 3H

WORK ORDER	SAMPLE ID	SAMPLE CONDITION		
		Dry/Wet	TEXTURE	Remarks
0912056	1	as recd	swipe / solid	none
"	2	"	"	"

GDW 12-09-09

Section 8

STANDARDS TRACEABILITY DOCUMENTS

8

Prepare a working dilution of ~5000 dpm/mL of Tritium from 648.2382.75.

1) Density of DI water

Mass of 100 mL Vol flask	66.4336 g	
Mass of flask + Water	166.1135 g	
Net Mass	99.6799	
ρ = 0.9968 g/mL		

2) Mass of Std Transferred

Mass of Empty 500 mL Glass	260.38 g	
Mass of Glass + Std	266.45 g	
Net Mass Transferred	6.07 g	

3) Dilute to Fin. Vol. w/ DI water

Mass of Glass Std, Diluent	733.7 g	
Mass of Glass	260.38 g	
Net Mass of New Dilution	473.32 g	

Final Activity Calc

$$\left(369{,}580.45 \frac{dpm}{mL}\right)\left(\frac{0.9968 \text{ g/mL}}{0.9958 \text{ g/mL}}\right)\left(\frac{6.07 \text{ g}}{473.32 \text{ g}}\right) = \boxed{4{,}743.7 \frac{dpm}{mL}}$$

RG 10/23/09 RG 10/23/09

Stnd ID: 648.3610.44

RG 10/23/09

Description: 3H
Expiration: 10/21/2010
Activity: 4743.70 dpm/mL

2s Uncertainty: 34.15 dpm/mL
Ref. Date: 9/3/1998
Ref Time: N/A
Prep Date: 9/29/2009 Prep by: JD
Matrix/Comp. DI Water
Half Life (y): 1.23E+01

RG 10/23/09 RG 10/23/09

Reverification Log		
Analysis Date	Initials	Expiration Date

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
	9/29/09	Renee Gallegos	10/23/09

Prepare a ~~working~~ 10 dilution ~~solution~~ dilution (at approximately 2500 DPM/mL) tritium standard using RSO #648 and diluting with DI water.

1) Determine the density of DI water:

Mass of empty 100mL Class A volumetric flask	67.1522 g	Bal #13
Mass of flask + water	166.7351 g	↓
Net mass of 100mL H_2O	99.5829 g	

$\rho = .9958$ g/mL

2) Transfer contents of Ampoule SRM 4927F to a ~~40mL VOA vial~~ 500mL glass amber bottle
CW 3/17/03

mass of 500mL bottle w/o lid	255.04g	Bal #26
mass of open ampoule + 50mL beaker	40.9075g	Bal #12
mass of empty ampoule + 50mL beaker	36.0148g	↓
Net mass of Std.	4.8927 g	

3) Dilute Std. with DI water

mass of bottle w/o lid	255.04 g	Bal #26
mass of bottle, Std. + DI water	757.1 g	↓
Net mass of Std + DI water	502.1g	

4. Final Activity Calculation.

$$\frac{(634.7\ kBq/g)(1000\ Bq/kBq)(60\ DPM/Bq)(4.8927\ g)(.9958\ g/mL)}{502.1\ g} = 369,530.45\ \frac{DPM}{mL}$$

U.S. Department of Commerce
National Institute of Standards and Technology
SRM 4927F
Hydrogen-3
<4 MBq in distilled water

CAUTION RADIOACTIVE

Continued on Page

Read and Understood By

Signed 3/27/03 Date

Signed 3/27/03 Date

National Institute of Standards & Technology

Certificate

PA IP 0648
Version 17-04-02

Standard Reference Material 4927F
Hydrogen-3 Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive hydrogen-3, as water, in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of beta-particle counting instruments and for the monitoring of radiochemical procedures.

Radiological Hazard

The SRM ampoule contains hydrogen-3 with a total activity of approximately 3.2 MBq. Hydrogen-3 decays by beta-particle emission. None of the beta particles escape from the SRM ampoule. During the decay process no photons are emitted. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]*. There is no detectable external radiation. The SRM should be used only by persons qualified to handle radioactive material.

Chemical Hazard

The SRM ampoule contains only distilled water. There is no chemical hazard. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2.

Storage and Handling

The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least September 2008.

The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) because of the radioactivity.

Preparation

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, L.R. Karam, Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas and M.P. Unterweger of the Radioactivity Group.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by J.W.L. Thomas.

Bert M. Coursey, Chief
Ionizing Radiation Division

Gaithersburg, Maryland 20899
June 1999
Half-life and text revised October 2000

Nancy M. Trahey, Chief
Standard Reference Materials Program

*Notes and references are on pages 5 and 6.

Recommended Procedure for Opening the SRM Ampoule

1) If the SRM solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the SRM solution.

2) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood.

3) Shake the ampoule to wet all of the inside surface of the ampoule. Return the ampoule to the upright position.

4) Check that all of the liquid has drained out of the neck of the ampoule. If necessary, gently tap the neck to speed the process.

5) Holding the ampoule upright, score the narrowest part of the neck with a scribe or diamond pencil.

6) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.

7) Hold the ampoule upright with a paper towel, a wiper, or a support jig. Position the scored line away from you. Using a paper towel or wiper to avoid contamination, snap off the top of the ampoule by pressing the narrowest part of the neck away from you while pulling the tip of the ampoule towards you.

8) Transfer the solution from the ampoule using a pycnometer or a pipet with dispenser handle. NEVER PIPETTE BY MOUTH.

9) Seal any unused SRM solution in a flame-sealed glass ampoule, if possible, to minimize the evaporation loss.

See also reference [4]*.

*Notes and references are on pages 5 and 6.

PROPERTIES OF SRM 4927F

Certified values

Solution density	**(0.998 ± 0.002) g·mL^{-1} at 20.0 °C [b]***
Radionuclide	**Hydrogen-3**
Reference time	**1200 EST, 3 September 1998**
Massic activity of the solution [c]	**634.7 kBq·g^{-1}**
Relative expanded uncertainty (k=2)	**0.72% [d] [e]**

Uncertified values

Physical Properties:			
Source description	Liquid in flame-sealed NIST borosilicate-glass ampoule		
Ampoule specifications	Body outside diameter	(16.5 ± 0.5) mm	
	Wall Thickness	(0.60 ± 0.04) mm	
	Barium content	Less than 2.5%	
	Lead-oxide content	Less than 0.02%	
	Other heavy elements	Trace quantities	
Solution mass	Approximately 5.0 g		
Chemical Properties:			
Solution composition	Chemical Formula	Concentration (mol·L^{-1})	Mass Fraction (g·g^{-1})
	H_2O	55	1.00
	^3HHO	6×10^{-7}	1×10^{-5}
Radiological Properties:			
Radionuclidic impurities	None detected [f]		
Half lives used	Hydrogen-3: (4500 ± 8) d [g]		
Calibration method and measuring instrument(s)	4πß gas counting of SRM 4927E using the NIST length-compensated internal gas proportional counters and intercomparison of SRMs 4927E/4927F using two 4πß liquid-scintillation counting systems [h]		

*Notes and references are on pages 5 and 6.

EVALUATION OF THE UNCERTAINTY OF THE MASSIC ACTIVITY [d]*

Input Quantity x_i, the source of uncertainty (and individual uncertainty components where appropriate)	Method Used To Evaluate $u(x_i)$, the standard uncertainty of x_i (A) denotes evaluation by statistical methods (B) denotes evaluation by other methods	Relative Uncertainty Of Input Quantity, $u(x_i)/x_i$, (%) [i]	Relative Sensitivity Factor, $\lvert\partial y/\partial x_i\rvert \cdot (x_i/y)$ [j]	Relative Uncertainty Of Output Quantity, $u_i(y)/y$, (%) [k]
Massic count rate of SRM 4927E, corrected for background and decay [h]	Standard deviation of the mean for 23 sets of gas counting measurements (A)	0.18	1.0	0.18
Gram-mole measurements	Estimated (B)	0.20	1.0	0.20
Live-time [p]	Estimated (B)	0.10	1.0	0.10
Extrapolation of count-rate-versus-energy to zero energy	Estimated (B)	0.20	1.0	0.20
Half life of H-3	Standard uncertainty of the half life (A)	0.18 [m]	0.009 [n]	0.002
Liquid-scintillation intercomparison of SRM 4927F and SRM-4927E	Standard deviation of the mean for 7 sets of liquid-scintillation measurements (A)	0.06	1.0	0.06
Radionuclidic impurities	Limit of detection (B) [q]	100.	0.0005	0.05
Relative Combined Standard Uncertainty of the Output Quantity, $u_c(y)/y$, (%)				0.36
Coverage Factor, k				x 2
Relative Expanded Uncertainty of the Output Quantity, U/y, (%)				0.72

*Notes and references are on pages 5 and 6.

NOTES

[a] The Sievert is the SI unit for dose equivalent. See reference [1]. One μSv is equal to 0.1 mrem.

Distance from Ampoule (cm):	1	30	100
Approximate Dose Rate (μSv/h):	<0.1 (Not detectable)		

[b] The stated uncertainty is two times the standard uncertainty.

[c] **Massic activity** is the preferred name for the quantity activity divided by the total mass of the sample. See reference [1].

[d] The reported value, y, of massic activity (activity per unit mass) at the reference time was not measured directly but was derived from measurements and calculations of other quantities. This can be expressed as $y = f(x_1, x_2, x_3, \ldots x_n)$, where f is a mathematical function derived from the assumed model of the measurement process.

The value, x_i, used for each input quantity i has a **standard uncertainty**, $u(x_i)$, that generates a corresponding uncertainty in y, $u_i(y) \equiv |\partial y/\partial x_i| \cdot u(x_i)$, called a **component of combined standard uncertainty** of y.

The **combined standard uncertainty** of y, $u_c(y)$, is the positive square root of the sum of the squares of the components of combined standard uncertainty.

The combined standard uncertainty is multiplied by a **coverage factor** of $k = 2$ to obtain U, the **expanded uncertainty** of y.

Since it can be assumed that the possible estimated values of the massic activity are approximately normally distributed with approximate standard deviation $u_c(y)$, the unknown value of the massic activity is believed to lie in the interval $y \pm U$ with a level of confidence of approximately 95 percent.

For further information on the expression of uncertainties, see references [2] and [3].

[e] The value of each standard uncertainty component, and hence the value of the expanded uncertainty itself, is a best estimate based upon all available information, but is only approximately known. That is to say, the "uncertainty of the uncertainty" is large and not well known. This is true for uncertainties evaluated by statistical methods (e.g., the relative standard deviation of the standard deviation of the mean for the massic response is approximately 50%) and for uncertainties evaluated by other methods (which could easily be over estimated or under estimated by substantial amounts). The unknown value of the expanded uncertainty is believed to lie in the interval $U/2$ to $2U$ (i.e., within a factor of 2 of the estimated value).

[f] The estimated limit of detection for radionuclidic impurities is 300 $Bq \cdot g^{-1}$.

[g] The stated uncertainty is the standard uncertainty. See reference [5].

[h] Extensive gas-counting measurements were made on the SRM 4927E solution during 1998 and 1999. The SRM 4927F solution was intercompared with the SRM 4927E solution using liquid-scintillation counting.

[i] Relative standard uncertainty of the input quantity x_i.

[j] The relative change in the output quantity y divided by the relative change in the input quantity x_i. If $|\partial y/\partial x_i| \cdot (x_i/y) = 1.0$, then a 1% change in x_i results in a 1% change in y. If $|\partial y/\partial x_i| \cdot (x_i/y) = 0.05$, then a 1% change in x_i results in a 0.05% change in y.

[k] Relative component of combined standard uncertainty of output quantity y, rounded to two significant figures or less. The relative component of combined standard uncertainty of y is given by $u_i(y)/y \equiv |\partial y/\partial x_i| \cdot u(x_i)/y = |\partial y/\partial x_i| \cdot (x_i/y) \cdot u(x_i)/x_i$. The numerical values of $u(x_i)/x_i$, $|\partial y/\partial x_i| \cdot (x_i/y)$, and $u_i(y)/y$, all dimensionless quantities, are listed in columns 3, 4, and 5, respectively. Thus, the value in column 5 is equal to the value in column 4 multiplied by the value in column 3. The input quantities are independent, or very nearly so. Hence the covariances are zero or negligible.

[m] The relative standard uncertainty of $\lambda \cdot t$ is determined by the relative standard uncertainty of λ (i.e., of the half life). The relative standard uncertainty of t is negligible.

[n] $|\partial y/\partial x_i| \cdot (x_i/y) = |\lambda \cdot t|$

[p] The live time is determined by counting the pulses from a gated crystal-controlled oscillator.

[q] The standard uncertainty for each undetected impurity that might reasonably be expected to be present is estimated to be equal to the estimated limit of detection for that impurity, i.e. $u(x_i)/x_i = 100\%$. $|\partial y/\partial x_i| \cdot (x_i/y)$ = {(response per Bq of impurity)/(response per Bq of H-3)} · {(Bq of impurity)/(Bq of H-3)}. Thus $u_i(y)/y$ is the relative change in y if the impurity were present with a massic activity equal to the estimated limit of detection.

REFERENCES

[1] International Organization for Standardization (ISO), *ISO Standards Handbook - Quantities and Units*, 1993. Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, U.S.A. 1-212-642-4900.

[2] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993. Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, U.S.A. 1-212-642-4900. (Listed under ISO miscellaneous publications as "ISO Guide to the Expression 1993".)

[3] B. N. Taylor and C. E. Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20407, U.S.A.

[4] National Council on Radiation Protection and Measurements Report No. 58, *A Handbook of Radioactivity Measurements Procedures*, Second Edition, 1985. Available from the National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814 U.S.A.

[5] L.L. Lucas and M.P. Unterweger, *Comprehensive Review and Critical Evaluation of the Half-Life of Tritium*, J. Res. Natl. Inst. Stand. Technol. 105, 541-549 (2000).

Section 9

ADDITIONAL SUPPORTING DOCUMENTATION

9

Liquid Scintillation Counter

Instrumentation Calibration

Initial Efficiency Calibration Standards Traceability

H-3 Swipe Quench Curve Background and Efficiency Determination

LS6000
12/28/2009

Polynomial Coefficient				
	Efficiency	Background	H # Range	
x^0	3.7192E-01	6.0669E+00	Low =	113.6
x^1	-1.1270E-03	6.9704E-03	High =	283.3

Calib. Date : 10/26/2009

Sample ID	Pos #	H#	Obs.CPM	Corr. BCPM	CPM Corr.Fact.
3H091209-2CB1	36-1	129.8	6.58	6.972	0.392
3H091209-2CB2	36-5	129.7	6.75	6.971	0.221
3H091209-2CB3	36-8	130.0	7.45	6.973	-0.477
				Average=	0.045

Sample ID	Pos #	H #	Efficiency	Background	H # Check
0912056-1	36-2	115.8	0.2414	6.829	OK
0912056-2	36-3	117.1	0.2399	6.838	OK
3H091209-2MB	36-4	127.8	0.2279	6.912	OK
3H091209-2LCS	36-6	126.3	0.2296	6.902	OK
3H091209-2LCSD	36-7	126.3	0.2296	6.902	OK

H-3 Swipes "Window 2" Control Limits (LS 6000)

The background count rate is determined from the average of the reagent blanks for the batch.

Window 2 control limits are established using the average count rate from the three reagent blanks associated with each prep batch +/- 3X the estimated poisson uncertainty.

Updated 10/29/09 mh

COUNT DATE	#	Sample ID	Count Duration (min.)	**Average count Duration (min.)**	Count Rate (CPM)	Batch Average Reagent Blank	**Lower Control Limit**	**Upper Control Limit**	**PASS/ FAIL**
12/24/2009	22	3H091209-2CB1	60		30.27				
12/24/2009	23	3H091209-2CB2	60		29.78				
12/25/2009	24	3H091209-2CB3	60	**60**	28.15	29.40	**27.30**	**31.50**	PASS

Tritium Swipe (Glass Vial) Quench Curve

10/26/2009
Beckman LS6000

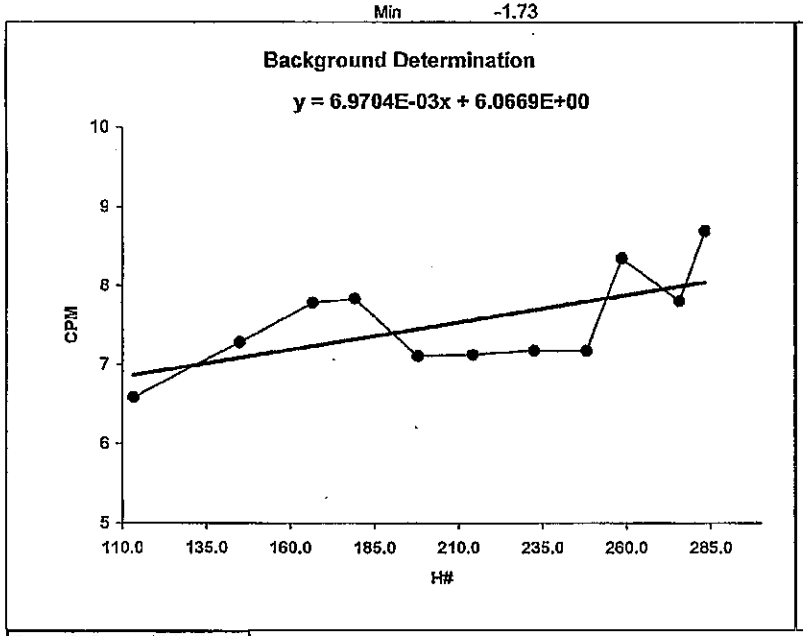
Standard : 699.3020.95
Ref. Date : 9/3/1998
Spike Act. : 160351.040 dpm/mL
Spike Vol. : 0.10000 mL

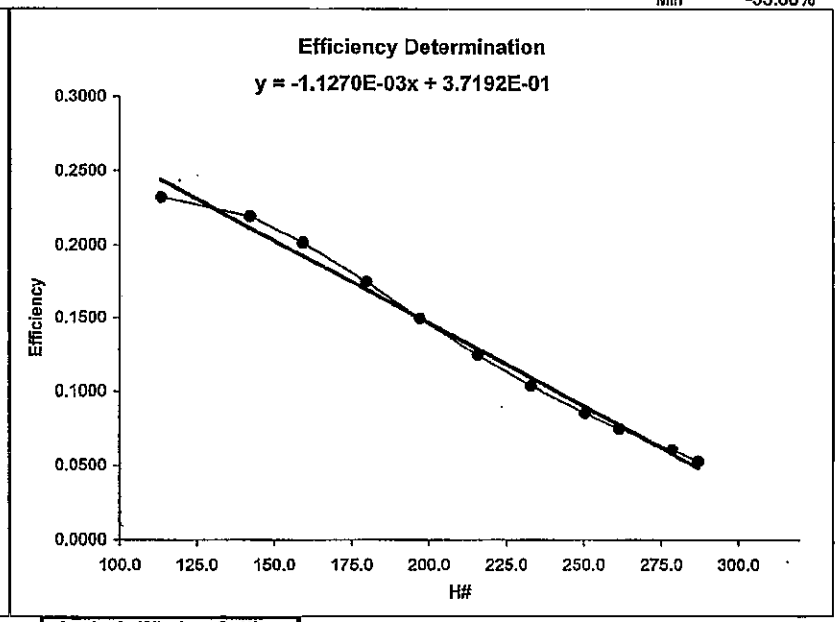
Bkg. Coefficients
Ax= 6.9704E-03
B= 6.0669E+00

Eff. Coefficients
Bx= -1.1270E-03
C= 3.7192E-01

Window 2
Control limit determination

Non-Spiked/ Background					Spiked / Efficiency									Control limit determination	
Sample ID	H#	CPM	Calc. Bkg.	Sigma Diff.	Sample ID	H#	CPM	Corr. Bckg.	Corr. CPM	DPM	Efficiency	Calc. Eff.	% Diff.	Sam. ID	CPM
3H090422-2B01	113.5	6.58	6.86	0.84	0916022-1	113.6	1992.88	6.86	1986.02	8556.38	0.2321	0.2439	5.08%	3H090422-2B01	26.75
3H090422-2B02	145.1	7.28	7.08	-0.58	0916022-2	142.4	1885.90	7.06	1878.84	8556.38	0.2196	0.2114	-3.71%	3H090422-2B02	27.73
3H090422-2B03	166.9	7.78	7.23	-1.53	0916022-3	159.4	1731.13	7.18	1723.95	8556.38	0.2015	0.1923	-4.57%	3H090422-2B03	26.78
3H090422-2B04	179.4	7.83	7.32	-1.42	0916022-4	179.9	1499.31	7.32	1491.99	8556.38	0.1744	0.1692	-2.98%	3H090422-2B04	27.63
3H090422-2B05	198.1	7.1	7.45	1.01	0916022-5	197.1	1285.78	7.44	1278.34	8556.38	0.1494	0.1498	0.26%	3H090422-2B05	27.60
3H090422-2B06	214.4	7.12	7.56	1.28	0916022-6	215.7	1071.89	7.57	1064.32	8556.38	0.1244	0.1288	3.56%	3H090422-2B06	27.55
3H090422-2B07	232.7	7.17	7.69	1.50	0916022-7	233.0	894.86	7.69	887.17	8556.38	0.1037	0.1093	5.44%	3H090422-2B07	29.35
3H090422-2B08	248.2	7.17	7.80	1.81	0916022-8	250.4	737.97	7.81	730.16	8556.38	0.0853	0.0897	5.13%	3H090422-2B08	29.17
3H090422-2B09	258.7	8.35	7.87	-1.29	0916022-9	261.4	644.34	7.89	636.45	8556.38	0.0744	0.0773	3.95%	3H090422-2B09	29.07
3H090422-2B10	275.8	7.8	7.99	0.53	0916022-10	278.5	528.08	8.01	520.07	8556.38	0.0608	0.0580	-4.50%	3H090422-2B10	29.12
3H090422-2B11	283.3	8.7	8.04	-1.73	0916022-11	287	459.26	8.07	451.19	8556.38	0.0527	0.0485	-8.09%	3H090422-2B11	27.43
3H090422-2B12*	295.9	8.72	8.13	-1.55	0916022-12*	303.6	393.26	8.18	385.08	8556.38	0.0450	0.0298	-33.88%	3H090422-2B12*	28.15
			(BKG CLs = +/- 3 sigma)		*These data points are not used in the calibration							(Eff CLs = +/- 10%)		0916022-1	27.73
			Max	1.81	due to poor fit.							Max	5.44%	0916022-2	27.34
			Min	-1.73								Min	-33.88%	0916022-3	28.48
														0916022-4	29.37
														0916022-5	26.96
														0916022-6	26.07
														0916022-7	30.41
														0916022-8	30.03
														0916022-9	26.80
														0916022-10	27.47
														0916022-11	25.94
														0916022-12*	27.34
														Ave. =	27.92
														UCL =	31.60
														LCL =	24.24





Quench Control Limits	
Upper	283.3
Lower	113.6

Analysis Window Settings
WIN 1 (50-250)
WIN 2 (450-980)

10-29-09
Instrument Technician — Date

10/30/09
Supervisory Review — Date

r:\inst\lsc\ls6000\Calibrations\Quench Curves\2009\10.26.09_H3_swipes_QCurve (H-3 Quench Curve)

^{3}H Swipe Efficiency Calibration Verification / Method Blank Verification 10/27/09

Calibration Source Check

LS6000
Analysis Date: 10/27/2009
Nuclide: ^{3}H
Half Life: 1.230E+01 yr.

Calibration Check Source:

Spike Standard: 648.3610.05
Reference Date : 9/3/1998
Spiked DPM : 5141.07 dpm/mL
Spike Volume : 0.1 mL
Spiked into : 1 sample
Current Spk. Act. : 127.19 pCi/sample

Calibration Check Source Count

															IU= 0.112	PU= 0.102	
Sample ID	Rack	Pos	Prep Date	Cnt. Dur.	Anal. Vol.	GrsCPM	BkgCPM	Efficiency	Activity	k (denom.)	Chem. Yield	LCS Recovery:	Pass/Fail	Units	2s CU	IU	PU	2s TPU
0916023-1	25	2	4/22/2009	180	1	70.06	7.23	0.2216	131.50	0.478	100%	103.4%	PASS	pCi/sample	2.743	14.72765	13.41268	20.108
0916023-2	25	3	4/22/2009	180	1	47.93	7.67	0.1497	124.73	0.323	100%	98.1%	PASS	pCi/sample	3.444	13.96964	12.72235	19.206
0916023-3	25	4	4/22/2009	180	1	25.13	8.21	0.0622	126.09	0.134	100%	99.1%	PASS	pCi/sample	6.415	14.12263	12.86168	20.150

Method Blank Check Count

																IU= 0.112	PU= 0.102	
Sample ID	Rack	Pos	Prep Date	Cnt. Dur.	Anal. Vol.	GrsCPM	BkgCPM	Efficiency	Chem. Yield	k (denom.)	activity	MDC	Pass/Fail	Units	2s CU	IU	PU	2s TPU
3H090422-3B01	25	6	4/22/2009	180	1	7.52	7.18	0.2298	100%	0.496	0.6957	1.95	PASS	pCi/sample	1.153	0.07792	0.07096	1.158
3H090422-3B02	25	7	4/22/2009	180	1	7.93	7.68	0.1476	100%	0.318	0.7746	3.11	PASS	pCi/sample	1.850	0.08676	0.07901	1.854
3H090422-3B03	25	8	4/22/2009	180	1	8.12	8.24	0.0574	100%	0.124	-0.9835	8.10	PASS	pCi/sample	4.874	-0.11016	-0.10032	4.876

H-3 Swipe Quench Curve Background and Efficiency Determination

LS6000
10/28/2009

Polynomial Coefficient				
	Efficiency	Background	H # Range	
x^0	3.7192E-01	6.0669E+00	Low =	113.6
x^1	-1.1270E-03	6.9704E-03	High =	283.3

Calib. Date : 10/26/2009

Sample ID	Pos #	H#	Obs.CPM	Corr. BCPM	CPM Corr.Fact.
3H090422-3CB1	25-1	132.3	7.16	6.989	-0.171
3H090422-3CB2	25-5	129.3	7.38	6.968	-0.412
3H090422-3CB3	25-9	128.8	7.07	6.965	-0.105
				Average=	-0.229

Sample ID	Pos #	H #	Efficiency	Background	H # Check
0916023-1	25-2	133.4	0.2216	7.226	OK
0916023-2	25-3	197.2	0.1497	7.671	OK
0916023-3	25-4	274.8	0.0622	8.212	OK
3H090422-3B01	25-6	126.1	0.2298	7.175	OK
3H090422-3B02	25-7	199.0	0.1476	7.683	OK
3H090422-3B03	25-8	279.1	0.0574	8.242	OK

ID: 3H: 5-ML, 10-ML 26 OCT 2009 10:12

USER: 4 COMMENT:LS6000

PRESET TIME :	60.00						
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		
SCINTILLATOR:	LIQUID	LUMEX: NO	LOW SAMPLE REJ:	0		
LOW LEVEL :	YES	HALF LIFE CORRECTION DATE:		none		

CHAN: 50.0 - 250.0 %ERROR: 1.75 FACTOR: 1.000000 BKG. SUB: 0
CHAN: 450.0 - 900.0 %ERROR:20.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	H#	WIND1 CPM	WIND1 %ERROR	WIND2 CPM	WIND2 %ERROR	LUMEX %	ELAPSED TIME
1	34-1	6.60	113.6	1992.88	1.74	27.73	14.78	0.08	7.20
2	34-2	6.95	142.4	1885.90	1.75	27.34	14.51	0.06	14.85
3	34-3	7.55	159.4	1731.13	1.75	28.48	13.64	0.05	23.07
4	34-4	8.75	179.9	1499.31	1.75	29.37	12.48	0.05	32.52
5	34-5	10.20	197.1	1285.78	1.75	26.96	12.06	0.05	43.43
6	34-6	12.20	215.7	1071.89	1.75	26.07	11.22	0.05	56.36
7	34-7	14.60	233.0	894.86	1.75	30.41	9.49	0.05	71.71
8	34-8	17.75	250.4	737.97	1.75	30.03	8.66	0.06	90.23
9	34-9	20.30	261.4	644.34	1.75	26.80	8.57	0.05	111.34
10	34-10	24.75	278.5	528.08	1.75	27.47	7.67	0.05	136.95
11	34-11	28.45	287.0	459.26	1.75	25.94	7.36	0.05	166.25
12	34-12	33.25	303.6	393.26	1.75	27.34	6.63	0.05	200.41
13	50-1	60.00	113.5	6.58	10.06	26.75	4.99	0.84	261.76
14	50-2	60.00	145.1	7.28	9.57	27.73	4.90	0.63	322.99
15	50-3	60.00	166.9	7.78	9.25	26.78	4.99	0.39	384.17
16	50-4	60.00	179.4	7.83	9.23	27.63	4.91	0.24	445.34
17	50-5	60.00	198.1	7.10	9.69	27.60	4.91	0.22	506.46
18	50-6	60.00	214.4	7.12	9.68	27.55	4.92	0.23	567.60
19	50-7	60.00	232.7	7.17	9.64	29.35	4.77	0.21	628.73
20	50-8	60.00	248.2	7.17	9.64	29.17	4.78	0.24	689.85
21	50-9	60.00	258.7	8.35	8.94	29.07	4.79	0.20	750.98
22	50-10	60.00	275.8	7.80	9.25	29.12	4.79	0.21	812.09
23	50-11	60.00	283.3	8.70	8.75	27.43	4.93	0.19	873.21
24	50-12	60.00	295.9	8.72	8.75	28.15	4.87	0.18	934.33

B60-04-102601

10-27-09

B60_04_102601

BSF Version	: 3
Instrument Type	: LS 6000
Data Capture Date	: 26 Oct 2009 09:14:01
User Filename	: C:\...\LS WINCONNECTION\DATA\USER04\UN102601.BSF
User Number	: 4
User Id	: 3H:5-ML,10-ML
User Comments	: LS6000
Preset Count Time	: 60.00
Calculation Mode	: CPM
H# Selected	: YES
Sample Repeats	: 1
Printer Output Mode	: STD
Blank Count	: NO
IC# or SCR Selected	: NO
Replicates	: 1
RS232 Output Mode	: EDIT
Two-Phase Selected	: NO
AQC Choice	: NO
Cycle Repeats	: 1
Scintillator Choice	: LIQUID
Lumex Selected	: NO
Low Sample Reject Count	: 0
Low Level Selection	: YES
Half Life Correction Date	: none
Window Limits Window 1	: 50.00
Preset %Error Iso1	: 1.75
Norm Multiplier Iso1	: 1.00000
Background CPM 1	: 0.00
Window Limits Window 2	: 450.00
Preset %Error Iso2	: 20.00
Norm Multiplier Iso2	: 1.00000
Background CPM 2	: 0.00
Alpha/Beta Discrimination	: NO

Sam	Rack	Time	H#	CPM Iso1	%Err1	CPM Iso2	%Err2	LumEx	ElTime
1	34-1	6.60	113.6	1992.88	1.74	27.73	14.78	0.08	7.20
2	34-2	6.95	142.4	1885.90	1.75	27.34	14.51	0.06	14.85
3	34-3	7.55	159.4	1731.13	1.75	28.48	13.64	0.05	23.07
4	34-4	8.75	179.9	1499.31	1.75	29.37	12.48	0.05	32.52
5	34-5	10.20	197.1	1285.78	1.75	26.96	12.06	0.05	43.43
6	34-6	12.20	215.7	1071.89	1.75	26.07	11.22	0.05	56.36
7	34-7	14.60	233.0	894.86	1.75	30.41	9.49	0.05	71.71
8	34-8	17.75	250.4	737.97	1.75	30.03	8.66	0.06	90.23
9	34-9	20.30	261.4	644.34	1.75	26.80	8.57	0.05	111.34
10	34-10	24.75	278.5	528.08	1.75	27.47	7.67	0.05	136.95
11	34-11	28.45	287.0	459.26	1.75	25.94	7.36	0.05	166.25
12	34-12	33.25	303.6	393.26	1.75	27.34	6.63	0.05	200.41
13	50-1	60.00	113.5	6.58	10.06	26.75	4.99	0.84	261.76
14	50-2	60.00	145.1	7.28	9.57	27.73	4.90	0.63	322.99
15	50-3	60.00	166.9	7.78	9.25	26.78	4.99	0.39	384.17
16	50-4	60.00	179.4	7.83	9.23	27.63	4.91	0.24	445.34
17	50-5	60.00	198.1	7.10	9.69	27.60	4.91	0.22	506.46
18	50-6	60.00	214.4	7.12	9.68	27.55	4.92	0.23	567.60
19	50-7	60.00	232.7	7.17	9.64	29.35	4.77	0.21	628.73
20	50-8	60.00	248.2	7.17	9.64	29.17	4.78	0.24	689.85
21	50-9	60.00	258.7	8.35	8.94	29.07	4.79	0.20	750.98
22	50-10	60.00	275.8	7.80	9.25	29.12	4.79	0.21	812.09
23	50-11	60.00	283.3	8.70	8.75	27.43	4.93	0.19	873.21
24	50-12	60.00	295.9	8.72	8.75	28.15	4.87	0.18	934.33

AMR 10-27-09

ID: 3H: 5-ML, 10-ML 27 OCT 2009 02:41

USER: 8 COMMENT:LS6000

PRESET TIME :	180.00						
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		
SCINTILLATOR:	LIQUID	LUMEX:	NO	LOW SAMPLE REJ:	0		
LOW LEVEL :	YES	HALF LIFE CORRECTION DATE:			none		

CHAN: 50.0 - 250.0 %ERROR: 1.75 FACTOR: 1.000000 BKG. SUB: 0
CHAN: 450.0 - 900.0 %ERROR:20.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	H#	WIND1 CPM	WIND1 %ERROR	WIND2 CPM	WIND2 %ERROR	LUMEX %	ELAPSED TIME
1	25-1	180.00	132.3	7.16	5.57	29.98	2.72	0.36	182.24
2	25-2	180.00	133.4	70.06	1.78	30.97	2.68	0.14	364.55
3	25-3	180.00	197.2	47.93	2.15	28.71	2.78	0.13	546.79
4	25-4	180.00	274.8	25.13	2.97	28.56	2.79	0.14	728.98
5	25-5	180.00	129.3	7.58	5.49	28.89	2.77	0.28	911.24
6	25-6	180.00	126.1	7.52	5.44	30.03	2.72	0.26	1093.50
7	25-7	180.00	199.0	7.93	5.29	30.23	2.71	0.17	1275.71
8	25-8	180.00	279.1	8.12	5.23	29.88	2.73	0.14	1457.83
9	25-9	180.00	128.8	7.07	5.61	30.01	2.72	0.17	1640:02

0660-08-102701

10-28-09

B60_08_102701

BSF Version	: 3
Instrument Type	: LS 6000
Data Capture Date	: 27 Oct 2009 02:45:15
User Filename	: C:\...\LS WINCONNECTION\DATA\USER08\UN102701.BSF
User Number	: 8
User Id	: 3H:5-ML,10-ML
User Comments	: LS6000
Preset Count Time	: 180.00
Calculation Mode	: CPM
H# Selected	: YES
Sample Repeats	: 1
Printer Output Mode	: STD
Blank Count	: NO
IC# or SCR Selected	: NO
Replicates	: 1
RS232 Output Mode	: EDIT
Two-Phase Selected	: NO
AQC Choice	: NO
Cycle Repeats	: 1
Scintillator Choice	: LIQUID
Lumex Selected	: NO
Low Sample Reject Count	: 0
Low Level Selection	: YES
Half Life Correction Date	: none
Window Limits Window 1	: 50.00
Preset %Error Iso1	: 1.75
Norm Multiplier Iso1	: 1.00000
Background CPM 1	: 0.00
Window Limits Window 2	: 450.00
Preset %Error Iso2	: 20.00
Norm Multiplier Iso2	: 1.00000
Background CPM 2	: 0.00
Alpha/Beta Discrimination	: NO

Sam	Rack	Time	H#	CPM Iso1	%Err1	CPM Iso2	%Err2	LumEx	ElTime
1	25-1	180.00	132.3	7.16	5.57	29.98	2.72	0.36	182.24
2	25-2	180.00	133.4	70.06	1.78	30.97	2.68	0.14	364.55
3	25-3	180.00	197.2	47.93	2.15	28.71	2.78	0.13	546.79
4	25-4	180.00	274.8	25.13	2.97	28.56	2.79	0.14	728.98
5	25-5	180.00	129.3	7.38	5.49	28.89	2.77	0.28	911.24
6	25-6	180.00	126.1	7.52	5.44	30.03	2.72	0.26	1093.50
7	25-7	180.00	199.0	7.93	5.29	30.23	2.71	0.17	1275.71
8	25-8	180.00	279.1	8.12	5.23	29.88	2.73	0.14	1457.83
9	25-9	180.00	128.8	7.07	5.61	30.01	2.72	0.17	1640.02

10-28-09

LSC Run Log

Instrument ID: LS6000

379825

ALS Laboratory Group - Fort Collins

	Date	Sample ID	CountTime (min.)	Rack & Position	Test	User #	Batch ID	Position Check	Initials	Comments
1	10-21-09	0909050-3	180	35 - 2	FE-SS	12	FE091016-1	MR	MR	NA
2		-3D		- 3						↓
3		-3REPDup		- 4						↓
4		-3Rep2Dup2		- 5						Recount, Lumex >5%.
5	MR 10-25-09	FE091016-1CB2		- 6						NA
6		0909050-3MS	28.10	- 7						↓
7		-3REP	180	- 8						↓
8		-3REP2		- 9						Recount, Lumex >5%.
9		0922005-1		- 10						NA
10		FE091016-1MB		- 11						↓
11		-1LCS	189.30	- 12						↓
12	↓	FE091016-1CB3	180	17 - 1	↓	↓	↓	↓	↓	↓
13	10-23-09	Daily QC	10	1,3 -1-3, 1-2	—	1,3	—	MR	MR	NA
14	10-23-09	0909050-3Rep2dup2	180	57 - 1	FE-SS	12	FE091016-1			Lumex still >5%.
15	↓	-3Rep2	↓	↓ - 2	↓	↓	↓	↓	↓	NA
16	10-23-09	Daily QC	10	1,3 -1-3, 1-2	—	1,3	—	MR	MR	NA
17	10-26-09	↓	↓	↓ - ↓	—	↓	—	↓	↓	↓
18	10-26-09	0916022-1	6.60	34 - 1	H3	4	3H090422-2	MR	MR	H3 glass vial swipe Q. Curve calibration
19		-2	6.95	- 2						
20		-3	7.55	- 3						
21		-4	8.75	- 4						
22		-5	10.10	- 5						
23		-6	12.20	- 6						
24		-7	14.60	- 7						
25		-8	17.75	- 8						
26		-9	20.30	- 9						
27		-10	24.75	- 10						
28		-11	28.45	- 11						
29		-12	33.25	↓ - 12						
30	↓	3H090422-2MB1	60	50 - 1	↓	↓	↓	↓	↓	↓

Analyst / Date MR 10-28-09

FORM 762r6.xls (3/7/09)

Note: Each page is copied as completed and included with the workorder/run documentation; reviewed subsequently.

LSC Run Log

Instrument ID: LS6000 379826 **ALS Laboratory Group - Fort Collins**

	Date	Sample ID	CountTime (min.)	Rack & Position	Test	User #	Batch ID	Position Check	Initials	Comments
1	10-26-09	3H0904 22-2 MB2	60	50 - 2	H3	4	3H0904 22-2	WA	WA	H3 glass vial D.C swipe Calibration
2		-2 MB3		- 3						
3		-2 MB4		- 4						
4		-2 MB5		- 5						
5		-2 MB6		- 6						
6		-2 MB7		- 7						
7		-2 MB8		- 8						
8		-2 MB9		- 9						
9		-2 MB10		- 10						
10		-2 MB11		- 11						
11		-2 MB12		- 12						
12	10-27-09	Daily QC	10	L3 - 13, 1-2	—	L3	—	WA	WA	NA
13	10-27-09	3H0904 22-3 CB1	180	25 - 1	H3	8	3H0904 22-3			H3 glass vial swipes ICV's/ICB's
14		0916 023-1		- 2						
15		-2		- 3						
16		-3		- 4						
17		3H0904 22-3 CB2		- 5						
18		-3 MB1		- 6						
19		-3 MB2		- 7						
20		-3 MB3		- 8						
21		-3 CB3		- 9						
22	10-28-09	Daily QC	10	L3 - 13, 10 1-2	WA 10-28-09 —	L3	—	WA	WA	NA
23										
24				-						
25				-						
26				-						
27				-						
28				-						
29				-						
30										WA 10-28-09

Analyst / Date WA 10-28-09

FORM 762r6.xls (3/7/09)

Note: Each page is copied as completed and included with the workorder/run documentation; reviewed subsequently.

Radiochemistry Instrument Worksheet

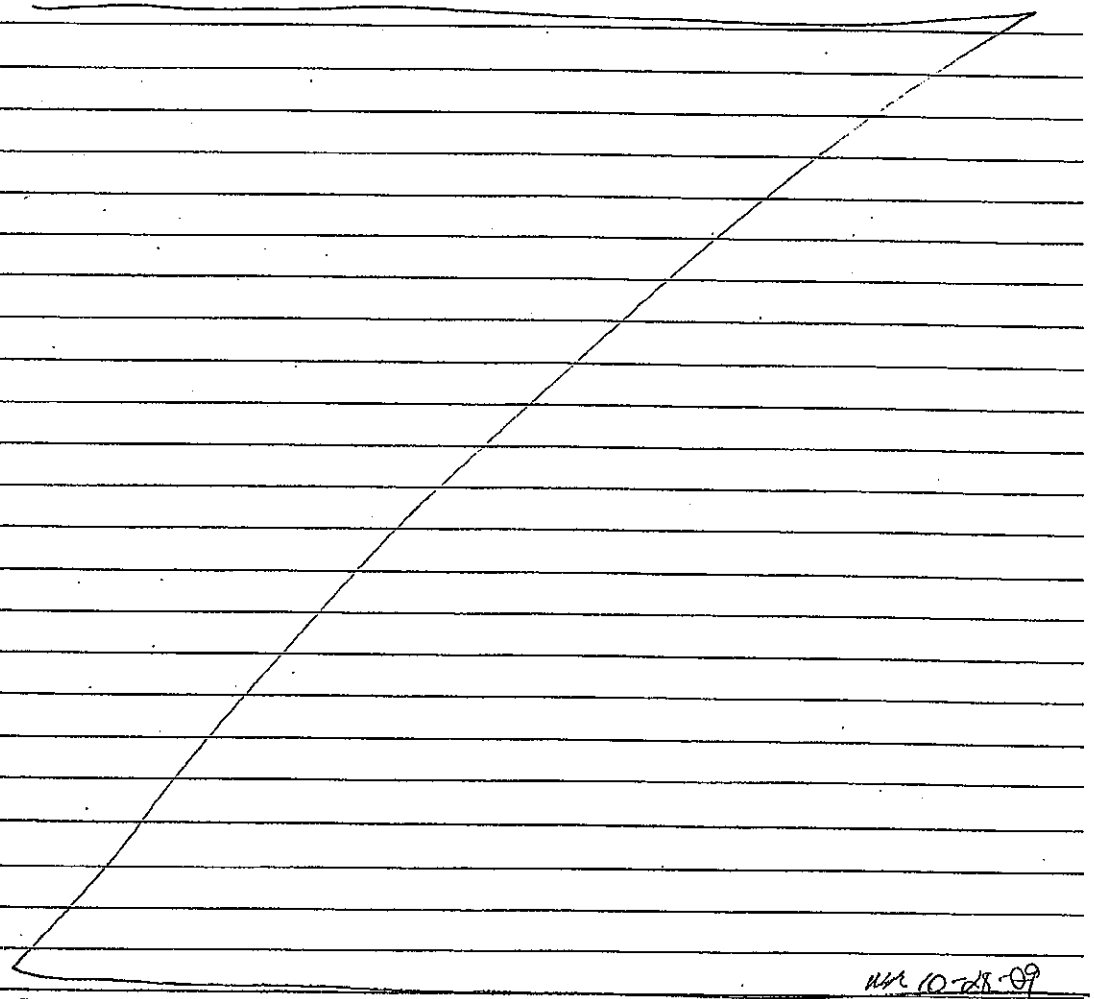
ALS Laboratory Group -- FC

Prep Batch: 3H090422-2

Prep Procedure: H3 Glass Vial Swipe QCurve Calibration

Analytical QASS / NCR? Y / (N) NA

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Report Units	Cnt 1 File/Inst	Cnt 1 Rack-Pos	Cnt 1 Pos Chk By	Cnt 2 File/Inst	Cnt 2 Rack-Pos	Cnt 2 Pos Chk By	Cnt 3 File/Inst	Cnt 3 Rack-Pos	Cnt 3 Pos Chk By	Notes
1	0916022-1	SMP	1	1	sample	pCi/l	LS6000	34-1	MM							
1	0916022-2	SMP	1	1	sample	pCi/l		-2								
1	0916022-3	SMP	1	1	sample	pCi/l		-3								
1	0916022-4	SMP	1	1	sample	pCi/l		-4								
1	0916022-5	SMP	1	1	sample	pCi/l		-5								
1	0916022-6	SMP	1	1	sample	pCi/l		-6								
1	0916022-7	SMP	1	1	sample	pCi/l		-7								
1	0916022-8	SMP	1	1	sample	pCi/l		-8								
1	0916022-9	SMP	1	1	sample	pCi/l		-9								
1	0916022-10	SMP	1	1	sample	pCi/l		-10								
1	0916022-11	SMP	1	1	sample	pCi/l		-11								
1	0916022-12	SMP	1	1	sample	pCi/l		-12								
1	3H090422-2B01	MB	1	1	sample	pCi/l		50-1								
1	3H090422-2B02	MB	1	1	sample	pCi/l		-2								
1	3H090422-2B03	MB	1	1	sample	pCi/l		-3								
1	3H090422-2B04	MB	1	1	sample	pCi/l		-4								
1	3H090422-2B05	MB	1	1	sample	pCi/l		-5								
1	3H090422-2B06	MB	1	1	sample	pCi/l		-6								
1	3H090422-2B07	MB	1	1	sample	pCi/l		-7								
1	3H090422-2B08	MB	1	1	sample	pCi/l		-8								
1	3H090422-2B09	MB	1	1	sample	pCi/l		-9								
1	3H090422-2B10	MB	1	1	sample	pCi/l		-10								
1	3H090422-2B11	MB	1	1	sample	pCi/l		-11								
1	3H090422-2B12	MB	1	1	sample	pCi/l		-12								



MM 10-28-09

Spike Solution Information #

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	H-3	699,3020.95	88,189.122	DPM/ml	04/22/09	0.1	ml	RS-008

Reporting Units

LabID:	TstGrpName:	RptUnits:
0916022-1	H3	pCi/l
0916022-2	H3	pCi/l
0916022-3	H3	pCi/l
0916022-4	H3	pCi/l
0916022-5	H3	pCi/l
0916022-6	H3	pCi/l
0916022-7	H3	pCi/l
0916022-8	H3	pCi/l
0916022-9	H3	pCi/l
0916022-10	H3	pCi/l
0916022-11	H3	pCi/l
0916022-12	H3	pCi/l

Sample Barcodes

0916022-1 3H090422-2PS1	0916022-2 3H090422-2PS2
0916022-3 3H090422-2PS3	0916022-4 3H090422-2PS4
0916022-5 3H090422-2PS5	0916022-6 3H090422-2PS6
0916022-7 3H090422-2PS7	0916022-8 3H090422-2PS8
0916022-9 3H090422-2PS9	0916022-10 3H090422-2PS10
0916022-11 3H090422-2PS11	0916022-12 3H090422-2PS12
3H090422-2B01MB 3H090422-2PS13	3H090422-2B02MB 3H090422-2PS14
3H090422-2B03MB 3H090422-2PS15	3H090422-2B04MB 3H090422-2PS16
3H090422-2B05MB 3H090422-2PS17	3H090422-2B06MB 3H090422-2PS18
3H090422-2B07MB 3H090422-2PS19	3H090422-2B08MB 3H090422-2PS20
3H090422-2B09MB 3H090422-2PS21	3H090422-2B10MB 3H090422-2PS22

Radiochemistry Instrument Worksheet

ALS Laboratory Group -- FC

Prep Batch: 3H090422-2

3H090422-2B11MB 3H090422-2PS23		3H090422-2B12MB 3H090422-2PS24	

Radiochemistry Prep Worksheet

ALS Paragon

Prep Batch: 3H090422-2

Prep Procedure: H3

Reviewed By: DBC DBC Review Date: 4/23/2009

Non-Routine Pre-Treatment? Y / (N) Batch: N/A Re-Prep? Y / (N) Batch: N/A Prep QASS / NCR? Y / (N) N/A

Prep SOP: PAI 700 Rev: 10
Prep SOP: NONE
Matrix Class: liquid

Prep Analyst: Derek B. Caduff
Prep Date: 4/22/2009
Prep Dept: RS

Balance:
Balance:

Cocktail: UG LLT
Cocktail Pipet: T-002
Aliquot Pipet: RS-015

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq sample	Fin Alq sample	Prep Basis	Analysis Vol.(ml)	Standards	Prep Notes
1	1	0916022-1	SMP		1	1	As Received		S1	0 UL NITROMETHANE ADDED
2	1	0916022-2	SMP		1	1	As Received		S1	15
3	1	0916022-3	SMP		1	1	As Received		S1	30
4	1	0916022-4	SMP		1	1	As Received		S1	45
5	1	0916022-5	SMP		1	1	As Received		S1	60
6	1	0916022-6	SMP		1	1	As Received		S1	75
7	1	0916022-7	SMP		1	1	As Received		S1	90
8	1	0916022-8	SMP		1	1	As Received		S1	105
9	1	0916022-9	SMP		1	1	As Received		S1	120
10	1	0916022-10	SMP		1	1	As Received		S1	135
11	1	0916022-11	SMP		1	1	As Received		S1	150
12	1	0916022-12	SMP		1	1	As Received		S1	165
13	1	3H090422-2B01	MB		1	1	As Received			0
14	1	3H090422-2B02	MB		1	1	As Received			15
15	1	3H090422-2B03	MB		1	1	As Received			30
16	1	3H090422-2B04	MB		1	1	As Received			45
17	1	3H090422-2B05	MB		1	1	As Received			60
18	1	3H090422-2B06	MB		1	1	As Received			75
19	1	3H090422-2B07	MB		1	1	As Received			90
20	1	3H090422-2B08	MB		1	1	As Received			105
21	1	3H090422-2B09	MB		1	1	As Received			120
22	1	3H090422-2B10	MB		1	1	As Received			135
23	1	3H090422-2B11	MB		1	1	As Received			150
24	1	3H090422-2B12	MB		1	1	As Received			165

Radiochemistry Prep Worksheet

ALS Paragon

Prep Batch: 3H090422-2

Prep Procedure: H3

Reviewed By: DBC DBC Review Date: 4/23/2009

Non-Routine Pre-Treatment? Y / (N) Batch: NA Re-Prep? Y / (N) Batch: NA Prep QASS / NCR? Y / (N) NA

Prep SOP: PAI 700 Rev: 10
Prep SOP: NONE
Matrix Class: liquid

Prep Analyst: Derek B. Caduff
Prep Date: 4/22/2009
Prep Dept: RS

Balance:
Balance:

Cocktail: UG LLT
Cocktail Pipet: T-002
Aliquot Pipet: RS-015

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq sample	Fin Alq sample	Prep Basis	Analysis Vol.(ml)	Standards	Prep Notes

Comments
UG LLT LOT #97-080401

Spiked By: Derek B. Caduff Date: 4/22/2009

Witnessed By: Jeff Kujawa Date: 4/22/2009

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	H-3	699.3020.95	88,189.122	DPM/ml	04/22/09	0.1	ml	RS-008

ALS Paragon

Radiochemistry Prep Worksheet

Prep Batch: 3H090422-2

Prep Procedure: H3

Prep Batch Not Validated!!!

Reviewed By: Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 700 Rev: 10
Prep SOP: NONE
Matrix Class: liquid

Prep Analyst: Derek B. Caduff DBC
Prep Date: 4/22/2009
Prep Dept: RS

Balance:
Balance:

Cocktail:
Cocktail Pipet:
Aliquot Pipet:

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq sample	Fin Alq sample	Prep Basis	Analysis Vol.(ml)	Standards	Prep Notes
1	1	0916022-1	SMP		1	1	As Received		S1	0 UL NITROMETHANE ADDED
2	1	0916022-2	SMP		1	1	As Received		S1	15
3	1	0916022-3	SMP		1	1	As Received		S1	30
4	1	0916022-4	SMP		1	1	As Received		S1	45
5	1	0916022-5	SMP		1	1	As Received		S1	60
6	1	0916022-6	SMP		1	1	As Received		S1	75
7	1	0916022-7	SMP		1	1	As Received		S1	90
8	1	0916022-8	SMP		1	1	As Received		S1	105
9	1	0916022-9	SMP		1	1	As Received		S1	120
10	1	0916022-10	SMP		1	1	As Received		S1	135
11	1	0916022-11	SMP		1	1	As Received		S1	150
12	1	0916022-12	SMP		1	1	As Received		S1	165
13	1	3H090422-2B01	MB		1	1	As Received			0
14	1	3H090422-2B02	MB		1	1	As Received			15
15	1	3H090422-2B03	MB		1	1	As Received			30
16	1	3H090422-2B04	MB		1	1	As Received			45
17	1	3H090422-2B05	MB		1	1	As Received			60
18	1	3H090422-2B06	MB		1	1	As Received			75
19	1	3H090422-2B07	MB		1	1	As Received			90
20	1	3H090422-2B08	MB		1	1	As Received			105
21	1	3H090422-2B09	MB		1	1	As Received			120
22	1	3H090422-2B10	MB		1	1	As Received			136
23	1	3H090422-2B11	MB		1	1	As Received			150
24	1	3H090422-2B12	MB		1	1	As Received			165

ALS Paragon

Radiochemistry Prep Worksheet

Prep Batch: 3H090422-2

Prep Procedure: H3

Prep Batch Not Validated!!!

Reviewed By: Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 700 Rev: 10
Prep SOP: NONE
Matrix Class: liquid

Prep Analyst: Derek B. Caduff DBC
Prep Date: 4/22/2009
Prep Dept: RS

Balance:
Balance:

Cocktail:
Cocktail Pipet:
Aliquot Pipet:

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq sample	Fin Alq sample	Prep Basis	Analysis Vol.(ml)	Standards	Prep Notes

Comments
UG LLT LOT # 97-080401

Spiked By: DBC Date: 4/22/09
Witnessed By: JRS Date: 4/22/09

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	H-3	699.3020.95	88,189.122	DPM/ml	04/22/09	0.1	ml	RS-008

Exp. 4/1/10

Radiochemistry Instrument Worksheet

ALS Laboratory Group -- FC

Prep Batch: 3H090422-3

Prep Procedure: H3 Glass Vial Swipes ICVs/ICBs

Analytical QASS / NCR? Y (N) NA

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Report Units	Cnt 1 File/Inst	Cnt 1 Rack-Pos	Cnt 1 Pos Chk By	Cnt 2 File/Inst	Cnt 2 Rack-Pos	Cnt 2 Pos Chk By	Cnt 3 File/Inst	Cnt 3 Rack-Pos	Cnt 3 Pos Chk By	Notes
1	0916023-1	SMP	1	1	sample	pCi/l	LSC6000	25-2	mm							Added 10uL Nitro
1	0916023-2	SMP	1	1	sample	pCi/l		-3								60
1	0916023-3	SMP	1	1	sample	pCi/l		-4								140
1	3H090422-3B01	MB	1	1	sample	pCi/l		-6								10
1	3H090422-3B02	MB	1	1	sample	pCi/l		-7								60
1	3H090422-3B03	MB	1	1	sample	pCi/l		-8								140
1	3H090422-3CB1	MB	1	1	sample	pCi/l		-1								10
1	3H090422-3CB2	MB	1	1	sample	pCi/l		-5								10
1	3H090422-3CB3	MB	1	1	sample	pCi/l		-9								10

MR 10-28-09

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	H-3	648.3610.05	2,827.459	DPM/ml	04/22/09	0.1	ml	RS-008

Reporting Units

LabID:	TstGrpName:	RptUnits:
0916023-1	H3	pCi/l
0916023-2	H3	pCi/l
0916023-3	H3	pCi/l

Sample Barcodes

0916023-1
3H090422-3PS1

0916023-2
3H090422-3PS2

0916023-3
3H090422-3PS3

3H090422-3B01MB
3H090422-3PS4

3H090422-3B02MB
3H090422-3PS5

3H090422-3B03MB
3H090422-3PS6

3H090422-3CB1MB
3H090422-3PS7

3H090422-3CB2MB
3H090422-3PS8

3H090422-3CB3MB
3H090422-3PS9

Radiochemistry Prep Worksheet

ALS Paragon

Prep Batch: 3H090422-3

Prep Procedure: H3

Reviewed By: DBC DBC Review Date: 5/1/2009

Non-Routine Pre-Treatment? Y / (N) Batch: N/A Re-Prep? Y / (N) Batch: N/A Prep QASS / NCR? Y / (N) N/A

Prep SOP: PAI 700 Rev: 10
Prep SOP: NONE
Matrix Class: liquid

Prep Analyst: Derek B. Caduff
Prep Date: 4/22/2009
Prep Dept: RS

Balance:
Balance:

Cocktail: UG LLT
Cocktail Pipet: T-002
Aliquot Pipet: RS-015

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq sample	Fin Alq sample	Prep Basis	Analysis Vol.(ml)	Standards	Prep Notes
1	1	0916023-1	SMP		1	1	As Received		S1	
2	1	0916023-2	SMP		1	1	As Received		S1	
3	1	0916023-3	SMP		1	1	As Received		S1	
4	1	3H090422-3B01	MB		1	1	As Received			
5	1	3H090422-3B02	MB		1	1	As Received			
6	1	3H090422-3B03	MB		1	1	As Received			
7	1	3H090422-3CB1	MB		1	1	As Received			
8	1	3H090422-3CB2	MB		1	1	As Received			
9	1	3H090422-3CB3	MB		1	1	As Received			

DBC 4/22/09 (Analysis Vol.) DBC 4/22/09 (Standards) DBC 4/22/09 (Prep Notes)

Comments
UG LLT LOT #97-080401

Spiked By: Derek B. Caduff Date: 4/22/2009

Witnessed By: Jeff Kujawa Date: 4/22/2009

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	H-3	648.3610.05	2,827.459	DPM/ml	04/22/09	0.1	ml	RS-008

ALS Paragon

Radiochemistry Prep Worksheet

Prep Batch: 3H090422-3

Prep Procedure: H3

Prep Batch Not Validated!!!

Reviewed By: Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 700 Rev: 10
Prep SOP: NONE
Matrix Class: liquid

Prep Analyst: Derek B. Caduff DBC
Prep Date: 4/22/2009
Prep Dept: RS

Balance:
Balance:

Cocktail: UG LLT
Cocktail Pipet: T-002
Aliquot Pipet: RS-015

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq sample	Fin Alq sample	Prep Basis	Analysis Vol.(ml)	Standards	Prep Notes
1	1	0916023-1	SMP		1	1	As Received		S1	
2	1	0916023-2	SMP		1	1	As Received		S1	
3	1	0916023-3	SMP		1	1	As Received		S1	
4	1	3H090422-3B01	MB		1	1	As Received			
5	1	3H090422-3B02	MB		1	1	As Received			
6	1	3H090422-3B03	LCSD		1	1	As Received			

Comments
UG LLT LOT # 97-0804-01

Spiked By: Derek B. Caduff DBC Date: 4/22/09
Witnessed By: [signature] Date: 4/22/09

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	H-3	648.3610.05	2,827.459	DPM/ml	04/22/09	0.1	ml	RS-008

Exp. 4/30/09

Prepare a working dilution ~ 99000 dpm/mL of 3H from 699.2613.18.

1) Determine the density of DI water Bal. #
Mass of empty 100 ml volumetric flask: 66.457g 12
Mass of flask and 100 ml DI water: 166.065g ↓
Net mass of DI water: 99.608g
ρ = 0.9960 g/ml

2) Transfer standard:
Mass of empty bottle without lid: 97.195g 12
Mass of bottle and standard: 100.566g ↓
Net mass of standard: 3.371g

3) Dilute with DI water.
Mass of empty bottle without lid: 97.195g 12
Mass of bottle, standard and DI water: 197.744g ↓
Net mass of standard and DI water: 100.549g

4) Final activity calculation:

$$\frac{(4,733,412.57\ dpm/ml)(3.371g)(0.9963\ g/ml)}{(100.549g)(0.9958\ g/ml)} = 159,961.57\ dpm/mL$$

DC 7/7/08

To reverse density corrected activity for 699.0413.18.

160351.042 dpm/ml

MC 7/13/08

Stnd ID: 699.3020.95

Description: H-3
Expiration: 2/25/2009
Activity: 160351.04 dpm/mL
MC 7/13/08
2s Uncertainty: 1154.53 dpm/mL
Ref. Date: 9/3/1998
Ref Time: N/A
Prep Date: 2/7/2008 Prep by: DC
Matrix/Comp. DI WATER
Half Life (y): 1.23E+01

Reverification Log		
Analysis Date	Initials	Expiration Date
4/1/09	[illegible]	4/1/10

MC 7/13/08

MC 7/13/08

Continued on Page

Read and Understood By

Signed Date 7/7/08 Signed Date 7/13/08

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PROJECT 699.2613.18 3H Notebook No. 2CVS

Continued From Page

Prepare a 1° dilution of Ampoule 6099 by diluting with DI water.

1) Determine the density of DI water

Mass of empty Class A 100mL volumetric flask	67.7956 g	Bal #12
Mass of flask + 100mL of DI water	167.3755 g	↓
Net mass of DI water	99.5799 g	

$\rho = 0.9958\ g/mL$

2) Transfer contents of ampoule 6099 into a 40 mL Amber glass VOA vile.

Mass of VOA vile w/o lid	24.3883g	Bal #12
Mass of opened ampoule before transfer	40.4432g	↓
Mass of opened ampoule after transfer	36.0281 g	
Net mass of Std transferred	4.8151 g	

3) Add DI water to final dilution

Mass of VOA vile w/o lid/septa from above	24.3883g	Bal #12
Mass of VOA vile, std + DI water	62.9648g	↓
Net mass of Std + DI water	38.5765 g	

4) Final Activity Calculation

$$\left(634.7\ \frac{kBq}{g}\right)(4.8151\ g)\left(\frac{60\ DPM}{1\ Bq}\right)\left(\frac{1000\ Bq}{1\ kBq}\right)\left(0.9958\ \frac{g}{mL}\right)$$

$$38.5765\ g$$

$$= 4,733,412.57\ \frac{DPM}{mL}$$

U.S. Department of Commerce
National Institute of Standards and Technology
SRM 4927F
Hydrogen-3
<4 MBq in distilled water
CAUTION
RADIOACTIVE

Continued on Page

Read and Understood By

Signed	7/29/03	Signed	7/31/03
	Date		Date

National Institute of Standards & Technology

Certificate

PAF ID 0699
Recd 5-09-03

Standard Reference Material 4927F
Hydrogen-3 Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive hydrogen-3, as water, in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of beta-particle counting instruments and for the monitoring of radiochemical procedures.

Radiological Hazard

The SRM ampoule contains hydrogen-3 with a total activity of approximately 3.2 MBq. Hydrogen-3 decays by beta-particle emission. None of the beta particles escape from the SRM ampoule. During the decay process no photons are emitted. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]*. There is no detectable external radiation. The SRM should be used only by persons qualified to handle radioactive material.

Chemical Hazard

The SRM ampoule contains only distilled water. There is no chemical hazard. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2.

Storage and Handling

The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least September 2008.

The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) because of the radioactivity.

Preparation

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, L.R. Karam, Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas and M.P. Unterweger of the Radioactivity Group.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by J.W.L. Thomas.

Bert M. Coursey, Chief
Ionizing Radiation Division

Nancy M. Trahey, Chief
Standard Reference Materials Program

Gaithersburg, Maryland 20899
June 1999
Half-life and text revised October 2000

*Notes and references are on pages 5 and 6.

Recommended Procedure for Opening the SRM Ampoule

1) If the SRM solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the SRM solution.

2) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood.

3) Shake the ampoule to wet all of the inside surface of the ampoule. Return the ampoule to the upright position.

4) Check that all of the liquid has drained out of the neck of the ampoule. If necessary, gently tap the neck to speed the process.

5) Holding the ampoule upright, score the narrowest part of the neck with a scribe or diamond pencil.

6) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.

7) Hold the ampoule upright with a paper towel, a wiper, or a support jig. Position the scored line away from you. Using a paper towel or wiper to avoid contamination, snap off the top of the ampoule by pressing the narrowest part of the neck away from you while pulling the tip of the ampoule towards you.

8) Transfer the solution from the ampoule using a pycnometer or a pipet with dispenser handle. NEVER PIPETTE BY MOUTH.

9) Seal any unused SRM solution in a flame-sealed glass ampoule, if possible, to minimize the evaporation loss.

See also reference [4]*.

*Notes and references are on pages 5 and 6.

PROPERTIES OF SRM 4927F

Certified values

Solution density	(0.998 ± 0.002) g·mL^{-1} at 20.0 °C [b]*
Radionuclide	Hydrogen-3
Reference time	1200 EST, 3 September 1998
Massic activity of the solution [c]	634.7 kBq·g^{-1}
Relative expanded uncertainty (k=2)	0.72% [d] [e]

Uncertified values

Physical Properties:			
Source description	Liquid in flame-sealed NIST borosilicate-glass ampoule		
Ampoule specifications	Body outside diameter Wall Thickness Barium content Lead-oxide content Other heavy elements	(16.5 ± 0.5) mm (0.60 ± 0.04) mm Less than 2.5% Less than 0.02% Trace quantities	
Solution mass	Approximately 5.0 g		
Chemical Properties:			
Solution composition	Chemical Formula	Concentration (mol·L^{-1})	Mass Fraction (g·g^{-1})
	H_2O ^3HHO	55 6×10^{-7}	1.00 1×10^{-8}
Radiological Properties:			
Radionuclidic impurities	None detected [f]		
Half lives used	Hydrogen-3: (4500 ± 8) d [g]		
Calibration method and measuring instrument(s)	4πß gas counting of SRM 4927E using the NIST length-compensated internal gas proportional counters and intercomparison of SRMs 4927E/4927F using two 4πß liquid-scintillation counting systems [h]		

*Notes and references are on pages 5 and 6.

EVALUATION OF THE UNCERTAINTY OF THE MASSIC ACTIVITY [d]*

Input Quantity x_i, the source of uncertainty (and individual uncertainty components where appropriate)	Method Used To Evaluate $u(x_i)$, the standard uncertainty of x_i (A) denotes evaluation by statistical methods (B) denotes evaluation by other methods	Relative Uncertainty Of Input Quantity, $u(x_i)/x_i$, (%) [i]	Relative Sensitivity Factor, $\lvert \partial y/\partial x_i \rvert \cdot (x_i/y)$ [j]	Relative Uncertainty Of Output Quantity, $u_i(y)/y$, (%) [k]
Massic count rate of SRM 4927E, corrected for background and decay [h]	Standard deviation of the mean for 23 sets of gas counting measurements (A)	0.18	1.0	0.18
Gram-mole measurements	Estimated (B)	0.20	1.0	0.20
Live-time [p]	Estimated (B)	0.10	1.0	0.10
Extrapolation of count-rate-versus-energy to zero energy	Estimated (B)	0.20	1.0	0.20
Half life of H-3	Standard uncertainty of the half life (A)	0.18 [m]	0.009 [n]	0.002
Liquid-scintillation intercomparison of SRM 4927F and SRM 4927E	Standard deviation of the mean for 7 sets of liquid-scintillation measurements (A)	0.06	1.0	0.06
Radionuclidic impurities	Limit of detection (B) [q]	100.	0.0005	0.05
Relative Combined Standard Uncertainty of the Output Quantity, $u_c(y)/y$, (%)				0.36
Coverage Factor, k				x 2
Relative Expanded Uncertainty of the Output Quantity, U/y, (%)				0.72

*Notes and references are on pages 5 and 6.

NOTES

[a] The Sievert is the SI unit for dose equivalent. See reference [1]. One μSv is equal to 0.1 mrem.

Distance from Ampoule (cm):	1	30	100
Approximate Dose Rate (μSv/h):	<0.1 (Not detectable)		

[b] The stated uncertainty is two times the standard uncertainty.

[c] Massic activity is the preferred name for the quantity activity divided by the total mass of the sample. See reference [1].

[d] The reported value, y, of massic activity (activity per unit mass) at the reference time was not measured directly but was derived from measurements and calculations of other quantities. This can be expressed as $y = f(x_1, x_2, x_3, \ldots x_n)$, where f is a mathematical function derived from the assumed model of the measurement process.

The value, x_i, used for each input quantity i has a standard uncertainty, $u(x_i)$, that generates a corresponding uncertainty in y, $u_i(y) = |\partial y/\partial x_i| \cdot u(x_i)$, called a component of combined standard uncertainty of y.

The combined standard uncertainty of y, $u_c(y)$, is the positive square root of the sum of the squares of the components of combined standard uncertainty.

The combined standard uncertainty is multiplied by a coverage factor of $k = 2$ to obtain U, the expanded uncertainty of y.

Since it can be assumed that the possible estimated values of the massic activity are approximately normally distributed with approximate standard deviation $u_c(y)$, the unknown value of the massic activity is believed to lie in the interval $y \pm U$ with a level of confidence of approximately 95 percent.

For further information on the expression of uncertainties, see references [2] and [3].

[e] The value of each standard uncertainty component, and hence the value of the expanded uncertainty itself, is a best estimate based upon all available information, but is only approximately known. That is to say, the "uncertainty of the uncertainty" is large and not well known. This is true for uncertainties evaluated by statistical methods (e.g., the relative standard deviation of the standard deviation of the mean for the massic response is approximately 50%) and for uncertainties evaluated by other methods (which could easily be over estimated or under estimated by substantial amounts). The unknown value of the expanded uncertainty is believed to lie in the interval $U/2$ to $2U$ (i.e., within a factor of 2 of the estimated value).

[f] The estimated limit of detection for radionuclidic impurities is 300 $Bq \cdot g^{-1}$.

[g] The stated uncertainty is the standard uncertainty. See reference [5].

[h] Extensive gas-counting measurements were made on the SRM 4927E solution during 1998 and 1999. The SRM 4927F solution was intercompared with the SRM 4927E solution using liquid-scintillation counting.

[i] Relative standard uncertainty of the input quantity x_i.

[j] The relative change in the output quantity y divided by the relative change in the input quantity x_i. If $|\partial y/\partial x_i| \cdot (x_i/y) = 1.0$, then a 1% change in x_i results in a 1% change in y. If $|\partial y/\partial x_i| \cdot (x_i/y) = 0.05$, then a 1% change in x_i results in a 0.05% change in y.

[k] Relative component of combined standard uncertainty of output quantity y, rounded to two significant figures or less. The relative component of combined standard uncertainty of y is given by $u_i(y)/y = |\partial y/\partial x_i| \cdot u(x_i)/y = |\partial y/\partial x_i| \cdot (x_i/y) \cdot u(x_i)/x_i$. The numerical values of $u(x_i)/x_i$, $|\partial y/\partial x_i| \cdot (x_i/y)$, and $u_i(y)/y$, all dimensionless quantities, are listed in columns 3, 4, and 5, respectively. Thus, the value in column 5 is equal to the value in column 4 multiplied by the value in column 3. The input quantities are independent, or very nearly so. Hence the covariances are zero or negligible.

[m] The relative standard uncertainty of $\lambda \cdot t$ is determined by the relative standard uncertainty of λ (i.e., of the half life). The relative standard uncertainty of t is negligible.

[n] $|\partial y/\partial x_i| \cdot (x_i/y) = |\lambda \cdot t|$

[p] The live time is determined by counting the pulses from a gated crystal-controlled oscillator.

[q] The standard uncertainty for each undetected impurity that might reasonably be expected to be present is estimated to be equal to the estimated limit of detection for that impurity, i.e. $u(x_i)/x_i = 100\%$. $|\partial y/\partial x_i| \cdot (x_i/y) = \{$(response per Bq of impurity)/(response per Bq of H-3)$\} \cdot \{$(Bq of impurity)/(Bq of H-3)$\}$. Thus $u_i(y)/y$ is the relative change in y if the impurity were present with a mass activity equal to the estimated limit of detection.

REFERENCES

[1] International Organization for Standardization (ISO), *ISO Standards Handbook - Quantities and Units*, 1993. Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, U.S.A. 1-212-642-4900.

[2] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993. Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, U.S.A. 1-212-642-4900. (Listed under ISO miscellaneous publications as "ISO Guide to the Expression 1993".)

[3] B. N. Taylor and C. E. Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20407, U.S.A.

[4] National Council on Radiation Protection and Measurements Report No. 58, *A Handbook of Radioactivity Measurements Procedures*, Second Edition, 1985. Available from the National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814 U.S.A.

[5] L.L. Lucas and M.P. Unterweger, *Comprehensive Review and Critical Evaluation of the Half-Life of Tritium*, J. Res. Natl. Inst. Stand. Technol. 105, 541-549 (2000).

Prepare a working dilution of ~ 4,000 dpm/ml of ^3H, 648.3382.76.

1) Determine density of DI water
Mass of 100 ml vol. flask 68.2975g
Mass of flask and 100 ml DI H_2O 168.0291g
Net Mass of water 99.7316g
JDD 4/28/08 ρ = .9973 g/ml

2) Transfer Std.
Mass of empty Amber jar (No Hd) 257.75g
Mass of Jar + Std transfered 264.58g
* Net Mass of Std. Transferred 6.8506g
↳ from below JDD 4/28/08

4) Dilute to Final Vol. w/ DI water
Mass of Std. H_2O, Jar 750.9g
Mass of Jar from above 257.75g
Net Mass of new dilution 493.15g

* Standard was transferred by difference from a plastic cup
Mass of Cup and ~10g of Standard 23.6533g
Mass of Cup and Std. [Not] Transferred 16.8027g

Final Activity Calculation

$$\frac{\left(369{,}530.45\ \frac{dpm}{ml}\right)\left(6.8506g\right)\left(.9973\ \frac{g}{ml}\right)}{\left(.9958\ \frac{g}{ml}\right)\left(493.15g\right)} = 5141.07\ \frac{dpm}{g} \approx \frac{dpm}{ml}$$

JDD 4/28/08

MC 7/13/08

Stnd ID: 648.3610.05
Description: H-3
Expiration: 4/30/2009
Activity: 5141.07 dpm/mL
MC 7/13/08
2s Uncertainty: 37.02 dpm/mL
Ref. Date: 9/3/1998
Ref Time: N/A
Prep Date: 4/30/2008 Prep by: JD
Matrix/Comp. DI WATER
Half Life (y): 1.23E+01

Reverification Log		
Analysis Date	Initials	Expiration Date
4/11/09		4/1/10

MC 7/13/08

Page

JDD 4/28/08 Signed 4/28/08 Date

MC 7/13/08 Signed 7/13/08 Date

PROJECT 648.2382.75 3H

Continued From Page

Prepare a 10 dilution (i.e. approximately 250 Bq/mL) diluted from standard using RSO #648 and diluting with DI water.

1) Determine the density of DI water:

Mass of empty 100mL Class A volumetric flask	67.1522 g	Bal #H3
Mass of flask + water	166.7351 g	↓
Net mass of 100mL H_2O	99.5829 g	

$\rho = .9958$ g/mL

2) Transfer contents of Ampoule Sem 4927F to a 40mL VOA vial. 500mL glass amber bottle

mass of 40mL VOA vial w/o lid	255.04 g	Bal #20
mass of open ampoule + 50mL beaker	310.9075 g	↓
mass of empty ampoule + 50mL beaker	306.0248 g	
Net mass of Std.	4.8827 g	

3) Dilute Std. with DI water.

mass of bottle w/o lid	255.04 g	Bal #20
mass of bottle, Std. + DI water	757.14 g	↓
Net mass of Std + DI water	502.1 g	

4. Final Activity Calculation.

$$\frac{(634.7\ \text{kBq/g})(1000\ \text{Bq/kBq})(60\ \text{DPM/Bq})(4.8827\ \text{g})(.9958\ \text{g/mL})}{502.1\ \text{g}} = 369,530.45\ \frac{\text{DPM}}{\text{mL}}$$

U.S. Department of Commerce
National Institute of Standards and Technology
SRM 4927F
Hydrogen-3
<4 MBq in distilled water

CAUTION
RADIOACTIVE

Continued on Page

Read and Understood By

3/27/03 Date — Signed

Signed — 3/27/03 Date

National Institute of Standards & Technology

Certificate

PA IQ 0648
Reorder: 37-DH-02

Standard Reference Material 4927F
Hydrogen-3 Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive hydrogen-3, as water, in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of beta-particle counting instruments and for the monitoring of radiochemical procedures.

Radiological Hazard

The SRM ampoule contains hydrogen-3 with a total activity of approximately 3.2 MBq. Hydrogen-3 decays by beta-particle emission. None of the beta particles escape from the SRM ampoule. During the decay process no photons are emitted. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]*. There is no detectable external radiation. The SRM should be used only by persons qualified to handle radioactive material.

Chemical Hazard

The SRM ampoule contains only distilled water. There is no chemical hazard. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2.

Storage and Handling

The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least September 2008.

The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) because of the radioactivity.

Preparation

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, L.R. Karam, Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas and M.P. Unterweger of the Radioactivity Group.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by J.W.L. Thomas.

Bert M. Coursey, Chief
Ionizing Radiation Division

Nancy M. Trahey, Chief
Standard Reference Materials Program

Gaithersburg, Maryland 20899
June 1999
Half-life and text revised October 2000

*Notes and references are on pages 5 and 6.

Recommended Procedure for Opening the SRM Ampoule

1) If the SRM solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the SRM solution.

2) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood.

3) Shake the ampoule to wet all of the inside surface of the ampoule. Return the ampoule to the upright position.

4) Check that all of the liquid has drained out of the neck of the ampoule. If necessary, gently tap the neck to speed the process.

5) Holding the ampoule upright, score the narrowest part of the neck with a scribe or diamond pencil.

6) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.

7) Hold the ampoule upright with a paper towel, a wiper, or a support jig. Position the scored line away from you. Using a paper towel or wiper to avoid contamination, snap off the top of the ampoule by pressing the narrowest part of the neck away from you while pulling the tip of the ampoule towards you.

8) Transfer the solution from the ampoule using a pycnometer or a pipet with dispenser handle. NEVER PIPETTE BY MOUTH.

9) Seal any unused SRM solution in a flame-sealed glass ampoule, if possible, to minimize the evaporation loss.

See also reference [4]*.

*Notes and references are on pages 5 and 6.

PROPERTIES OF SRM 4927F

Certified values

Solution density	(0.998 ± 0.002) g·mL^{-1} at 20.0 °C [b]*
Radionuclide	Hydrogen-3
Reference time	1200 EST, 3 September 1998
Massic activity of the solution [c]	634.7 kBq·g^{-1}
Relative expanded uncertainty (k=2)	0.72% [d] [e]

Uncertified values

Physical Properties:			
Source description	Liquid in flame-sealed NIST borosilicate-glass ampoule		
Ampoule specifications	Body outside diameter	(16.5 ± 0.5) mm	
	Wall Thickness	(0.60 ± 0.04) mm	
	Barium content	Less than 2.5%	
	Lead-oxide content	Less than 0.02%	
	Other heavy elements	Trace quantities	
Solution mass	Approximately 5.0 g		
Chemical Properties:			
Solution composition	Chemical Formula	Concentration (mol·L^{-1})	Mass Fraction (g·g^{-1})
	H_2O	55	1.00
	^3HHO	6×10^{-7}	1×10^{-8}
Radiological Properties:			
Radionuclidic impurities	None detected [f]		
Half lives used	Hydrogen-3: (4500 ± 8) d [g]		
Calibration method and measuring instrument(s)	4πβ gas counting of SRM 4927E using the NIST length-compensated internal gas proportional counters and intercomparison of SRMs 4927E/4927F using two 4πβ liquid-scintillation counting systems [h]		

*Notes and references are on pages 5 and 6.

EVALUATION OF THE UNCERTAINTY OF THE MASSIC ACTIVITY [d]*

Input Quantity x_i, the source of uncertainty (and individual uncertainty components where appropriate)	Method Used To Evaluate $u(x_i)$, the standard uncertainty of x_i, (A) denotes evaluation by statistical methods, (B) denotes evaluation by other methods	Relative Uncertainty Of Input Quantity, $u(x_i)/x_i$, (%) [i]	Relative Sensitivity Factor, $\lvert \partial y/\partial x_i \rvert \cdot (x_i/y)$ [j]	Relative Uncertainty Of Output Quantity, $u_i(y)/y$, (%) [k]
Massic count rate of SRM 4927E, corrected for background and decay [h]	Standard deviation of the mean for 23 sets of gas counting measurements (A)	0.18	1.0	0.18
Gram-mole measurements	Estimated (B)	0.20	1.0	0.20
Live-time [p]	Estimated (B)	0.10	1.0	0.10
Extrapolation of count-rate-versus-energy to zero energy	Estimated (B)	0.20	1.0	0.20
Half life of H-3	Standard uncertainty of the half life (A)	0.18 [m]	0.009 [n]	0.002
Liquid-scintillation intercomparison of SRM 4927F and SRM-4927E	Standard deviation of the mean for 7 sets of liquid-scintillation measurements (A)	0.06	1.0	0.06
Radionuclidic-impurities	Limit of detection (B) [q]	100.	0.0005	0.05
Relative Combined Standard Uncertainty of the Output Quantity, $u_c(y)/y$, (%)				0.36
Coverage Factor, k				x 2
Relative Expanded Uncertainty of the Output Quantity, U/y, (%)				0.72

*Notes and references are on pages 5 and 6.

NOTES

[a] The Sievert is the SI unit for dose equivalent. See reference [1]. One μSv is equal to 0.1 mrem.
Distance from Ampoule (cm): 1 30 100
Approximate Dose Rate (μSv/h): <0.1 (Not detectable)

[b] The stated uncertainty is two times the standard uncertainty.

[c] Massic activity is the preferred name for the quantity activity divided by the total mass of the sample. See reference [1].

[d] The reported value, y, of massic activity (activity per unit mass) at the reference time was not measured directly but was derived from measurements and calculations of other quantities. This can be expressed as $y = f(x_1, x_2, x_3, \ldots x_n)$, where f is a mathematical function derived from the assumed model of the measurement process.

The value, x_i, used for each input quantity i has a standard uncertainty, $u(x_i)$, that generates a corresponding uncertainty in y, $u_i(y) = |\partial f/\partial x_i| \cdot u(x_i)$, called a component of combined standard uncertainty of y.

The combined standard uncertainty of y, $u_c(y)$, is the positive square root of the sum of the squares of the components of combined standard uncertainty.

The combined standard uncertainty is multiplied by a coverage factor of $k = 2$ to obtain U, the expanded uncertainty of y.

Since it can be assumed that the possible estimated values of the massic activity are approximately normally distributed with approximate standard deviation $u_c(y)$, the unknown value of the massic activity is believed to lie in the interval $y \pm U$ with a level of confidence of approximately 95 percent.

For further information on the expression of uncertainties, see references [2] and [3].

[e] The value of each standard uncertainty component, and hence the value of the expanded uncertainty itself, is a best estimate based upon all available information, but is only approximately known. That is to say, the "uncertainty of the uncertainty" is large and not well known. This is true for uncertainties evaluated by statistical methods (e.g., the relative standard deviation of the standard deviation of the mean for the massic response is approximately 50%) and for uncertainties evaluated by other methods (which could easily be over estimated or under estimated by substantial amounts). The unknown value of the expanded uncertainty is believed to lie in the interval $U/2$ to $2U$ (i.e., within a factor of 2 of the estimated value).

[f] The estimated limit of detection for radionuclidic impurities is 300 $Bq \cdot g^{-1}$.

[g] The stated uncertainty is the standard uncertainty. See reference [5].

[h] Extensive gas-counting measurements were made on the SRM 4927E solution during 1998 and 1999. The SRM 4927F solution was intercompared with the SRM 4927E solution using liquid-scintillation counting.

[i] Relative standard uncertainty of the input quantity x_i.

[j] The relative change in the output quantity y divided by the relative change in the input quantity x_i. If $|\partial y/\partial x_i| \cdot (x_i/y) = 1.0$, then a 1% change in x_i results in a 1% change in y. If $|\partial y/\partial x_i| \cdot (x_i/y) = 0.05$, then a 1% change in x_i results in a 0.05% change in y.

[k] Relative component of combined standard uncertainty of output quantity y, rounded to two significant figures or less. The relative component of combined standard uncertainty of y is given by $u_i(y)/y = |\partial y/\partial x_i| \cdot u(x_i)/y = |\partial y/\partial x_i| \cdot (x_i/y) \cdot u(x_i)/x_i$. The numerical values of $u(x_i)/x_i$, $|\partial y/\partial x_i| \cdot (x_i/y)$, and $u_i(y)/y$, all dimensionless quantities, are listed in columns 3, 4, and 5, respectively. Thus, the value in column 5 is equal to the value in column 4 multiplied by the value in column 3. The input quantities are independent, or very nearly so. Hence the covariances are zero or negligible.

[m] The relative standard uncertainty of $\lambda \cdot t$ is determined by the relative standard uncertainty of λ (i.e., of the half life). The relative standard uncertainty of t is negligible.

[n] $|\partial y/\partial x_i| \cdot (x_i/y) = |\lambda \cdot t|$

[p] The live time is determined by counting the pulses from a gated crystal-controlled oscillator.

[q] The standard uncertainty for each undetected impurity that might reasonably be expected to be present is estimated to be equal to the estimated limit of detection for that impurity, i.e. $u(x_i)/x_i = 100\%$. $|\partial y/\partial x_i| \cdot (x_i/y)$ = {(response per Bq of impurity)/(response per Bq of H-3)}·{(Bq of impurity)/(Bq of H-3)}. Thus $u_i(y)/y$ is the relative change in y if the impurity were present with a massic activity equal to the estimated limit of detection.

REFERENCES

[1] International Organization for Standardization (ISO), *ISO Standards Handbook - Quantities and Units*, 1993. Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, U.S.A. 1-212-642-4900.

[2] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993. Available from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, U.S.A. 1-212-642-4900. (Listed under ISO miscellaneous publications as "ISO Guide to the Expression 1993".)

[3] B. N. Taylor and C. E. Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20407, U.S.A.

[4] National Council on Radiation Protection and Measurements Report No. 58, *A Handbook of Radioactivity Measurements Procedures*, Second Edition, 1985. Available from the National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814 U.S.A.

[5] L.L. Lucas and M.P. Unterweger, *Comprehensive Review and Critical Evaluation of the Half-Life of Tritium*, J. Res. Natl. Inst. Stand. Technol. 105, 541-549 (2000).

LS6000 H-3 Swipes Background Determination

Interim control limits are established from the initial calibration for the geometry of interest. Limits are +/- 3 standard deviations from the initial unquenched calibration blank data. Once enough historical data is acquired, new historical limits are set as follows: Control limits for reagent blanks are established from 30 individual historical data points (10 batches). Limits are +/- 3 standard deviations from 30 individual historical data points. Individual reagent blanks and the average of reagent blanks from each batch are in control if the Count Rate (CPM) is within the established control limits.

CURRENTLY UNDER INTERIM LIMITS!

Updated 10/29/09 mh

							Individual Reagent Blanks			Average of Reagent Blanks		
COUNT DATE	#	Sample ID	Count Duration (m)	Count Rate (CPM)	Total Cts.	Mean	LCL	UCL	Pass ?	LCL	UCL	Pass ?
10/27/2009	1	3H090422-3CB1	180	7.16	1288.8		3.49	8.24	PASS			
10/27/2009	2	3H090422-3CB2	180	7.38	1328.4		3.49	8.24	PASS			
10/28/2009	3	3H090422-3CB3	180	7.07	1272.6	7.20	3.49	8.24	PASS	3.49	8.24	PASS

H-3 Swipes "Window 2" Control Limits (LS 6000)

The background count rate is determined from the average of the reagent blanks for the batch.

Window 2 control limits are established using the average count rate from the three reagent blanks associated with each prep batch +/- 3X the estimated poisson uncertainty.

Updated 10/29/09 mh

COUNT DATE	#	Sample ID	Count Duration (min.)	**Average count Duration (min.)**	Count Rate (CPM)	Batch Average Reagent Blank	**Lower Control Limit**	**Upper Control Limit**
10/27/2009	1	3H090422-3CB1	180		29.98			
10/27/2009	2	3H090422-3CB2	180		28.89			
10/28/2009	3	3H090422-3CB3	180	**180**	30.01	29.63	**28.41**	**30.84**

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DAILY INSTRUMENT PERFORMANCE CHECKS - LS6000 (LL OFF, LUMEX OFF)

Daily IPCs consist of the following standards;

Efficiency Check -

Beckman Tritium Standard		**Beckman C-14 Standard**	
Lot HNZ0202		Lot CNZ3112	
101900.00	dpm	98500.0	dpm
2/17/2005	REF	2/17/2005	REF
2/17/2010	EXP	2/17/2010	EXP

INSTRUMENT RE-CALIBRATED FOR ALL TESTS STARTING 04/08/09. mbc

Historical Control Limits	as of 06/12/09 MH	
	Decay Corrected Tritium	Carbon-14
UCL	70748.54	80439.21
Mean Value	67379.56	76608.77
LCL	64010.58	72778.33

			Decay Corrected			
Obs	Date	H-3 CPM	H-CPM	PASS?	C-14 CPM	PASS?
122	10/26/2009	51452.50	67035.95	OK	76690.2	OK
123	10/27/2009	51352.20	66915.61	OK	76616.2	OK
124	10/28/2009	51270.40	66819.35	OK	76543.7	OK

DAILY CHECK LL ON ^{99}Tc SOURCE- LS6000

^{99}Tc standard		SPIKE	
836.3020.70		KNOWN ACTIVITY	
7/25/2008	REF	58000.38	dpm/g
7/25/2009	EXP	58000.38	dpm

INSTRUMENT RE-CALIBRATED FOR ALL TESTS STARTING 04/08/09. mbc

Historical Control Limits 6/12/2009

	blank	Blank Quench #	spike
UCL	21.36	52.5	11454.01
Mean Value	17.11	50.0	10187.61
LCL	12.85	47.5	8921.21

Obs #	Date	Blank C.R.	Pass ?	Quench #	Pass	Spiked C.R.	Pass ?
122	10/26/2009	16.9	OK	49	OK	10005	OK
123	10/27/2009	18.9	OK	48.4	OK	10076	OK
124	10/28/2009	16.2	OK	50.2	OK	10045.7	OK

Liquid Scintillation Counter

Quality Control Data

Daily Instrument Performance Checks

DAILY INSTRUMENT PERFORMANCE CHECKS - LS6000 (LL OFF, LUMEX OFF)

Daily IPCs consist of the following standards;

Efficiency Check -

Beckman Tritium Standard		**Beckman C-14 Standard**	
Lot HNZ0202		Lot CNZ3112	
101900.00	dpm	98500.0	dpm
2/17/2005	REF	2/17/2005	REF
2/17/2010	EXP	2/17/2010	EXP

INSTRUMENT RE-CALIBRATED FOR ALL TESTS STARTING 04/08/09. mbc

Historical Control Limits	as of 06/12/09 MH	
	Decay Corrected Tritium	Carbon-14
UCL	70748.54	80439.21
Mean Value	67379.56	76608.77
LCL	64010.58	72778.33

			Decay Corrected			
Obs	Date	H-3 CPM	H-CPM	PASS?	C-14 CPM	PASS?
160	12/23/2009	50835.30	66828.14	OK	76503.9	OK
161	12/26/2009	50846.80	66874.25	OK	76138.9	OK

DAILY CHECK LL ON ^{99}Tc SOURCE- LS6000

^{99}Tc standard		SPIKE
836.3020.70		KNOWN ACTIVITY
12/1/2009	REF	58000.38 dpm/g
12/1/2010	EXP	58000.38 dpm

INSTRUMENT RE-CALIBRATED FOR ALL TESTS STARTING 04/08/09. mbc

Historical Control Limits 6/12/2009

	blank	Blank Quench #	spike
UCL	20.61	55.9	12600.00
Mean Value	16.50	53.2	11206.90
LCL	12.40	50.5	9813.80

Obs #	Date	Blank C.R.	Pass ?	Quench #	Pass	Spiked C.R.	Pass ?
160	12/23/2009	15.9	OK	52.2	OK	11055.7	OK
161	12/26/2009	16.9	OK	53	OK	10874.6	OK