SAF-RC-242
618-10 VPU Field Remediation – Soil In-Process
FINAL DATA PACKAGE

COMPLETE COPY OF DATA PACKAGE TO:

No Distribution Required KW 7/14/16
INITIAL/DATE

COMMENTS:

SDG X0118 **SAF-RC-242**

☑ Rad only Chem only Rad & Chem

☑ Complete Partial

Sample Location: 618-10 (VPU-45)

WASHINGTON CLOSURE HANFORD

SAF: RC-242, SDG: X0118

STANDARD LEVEL IV
REPORT OF ANALYSIS

WORK ORDER #16-06111-OR

July 13, 2016

EBERLINE ANALYTICAL/OAK RIDGE LABORATORY
OAK RIDGE, TN

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Eberline Services – Oak Ridge Laboratory

LABORATORY DATA SUPPORT CHECKLIST

MP-001-3

Eberline Services Work Order # 16-06111

The checklist items listed below are to be initialed by appropriate staff upon completion/verification.

Date for Partial	Initials	Date	Initials	Checklist Items
		6-23-16	SEB	Sample Log-In
		7/11/16	KBS	Data Compilation
		7-12-16	MHT	First Technical Data Review
		7/12/16	[illegible]	Second Technical Data Review
		7/12/16	[illegible]	Data Entry/Electronic Deliverable
		7/12/16	[illegible]	Case Narrative
		7/13/16	KBS	Electronic Deliverable Proof
		7/13/16	[illegible]	Samples Analyzed within Holding Time Yes? [X] No? [ ]
		7/13/16	[illegible]	QA/QC Review
				Client in Possession of Data Electronic or Hard Copy
				Invoiced by Laboratory

Technical/Clerical Corrections, Signatures Needed, Problems, Etc	Date/Initials

Date package approved by: [signature] 7/13/16

Laboratory Manager Date

Copy No. _____

SECTION I

CHAIN OF CUSTODY

Washington Closure Hanford

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

RC-242-003

Collector: J. Craig	Company Contact: Joan Kessner	Telephone No.: 375-4688	Project Coordinator: KESSNER, JH
Price Code: 8D	Data Turnaround: 21 days		
Project Designation: 618-10 Vertical Pipe Unit (VPU)	Sampling Location: 618-10 (VPU-45)		SAF No.: RC-242
Ice Chest No.: WCH-11-023	Field Logbook No.: EL-1671	COA: R618LW8100 ~~R618VUY000~~ 06/14/16	Method of Shipment: Commercial Carrier
Shipped To: Eberline Services Oak Ridge	Offsite Property No.: N/A TRE 6-22-16		Bill of Lading/Air Bill No.: JEE RSR

Other Labs Shipped To: N/A TRE 6-22-16

POSSIBLE SAMPLE HAZARDS/REMARKS

Radioactive

Special Handling and/or Storage

Trans-ship RCF to EBRLOR

Preservation	None	None	None	None								
Type of Container	G/P	G/P	G/P	P								
No. of Container(s)	1	0	0	0								
Volume	60mL	60mL	60mL	60mL								
Sample Analysis	Carbon-14; Tritium - H3	Technetium-99	Nickel-63	RCF GEA Screen Tranship OR								
Sample No.	Matrix	Sample Date	Sample Time									
J1V930-A 4	SOIL	06/15/16	1340	X	X	X	X	40054	81g			

CHAIN OF POSSESSION — **Sign/Print Names**

Relinquished By/Removed From	Date/Time	Received By/Stored In	Date/Time
Jim Craig for Craig	6-15-16 1405	C. Martinez / C. Martinez	1405 6/15/16
C. Martinez / C. Martinez	1425 6/15/16	T.R. Edmundson / T.R. Edmundson	6-15-16 1425
T.R. Edmundson / T.R. Edmundson	6-15-16 1450	D. Miller / D. Miller	RCF 1450 6-15-16
D. Miller / D. Miller	RCF 0815 6-22-16	T.R. Edmundson / T.R. Edmundson	6-22-16 0815
T.R. Edmundson / T.R. Edmundson	WCH 6-22-16 1500	Fed Ex	6-22-16 —
		[illegible]	6-23-16 0900

FINAL SAMPLE DISPOSITION	Disposal Method	Disposed By	Date/Time

SPECIAL INSTRUCTIONS

16-06111

REC'D JUN 23 2016

REVIEWED BY KW pastelo DATE 6-22-16

X0118

WCH-EE-011

EBERLINE ANALYTICAL Oak Ridge Laboratory	**Internal Chain of Custody**	*Work Order #*	**16-06111**
		Lab Deadline	**See Comments**
		Analysis	**Tc099 - Level 4**
		Sample Matrix	**SO**

Comments	*Sample Fraction*	*HP 210 / 270 Detector Activity*	*Storage Location*
Re-Analysis: 2Run MS	04	10689	ESC1.3
	05	0	ESC1.3
Original Lab Deadline: 07/14/16 **Rerun Lab Deadline: 07/14/16**			

	Location (circle one)					*Technician Initials*	
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible] 6/30/16	16:30
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible] 6/30/16	17:30
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MH	1JUL16
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MH	1JUL16 0545
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	0545
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	1246
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

EBERLINE SERVICES Oak Ridge Laboratory	Internal Chain of Custody	Work Order #	16-06111
		Lab Deadline	7/8/2016
		Analysis	H0003 - Level 4
		Sample Matrix	Soil/Solid

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
Run MS	04	10689	ESC1.3
	05	0	ESC1.3

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MW	6-24-16
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MW	7-1-16
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	AG	7/2/16 0930
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

Printed: 6/23/2016 9:30 AM

EBERLINE SERVICES Oak Ridge Laboratory	Internal Chain of Custody	Work Order #	16-06111
		Lab Deadline	7/8/2016
		Analysis	C0014 - Level 4
		Sample Matrix	Soil/Solid

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
Run MS	04	10689	ESC1.3
	05	0	ESC1.3

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room 1305	Kary Scis	6-28-16
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room 0852	Kary Scis	6-30-16
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room 0852	[illegible]	
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	7/1/16 0900
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

EBERLINE SERVICES Oak Ridge Laboratory	Internal Chain of Custody	Work Order #	16-06111
		Lab Deadline	7/8/2016
		Analysis	Ni063 - Level 4
		Sample Matrix	Soil/Solid

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
Run MS	04	10689	ESC1.3
	05	0	ESC1.3

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	6/28/16 10:30
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	6/28/16 15:15
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JB	6/28/16 1515
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JB	7/8/16 1050
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JB	7/8/16 1051
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JB	7/9/16 0900
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

SECTION II

SAMPLE ACKNOWLEDGEMENT

Client Name	Contract/PO	Project Type	Date Received	Required Turnaround Days	Eberline Services Work Order
Washington Closure Hanford	S00W235A01	Environmental	06/23/2016	21	16-06111
Project Name	**Client WO**	**Sample Disp**	**Lab Deadline**	**Internal Deadline**	**Client Deadline**
S00W235A01	SAF: RC-242 SDG: X0118	H	07/08/2016	07/13/2016	07/14/2016

Internal ID	Client ID	Sample Date	Matrix	Storage	C0014	H0003	Ni063	Tc099																			Ttl
01	LCS	06/23/16	SO	ESC1.3	X	X	X	X																			4
02	BLANK	06/23/16	SO	ESC1.3	X	X	X	X																			4
03	DUP	06/23/16	SO	ESC1.3	X	X	X	X																			4
04	J1V930-A SAF: RC-242	06/15/16 13:40	SO	ESC1.3	X	X	X	X																			4
05	J1V930-A SAF: RC-242 MS	06/15/16 13:40	SO	ESC1.3	X	X	X	X																			4
																											0

Eberline Services – Oak Ridge Laboratory

SAMPLE RECEIPT CHECKLIST
MP-001-2

WORK ORDER # 16-06111

SAMPLE MATRIX/MATRICES: (CIRCLE ONE OR BOTH)

AQUEOUS NON-AQUEOUS

(CIRCLE EITHER YES, NO, OR N/A)

WERE SAMPLES:

Received in good condition?	Y	N	
If aqueous, properly preserved	Y	N	N/A

WERE CHAIN OF CUSTODY SEALS:

Present on outside of package?	Y	N
Unbroken on outside of package?	Y	N
Present on samples?	Y	N
Unbroken on samples?	Y	N
Was chain of custody present upon sample receipt?	Y	N

IF THE RESPONSE TO ANY OF THE ABOVE IS **NO**, A DISCREPANT SAMPLE RECEIPT REPORT (DSR) HAS BEEN ISSUED.

REMARKS: _____

SIGNATURE: James E. Bailey DATE: _____

SECTION III

CASE NARRATIVE

EBERLINE SERVICES

EBERLINE ANALYTICAL CORPORATION
601 SCARBORO ROAD
OAK RIDGE, TENNESSEE 37830
PHONE (865) 481-0683
FAX (865) 483-4621

EBS-OR-40981

July 13, 2016

Joan Kessner
Washington Closure Hanford
2620 Fermi Avenue
Richland, WA 99354

CASE NARRATIVE
SAF: RC-242, SDG: X0118
Work Order # 16-06111-OR

SAMPLE RECEIPT

This work order contains one soil sample received 06/23/2016. Sample was analyzed for Technetium-99, Tritium, Carbon-14 and Nickel-63.

CLIENT ID	LAB ID
J1V930-A	16-06111-04
J1V930-A MS	16-06111-05

ANALYTICAL METHODS

Technetium-99 was analyzed using EIChroM Method TCS01 Modified. Tritium was performed using Method LANL ER-210 Modified. Carbon-14 was performed using EPA Method 520.0 Modified. Nickel-63 was performed using Method ASTM 3500-Ni Modified.

Laboratory qualifier is as follows:

U - Result is less than or equal to MDA.

ANALYTICAL RESULTS

Combined Standard Uncertainty is reported at 2-sigma value.

Minimum Detectable Activity (MDA) values for data represented in this report are sample-specific. MDA measurements are determined based on factors and conditions including instrument settings, aliquot size and matrix type.

TECHNETIUM-99

A representative aliquot of the sample was prepared by oxidative reactions with Nitric acid and Hydrogen Peroxide. After complete oxidization, Technetium was selectively extracted by the use of EIChroM stabilized resins. Special cleanup chemistry was conducted for complete removal of interferences associated with Uranium. Processed resins were then transferred to liquid scintillation vials, scintillation cocktail was added and sample was then counted by beta liquid scintillation.

ANALYTICAL RESULTS CONTINUED

TECHNETIUM-99 CONTINUED

2nd Analytical

Due to inadvertently not spiking the laboratory control sample, sample was reanalyzed. Sample demonstrated acceptable results for all Technetium-99 analyses. The Technetium-99 method blank demonstrated an acceptable result. Results for the Technetium-99 duplicate demonstrated an acceptable relative percent difference and normalized difference. Results for the Technetium-99 laboratory control sample demonstrated an acceptable percent recovery. Results for the Technetium-99 matrix spike demonstrated an acceptable percent recovery.

TRITIUM

A representative aliquot of the sample was equilibrated with Tritium free water. Equilibrate was transferred into a round-bottomed distillation flask and attached to a single stage still. A portion of the middle distillation fraction was transferred to a liquid scintillation vial and cocktail was added. Sample was then counted by beta liquid scintillation.

Sample demonstrated acceptable results for all Tritium analyses. The Tritium method blank demonstrated an acceptable result. Results for the Tritium duplicate demonstrated a high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. Results for the Tritium laboratory control sample demonstrated an acceptable percent recovery. Results for the Tritium matrix spike demonstrated an acceptable percent recovery.

CARBON-14

A representative aliquot of the sample was placed into a 1-liter reaction vessel. A carbonate solution was added. Sample was oxidized using Potassium Permanganate. Carbon dioxide was evolved and Carbon-14 was captured into Harvey brand, Carb-Sorb cocktail. Carbon-14 beta emissions were then determined by beta liquid scintillation using an energy selective region.

Sample demonstrated acceptable results for all Carbon-14 analyses. The Carbon-14 method blank demonstrated an acceptable result. Results for the Carbon-14 duplicate demonstrated an acceptable relative percent difference and normalized difference. Results for the Carbon-14 laboratory control sample demonstrated an acceptable percent recovery. Results for the Carbon-14 matrix spike demonstrated an acceptable percent recovery.

NICKEL-63

Sample was prepared by leaching with mixed acids followed by subsequent digestions and dilutions as appropriate. An aliquot from dilution was taken and was placed into an appropriately sized beaker. Stable elemental Nickel carrier was added to the sample prior to digestion. Sample was digested in concentrated Nitric acid. After digestion, sample pH was adjusted and Nickel-63 was precipitated selectively with Dimethylglyoxime. Precipitates were selectively separated, redissolved, and residual acid was effectively neutralized. Sample residuals were placed into scintillation vials, scintillation cocktail was added and Nickel-63 activity was determined by beta liquid scintillation.

00015

ANALYTICAL RESULTS CONTINUED

NICKEL-63 CONTINUED

Sample demonstrated acceptable results for all Nickel-63 analyses. The Nickel-63 method blank demonstrated an acceptable result. Results for the Nickel-63 duplicate demonstrated a high relative percent difference and normalized difference. Results for the Nickel-63 laboratory control sample demonstrated an acceptable percent recovery. Results for the Nickel-63 matrix spike demonstrated an acceptable percent recovery.

CERTIFICATION OF ACCURACY

I certify that this data report is in compliance with the terms and conditions of the Purchase Order, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the cognizant project manager or his/her designee to be accurate as verified by the following signature.

M.R. McDougall
Laboratory Manager

Date: 7/13/2016

Eberline Analytical wants and encourages your feedback regarding our performance providing radioanalytical services. Please visit http://www.eberlineservices.com/client.htm to provide us with feedback on our services.

SECTION IV

ANALYTICAL RESULTS SUMMARY

Joan Kessner
Washington Closure Hanford
2620 Fermi Avenue
Richland, WA 99354

SAF: RC-242
SDG: X0118
Work Order: 16-06111
Date Received: 06/23/2016
Matrix: Soil

7/13/2016

Sample Number	Lab Sample ID	QC Type	Date Analyzed	Method Name	CAS Number	Isotope	Result	2-Sigma Counting Error	Total Propagated Uncertainty	MDA	Lab Qualifier	Analysis Units
NA	16-06111-01	LCS	6/30/2016	C14_CHEM_LSC	14762-75-5	Carbon-14	1360.411	13.34	189.89	5.14		pCi/g
		LCS	7/1/2016	TRITIUM_DIST_LSC	10028-17-8	Tritium	240.923	5.78	14.68	3.74		pCi/g
		LCS	7/8/2016	NI63_LSC	13981-37-8	Nickel-63	1644.779	9.96	97.22	2.44		pCi/g
		LCS	7/1/2016	TC99_ETVDSK_LSC	14133-76-7	Technetium-99	981.405	5.60	98.06	1.41		pCi/g
NA	16-06111-02	BLK	6/30/2016	C14_CHEM_LSC	14762-75-5	Carbon-14	1.702	2.97	2.98	5.02	U	pCi/g
		BLK	7/1/2016	TRITIUM_DIST_LSC	10028-17-8	Tritium	-0.037	0.22	0.22	0.37	U	pCi/g
		BLK	7/8/2016	NI63_LSC	13981-37-8	Nickel-63	-1.084	1.37	1.37	2.38	U	pCi/g
		BLK	7/1/2016	TC99_ETVDSK_LSC	14133-76-7	Technetium-99	0.194	0.83	0.83	1.40	U	pCi/g
J1V930-A	16-06111-03	DUP	6/30/2016	C14_CHEM_LSC	14762-75-5	Carbon-14	14.232	1.56	2.52	2.21		pCi/g
		DUP	7/1/2016	TRITIUM_DIST_LSC	10028-17-8	Tritium	16.239	12.32	12.35	20.44	U	pCi/g
		DUP	7/8/2016	NI63_LSC	13981-37-8	Nickel-63	23915.413	106.16	1410.22	19.20		pCi/g
		DUP	7/1/2016	TC99_ETVDSK_LSC	14133-76-7	Technetium-99	416.223	25.72	48.84	32.51		pCi/g
J1V930-A	16-06111-04		6/30/2016	C14_CHEM_LSC	14762-75-5	Carbon-14	16.005	1.97	2.97	2.85		pCi/g
			7/1/2016	TRITIUM_DIST_LSC	10028-17-8	Tritium	-2.028	11.81	11.81	20.42	U	pCi/g
			7/8/2016	NI63_LSC	13981-37-8	Nickel-63	38357.233	134.78	2259.41	19.38		pCi/g
			7/1/2016	TC99_ETVDSK_LSC	14133-76-7	Technetium-99	375.623	25.08	45.09	32.39		pCi/g
J1V930-A	16-06111-05	MS	6/30/2016	C14_CHEM_LSC	14762-75-5	Carbon-14	753.666	7.51	105.21	2.94		pCi/g
		MS	7/1/2016	TRITIUM_DIST_LSC	10028-17-8	Tritium	1159.776	29.98	71.54	20.52		pCi/g
		MS	7/8/2016	NI63_LSC	13981-37-8	Nickel-63	135161.252	393.17	7957.15	46.91		pCi/g
		MS	7/1/2016	TC99_ETVDSK_LSC	14133-76-7	Technetium-99	47002.280	184.74	4692.12	32.51		pCi/g

SECTION V

ANALYTICAL STANDARD

Tc-2

CERTIFICATE OF CALIBRATION
BETA STANDARD SOLUTION

Radionuclide	Tc-99	Customer:	TMA EBERLINE (NEW MEXICO)	
Half Life:	(2.13 ± 0.05) x 10^5 years	P.O.No.:	LQ 9724	
Catalog No.:	7099-100U	Reference Date:	July 1 1995	12:00 PST.
Source No.:	499-15	Contained Radioactivity:	99.3	µCi.
		Contained Radioactivity:	3670	kBq

Description of Solution

a. Mass of solution: 5.06314 g in a 5 ml flame sealed ampoule

b. Chemical form: NH4TcO4 in H2O

c. Carrier content: None

d. Density: Approximately 0.9982 g/ml @ 20°C.

Radioimpurities None detected

Radioactive Daughters None

Radionuclide Concentration 19.61 µCi/g.

Method of Calibration

The source was prepared from a weighed aliquot of solution whose concentration in µCi/gram was determined by a liquid scintillation counter.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	±	2.1%
b. Random uncertainty in assay:	±	0.7%
c. Random uncertainty in weighing(s):	±	0.1%
d. Total uncertainty at the 99% confidence level:	±	2.2%

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Notes

1. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay(and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).

QA/QC REVIEWED
Date 1/24/96 Initials

ERIC ALLAS
QUALITY CONTROL

29 JUNE 1995
Date Signed

ISOTOPE PRODUCTS LABORATORIES
3017 N. SAN FERNANDO BLVD.
BURBANK, CALIFORNIA 91504
818·843·7000 FAX 818·843·6168

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
MP-009

Rev.8; 1/10/03
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
PRIMARY DILUTION RECERTIFICATION
MP 009

CURRENT DATE October 1, 2015
SOLUTION REFERENCE # IPL 499-15 **SOLUTION #** Tc-2

Principal Radionuclide	Half Life, Years	Half Life, Days
^{99}Tc	2.130E+05	7.780E+07

Radionuclide ^{99}Tc
Reference Date 7/1/1995 0:00
Certified Activity 9.930E+01 µCi
Certified Concentration µCi per gram

Ampoule /Solution Gross	9.6308	Weight, Grams
Empty Ampoule	4.3700	Weight, Grams
Solution Net	5.2608	Weight, Grams
Total Activity in Ampoule	99.3000	µCi

Chemical Composition of Standard Solution
$NH_4{}^{99}TcO_4$ in 1% NH_4OH

Dilution Instructions: **Dilution Solvent Used** 1% NH_4OH

Dilute to a volume of 1000.00 **milliliters**

Certified Total Activity of 99.3000 µCi **Which Equals** 2.204E+08 **dpm at the date listed above**

And after dilution the activity of this solution is 2.204E+05 **dpm/ml**

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: September 18, 2016

Recertified & Approved By _____ Date: 10/1/2015 0:00

QC Approval _____ Date: 10/1/15

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
MP-009

Rev.8; 1/10/03
Title: **Radioactive Reference Standards Solutions & Records**

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE STANDARD SOLUTIONS
SECONDARY DILUTION RECERTIFICATION

QCP-009-1-A

Solution Reference # IPL 499-15 | **Date** 10/1/2015 0:00 | **Solution #** Tc-2a

Principal Radionuclide	Half Life, Years	Half Life, Days
^{99}Tc	2.130E+05	7.780E+07

Radionuclide of interest ^{99}Tc
Parent Solution Conc. 2.20E+05 dpm/ml

Reference Date 7/1/1995 0:00

Chemical Composition of Standard Solution
$NH_4{}^{99}TcO_4$ in 1% NH_4OH

Dilution Instructions:

Dilution Solvent Used 1% NH_4OH

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 100.0000 ml
Total Activity: 2.2040E+07 dpm
Final Volume: 1000.00 ml

Final Activity Concentration: 2.2040E+04 dpm/ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: September 18, 2016

Recertified & Approved By _____ Date: 10/1/2015 0:00

QC Approval _____ Date: 10/1/15

(H-5)

CERTIFICATE OF CALIBRATION
BETA STANDARD SOLUTION

QA/QC REVIEWED
Date 4/16/99 Initials

Radionuclide	H-3	Customer:	THERMO NUTECH
Half Life:	12.35 ± 0.1 years	P.O.No.:	5108
Catalog No.:	7003	Reference Date:	15 Apr 99 12:00 PST.
Source No.:	660-25	Contained Radioactivity:	99.61 μCi (3686 kBq)

Description of Solution

a. Mass of solution: 4.91974 grams in 5 mL flame sealed ampoule

b. Chemical form: Tritiated water

c. Carrier content: Not applicable

d. Density: 0.9982 gram/ml @ 20°C.

Radioimpurities

None detected

Radioactive Daughters

None

Radionuclide Concentration

20.25 μCi/gram

Method of Calibration

This source was prepared from a weighed aliquot of solution whose concentration in μCi/gram was determined by a liquid scintillation counter.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	±3.0%
b. Random uncertainty in assay:	±1.9%
c. Random uncertainty in weighing(s):	±0.0%
d. Total uncertainty at the 99% confidence level:	±3.6%

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Leak Test(s)

See reverse side for Leak Test(s) applied to this source.

Notes

1. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay(and later NIST certification) of Standard Reference Materials. (As in NRC Regulatory Guide 4.15)

QUALITY CONTROL

2 Apr 99
Date Signed

ISOTOPE PRODUCTS LABORATORIES
1800 N. KEYSTONE STREET
BURBANK, CALIFORNIA 91504
818·843·7000 FAX 818·843·6168

Eberline Services

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
QCP-009

Rev.5, 11/01/03
Title: Radioactive Reference Standards Solutions & Records

Eberline Services - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
PRIMARY DILUTION (RECERTIFICATION)
QCP 009-1

CURRENT DATE 09/30/15
SOLUTION REFERENCE # IPL 660-25 **SOLUTION #** H-5

Principal Radionuclide	Half Life, Years	Half Life, Days
^{3}H	1.235E+01	4.511E+03

Radionuclide ^{3}H
Reference Date 4/15/1999 0:00
Certified Activity 9.961E+01 µCi
Certified Concentration µCi per gram

Ampoule /Solution Gross Weight, Grams
Empty Ampoule Weight, Grams
Solution Net Weight, Grams
Total Activity in Ampoule 99.6100 µCi

Chemical Composition of Standard Solution
$^{3}H_2O$ in water

Dilution Instructions:

Dilution Solvent Used Water

Dilute to a volume of 1000.00 **milliliters**

Certified Total Activity of 99.6100 µCi **Which Equals** 2.211E+08 **dpm**

And after dilution the activity of this solution is 2.211E+05 **dpm/ml**

Tthis standard was recertified by measurement of the activity of its daughter solution, H-5a.

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data **processing software.**

Expiration Date: 09/14/16

Verified & Approved By _____ Date: 09/30/15

QC Approval _____ Date: 10/1/15

Eberline Services

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
QCP-009

Title: Radioactive Reference Standards Solutions & Records

Eberline Services - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE STANDARD SOLUTIONS
SECONDARY DILUTION (RECERTIFICATION)

Solution Reference # QCP-009-1-A IPL 660-25 **Date** 9/30/15 **Solution #** H-5a

Principal Radionuclide	Half Life, Years	Half Life, Days
^{3}H	1.235E+01	4.511E+03

Radionuclide of Interest ^{3}H
Parent Solution Conc. 2.21E+05 dpm/ml

Reference Date 4/15/1999 0:00

Chemical Composition of Standard Solution
$^{3}H_2O$ in water

Dilution Instructions:

Dilution Solvent Used Water

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 65.0000 ml
Total Activity: 1.4372E+07 dpm
Final Volume: 1000.00 ml

Final Activity Concentration: 1.4372E+04 dpm/ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: 09/14/16

Recertified By: _____ Date: 09/30/15

QC Approval: _____ Date: 10/1/15

C-3

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
BETA STANDARD SOLUTION

Radionuclide:	C-14	**Customer:**	EBERLINE SERVICES
Half-life:	5730 ± 40 years	**P.O. No.:**	00009439
Catalog No.:	7014	**Reference Date:**	1-Nov-01 12:00 PST
Source No.:	841-40	**Contained Radioactivity:**	72.54 µCi 2684 kBq

Physical Description:

A. Mass of solution: 5.10940 g in 5 mL flame-sealed ampoule
B. Chemical form: Sodium Benzoate in 0.1M NaOH
C. Carrier content: None
D. Density: 1.002 g/mL @ 20°C.

Radioimpurities:

None detected

Radionuclide Concentration: 14.20 µCi/g, 525.4 kBq/g

Method of Calibration:

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

Uncertainty of Measurement:

A. Type A (random) uncertainty: ± 2.0 %
B. Type B (systematic) uncertainty: ± 2.0 %
C. Uncertainty in aliquot weighing: ± 0.0 %
D. Total uncertainty at the 99% confidence level: ± 2.8 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from NCRP Report No. 58, 1985.
- This solution has a working life of 5 years.

Quality Control — Date Signed: 12-Nov-01

IPL Ref. No.: 841-40

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

MP-009

Rev.8; 1/10/03
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
PRIMARY DILUTION REVERIFICATION
MP 009

CURRENT DATE: 10/1/2015 0:00

SOLUTION REFERENCE #: IPL 841-40 SOLUTION #: C-3

Principal Radionuclide	Half Life, Years	Half Life, Days
^{14}Carbon	5.730E+03	2.093E+06

Radionuclide: ^{14}Carbon
Reference Date: 11/1/2001 0:00
Certified Activity: 7.254E+01 µCi
Certified Concentration: µCi per gram

Ampoule /Solution Gross: Weight, Grams
Empty Ampoule: Weight, Grams
Solution Net: Weight, Grams
Total Activity in Ampoule: 72.5400 µCi

Chemical Composition of Standard Solution
Sodium Benzoate in 0.1M NaOH

Dilution Instructions:

Dilution Solvent Used: 0.1M NaOH

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 72.5400 µCi Which Equals 1.610E+08 dpm at the date listed above

And after dilution the activity of this solution is 1.610E+05 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: August 13, 2016

Verified & Approved By _____ Date: 10/1/2015 0:00

QC Approval _____ Date: 10/1/15

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
QCP-009

Rev.8; 1/10/03
Title: **Radioactive Reference Standards Solutions & Records**

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE STANDARD SOLUTIONS
SECONDARY DILUTION REVERIFICATION

MP-009-1-A

Solution Reference # IRL 841-40 **Date** 10/1/2015 0:00
Solution # C-3a

Principal Radionuclide	Half Life, Years	Half Life, Days
^{14}Carbon	5.730E+03	2.093E+06

Radionuclide of Interest ^{14}Carbon
Parent Solution Conc. 1.61E+05 dpm/ml

Reference Date 11/1/2001 0:00

Chemical Composition of Standard Solution
Sodium Benzoate in 0.1M NaOH

Dilution Instructions:

Dilution Solvent Used 0.1 M NaOH

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 20.0000 ml
Total Activity: 3.2208E+06 dpm
Final Volume: 1000.00 ml

Final Activity Concentration: 3.2208E+03 dpm/ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: August 13, 2016

Verified & Approved By _____ Date: 10/1/2015 0:00

QC Approval _____ Date: 10/1/15

Eckert & Ziegler
Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404•352•8677
Fax 404•352•2837
www.analyticsinc.com

CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

92791

Ni-63 5 mL Liquid in Flame Sealed Vial

Customer: Eberline Analytical Corporation
P.O. No.: 7873, Item 1 Product Code: 8063

This standard radionuclide source was prepared gravimetrically from a master solution, calibrated by Eckert & Ziegler Analytics. The master solution was calibrated by liquid scintillation counting. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Isotope	Half-Life, Days	Activity (Bq)	Uncertainty*, % Type u_A	u_B	U	Reference Date (12:00 PM EST)
Ni-63	3.656E+04	3.733E+05	0.2	1.5	3.0	02/06/2013

***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:
Impurities: γ-impurities<0.1%,
5.01669 g 0.1M HCl solution with approximately 30 μg/g Ni carrier.

Source Prepared by: R. Ormsby
R. Ormsby, Radiochemist

QA Approved:
J.D. McCorvey, Counting Room Manager

Date: 29 JAN 13

ANA Form005 Rev --

ACCREDITED SOURCE CALIBRATION LABORATORY HEALTH PHYSICS SOCIETY FOUNDED 1956

Single Isotope Certificate Rev 3, 23 August 2012

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

MP-009

Rev.4; 10/10/12
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
RECERTIFICATION

CURRENT DATE: 1/25/16

SOLUTION REFERENCE #: Analytics 92791

SOLUTION #: Ni-3

Principal Radionuclide	Half Life, Years	Half Life, Days
^{63}Ni	1.001E+02	3.656E+04

Radionuclide: ^{63}Ni

Reference Date: 2/6/2013 0:00

Certified Activity: 1.009E+01 µCi

Certified Concentration: µCi per gram

Ampoule /Solution Gross	9.2445	Weight, Grams
Empty Ampoule	4.2269	Weight, Grams
Solution Net	5.0176	Weight, Grams
Total Activity in Ampoule	10.0892	µCi

Mass checks certificate

Chemical Composition of Standard Solution

$NiCl_2$ in 0.1 N HCl

Dilution Instructions:

Dilution Solvent Used: 0.1 N HCl

Dilute to a volume of 1000.00 milliliters or grams

Certified Total Activity of 10.0892 µCi Which Equals 2.240E+07 dpm at the date listed above

And after dilution the activity of this solution is 2.240E+04 dpm/g

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: January 25, 2017

Verified & Approved By _____ Date: 3/5 ~~01/25~~/16

QC Approval _____ Date: 3/11/16

SECTION VI

QUALITY CONTROL SAMPLE RESULTS SUMMARY

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
16-06111	Tc099	2	pCi	g	Washington Closure Hanford

Laboratory Control Sample

Analyte		LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
TC-99		98.44%	9.99%	100.00%	2.20%	9.97E+02	2.19E+01	9.81E+02	9.81E+01	Tc-2a	2.20E+04	2.20E+00	1.00E-01

Matrix Spike

Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)
TC-99	0.40	102.13%	4.57E+04	1.00E+03	4.70E+04	4.69E+03	3.76E+02	4.51E+01	4.38E-02	Tc-2a	2.20E+04	2.20	2.01E-01

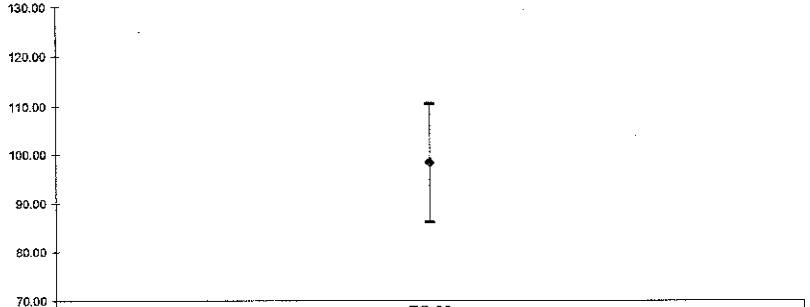
Replicate Sample / QC Summary

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R		MS % R	MS ND	Rep RPD	Rep ND
TC-99	1.20	10.25	3.76E+02	4.51E+01	4.16E+02	4.88E+01	0.98	OK			OK	OK	OK

Version

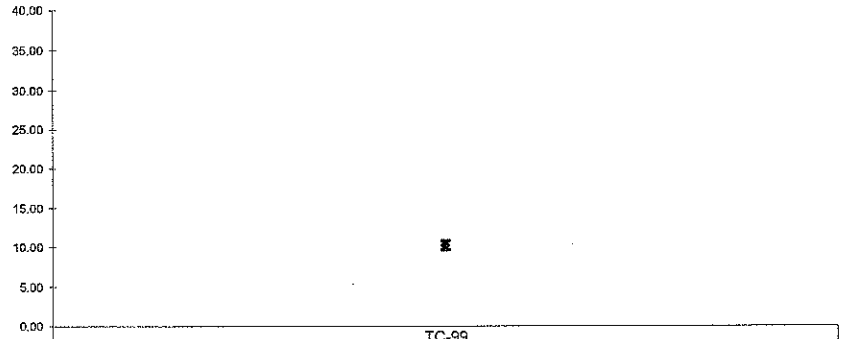
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
16-06111	Tc099	2	pCi	g	Washington Closure Hanford

LCS % Recovery



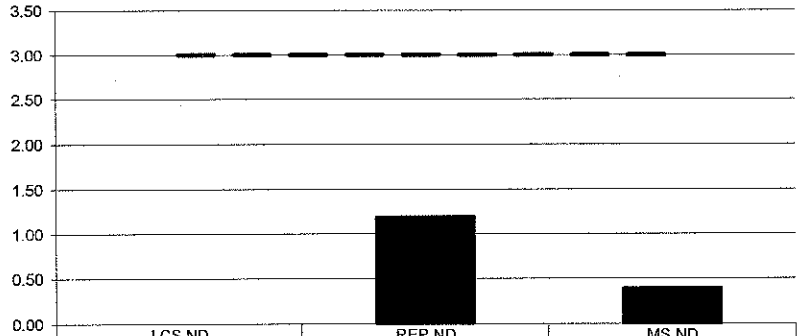
	TC-99
Lower Error	86.25
Upper Error	110.63
%R	98.44
LCL	75
Mean	100
UCL	125

Replicate Sample RPD



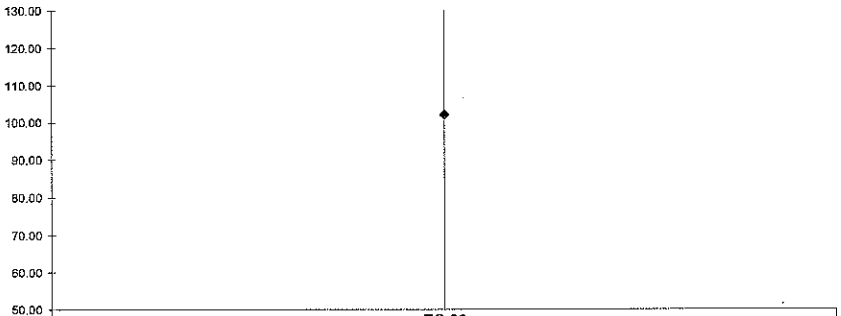
	TC-99
Lower Error	10.86
Upper Error	9.65
RPD	10.25
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
TC-99	0.00	1.20	0.40
UCL	3	3	3

Matrix Spike % Recovery



	TC-99
Lower Error	-5594.42
Upper Error	5798.67
%R	102.13
LCL	65
Mean	100
UCL	135

Eberline Analytical
Analysis Control Chart

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
16-06111	H0003	1	pCi	g	Washington Closure Hanford

Laboratory Control Sample

Analyte		LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
H-3		97.63%	6.09%	100.00%	3.60%	2.47E+02	8.88E+00	2.41E+02	1.47E+01	H-5a	5.44E+03	3.60E+00	1.01E-01

Matrix Spike

Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)
H-3	5.52	83.83%	1.39E+03	4.99E+01	1.16E+03	7.15E+01	-2.03E+00	1.18E+01	1.83E-01	H-5a	5.44E+03	3.60	1.04E-01

Replicate Sample

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU
H-3	2.09	257.08	-2.03E+00	1.18E+01	1.62E+01	1.23E+01

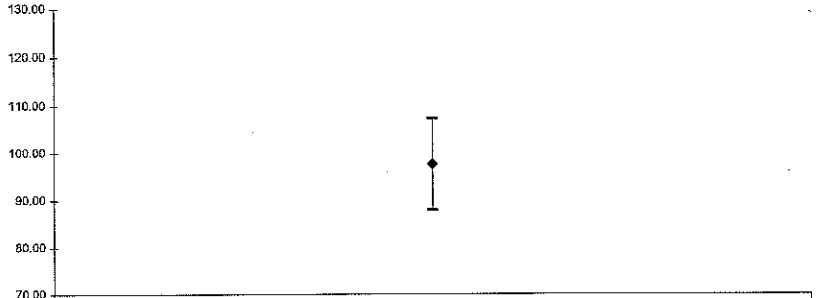
QC Summary

LCS Relative Bias	LCS % R		MS % R	MS ND	Rep RPD	Rep ND
0.98	OK			INV	INV	OK

Version

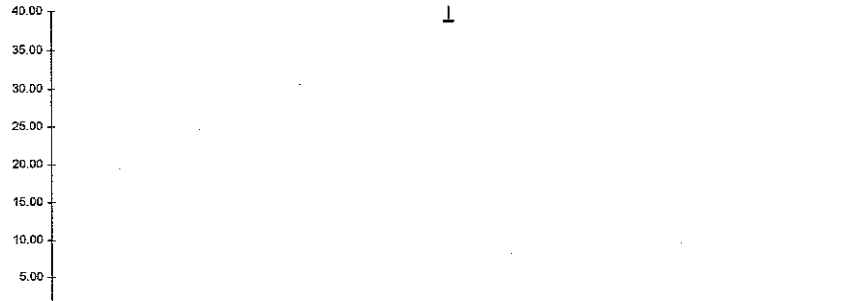
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
16-06111	H0003	1	pCi	g	Washington Closure Hanford

LCS % Recovery



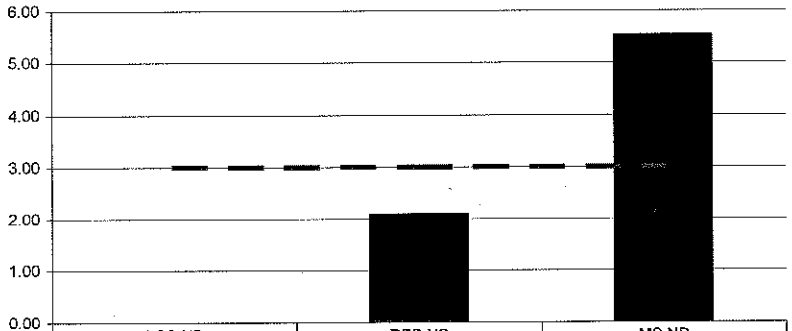
	H-3
Lower Error	87.94
Upper Error	107.32
%R	97.63
LCL	75
Mean	100
UCL	125

Replicate Sample RPD



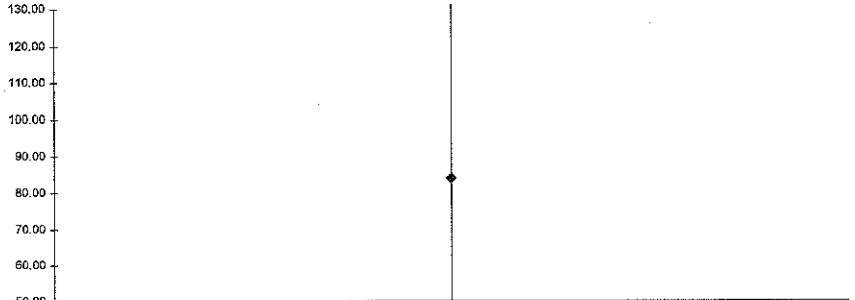
	H-3
Lower Error	475.63
Upper Error	38.52
RPD	257.08
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
H-3	0.00	2.09	5.52
UCL	3	3	3

Matrix Spike % Recovery



	H-3
Lower Error	-37.60
Upper Error	205.26
%R	83.83
LCL	65
Mean	100
UCL	135

Version

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
16-06111	C0014	1	pCi	g	Washington Closure Hanford

Laboratory Control Sample

Analyte		LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
C-14		97.03%	13.96%	100.00%	2.80%	1.40E+03	3.93E+01	1.36E+03	1.90E+02	C-3a	2.99E+03	2.80E+00	1.04E+00

Matrix Spike

Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)
C-14	0.93	93.58%	7.88E+02	2.21E+01	7.54E+02	1.05E+02	1.60E+01	2.97E+00	1.76E+00	C-3a	2.99E+03	2.80	1.03E+00

Replicate Sample

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU
C-14	0.89	11.73	1.60E+01	2.97E+00	1.42E+01	2.52E+00

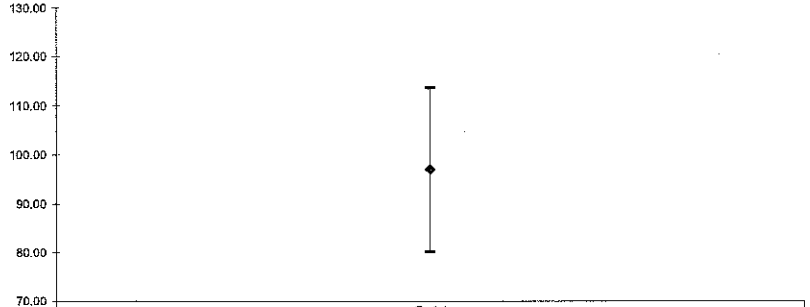
QC Summary

LCS Relative Bias	LCS % R		MS % R	MS ND	Rep RPD	Rep ND
0.97	OK			OK	OK	OK

Version

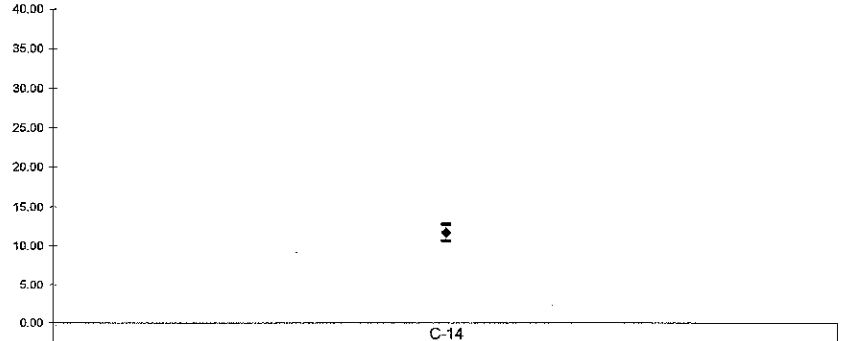
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
16-06111	C0014	1	pCi	g	Washington Closure Hanford

LCS % Recovery



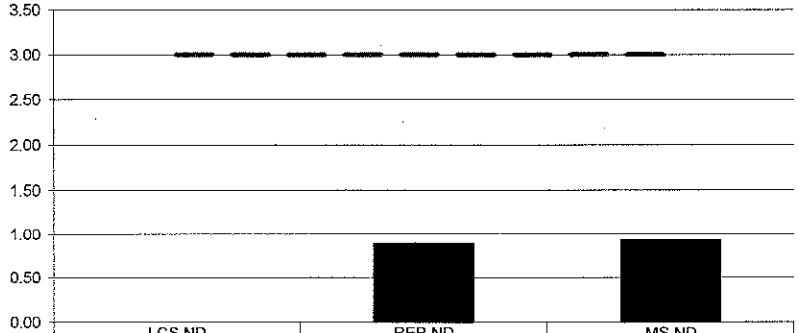
	C-14
Lower Error	80.27
Upper Error	113.79
%R	97.03
LCL	75
Mean	100
UCL	125

Replicate Sample RPD



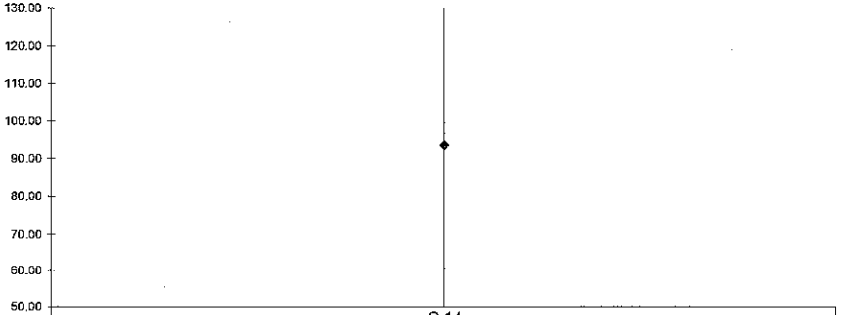
	C-14
Lower Error	12.79
Upper Error	10.66
RPD	11.73
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
C-14	0.00	0.89	0.93
UCL	3	3	3

Matrix Spike % Recovery



	C-14
Lower Error	-33.70
Upper Error	220.86
%R	93.58
LCL	65
Mean	100
UCL	135

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
16-06111	Ni063	1	pCi	g	Washington Closure Hanford

Laboratory Control Sample

Analyte		LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
NI-63		107.29%	5.91%	100.00%	3.00%	1.53E+03	4.60E+01	1.64E+03	9.72E+01	Ni-3	2.19E+04	3.00E+00	1.56E-01

Matrix Spike

Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)
NI-63	0.24	101.08%	9.58E+04	2.87E+03	1.35E+05	7.96E+03	3.84E+04	2.26E+03	1.31E-01	Ni-3	2.19E+04	3.00	1.28E+00

Duplicate Results

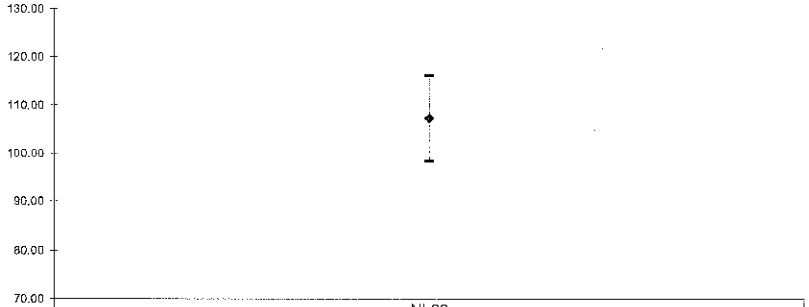
Analyte	Normalized Difference	RPD	Original Result	Original CSU	Duplicate Result	Duplicate CSU
NI-63	10.63	46.38	3.84E+04	2.26E+03	2.39E+04	1.41E+03

QC Summary

LCS Relative Bias	LCS % R		MS % R	MS ND	Rep RPD	Rep ND
1.07	OK			OK	INV	INV

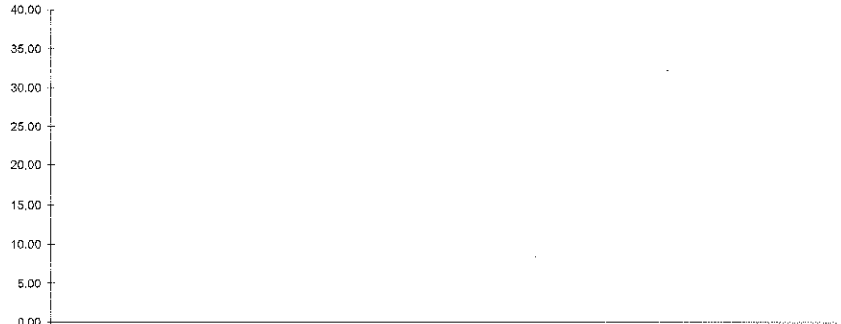
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
16-06111	Ni063	1	pCi	g	Washington Closure Hanford

LCS % Recovery



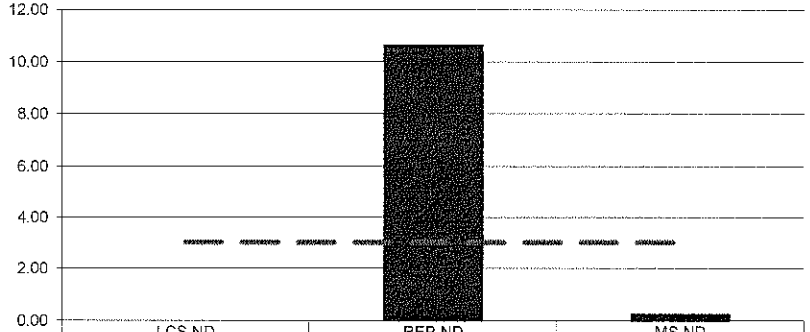
	NI-63
Lower Error	98.38
Upper Error	116.20
%R	107.29
LCL	75
Mean	100
UCL	125

Replicate Sample RPD



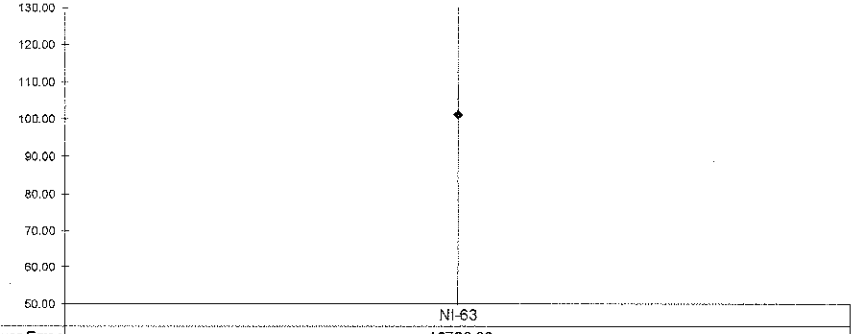
	NI-63
Lower Error	47.75
Upper Error	45.02
RPD	46.38
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
NI-63	0.00	10.63	0.24
UCL	3	3	3

Matrix Spike % Recovery



	NI-63
Lower Error	-10729.26
Upper Error	10931.41
%R	101.08
LCL	65
Mean	100
UCL	135

SECTION VII

LABORATORY TECHNICIAN'S NOTES

TC-99 NOTES

EBERLINE SERVICES **Work Order Analysis Notes**	**Oak Ridge Laboratory** **601 Scarboro Rd.** **Oak Ridge, TN 37830** **Voice: 865.481.0683** **www.eberlineservices.com**	Internal Work Order	16-06111
		Analysis Code	Tc099
		Run Number	2

#	Date	Dept	User	Notes
1	07/01/16 02:32	PREP	MHIGHTOWER	Prepared spike and blank and aliquoted samples. HNO3 and H2O2 were added and samples were heated for two hours. Set-up columns and conditioned with .1M HNO3. After samples passed through columns, they were rinsed with 1M HNO3 and .1M HNO3. Added TC resin from columns, LS cocktail, and .1M HNO3 to labeled LS vials, and submitted to countroom

MH 1 JUL16

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
16-06111	
Analysis Code	Run
Tc099	2

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
016080P	Hydrogen Peroxide	0.3	MHIGHTOWER	7/1/2016
017533D05	Nitric Acid	0.1N	MHIGHTOWER	7/1/2016
017533D02	Nitric Acid	1N	MHIGHTOWER	7/1/2016
017533P	Nitric Acid	Reagent Grade	MHIGHTOWER	7/1/2016
016329P	Ultima Gold XR	Reagent Grade	MHIGHTOWER	7/1/2016

Tricarb 3100 (A)

DATE	SAMPLE #	Protocol	Client	Lost Time	CT Time	Analysis	Tech
6/15/16	1605139A (3)	21	UCOR	1646	15 min	Ni63	ICB
6/15/16	1606025A (3)	22	UCOR	1655	15 min	Ni63	ICB
6/16	1605139A(3)	21	UCOR	0842	15	Ni63	C
6/16/16	1606025 A(4)	22	UCOR	1217	15	Ni63	ICB
6/16/16	1606025A (1-4,7)	26	UCOR	1418	5hr	Pu241	ICB
6/20/16	1606069A(1-3,5,B,R)	6	UCOR	1232	3hrs	C14	ICB
6/20/16	1606069A(1-3,5,B,R)	7	UCOR	1246	3hrs	C14	ICB
6/21/16	1606091A(1-3,5,B,R)	7	UCOR	0838	3hrs	C14	ICB
6/21/16	1606025A(1-4,6,B)	16	UCOR	0949	6hr	Tc99	ICB
6/21/16	1605139A(1-3,5,B)	1	UCOR	1224	10hrs	H3	ICB
6/23/16	1606091A(1-4,B)	21	UCOR	1055	1hr15	Ni63	ICB
6/23/16	1606035A(1-4,B)	22	UCOR	1100	1hr15	Ni63	ICB
6/23/16	1606091A (3)	21	UCOR	1231	15min	Ni63	ICB
6/23/16	1606091A (1-4)ms	21	UCOR	1437	1hr	Ni63	ICB
6/23/16	1606035A (1-4)ms	22	UCOR	1447	1hr	Ni63	ICB
6/23/16	1606011A(1-4,B)	1	Unitech	1535	5hrs	H3	ICB
6/23/16	1606091A(1-3,5,B)	2	UCOR	1537	10hrs	H3	ICB
6/24/16	1606092A(1-3,5,B,R)	6	UCOR	1058	3hrs	C14	ICB
6/24/16	1606108A(1-3,5,B,R)	7	UCOR	1100	3hrs	C14	ICB
6/24/16	1606035A(1-3,5,B)	1	UCOR	1440	10hrs	H3	ICB
6/27/16	1606048A (1-4,B)	1	Unitech	1531	5hrs	H3	ICB
6/27/16	1606069A(1-3,5,B)	2	UCOR	1533	10hrs	H3	ICB
6/28	1606065A(1-4,B)	21	UCOR	1301	1hr	Ni63	C
6/28/16	1606069A(1-4ms)	21	UCOR	1510	1hr	Ni63	ICB
6/28/16	1606069A(1-3,5,B)	2	UCOR	1527	10hrs	H3	ICB
6/28/16	1606069A(1-4,9)	25	UCOR	1600	5hr	Pu241	ICB
6/28	1606092A(1-4,6,B)	16	UCOR	0745	6hr	Tc99	C
6/29/16	1606129A(1-5)	26	MCL	1339	5hrs	Pu241	ICB
6/29/16	1606120A(1-4,B)	2	TWPC	1519	5hrs	H3	ICB
6/29/16	1606136A(1-4,B)	20	R1 Analytical	1524	5hrs	TotAct	ICB
6/30/16	1606120A(1-4,B,R)	6	TWPC	1002	6hrs	C14	ICB
6/30/16	1606092A(1-3,5,B)	1	UCOR	1452	10hrs	H3	ICB
7/1	1606111B(1-4B)	16	Washington	0627	6hr	Tc99	C

H-3 NOTES

EBERLINE SERVICES

Work Order Analysis Notes

Oak Ridge Laboratory
601 Scarboro Rd.
Oak Ridge, TN 37830
Voice: 865.481.0683
www.eberlineservices.com

Internal Work Order	16-06111
Analysis Code	H0003
Run Number	1

#	Date	Dept	User	Notes
1	07/01/16 10:52	PREP	JPACHELLA	SAMPLES WERE ALIQUOTED AND EQUILIBRATED WITH DI H2O. SAMPLES WERE ALLOWED TO SIT OVER NIGHT. SAMPLES WERE SHAKEN FOR 15 MINUTES AND CENTRIFUGED. EQUILIBRATE WAS DECANTED AND DISTILLED. DISTILLATE WAS ALIQUOTED AND MIXED WITH ULTIMA GOLD XR. SAMPLES WERE SUBMITTED TO COUNT ROOM.

7-1-14 JPachella

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
16-06111	
Analysis Code	Run
H0003	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
016805P	Ultima Gold XR	Reagent Grade	JPACHELLA	7/1/2016

Tricarb 3100 (A)

DATE	SAmple #	Protocol	Client	Load Time	CT. Time	Analysis	Tech
7/11	1606111A (1-5, B)	1	Washington	1320	6h	HJ	Σ
7/11	1606074A (1-4, 6, 8, 9, 11, 13, 15, 17, 19)	2	Rep Service	1320	13h	HJ	

C-14 NOTES

EBERLINE SERVICES **Work Order Analysis Notes**	**Oak Ridge Laboratory** **601 Scarboro Rd.** **Oak Ridge, TN 37830** **Voice: 865.481.0683** **www.eberlineservices.com**	Internal Work Order	16-06111
		Analysis Code	C0014
		Run Number	1

#	Date	Dept	User	Notes
1	06/30/16 07:42	PREP	KSALLINGS KS	1st Step Samples were aliquoted and placed into 600ml beakers. Carbonate was added and samples were then oxidized using potassium permanganate. Samples were left unattended for carbonate conversions. 2nd Step Samples were placed into 1liter reaction vessels. Carbon dioxide was evolved and Carbon-14 was captured in Harvey. Samples were taken to the for counting by beta LSC.

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
16-06111	
Analysis Code	Run
C0014	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
016885P	Harvey carbon14 cocktail	Reagent Grade	KSALLINGS	6/28/2016
017349D03	Nitric Acid	6N	KSALLINGS	6/28/2016
017404S	Potassium Permanganate	0.5M	KSALLINGS	6/28/2016
016679D03	Sulfuric acid	9M	KSALLINGS	6/28/2016
016940D02	Sodium Carbonate	0.25M	KSALLINGS	6/28/2016

Tricarb 3100 (B)

DATE	Sample #	Protocol	Client	Load Time	CT. Time	Analysis	Tech
6/21/16	1606023A (1-4,6,B)	13	UCOR	0755	6 hr	Tc-99	AG
6/22/16	1606091A (1-4,6,B)	13	UCOR	0735	6 hr	Tc-99	AG
6/22/16	1606035A (1-4,7)	24	UCOR	1428	5 hrs	Pu^{241}	KB
6/23/16	1606035A (1-4,6,B)	13	UCOR	0730	6 HR	Tc-99	AG
6/23/16	1606068A (1-4,B)	11	UCOR	1103	1hr 15-	Ni^{63}	KB
6/23/16	1606091A (1-4,7)	25	UCOR	1415	5 hrs	Pu^{241}	KB
6/23/16	1606068A (1-4) ms	11	UCOR	1530	1 hr	Ni^{63}	KB
6/23/16	1606023A (1-3,5,B)	1	UCOR	1553	10 hrs	H^3	KB
6/24/16	1606025A (1-3,5,B)	1	UCOR	1407	10 hrs	H^3	KB
6/27	1606068A (1-4,6,B)	13	UCOR	0550	6 hr	Tc99	C
6/27	1606069A (1-4,8,D)	16	UCOR	0550	6 hr	Tc99	C
6/27/16	1606068A (1-4,7)	24	UCOR	1455	5 hrs	Pu^{241}	KB
6/~~27~~ 6/28/16	1606037A (1-4,B)	1	Unitech	1536	5 hrs	H^3	KB
6/29	1606029A (1-3,6-11,14-18,B)	16	TN Dept	~~0733~~ 1239	16 hr	Tc99	C
6/29/16	1606111A (1-5,B)	13	Wash. Closure	1230	6 hrs	Tc^{99}	KB
6/30/16	1606111A (1-5,B,R)	6	Wash. Closure	1351	7 hrs	C^{14}	KB

NI-63 NOTES

EBERLINE SERVICES Work Order Analysis Notes	Oak Ridge Laboratory 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	16-06111
		Analysis Code	Ni063
		Run Number	1

#	Date	Dept	User	Notes
1	07/08/16 10:40	CHEM	EBAILEY	SAMPLES WERE ALIQUOTED. SPIKES AND CARRIER WERE ADDED. SAMPLES WERE DRIED. DI H2O WAS ADDED. SAMPLES WERE PLACED ON STIRRING HOTPLATES. HCL WAS ADDED WHILE STIRRING. CITRIC ACID WAS ADDED WHILE STIRRING. NH4OH WAS ADDED TILL PH OF 8 WAS ACHIEVED. THREE ML OF DMG WERE ADDED. SAMPLES WERE FILTERED. PRECIPITATE WAS DISSOLVED WITH 8M HNO3. SAMPLES WERE DRIED 3 TIMES TO REMOVE HNO3. SAMPLES WERE TRANSFERRED TO VIALS WITH DI H2O. SCINTILLATIION COCKTAIL WAS ADDED. SAMPLES WERE SUBMITTED TO COUNT ROOM.

7/8/16

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
16-06111	
Analysis Code	Run
Ni063	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
016687D01	Citric Acid	1M	EBAILEY	7/8/2016
016699D01	Dimethylglyoxime	1%	EBAILEY	7/8/2016
017371P	Hydrochloric Acid	Reagent Grade	EBAILEY	7/8/2016
016585D01	Nickel Chloride	10 mg/ml	EBAILEY	7/8/2016

Tricarb 3200 (A)

DATE	Sample #	Protocol	Client	Load Time	CT. Time	Analysis	Tech
7/1/14	1606111A (1-5, B)	1	Washington	1320	6hr	H3	[illegible]
7/1/14	1606074A (1-4, 6, 8, 9, 11, 13, 15, 17, 19)	2	Rep Service	1320	12hr	H3	[illegible]
7/7/14	1606075A (1-4, 6, 8, 10, 12, 14, 16, 18, 19, B)	1	Republic Seen		12 hrs	H3	KB
7/8/14	1607019A (1-35, BR)	6	ucon	0940	3hr	C14	C
7/8/14	1607020A (1-3, 10, B, R)	7	ucon	0940	3hr	C14	C
7/8/14	1606111A (1-5, B, R)	21	WASH-Closure	1205	7 hr	Ni63	KB

SECTION VIII

ANALYTICAL DATA (TECHNETIUM-99)

16-06111
Tc099
Run 2

Work Order	16-06111
Analysis Code	Tc099
Run	2
Date Received	6/23/2016
Lab Deadline	7/8/2016
Client	Washington Closure Hanford
Project	S00W235A01
Report Level	4
Activity Units	pCi
Aliquot Units	g
Matrix	SO
Method	ElChroM TCS01 Modified
Instrument Type	Beta LSC
Radiometric Tracer	Tc-99MS
Radiometric Sol#	Tc-2a
Tracer Act (dpm/g)	22043.49
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		06/23/16 00:00	1.0000E+00
02	MBL	BLANK		06/23/16 00:00	1.0000E+00
03	DUP	J1V930-A SAF: RC-242		06/15/16 13:40	4.3780E-02
04	DMSO	J1V930-A SAF: RC-242	10689	06/15/16 13:40	4.3780E-02
05	MS	J1V930-A SAF: RC-242		06/15/16 13:40	4.3780E-02

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

16-06111
Tc099
Run 2

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	1.0000	22043.5		0.00								
02	MBL	1.0000	22043.5		0.00								
03	DUP	1.0000	22043.5		0.00								
04	DMSO	1.0000	22043.5		0.00								
05	MS	1.0000	22043.5		0.00								

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

16-06111
Tc099
Run 2

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			07/01/16 02:37	MHIGHTOWER				
02	MBL			07/01/16 02:37	MHIGHTOWER				
03	DUP			07/01/16 02:37	MHIGHTOWER				
04	DMSO			07/01/16 02:37	MHIGHTOWER				
05	MS			07/01/16 02:37	MHIGHTOWER				

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Preliminary Data Report & Analytical Calculations
Work Order: 16-06111-Tc099-2

Client: Washington Closure Hanford
Eberline Analytical Work Order: 16-06111
Analysis Code: Tc099
Run: 2

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	TC-99	LCS	LCS	pCi/g	9.81E+02	5.60E+00	1.41E+00	9.97E+02	98.44	OK		OK	
02	TC-99	MBL	BLANK	pCi/g	1.94E-01	8.26E-01	1.40E+00					OK	OK
03	TC-99	DUP	J1V930-A SAF: RC-242	pCi/g	4.16E+02	2.57E+01	3.25E+01				OK	INV	
04	TC-99	DMSO	J1V930-A SAF: RC-242	pCi/g	3.76E+02	2.51E+01	3.24E+01					INV	
05	TC-99	MS	J1V930-A SAF: RC-242	pCi/g	4.70E+04	1.85E+02	3.25E+01					INV	

Preliminary Data Report & Analytical Calculations

Work Order: 16-06111-Tc099-2

Client	Eberline Analytical Work Order	Analysis Code	Run
Washington Closure Hanford	16-06111	Tc099	2

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	TC-99	LCS	06/23/16 00:00	1.00E+00	0.00	0.00	0.00			
02	TC-99	MBL	06/23/16 00:00	1.00E+00	0.00	0.00	0.00			
03	TC-99	DUP	06/15/16 13:40	4.38E-02	0.00	0.00	0.00			
04	TC-99	DMSO	06/15/16 13:40	4.38E-02	0.00	0.00	0.00			
05	TC-99	MS	06/15/16 13:40	4.38E-02	0.00	0.00	0.00			

Preliminary Data Report & Analytical Calculations

Work Order: 16-06111-Tc099-2

Client	Eberline Analytical Work Order	Analysis Code	Run
Washington Closure Hanford	16-06111	Tc099	2

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	TC-99	LCS	07/01/16 06:27	77798250	3100A	1	60	121950	22.5	0.922560849
02	TC-99	MBL	07/01/16 07:30	77798250	3100A	2	60	1374	22.5	0.92990349
03	TC-99	DUP	07/01/16 08:33	77798250	3100A	3	60	3576	22.5	0.917105728
04	TC-99	DMSO	07/01/16 09:36	77798250	3100A	4	60	3366	22.5	0.920362174
05	TC-99	MS	07/01/16 10:39	77798250	3100A	5	60	252696	22.5	0.917008014

Count Room Report
Client: Washington Closure Hanfor

16-06111-Tc099-2 (pCi/g) in SO
Tracer ID: Tc-2a

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	06/23/16 00:00	1.0000	1.0000	22043.4900		0.00		
02	MBL	BLANK	06/23/16 00:00	1.0000	1.0000	22043.4900		0.00		
03	DUP	J1V930-A SAF: RC-242	06/15/16 13:40	0.0438	1.0000	22043.4900		0.00		
04	DMSO	J1V930-A SAF: RC-242	06/15/16 13:40	0.0438	1.0000	22043.4900		0.00		
05	MS	J1V930-A SAF: RC-242	06/15/16 13:40	0.0438	1.0000	22043.4900		0.00		

Eberline Services
Oak Ridge Laboratory

Spike and Tracer Worksheet

Printed: 7/1/2016 2:37 AM

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
16-06111	2	Tc099	7/1/2016 2:33	MHIGHTOWER	MH	

LCS & Matrix Spikes					LCS	MS	LCSD	MSD	LCS		MS		LCSD		MSD	
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	Volume Used (g)	Volume Used (g)	Volume Used (g)	Volume Used (g)	Known pCi	Error Estimate	Added pCi	Error Estimate	Known pCi	Error Estimate	Added pCi	Error Estimate
Tc-99	Tc-2a	22043.490	7/1/2016	0.100	0.1004	0.2013			996.92	21.932	1998.81	43.974	0.00	0.000	0.00	0.000
Tc-99 MS	Tc-2a	22043.49	7/1/2016	0.1												

Tracers

fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition
01	Tc-99MS	Tc-2a	22043.490	7/1/2016	1.0000	0.1000
02	Tc-99MS	Tc-2a	22043.490	7/1/2016	1.0000	0.1000
03	Tc-99MS	Tc-2a	22043.490	7/1/2016	1.0000	0.1000
04	Tc-99MS	Tc-2a	22043.490	7/1/2016	1.0000	0.1000
05	Tc-99MS	Tc-2a	22043.490	7/1/2016	1.0000	0.1000

Balance Printer Tapes

Tracer	LCS

Matrix Spike

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
16-06111	2	Tc099	grams	7/8/2016	MMCDOUGALL

Lab Fraction	Washington Closure Hanford Client ID	Sample Type	Muffle Data Ratio Post/Pre	Dilution Data No of Dils	Dil Factor	Ratio	Aliquot Data Aliquot	Net Equiv	MS Aliquot Data Aliquot	Net Equiv	H-3 Solids Only Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	J1V930-A SAF: RC-242	DUP		1	22.84	4.38E-02	1.0000E+00	4.3780E-02				
04	J1V930-A SAF: RC-242	DMSO		1	22.84	4.38E-02	1.0000E+00	4.3780E-02				
05	J1V930-A SAF: RC-242 MS	MS		1	22.84	4.38E-02	1.0000E+00	4.3780E-02				

Comments	

Technician: _____ Date: 6/30/16

EBERLINE SERVICES	Internal Work Order	16-06111
	Fraction	> 03 <
Dilution Worksheet	Analysis Code	Tc099
	Run Number	2
	Analyst	MMCDOUGALL

Dilution Number	...	Amount Taken	Units	...	Diluted To	Units	Ratio
1	I took	**4.378**	ml	from the original sample and diluted it to	**100**	ml	0.0438
2	I took		ml	from the 1st dilution and diluted it to		ml	
3	I took		ml	from the 2nd dilution and diluted it to		ml	
4	I took		ml	from the 3rd dilution and diluted it to		ml	
5	I took		ml	from the 4th dilution and diluted it to		ml	

Dilutions Taken	1

Dilution Ratio	**0.04378**
Dilution Factor	**22.84148013**

Diluted by: _____ Date: 4/30/16

EBERLINE SERVICES	Internal Work Order	16-06111
	Fraction	> 04 <
Dilution Worksheet	Analysis Code	Tc099
	Run Number	2
	Analyst	MMCDOUGALL

Dilution Number	...	Amount Taken	Units	...	Diluted To	Units	Ratio
1	I took	**4.378**	ml	from the original sample and diluted it to	**100**	ml	0.0438
2	I took		ml	from the 1st dilution and diluted it to		ml	
3	I took		ml	from the 2nd dilution and diluted it to		ml	
4	I took		ml	from the 3rd dilution and diluted it to		ml	
5	I took		ml	from the 4th dilution and diluted it to		ml	

Dilutions Taken	1

Dilution Ratio	**0.04378**
Dilution Factor	**22.84148013**

Diluted by: _____ Date: 6/30/16

EBERLINE SERVICES

Dilution Worksheet	**Internal Work Order**	16-06111
	Fraction	**> 05 <**
	Analysis Code	**Tc099**
	Run Number	**2**
	Analyst	**MMCDOUGALL**

Dilution Number	...	Amount Taken	Units	...	Diluted To	Units	Ratio
1	I took	**4.378**	ml	from the original sample and diluted it to	**100**	ml	0.0438
2	I took		ml	from the 1st dilution and diluted it to		ml	
3	I took		ml	from the 2nd dilution and diluted it to		ml	
4	I took		ml	from the 3rd dilution and diluted it to		ml	
5	I took		ml	from the 4th dilution and diluted it to		ml	

Dilutions Taken	1

Dilution Ratio	**0.04378**
Dilution Factor	**22.84148013**

Diluted by: [signature]

Date: 6/30/16

7/11/16
A

Assay Definition-

Assay Description:
Tc99

Assay Type: CPM
Report Name: Report1
Output Data Path: C:\Packard\Tricarb\Results\Default\tc99-cpm-16\20160701_0625
Raw Results Path: C:\Packard\Tricarb\Results\Default\tc99-cpm-16\20160701_0625\20160701_0625.results
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Default\tc99-cpm-16\20160701_0625\1606111 btc99.csv
Assay File Name: C:\Packard\TriCarb\Assays\tc99-cpm-16.lsa

Count Conditions-

Nuclide: 99Tc
Quench Indicator: tSIE
External Std Terminator (sec): 0.5 2s%
Pre-Count Delay (min): 1.00
Quench Set: n/a
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: Off
Low CPM Threshold: Off
2 Sigma % Terminator: Off

Regions	LL	UL
A	5.0	75.0
B	5.0	294.0
C	5.0	300.0

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

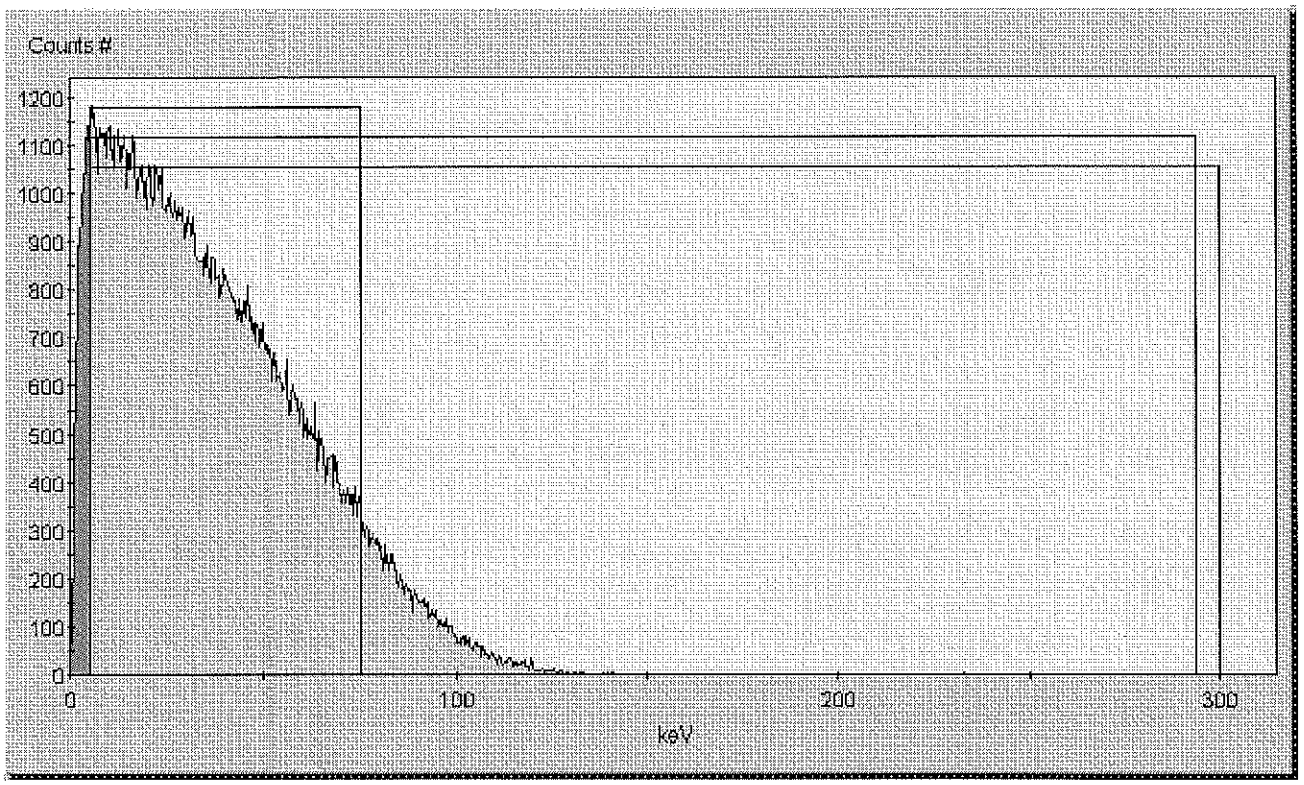
Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
A				
B				
C				

Cycle 1 Results

DATE	TIME	SMPL_ID	P#	PID	S#	CPMA	CPMB	CPMC	tSIE	Count Time
		16-06111-2-T99-01S	16	16	1	1836.1	2032.5	2032.7	344.90	60.00
7/1/2016	6:27:22 AM									

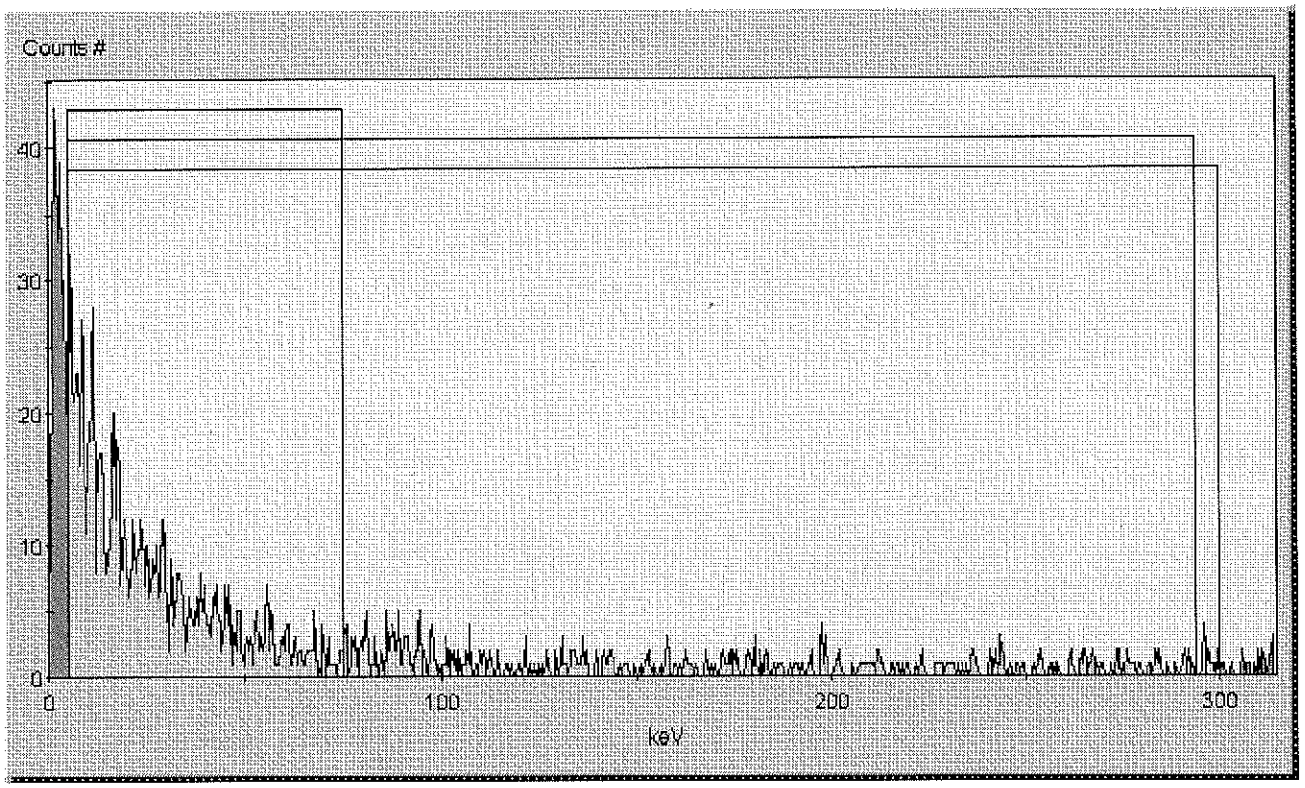
SpectraView Block Data



16-06111-2-T99-02S	16	16	2	16.4	22.9	23.1	350.80	60.00

7/1/2016 7:30:31 AM

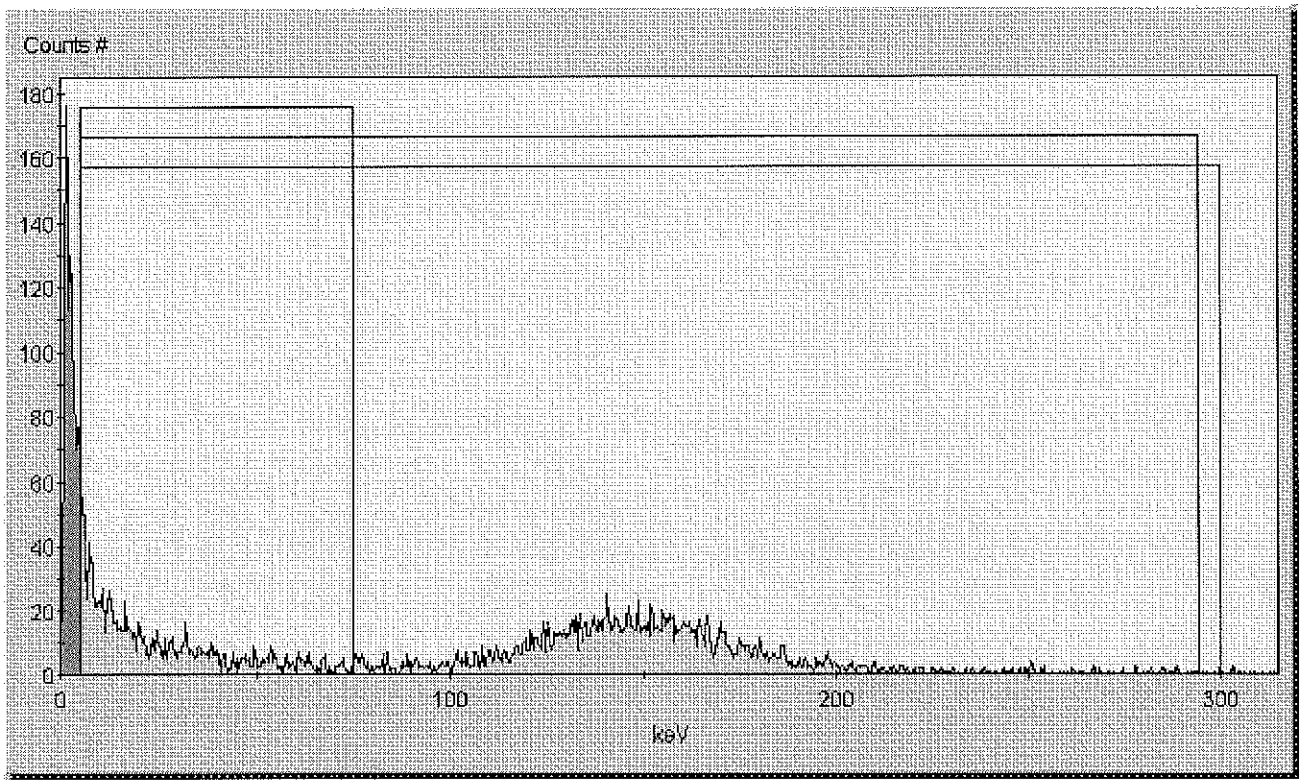
SpectraView Block Data



16-06111-2-T99-03S	16	16	3	21.4	59.6	59.7	340.09	60.00

7/1/2016 8:33:34 AM

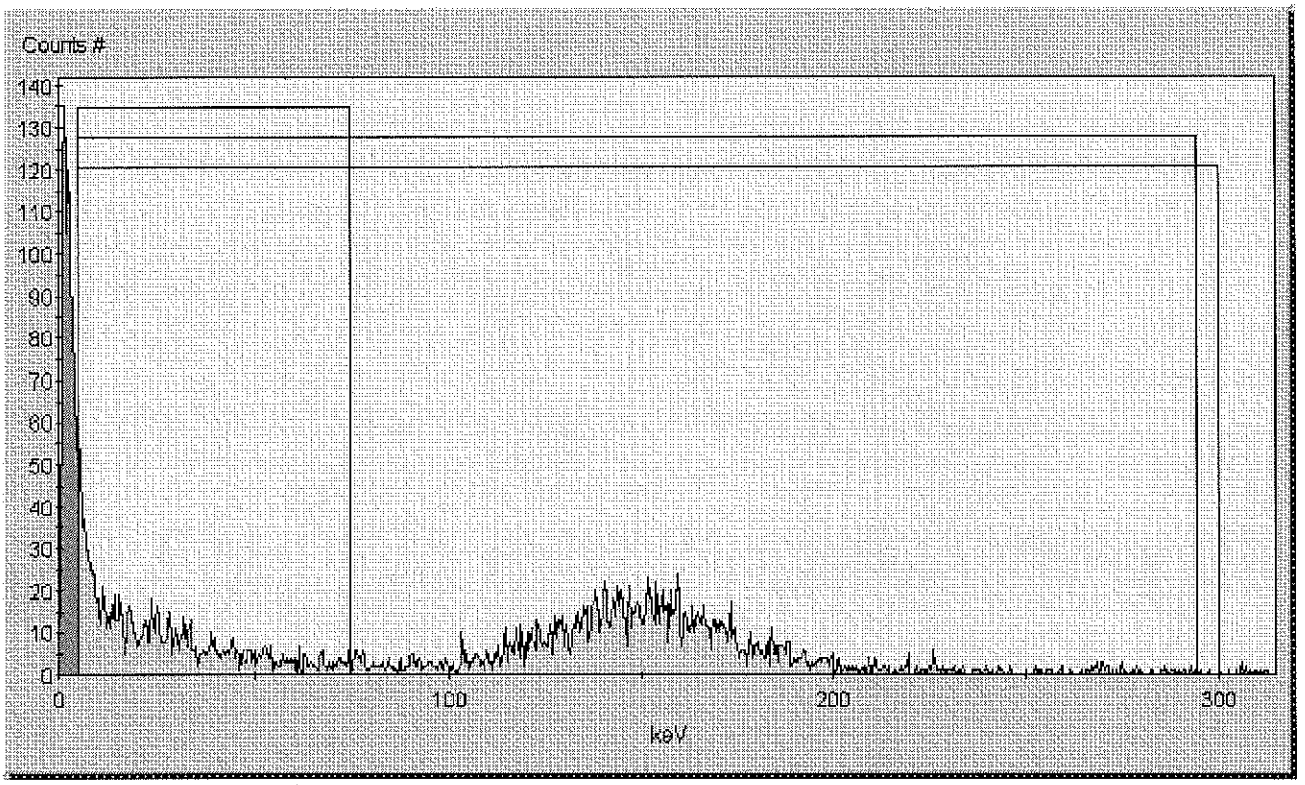
SpectraView Block Data



16-06111-2-T99-04S	16	16	4	20.6	56.1	56.1	343.01	60.00

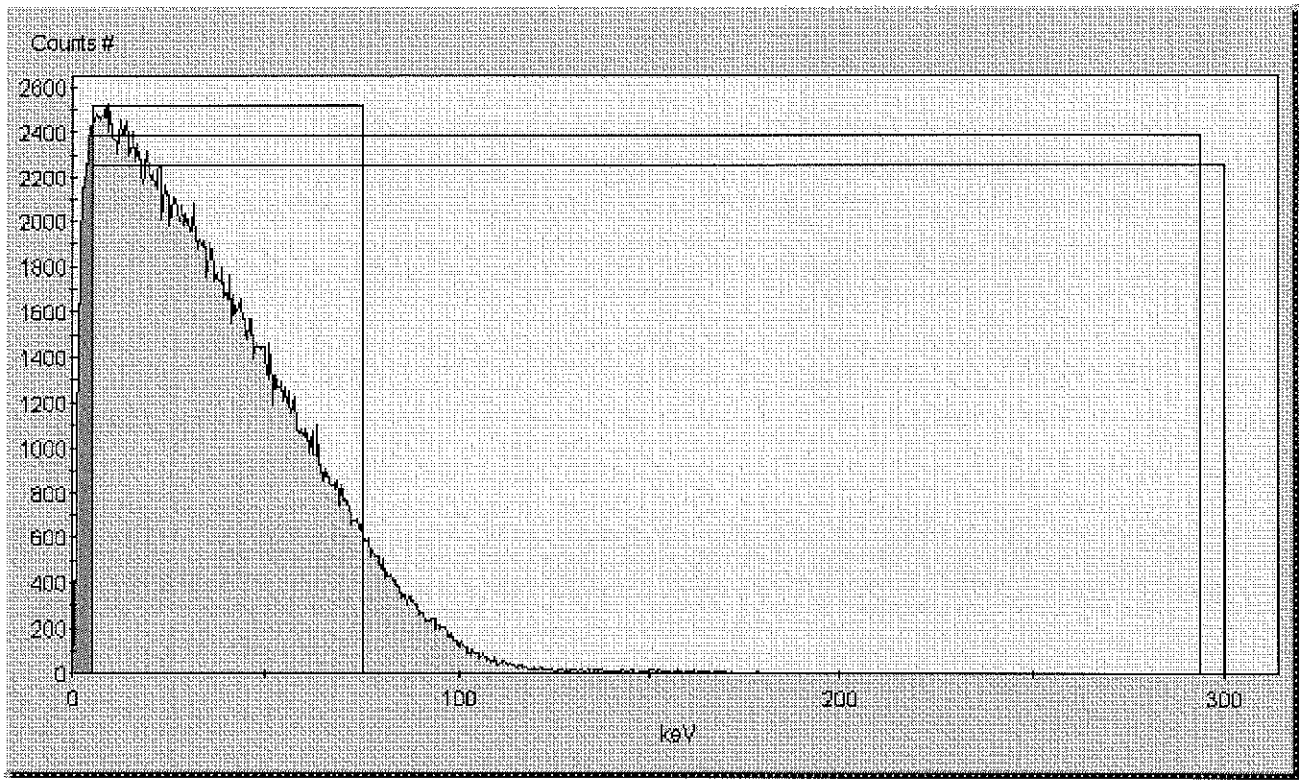
7/1/2016 9:36:45 AM

SpectraView Block Data



16-06111-2-T99-05S 16 16 5 3855.6 4211.6 4211.6 340.00 60.00
7/1/2016 10:39:47 AM

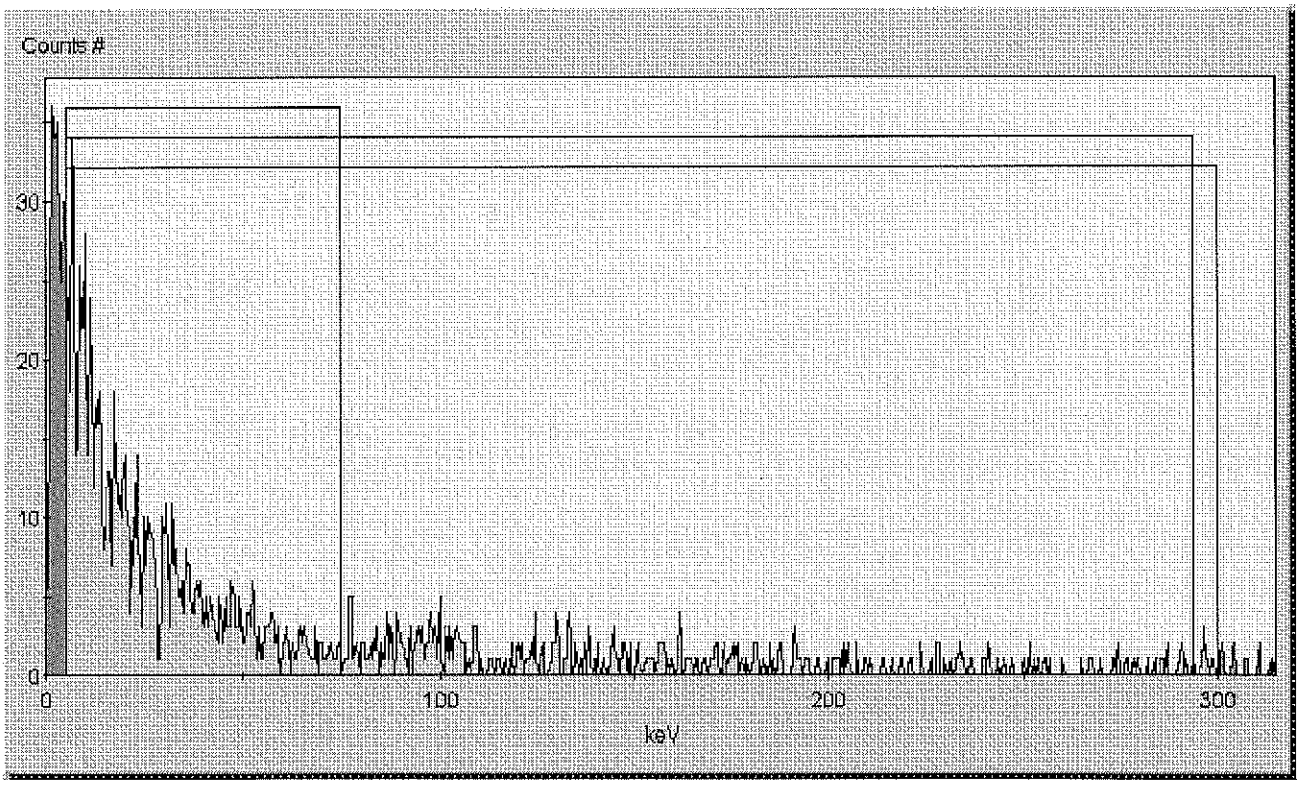
SpectraView Block Data



Sample #6	16	16	6	16.3	22.5	22.6	380.22	60.00

7/1/2016 11:42:57 AM

SpectraView Block Data


Counts #
30
20
10
0
0
100
200
300
keV

SNC Protocol

7/1/16

Calibration Information
Software Version IC: 2.11
Software Version EC: 2.02
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 426825
3H Chi Square: 18.70 Date Processed: 7/1/2016 4:03:12 AM
14C Chi Square: 9.15 Date Processed: 7/1/2016 4:03:12 AM
3H E^2/B (1-18.6 keV): 287.06 Date Processed: 7/1/2016 4:03:12 AM
14C E^2/B (4-156 keV): 550.69 Date Processed: 7/1/2016 4:03:12 AM
3H Efficiency (0-18.6 keV): 60.40 Date Processed: 7/1/2016 4:03:12 AM
14C Efficiency (0-156 keV): 96.02 Date Processed: 7/1/2016 4:03:12 AM
IPA Background Date Processed: 7/1/2016 4:03:12 AM
3H Background CPM (0-18.6 keV): 12.77 Date Processed: 7/1/2016 4:03:12 AM
14C Background CPM (0-156 keV): 20.23 Date Processed: 7/1/2016 4:03:12 AM
3H Calibration DPM: 183600
3H Reference Date: 2/27/2007
14C Calibration DPM: 136900

SECTION IX

ANALYTICAL DATA (TRITIUM)

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

16-06111
H0003
Run 1

Work Order	16-06111
Analysis Code	H0003
Run	1
Date Received	6/23/2016
Lab Deadline	7/8/2016
Client	Washington Closure Hanford
Project	S00W235A01
Report Level	4
Activity Units	pCi
Aliquot Units	g
Matrix	SO
Method	LANL ER-210 Modified
Instrument Type	Beta LSC
Radiometric Tracer	H-3 MS
Radiometric Sol#	H-5a
Tracer Act (dpm/g)	5440.25
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		06/23/16 00:00	1.0000E+00
02	MBL	BLANK		06/23/16 00:00	1.0000E+01
03	DUP	J1V930-A SAF: RC-242		06/15/16 13:40	1.8352E-01
04	DMSO	J1V930-A SAF: RC-242	10689	06/15/16 13:40	1.8352E-01
05	MS	J1V930-A SAF: RC-242		06/15/16 13:40	1.8337E-01

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

16-06111
H0003
Run 1

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	1.0000	5440.3		0.00								
02	MBL	1.0000	5440.3		0.00								
03	DUP	1.0000	5440.3		0.00								
04	DMSO	1.0000	5440.3		0.00								
05	MS	1.0000	5440.3		0.00								

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

16-06111
H0003
Run 1

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			07/01/16 08:48	JPACHELLA				
02	MBL			07/01/16 08:48	JPACHELLA				
03	DUP			07/01/16 08:48	JPACHELLA				
04	DMSO			07/01/16 08:48	JPACHELLA				
05	MS			07/01/16 08:48	JPACHELLA				

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Preliminary Data Report & Analytical Calculations

Work Order: 16-06111-H0003-1

Client: Washington Closure Hanford
Eberline Analytical Work Order: 16-06111
Analysis Code: H0003
Run: 1

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	H-3	LCS	LCS	pCi/g	2.41E+02	5.78E+00	3.74E+00	2.47E+02	97.63	OK		OK	
02	H-3	MBL	BLANK	pCi/g	-3.71E-02	2.16E-01	3.74E-01					OK	OK
03	H-3	DUP	J1V930-A SAF: RC-242	pCi/g	1.62E+01	1.23E+01	2.04E+01				INV	OK	
04	H-3	DMSO	J1V930-A SAF: RC-242	pCi/g	-2.03E+00	1.18E+01	2.04E+01					OK	
05	H-3	MS	J1V930-A SAF: RC-242	pCi/g	1.16E+03	3.00E+01	2.05E+01					OK	

Preliminary Data Report & Analytical Calculations
Work Order: 16-06111-H0003-1

Client	Eberline Analytical Work Order	Analysis Code	Run
Washington Closure Hanford	16-06111	H0003	1

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	H-3	LCS	06/23/16 00:00	1.00E+00	0.00	0.00	0.00			
02	H-3	MBL	06/23/16 00:00	1.00E+01	0.00	0.00	0.00			
03	H-3	DUP	06/15/16 13:40	1.84E-01	0.00	0.00	0.00			
04	H-3	DMSO	06/15/16 13:40	1.84E-01	0.00	0.00	0.00			
05	H-3	MS	06/15/16 13:40	1.83E-01	0.00	0.00	0.00			

Preliminary Data Report & Analytical Calculations

Work Order: 16-06111-H0003-1

Client	Eberline Analytical Work Order	Analysis Code	Run
Washington Closure Hanford	16-06111	H0003	1

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	H-3	LCS	07/01/16 13:26	4485.27	3100A	1	60	8418	10.7	0.242611332
02	H-3	MBL	07/01/16 14:28	4485.27	3100A	2	60	630	10.7	0.242931138
03	H-3	DUP	07/01/16 15:30	4485.27	3100A	3	60	738	10.7	0.24244214
04	H-3	DMSO	07/01/16 16:33	4485.27	3100A	4	60	630	10.7	0.242688697
05	H-3	MS	07/01/16 17:35	4485.27	3100A	5	60	7470	10.7	0.241640502

Count Room Report
Client: Washington Closure Hanfor

16-06111-H0003-1 (pCi/g) in SO
Tracer ID: H-5a

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	06/23/16 00:00	1.0000	1.0000	5440.2500		0.00		
02	MBL	BLANK	06/23/16 00:00	10.0000	1.0000	5440.2500		0.00		
03	DUP	J1V930-A SAF: RC-242	06/15/16 13:40	0.1835	1.0000	5440.2500		0.00		
04	DMSO	J1V930-A SAF: RC-242	06/15/16 13:40	0.1835	1.0000	5440.2500		0.00		
05	MS	J1V930-A SAF: RC-242	06/15/16 13:40	0.1834	1.0000	5440.2500		0.00		

Eberline Services
Oak Ridge Laboratory

Spike and Tracer Worksheet

Printed: 7/1/2016 8:48 AM

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
16-06111	1	H0003	7/1/2016 8:47	JPACHELLA	JMP	

LCS & Matrix Spikes					LCS	MS	LCSD	MSD	LCS		MS		LCSD		MSD	
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	Volume Used (g)	Volume Used (g)	Volume Used (g)	Volume Used (g)	Known pCi	Error Estimate	Added pCi	Error Estimate	Known pCi	Error Estimate	Added pCi	Error Estimate
H-3	H-5a	5440.250	7/1/2016	0.520	0.1007	0.1037			246.77	8.884	254.12	9.148	0.00	0.000	0.00	0.000
Tc-99 MS	Tc-2a	22043.636	7/5/2014	0.1												

Tracers

fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition
01	H-3 MS	H-5a	5440.250	7/1/2016	1.0000	0.5200
02	H-3 MS	H-5a	5440.250	7/1/2016	1.0000	0.5200
03	H-3 MS	H-5a	5440.250	7/1/2016	1.0000	0.5200
04	H-3 MS	H-5a	5440.250	7/1/2016	1.0000	0.5200
05	H-3 MS	H-5a	5440.250	7/1/2016	1.0000	0.5200

Balance Printer Tapes

Tracer	LCS

Matrix Spike

H-3 Known for solids = LCS Known / Net Equiv. Aliq.

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
16-06111	1	H0003	grams	7/8/2016	JPACHELLA

Lab Fraction	Washington Closure Hanford Client ID	Sample Type	Muffle Data	Dilution Data			Aliquot Data		MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00			100.0000	
02	BLANK	MBL					1.0000E+01	1.0000E+01			100.0000	
03	J1V930-A SAF: RC-242 MS	DUP		1	54.56	1.83E-02	1.0013E+01	1.8352E-01			100.0000	
04	J1V930-A SAF: RC-242	DMSO		1	54.56	1.83E-02	1.0013E+01	1.8352E-01			100.0000	
05	J1V930-A SAF: RC-242 MS	MS		1	54.56	1.83E-02	1.0005E+01	1.8337E-01			100.0000	

Comments	

Technician: JPachella Date: 7/1/16

EBERLINE SERVICES	Internal Work Order	16-06111
	Fraction	> 03 <
Dilution Worksheet	Analysis Code	**H0003**
	Run Number	**1**
	Analyst	**JPACHELLA**

Dilution Number	...	Amount Taken	Units	...	Diluted To	Units	Ratio
1	I took	**1.8328**	ml	from the original sample and diluted it to	**100**	ml	0.0183
2	I took		ml	from the 1st dilution and diluted it to		ml	
3	I took		ml	from the 2nd dilution and diluted it to		ml	
4	I took		ml	from the 3rd dilution and diluted it to		ml	
5	I took		ml	from the 4th dilution and diluted it to		ml	

Dilutions Taken	1

Dilution Ratio	**0.018328**
Dilution Factor	**54.56132693**

Diluted by: JPachella

Date: 7-1-16

EBERLINE SERVICES

Dilution Worksheet	**Internal Work Order**	16-06111
	Fraction	**> 04 <**
	Analysis Code	**H0003**
	Run Number	**1**
	Analyst	**JPACHELLA**

Dilution Number	...	Amount Taken	Units	...	Diluted To	Units	Ratio
1	I took	**1.8328**	ml	from the original sample and diluted it to	**100**	ml	0.0183
2	I took		ml	from the 1st dilution and diluted it to		ml	
3	I took		ml	from the 2nd dilution and diluted it to		ml	
4	I took		ml	from the 3rd dilution and diluted it to		ml	
5	I took		ml	from the 4th dilution and diluted it to		ml	

Dilutions Taken	1

Dilution Ratio	**0.018328**
Dilution Factor	**54.56132693**

Diluted by: JPachella Date: 7-1-16

63069

EBERLINE SERVICES	Internal Work Order	16-06111
	Fraction	> 05 <
Dilution Worksheet	Analysis Code	**H0003**
	Run Number	**1**
	Analyst	**JPACHELLA**

Dilution Number	...	Amount Taken	Units	...	Diluted To	Units	Ratio
1	I took	**1.8328**	ml	from the original sample and diluted it to	**100**	ml	0.0183
2	I took		ml	from the 1st dilution and diluted it to		ml	
3	I took		ml	from the 2nd dilution and diluted it to		ml	
4	I took		ml	from the 3rd dilution and diluted it to		ml	
5	I took		ml	from the 4th dilution and diluted it to		ml	

Dilutions Taken	1

Dilution Ratio	**0.018328**
Dilution Factor	**54.56132693**

Diluted by: JPachella

Date: 7-1-16

AG
7/2/16

Assay Definition-

Assay Description:
H3

Assay Type: CPM
Report Name: Report1
Output Data Path: C:\Packard\Tricarb\Results\Default\h3-cpm-1\20160701_1324
Raw Results Path: C:\Packard\Tricarb\Results\Default\h3-cpm-1\20160701_1324\20160701_1324.results
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Default\h3-cpm-1\20160701_1324\1606111 ah3.csv
Assay File Name: C:\Packard\TriCarb\Assays\h3-cpm-1.lsa

Count Conditions-

Nuclide: 3H
Quench Indicator: tSIE
External Std Terminator (sec): 0.5 2s%
Pre-Count Delay (min): 1.00
Quench Set: n/a
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: Off
Low CPM Threshold: Off
2 Sigma % Terminator: Off

Regions	LL	UL
A	0.0	18.6
B	2.0	18.6
C	0.0	0.0

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

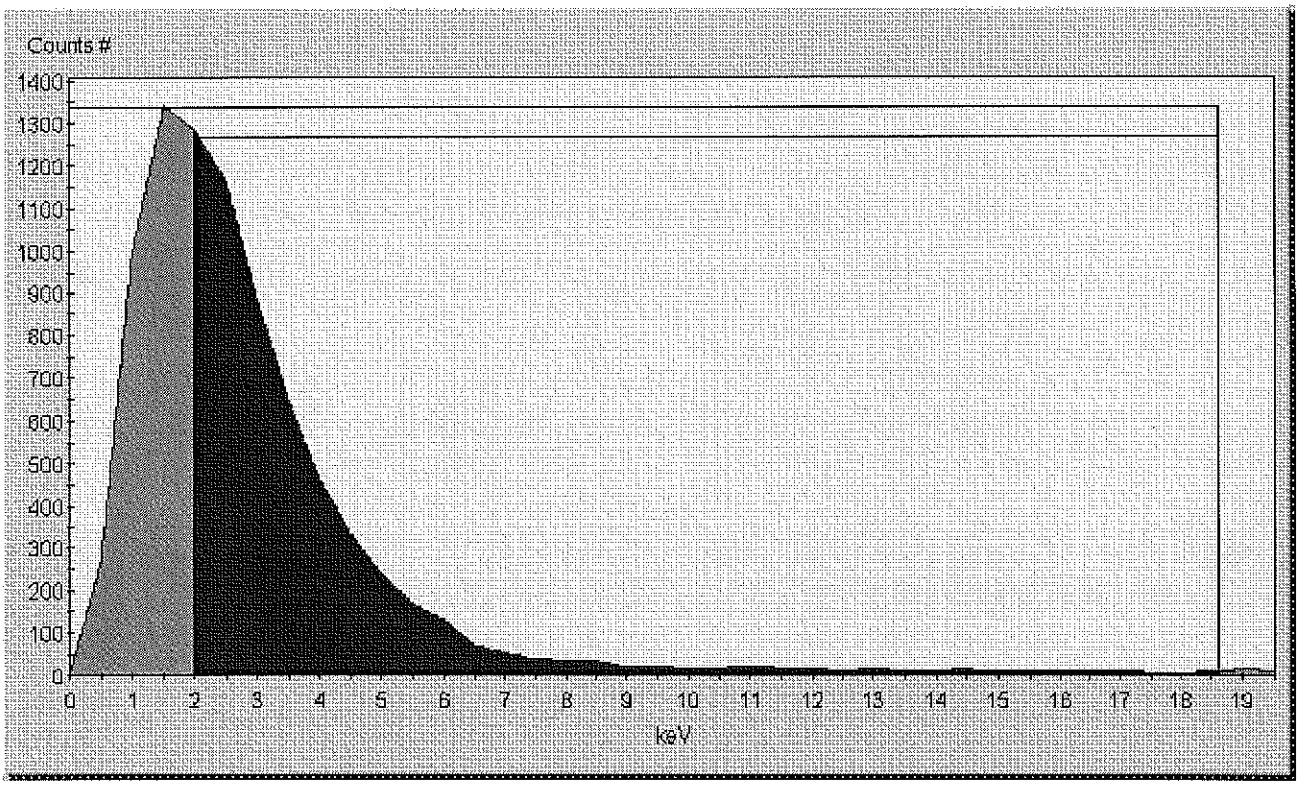
Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
A				
B				
C				

Cycle 1 Results

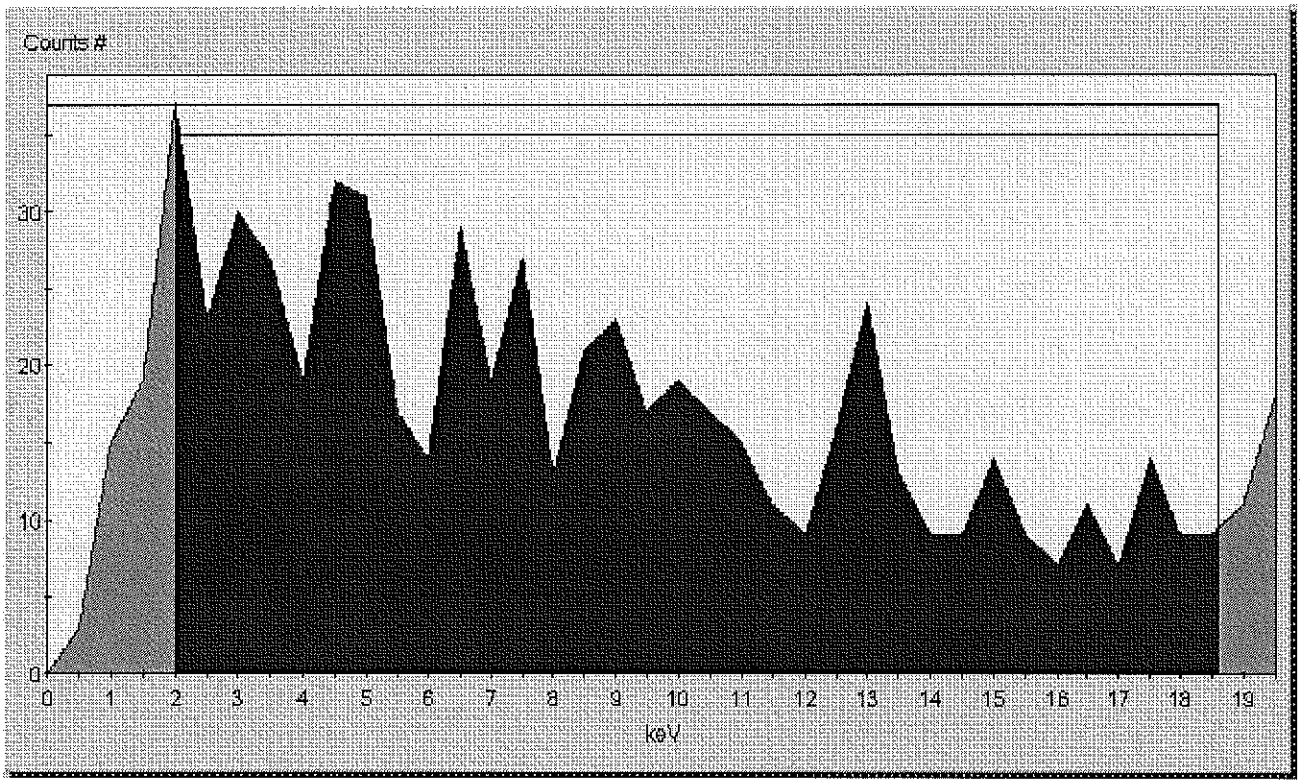
Time	DATE	SMPL_ID	P#	PID	S#	CPMA	CPMB	CPMC	tSIE	Count
		TIME								
	16-06111-1-H3-01S		1	1	1	140.3	96.7	0.0	282.50	
60.00	7/1/2016	1:26:19 PM								

SpectraView Block Data



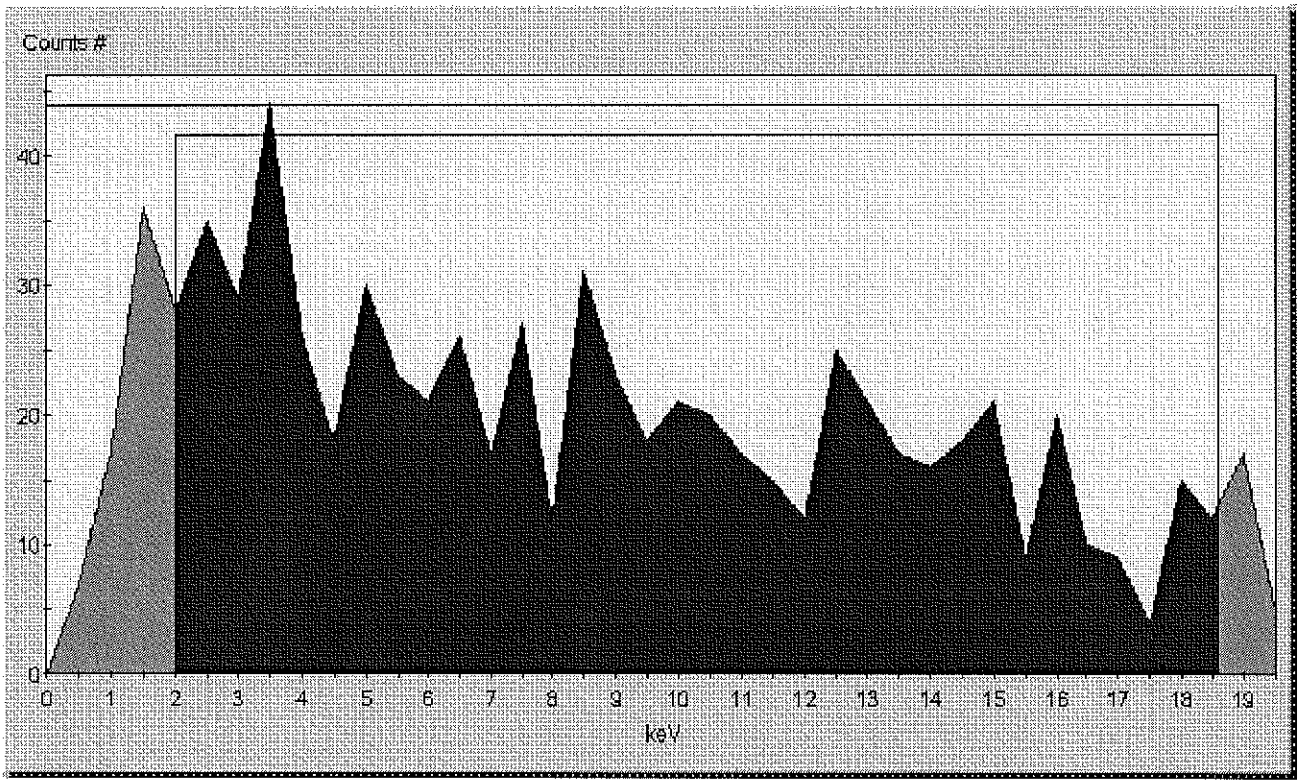
16-06111-1-H3-02S 1 1 2 10.5 9.9 0.0 293.23
60.00 7/1/2016 2:28:42 PM

SpectraView Block Data



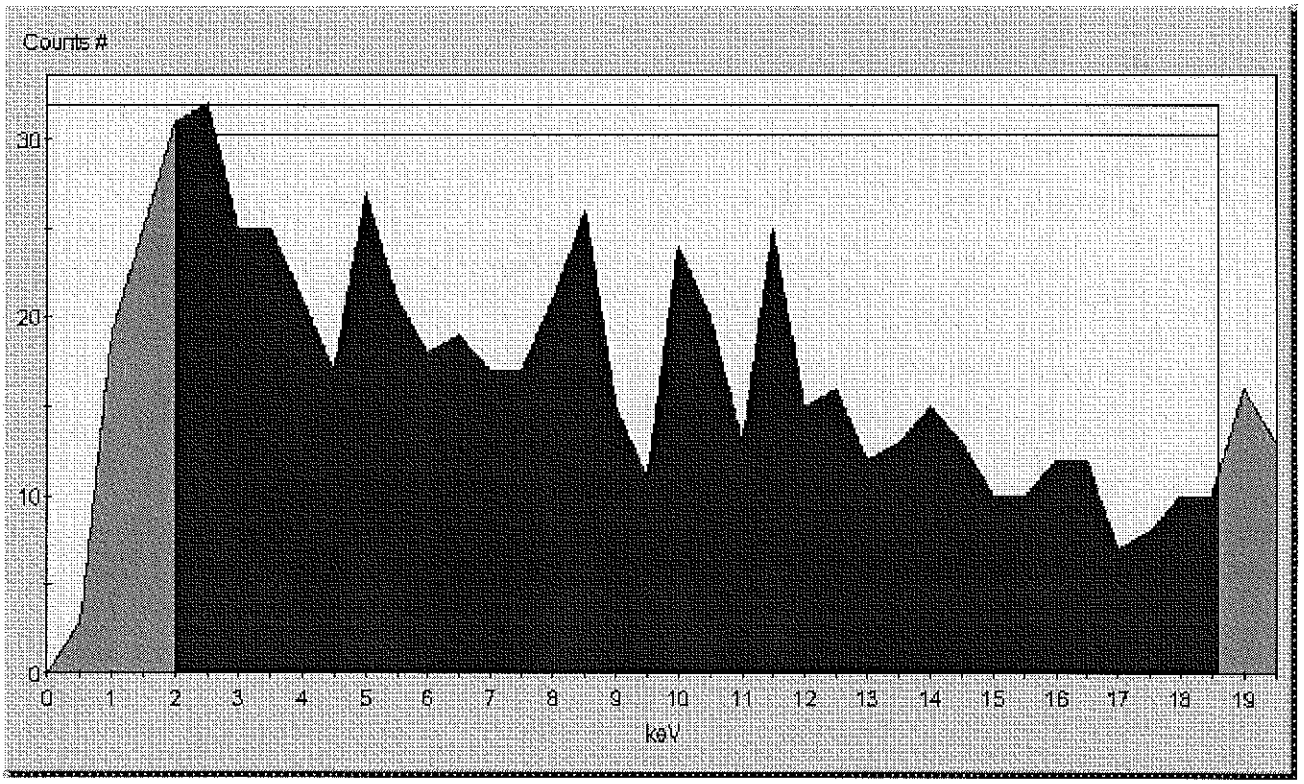
16-06111-1-H3-03S 1 1 3 12.3 11.3 0.0 281.11
60.00 7/1/2016 3:30:50 PM

SpectraView Block Data



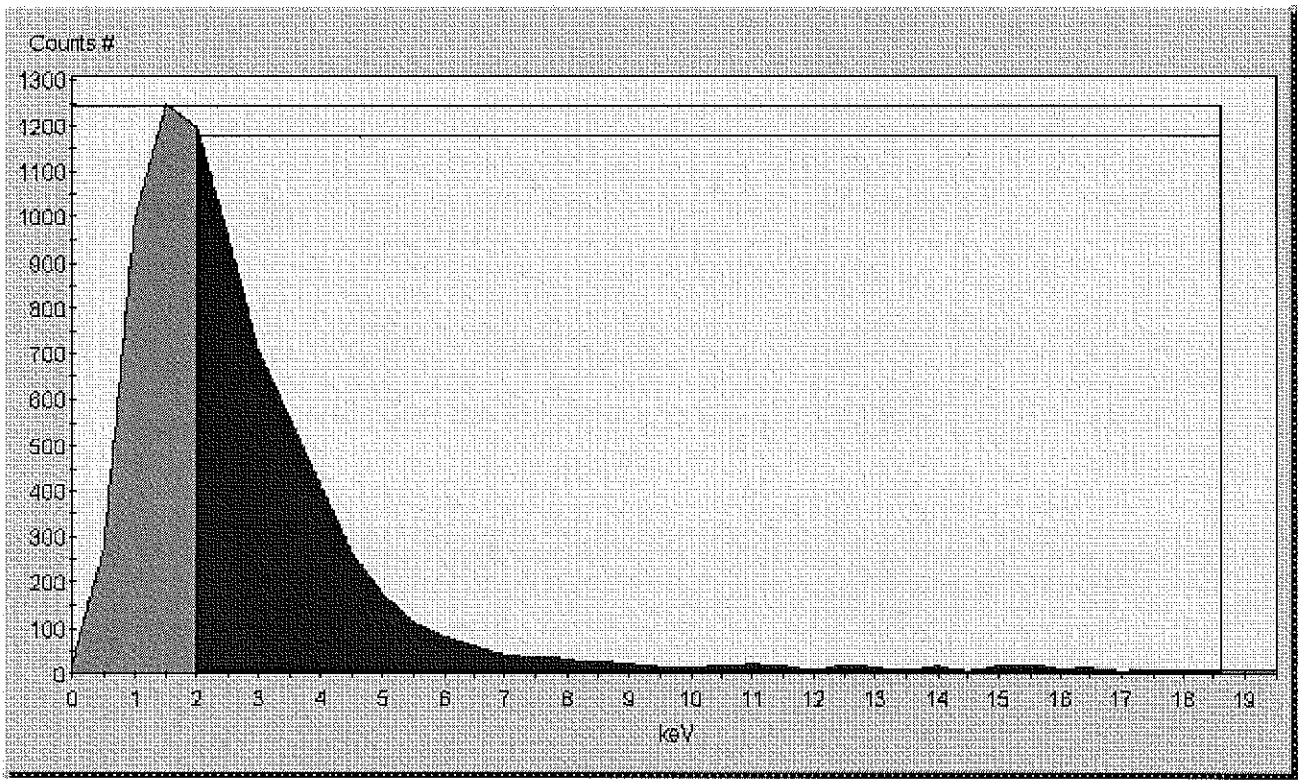
16-06111-1-H3-04S 1 1 4 10.5 9.7 0.0 283.23
60.00 7/1/2016 4:33:06 PM

SpectraView Block Data



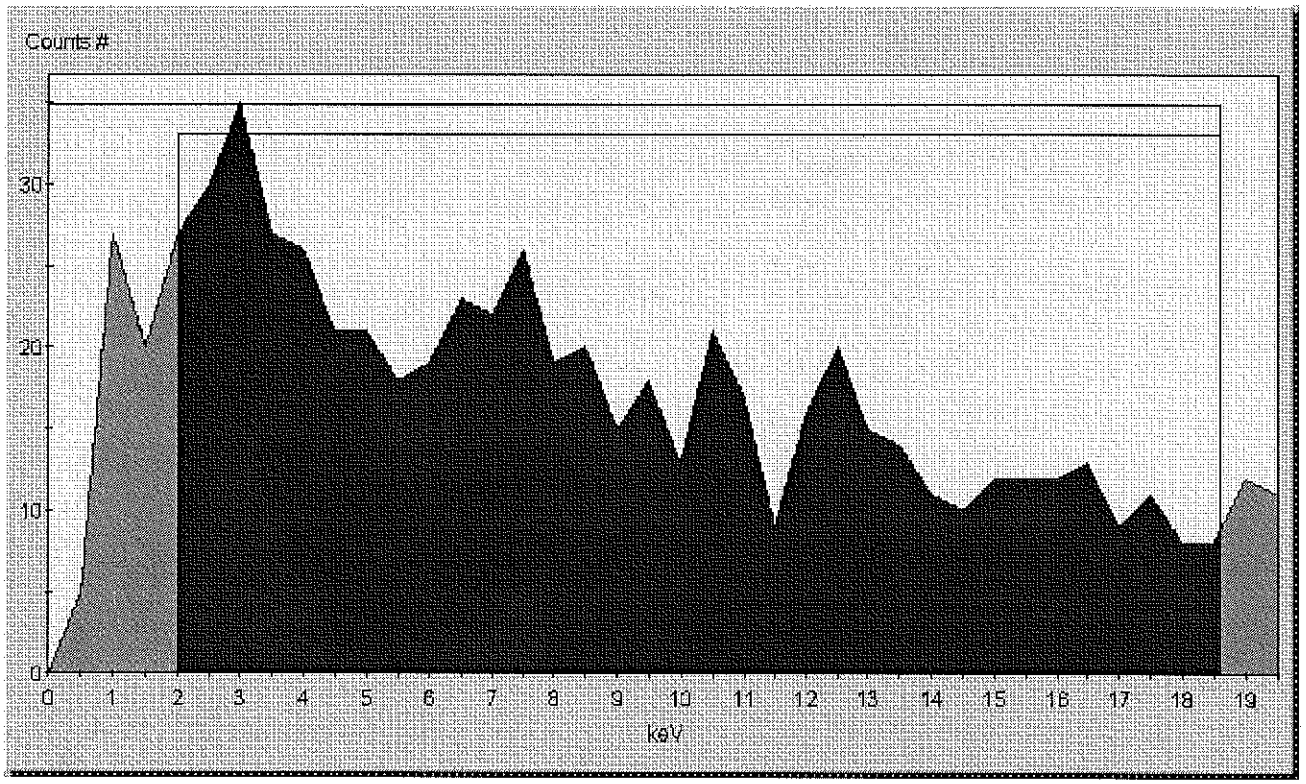
16-06111-1-H3-05S 1 1 5 124.5 82.3 0.0 276.31
60.00 7/1/2016 5:35:14 PM

SpectraView Block Data



Sample #6 1 1 6 10.7 9.9 0.0 291.77
60.00 7/1/2016 6:37:33 PM

SpectraView Block Data


Counts #
30
20
10
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
keV

SNC Protocol

7/1/16

Calibration Information
Software Version IC: 2.11
Software Version EC: 2.02
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 426825
3H Chi Square: 18.70 Date Processed: 7/1/2016 4:03:12 AM
14C Chi Square: 9.15 Date Processed: 7/1/2016 4:03:12 AM
3H E^2/B (1-18.6 keV): 287.06 Date Processed: 7/1/2016 4:03:12 AM
14C E^2/B (4-156 keV): 550.69 Date Processed: 7/1/2016 4:03:12 AM
3H Efficiency (0-18.6 keV): 60.40 Date Processed: 7/1/2016 4:03:12 AM
14C Efficiency (0-156 keV): 96.02 Date Processed: 7/1/2016 4:03:12 AM
IPA Background Date Processed: 7/1/2016 4:03:12 AM
3H Background CPM (0-18.6 keV): 12.77 Date Processed: 7/1/2016 4:03:12 AM
14C Background CPM (0-156 keV): 20.23 Date Processed: 7/1/2016 4:03:12 AM
3H Calibration DPM: 183600
3H Reference Date: 2/27/2007
14C Calibration DPM: 136900

SECTION X

ANALYTICAL DATA (CARBON-14)

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

16-06111
C0014
Run 1

Work Order	16-06111
Analysis Code	C0014
Run	1
Date Received	6/23/2016
Lab Deadline	7/8/2016
Client	Washington Closure Hanford
Project	S00W235A01
Report Level	4
Activity Units	pCi
Aliquot Units	g
Matrix	SO
Method	EPA 520.0 Modified
Instrument Type	Beta LSC
Radiometric Tracer	
Radiometric Sol#	
Tracer Act (dpm/g)	
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		06/23/16 00:00	1.0000E+00
02	MBL	BLANK		06/23/16 00:00	1.0000E+00
03	DUP	J1V930-A SAF: RC-242		06/15/16 13:40	2.3226E+00
04	DMSO	J1V930-A SAF: RC-242	10689	06/15/16 13:40	1.8218E+00
05	MS	J1V930-A SAF: RC-242		06/15/16 13:40	1.7615E+00

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

16-06111
C0014
Run 1

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS				0.00								
02	MBL				0.00								
03	DUP				0.00								
04	DMSO				0.00								
05	MS				0.00								

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

16-06111
C0014
Run 1

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			06/28/16 13:46	KSALLINGS				
02	MBL			06/28/16 13:46	KSALLINGS				
03	DUP			06/28/16 13:46	KSALLINGS				
04	DMSO			06/28/16 13:46	KSALLINGS				
05	MS			06/28/16 13:46	KSALLINGS				

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Preliminary Data Report & Analytical Calculations
Work Order: 16-06111-C0014-1

Client	Eberline Analytical Work Order	Analysis Code	Run
Washington Closure Hanford	16-06111	C0014	1

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	C-14	LCS	LCS	pCi/g	1.36E+03	1.33E+01	5.14E+00	1.40E+03	97.03	OK		OK	
02	C-14	MBL	BLANK	pCi/g	1.70E+00	2.97E+00	5.02E+00					OK	OK
03	C-14	DUP	J1V930-A SAF: RC-242	pCi/g	1.42E+01	1.56E+00	2.21E+00				OK	OK	
04	C-14	DMSO	J1V930-A SAF: RC-242	pCi/g	1.60E+01	1.97E+00	2.85E+00					OK	
05	C-14	MS	J1V930-A SAF: RC-242	pCi/g	7.54E+02	7.51E+00	2.94E+00					OK	

Preliminary Data Report & Analytical Calculations

Work Order: 16-06111-C0014-1

Run	Analysis Code	Eberline Analytical Work Order	Client
1	C0014	16-06111	Washington Closure Hanford

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	C-14	LCS	06/23/16 00:00	1.00E+00	0.00	0.00	0.00			
02	C-14	MBL	06/23/16 00:00	1.00E+00	0.00	0.00	0.00			
03	C-14	DUP	06/15/16 13:40	2.32E+00	0.00	0.00	0.00			
04	C-14	DMSO	06/15/16 13:40	1.82E+00	0.00	0.00	0.00			
05	C-14	MS	06/15/16 13:40	1.76E+00	0.00	0.00	0.00			

Preliminary Data Report & Analytical Calculations

Work Order: 16-06111-C0014-1

Client	Eberline Analytical Work Order	Analysis Code	Run
Washington Closure Hanford	16-06111	C0014	1

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	C-14	LCS	06/30/16 14:29	2092882.5	3100B	1	60	43230	18.8	0.661033226
02	C-14	MBL	06/30/16 15:32	2092882.5	3100B	2	60	1182	18.8	0.677698573
03	C-14	DUP	06/30/16 16:35	2092882.5	3100B	3	60	2154	18.8	0.662978508
04	C-14	DMSO	06/30/16 17:38	2092882.5	3100B	4	60	2022	18.8	0.654896232
05	C-14	MS	06/30/16 18:41	2092882.5	3100B	5	60	41922	18.8	0.656336166

Count Room Report
Client: Washington Closure Hanfor

16-06111-C0014-1 (pCi/g) in SO
Tracer ID:

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	06/23/16 00:00	1.0000				0.00		
02	MBL	BLANK	06/23/16 00:00	1.0000				0.00		
03	DUP	J1V930-A SAF: RC-242	06/15/16 13:40	2.3226				0.00		
04	DMSO	J1V930-A SAF: RC-242	06/15/16 13:40	1.8218				0.00		
05	MS	J1V930-A SAF: RC-242	06/15/16 13:40	1.7615				0.00		

Eberline Services
Oak Ridge Laboratory

Spike and Tracer Worksheet

Printed: 6/28/2016 1:46 PM

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
16-06111	1	C0014	6/28/2016 13:44	KSALLINGS KS		

LCS & Matrix Spikes					LCS	MS	RS	MSD	LCS		MS		LCSD		MSD	
Isotope	*Sol #*	*Activity dpm/g*	*Solution Date*	*Approx Addition*	*Volume Used (g)*	*Volume Used (g)*	*Volume Used (g)*	*Volume Used (g)*	*Known pCi*	*Error Estimate*	*Added pCi*	*Error Estimate*	*Known pCi*	*Error Estimate*	*Added pCi*	*Error Estimate*
C-14	C-3a	2992.860	6/28/2016	**1.070**	**1.0400**	**1.0300**	**1.0100**		1402.06	39.258	1388.58	38.880	1361.62	38.125	0.00	0.000
Tc-99 MS	Tc-2a	22043.636	7/5/2014	0.1												

Tracers

fraction	*Isotope*	*Sol #*	*Activity dpm/g*	*Solution Date*	*Volume Used (g)*	*Approx Addition*

Balance Printer Tapes

Tracer	LCS

Matrix Spike

Version 2.0 08/99

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
16-06111	1	C0014	grams	7/8/2016	MMCDOUGALL

Lab Fraction	Washington Closure Hanford Client ID	Sample Type	Muffle Data Ratio Post/Pre	Dilution Data No of Dils	Dilution Data Dil Factor	Dilution Data Ratio	Aliquot Data Aliquot	Aliquot Data Net Equiv	MS Aliquot Data Aliquot	MS Aliquot Data Net Equiv	H-3 Solids Only Water Added (ml)	H-3 Solids Only H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	J1V930-A SAF: RC-242	DUP					2.3226E+00	2.3226E+00				
04	J1V930-A SAF: RC-242	DMSO					1.8218E+00	1.8218E+00				
05	J1V930-A SAF: RC-242 MS	MS					1.7615E+00	1.7615E+00				

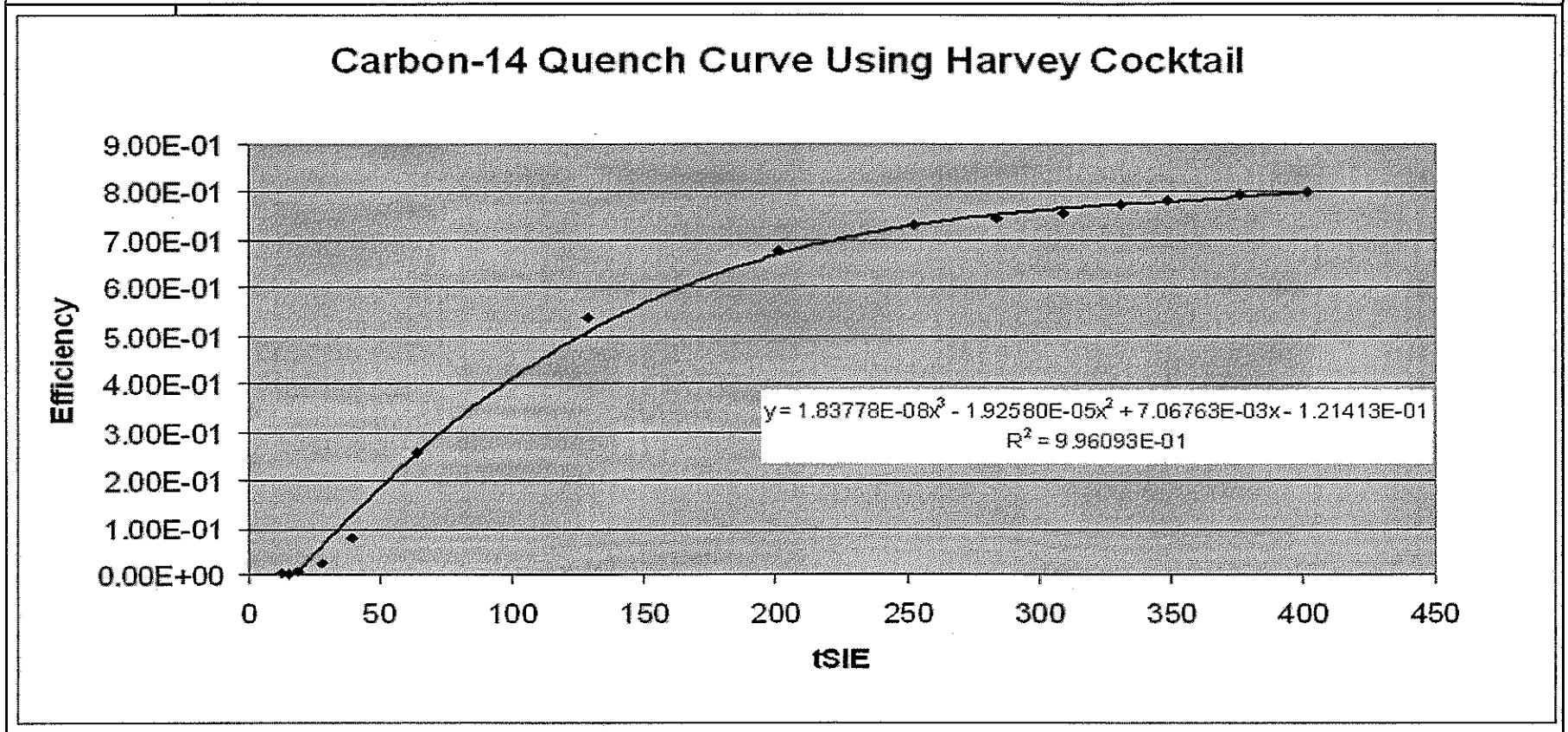
Comments	

Technician: _____ Date: 6/20/16

00108

Work Order #	16-06111		C-14 Recovery			EBERLINE SERVICES	
tSIE	EFFICIENCY	Recovery Spike Activity	Grams Added	Total Activity	cpm	Bkg, cpm	Recovery Factor
189.45	65.132%	2992.86	1.01	3022.7886	710.8	18.8	0.351484483

7/1/2016 7:24



7/11/16
(P)

Assay Definition-

Assay Description:
C14

Assay Type: CPM
Report Name: Report1
Output Data Path: C:\Packard\Tricarb\Results\Default\C14_cpm.6\20160630_1427
Raw Results Path: C:\Packard\Tricarb\Results\Default\C14_cpm.6\20160630_1427\20160630_1427.results
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Default\C14_cpm.6\20160630_1427\1606111 ac14.csv
Assay File Name: C:\Packard\TriCarb\Assays\C14_cpm.6.lsa

Count Conditions-

Nuclide: 14C
Quench Indicator: tSIE
External Std Terminator (sec): 0.5 2s%
Pre-Count Delay (min): 1.00
Quench Set: n/a
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: Off
Low CPM Threshold: Off
2 Sigma % Terminator: Off

Regions	LL	UL
A	0.0	156.0
B	4.0	156.0
C	0.0	0.0

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

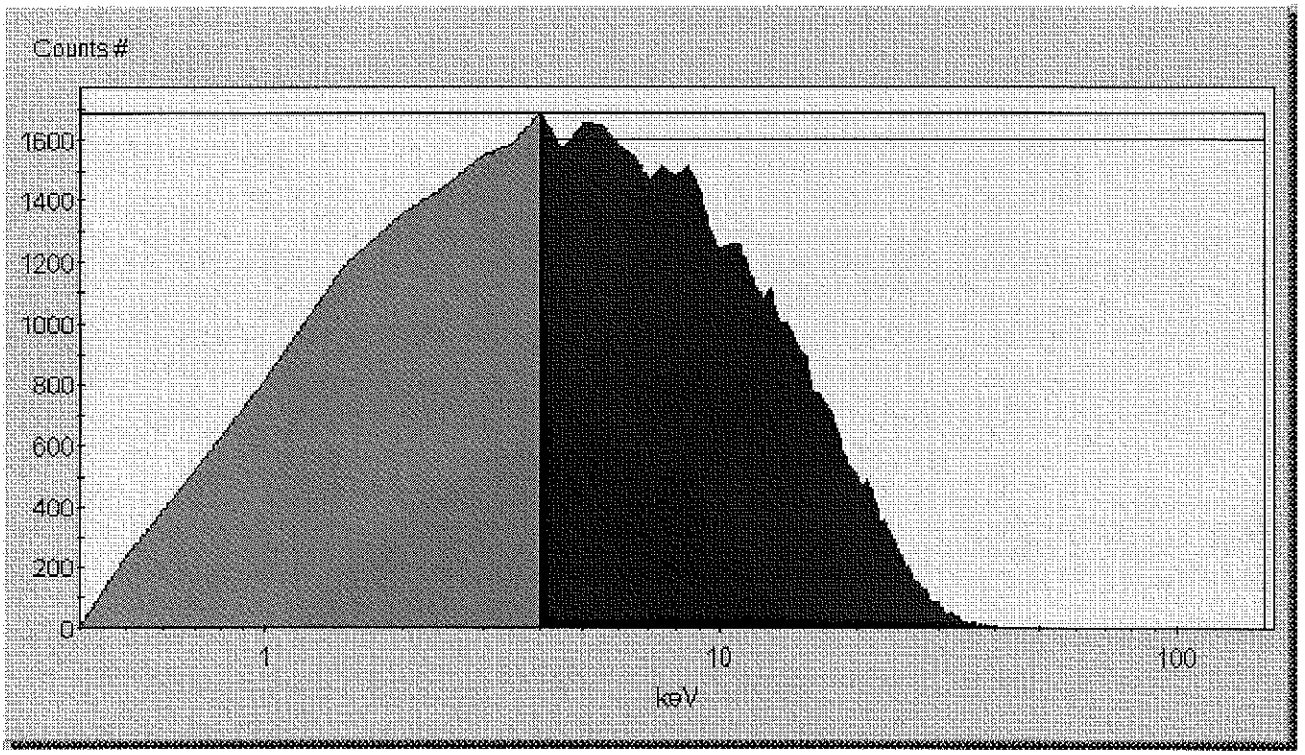
Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
A				
B				
C				

Cycle 1 Results

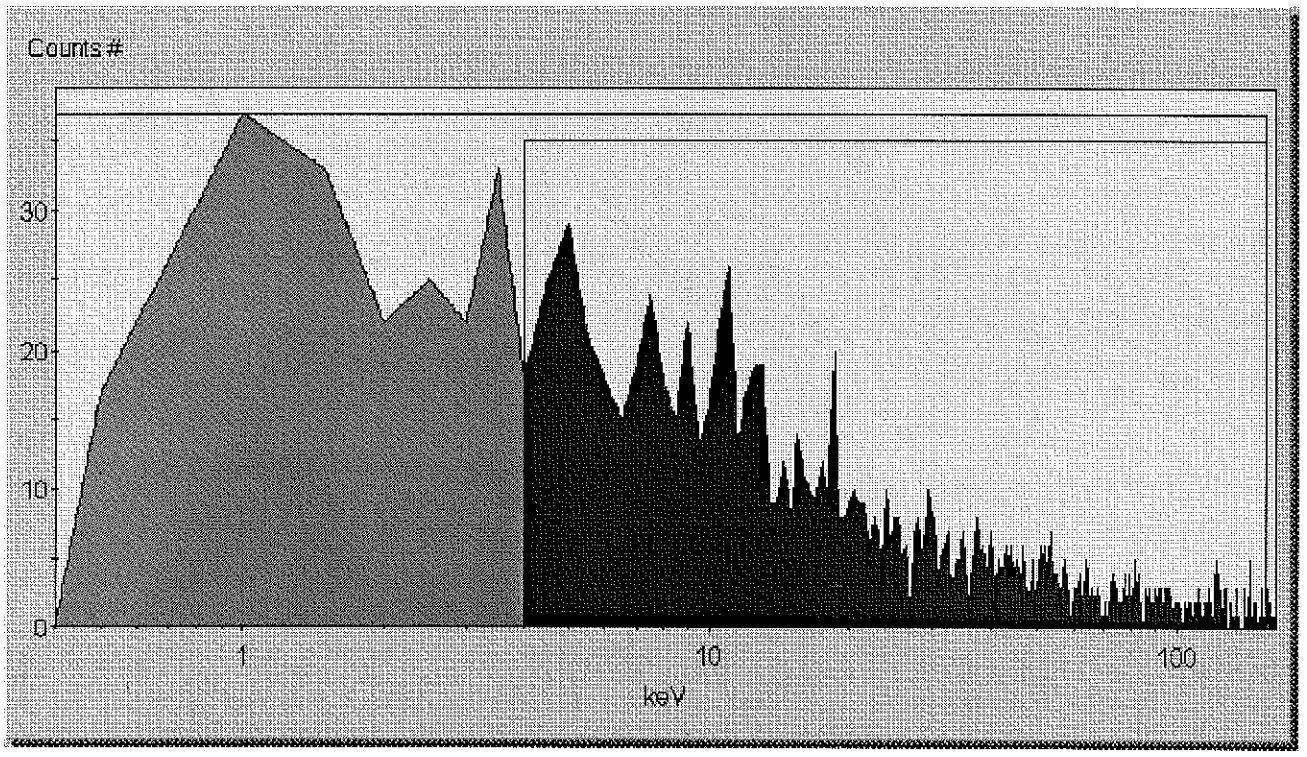
DATE	TIME	SMPL_ID	P#	PID	S#	CPMA	CPMB	CPMC	tSIE	Count Time
		16-06111-1-C14-01S	6	12	1	857.1	720.5	0.0	196.14	60.00
6/30/2016	2:29:22 PM									

SpectraView Block Data



16-06111-1-C14-02S 6 12 2 22.8 19.7 0.0 207.05 60.00
6/30/2016 3:32:26 PM

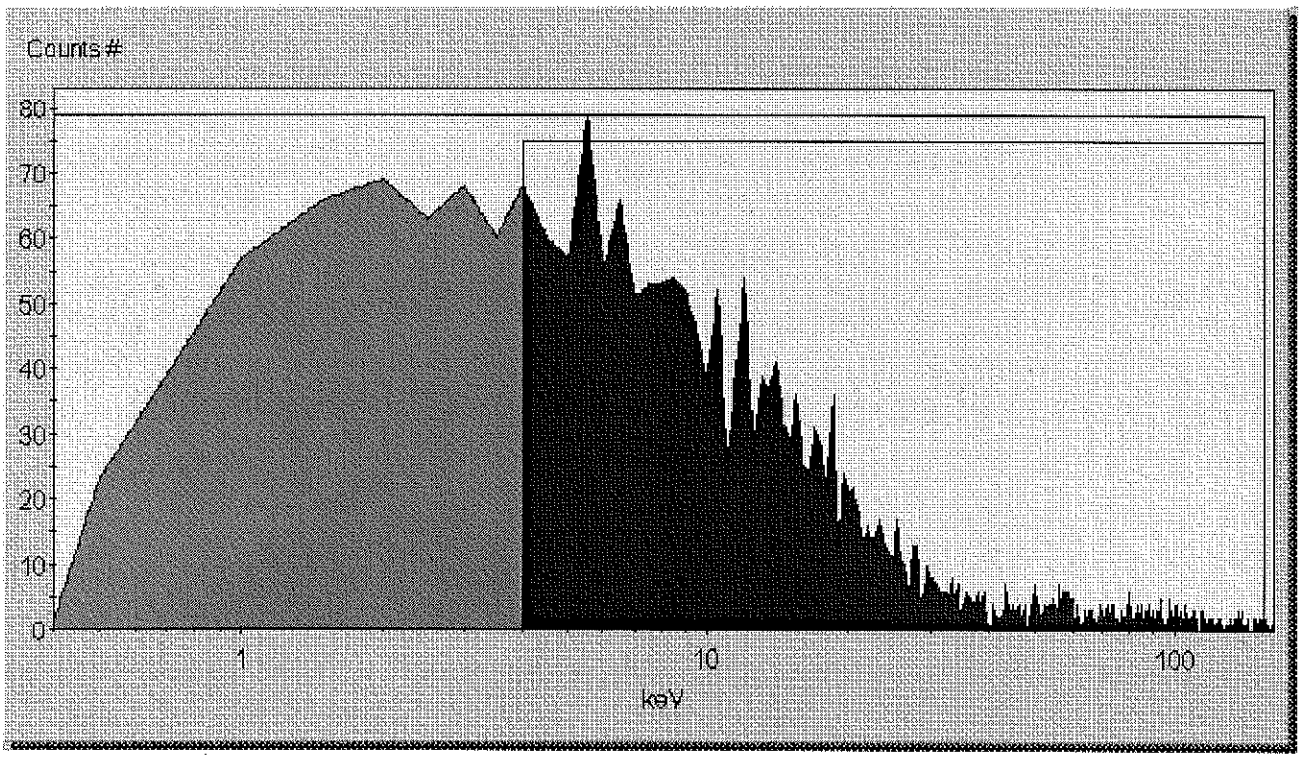
SpectraView Block Data



16-06111-1-C14-03S	6	12	3	42.6	35.9	0.0	197.35	60.00

6/30/2016 4:35:30 PM

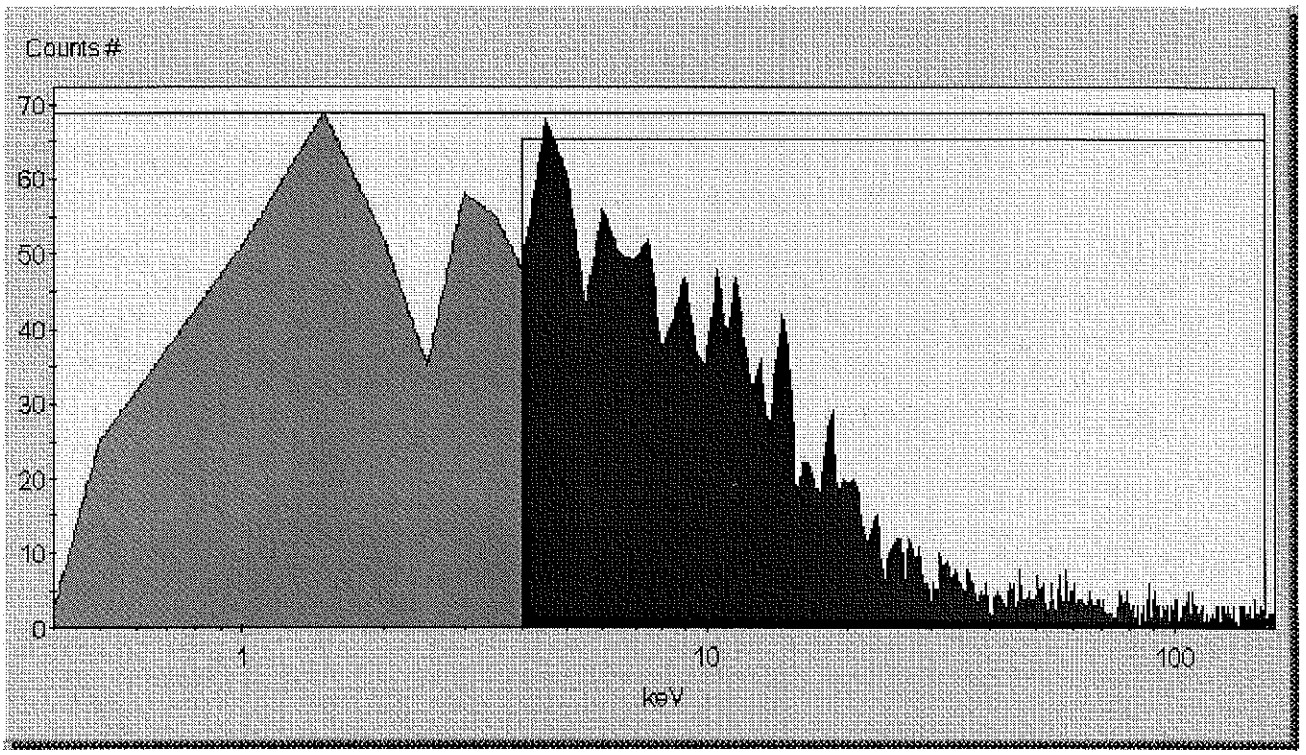
SpectraView Block Data



16-06111-1-C14-04S	6	12	4	39.5	33.7	0.0	192.42	60.00

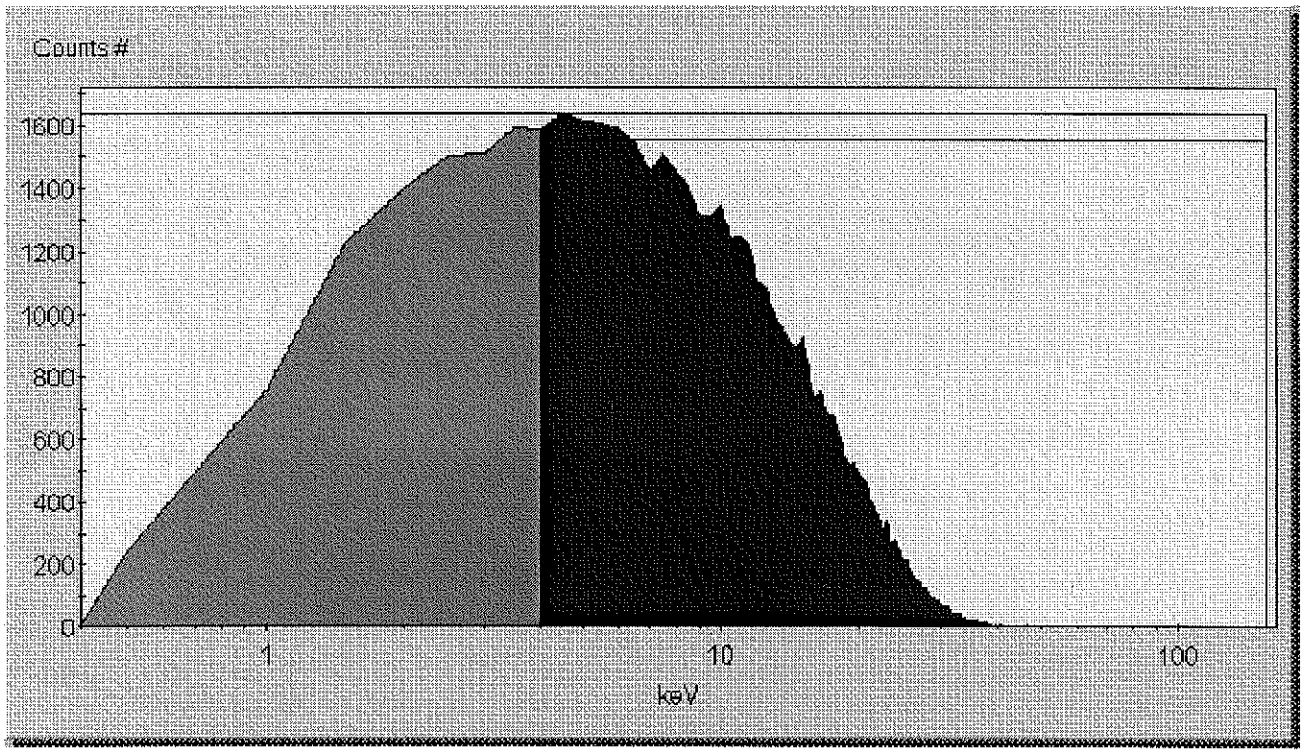
6/30/2016 5:38:35 PM

SpectraView Block Data



16-06111-1-C14-05S 6 12 5 836.0 698.7 0.0 193.28 60.00
6/30/2016 6:41:41 PM

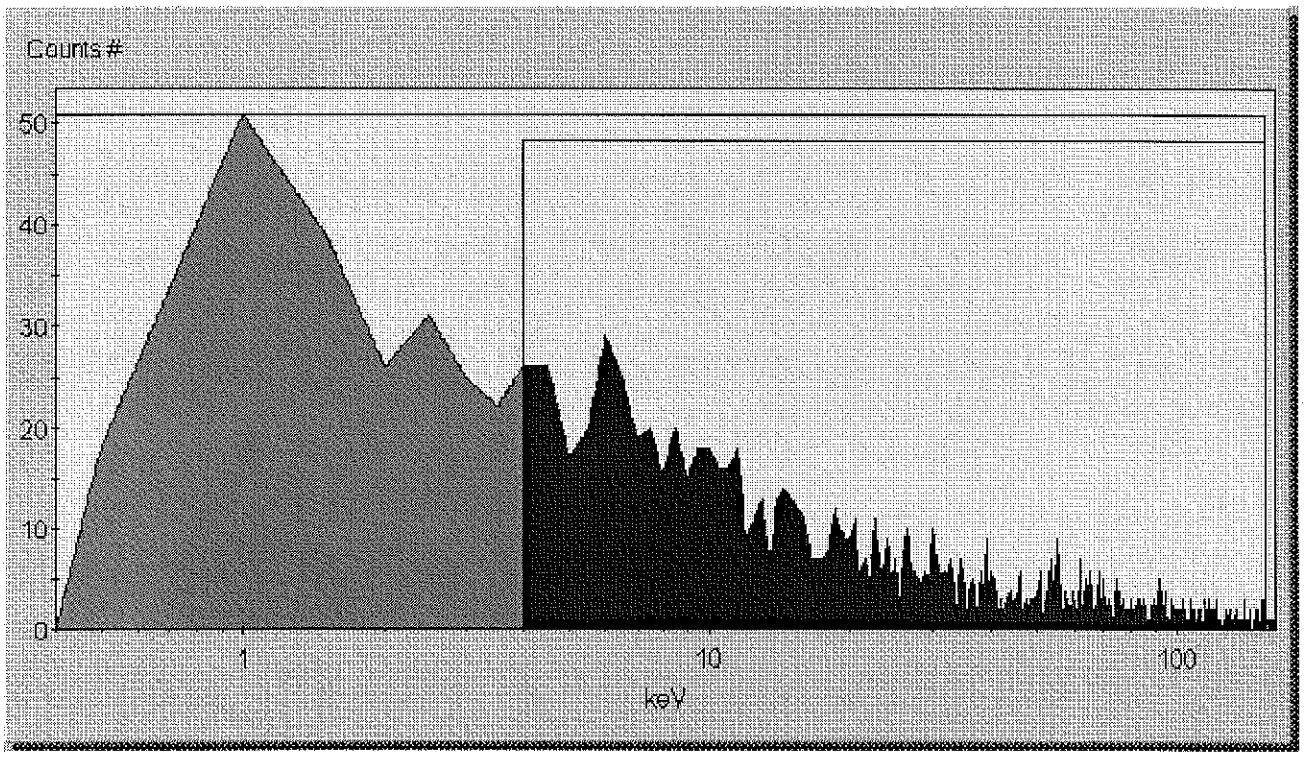
SpectraView Block Data



Sample #6	6	12	6	22.3	18.8	0.0	203.03	60.00

6/30/2016 7:44:46 PM

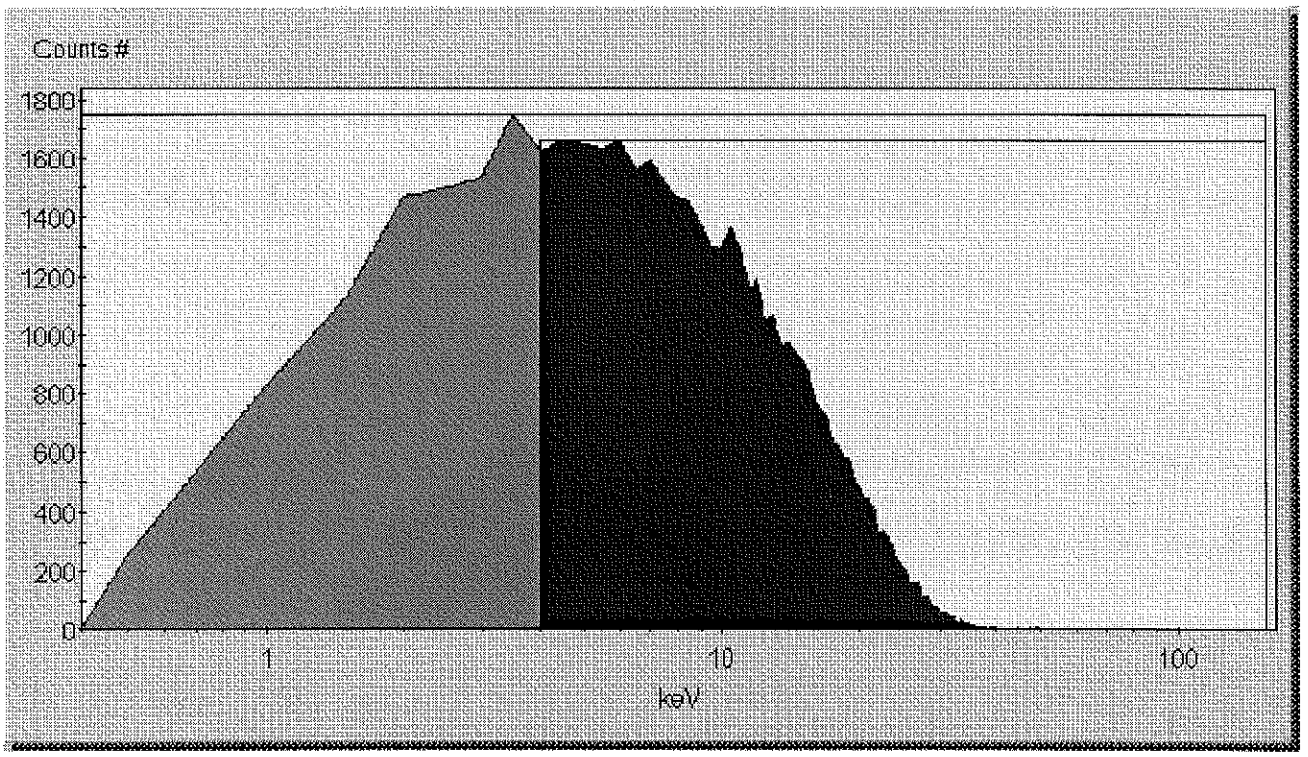
SpectraView Block Data



Sample #7	6	12	7	852.2	710.8	0.0	189.45	60.00

6/30/2016 8:47:51 PM

SpectraView Block Data


Counts #
1800
1600
1400
1200
1000
800
600
400
200
0
1
10
100
keV

SNC Protocol

(B) 6/30/16 JCB

Calibration Information
Software Version IC: 2.12
Software Version EC: 2.02
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 427086
3H Chi Square: 17.35 Date Processed: 6/30/2016 2:27:35 PM
14C Chi Square: 13.23 Date Processed: 6/30/2016 2:27:35 PM
3H E^2/B (1-18.6 keV): 313.73 Date Processed: 6/30/2016 2:27:35 PM
14C E^2/B (4-156 keV): 589.33 Date Processed: 6/30/2016 2:27:35 PM
3H Efficiency (0-18.6 keV): 61.91 Date Processed: 6/30/2016 2:27:35 PM
14C Efficiency (0-156 keV): 95.83 Date Processed: 6/30/2016 2:27:35 PM
IPA Background Date Processed: 6/30/2016 2:27:35 PM
3H Background CPM (0-18.6 keV): 12.08 Date Processed: 6/30/2016 2:27:35 PM
14C Background CPM (0-156 keV): 18.58 Date Processed: 6/30/2016 2:27:35 PM
3H Calibration DPM: 207400
3H Reference Date: 10/29/2007
14C Calibration DPM: 120521

SECTION XI

ANALYTICAL DATA (NICKEL-63)

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

16-06111
Ni063
Run 1

Work Order	16-06111
Analysis Code	Ni063
Run	1
Date Received	6/23/2016
Lab Deadline	7/8/2016
Client	Washington Closure Hanford
Project	S00W235A01
Report Level	4
Activity Units	pCi
Aliquot Units	g
Matrix	SO
Method	ASTM 3500-Ni Modified
Instrument Type	Beta LSC
Radiometric Tracer	
Radiometric Sol#	
Tracer Act (dpm/g)	
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		06/23/16 00:00	1.0000E+00
02	MBL	BLANK		06/23/16 00:00	1.0000E+00
03	DUP	J1V930-A SAF: RC-242		06/15/16 13:40	1.3134E-01
04	DMSO	J1V930-A SAF: RC-242	10689	06/15/16 13:40	1.3134E-01
05	MS	J1V930-A SAF: RC-242		06/15/16 13:40	1.3134E-01

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

16-06111
Ni063
Run 1

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS				0.00								
02	MBL				0.00								
03	DUP				0.00								
04	DMSO				0.00								
05	MS				0.00								

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

00115

16-06111
Ni063
Run 1

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			07/08/16 08:08	EBAILEY				
02	MBL			07/08/16 08:08	EBAILEY				
03	DUP			07/08/16 08:08	EBAILEY				
04	DMSO			07/08/16 08:08	EBAILEY				
05	MS			07/08/16 08:08	EBAILEY				

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ^ Indicates estimated SAF value.
** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Preliminary Data Report & Analytical Calculations
Work Order: 16-06111-Ni063-1

Client: Washington Closure Hanford
Eberline Analytical Work Order: 16-06111
Analysis Code: Ni063
Run: 1

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	NI-63	LCS	LCS	pCi/g	1.64E+03	9.96E+00	2.44E+00	1.53E+03	107.29	OK		OK	
02	NI-63	MBL	BLANK	pCi/g	-1.08E+00	1.37E+00	2.38E+00					OK	OK
03	NI-63	DUP	J1V930-A SAF: RC-242	pCi/g	2.39E+04	1.06E+02	1.92E+01				INV	OK	
04	NI-63	DMSO	J1V930-A SAF: RC-242	pCi/g	3.84E+04	1.35E+02	1.94E+01					OK	
05	NI-63	MS	J1V930-A SAF: RC-242	pCi/g	1.35E+05	3.93E+02	4.69E+01					INV	

Preliminary Data Report & Analytical Calculations
Work Order: 16-06111-Ni063-1

Client: Washington Closure Hanford
Eberline Analytical Work Order: 16-06111
Analysis Code: Ni063
Run: 1

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	NI-63	LCS	06/23/16 00:00	1.00E+00	0.00	0.00	0.00			
02	NI-63	MBL	06/23/16 00:00	1.00E+00	0.00	0.00	0.00			
03	NI-63	DUP	06/15/16 13:40	1.31E-01	0.00	0.00	0.00			
04	NI-63	DMSO	06/15/16 13:40	1.31E-01	0.00	0.00	0.00			
05	NI-63	MS	06/15/16 13:40	1.31E-01	0.00	0.00	0.00			

Preliminary Data Report & Analytical Calculations
Work Order: 16-06111-Ni063-1

Client	Eberline Analytical Work Order	Analysis Code	Run
Washington Closure Hanford	16-06111	Ni063	1

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	NI-63	LCS	07/08/16 16:15	36561.525	3100A	1	60	107994	18.6	0.487977746
02	NI-63	MBL	07/08/16 17:18	36561.525	3100A	2	60	1044	18.6	0.498856793
03	NI-63	DUP	07/08/16 18:20	36561.525	3100A	3	60	198294	18.6	0.471485887
04	NI-63	DMSO	07/08/16 19:23	36561.525	3100A	4	60	314454	18.6	0.467147396
05	NI-63	MS	07/08/16 20:27	36561.525	3100A	5	60	457326	18.6	0.193019297

Count Room Report
Client: Washington Closure Hanfor

16-06111-Ni063-1 (pCi/g) in SO
Tracer ID:

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	06/23/16 00:00	1.0000				0.00		
02	MBL	BLANK	06/23/16 00:00	1.0000				0.00		
03	DUP	J1V930-A SAF: RC-242	06/15/16 13:40	0.1313				0.00		
04	DMSO	J1V930-A SAF: RC-242	06/15/16 13:40	0.1313				0.00		
05	MS	J1V930-A SAF: RC-242	06/15/16 13:40	0.1313				0.00		

Eberline Analytical
Oak Ridge Laboratory

Spike and Tracer Worksheet

Printed: 7/8/2016 11:09 AM

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
16-06111	1	Ni063	7/8/2016 11:09	EBAILEY		

LCS & Matrix Spikes					LCS	MS	LCSD	MSD	LCS		MS		LCSD		MSD	
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	Volume Used (g)	Volume Used (g)	Volume Used (g)	Volume Used (g)	Known pCi	Error Estimate	Added pCi	Error Estimate	Known pCi	Error Estimate	Added pCi	Error Estimate
Ni-63	Ni-3	21872.040	7/8/2016	0.150	0.1556	1.2767	0.1593		1533.01	45.990	12578.79	377.364	1569.47	47.084	0.00	0.000

Tracers

fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition
01	Ni-63MS	Ni-3	21872.040	7/8/2016		0.1500
02	Ni-63MS	Ni-3	21872.040	7/8/2016		0.1500
03	Ni-63MS	Ni-3	21872.040	7/8/2016		0.1500
04	Ni-63MS	Ni-3	21872.040	7/8/2016		0.1500
05	Ni-63MS	Ni-3	21872.040	7/8/2016		0.1500

Balance Printer Tapes

Tracer	LCS

Matrix Spike

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
16-06111	1	Ni063	grams	7/8/2016	MMCDOUGALL

Lab Fraction	Washington Closure Hanford Client ID	Sample Type	Muffle Data	Dilution Data			Aliquot Data		MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	J1V930-A SAF: RC-242	DUP		1	22.84	4.38E-02	3.0000E+00	1.3134E-01				
04	J1V930-A SAF: RC-242	DMSO		1	22.84	4.38E-02	3.0000E+00	1.3134E-01				
05	J1V930-A SAF: RC-242 MS	MS		1	22.84	4.38E-02	3.0000E+00	1.3134E-01				

Comments	

Technician: _____ Date: ____/____/____

EBERLINE SERVICES	Internal Work Order	16-06111
	Fraction	> 03 <
Dilution Worksheet	Analysis Code	Ni063
	Run Number	1
	Analyst	MMCDOUGALL

Dilution Number	...	Amount Taken	Units	...	Diluted To	Units	Ratio
1	I took	**4.378**	ml	from the original sample and diluted it to	**100**	ml	0.0438
2	I took		ml	from the 1st dilution and diluted it to		ml	
3	I took		ml	from the 2nd dilution and diluted it to		ml	
4	I took		ml	from the 3rd dilution and diluted it to		ml	
5	I took		ml	from the 4th dilution and diluted it to		ml	

Dilutions Taken	1

Dilution Ratio	**0.04378**
Dilution Factor	**22.84148013**

Diluted by: [signature]

Date: 6/28/16

00127

EBERLINE SERVICES	Internal Work Order	16-06111
	Fraction	> 04 <
Dilution Worksheet	Analysis Code	Ni063
	Run Number	1
	Analyst	MMCDOUGALL

Dilution Number	...	Amount Taken	Units	...	Diluted To	Units	Ratio
1	I took	**4.378**	ml	from the original sample and diluted it to	**100**	ml	0.0438
2	I took		ml	from the 1st dilution and diluted it to		ml	
3	I took		ml	from the 2nd dilution and diluted it to		ml	
4	I took		ml	from the 3rd dilution and diluted it to		ml	
5	I took		ml	from the 4th dilution and diluted it to		ml	

Dilutions Taken	1

Dilution Ratio	**0.04378**
Dilution Factor	**22.84148013**

Diluted by: _____ Date: 6/28/16

.00128

EBERLINE SERVICES	Internal Work Order	16-06111
	Fraction	> 05 <
Dilution Worksheet	Analysis Code	**Ni063**
	Run Number	**1**
	Analyst	**MMCDOUGALL**

Dilution Number	...	Amount Taken	Units	...	Diluted To	Units	Ratio
1	I took	**4.378**	ml	from the original sample and diluted it to	**100**	ml	0.0438
2	I took		ml	from the 1st dilution and diluted it to		ml	
3	I took		ml	from the 2nd dilution and diluted it to		ml	
4	I took		ml	from the 3rd dilution and diluted it to		ml	
5	I took		ml	from the 4th dilution and diluted it to		ml	

Dilutions Taken	1

Dilution Ratio	**0.04378**
Dilution Factor	**22.84148013**

Diluted by: [signature]

Date: 6/28/16

00129

Work Order #	16-06111		Ni-63 Recovery			EBERLINE SERVICES	
tSIE	EFFICIENCY	Recovery Spike Activity	Grams Added	Total Activity	cpm	Bkg, cpm	RF
213.21	23.331%	21873.28	0.1593	3484.413504	1657.8	18.6	2.02

7/11/2016 9:15

Efficiency = 1.923E-08x3 - 1.264Ex2 +3.013E-03x -2.1070R-02

RECOVERY FACTOR

2.01638681

Remarks

A
7/9/16
KB

Assay Definition-

Assay Description:
ni-63

Assay Type: CPM
Report Name: Report1
Output Data Path: C:\Packard\Tricarb\Results\Default\Ni63-cpm-21\20160708_1613
Raw Results Path: C:\Packard\Tricarb\Results\Default\Ni63-cpm-21\20160708_1613\20160708_1613.results
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Default\Ni63-cpm-21\20160708_1613\1606111 ni63a.csv
Assay File Name: C:\Packard\TriCarb\Assays\Ni63-cpm-21.lsa

Count Conditions-

Nuclide: 63Ni
Quench Indicator: tSIE
External Std Terminator (sec): 0.5 2s%
Pre-Count Delay (min): 1.00
Quench Set: n/a
Count Time (min): 60.00
Count Mode: Normal
Assay Count Cycles: 1 Repeat Sample Count: 1
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: Off
Low CPM Threshold: Off
2 Sigma % Terminator: Off

Regions	LL	UL
A	0.0	75.0
B	2.0	75.0
C	0.0	150.0

Count Corrections-

Static Controller: On Luminescence Correction: Off
Colored Samples: n/a Heterogeneity Monitor: n/a
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

Half Life-

Half Life Correction: Off

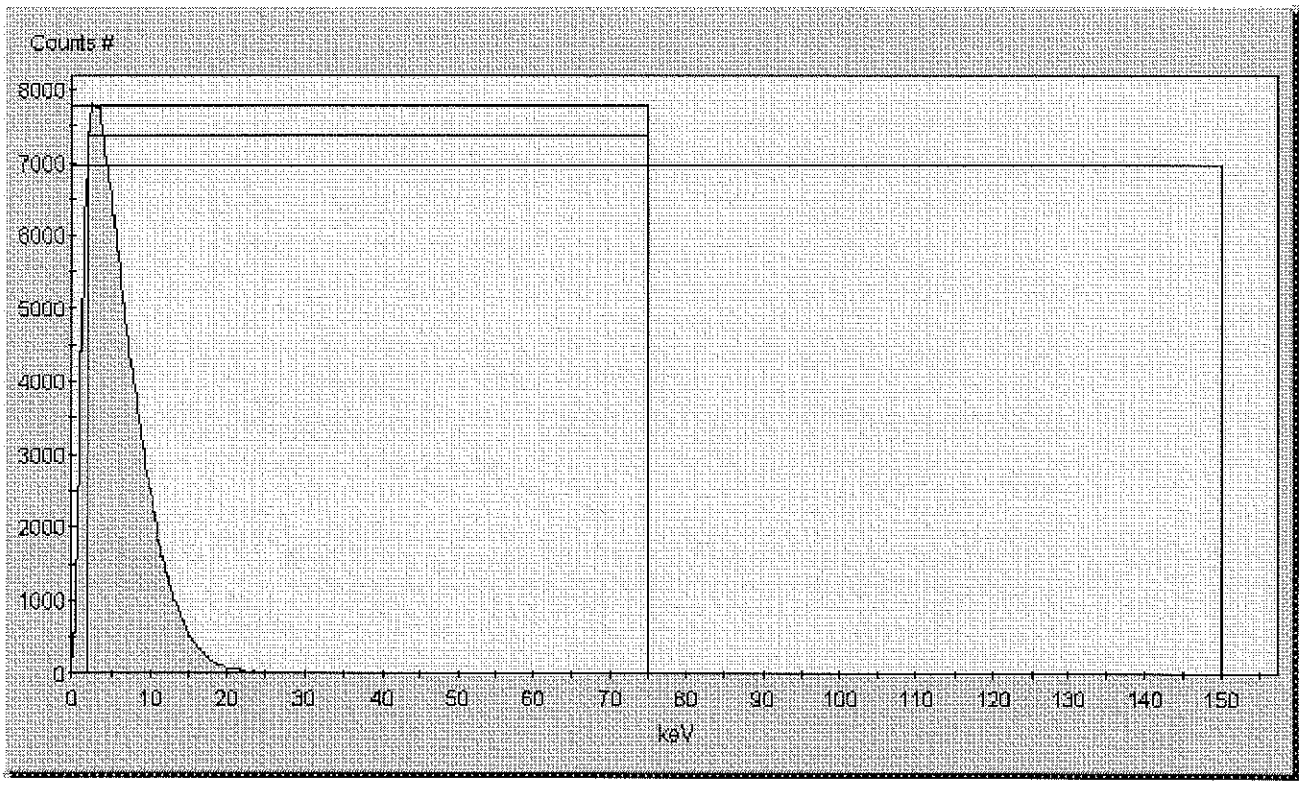
Regions	Half Life	Units	Reference Date	Reference Time
A				
B				
C				

Cycle 1 Results

DATE	TIME	SMPL_ID	P#	PID	S#	CPMA	CPMB	CPMC	tSIE	Count Time
	16-06111-1-N63-01S		21	13	1	1989.5	1799.9	1992.1	247.82	60.00

7/8/2016 4:15:13 PM

SpectraView Block Data



16-06111-1-N63-02S	21	13	2	18.3	17.4	21.1	264.47	60.00

7/8/2016 5:18:15 PM

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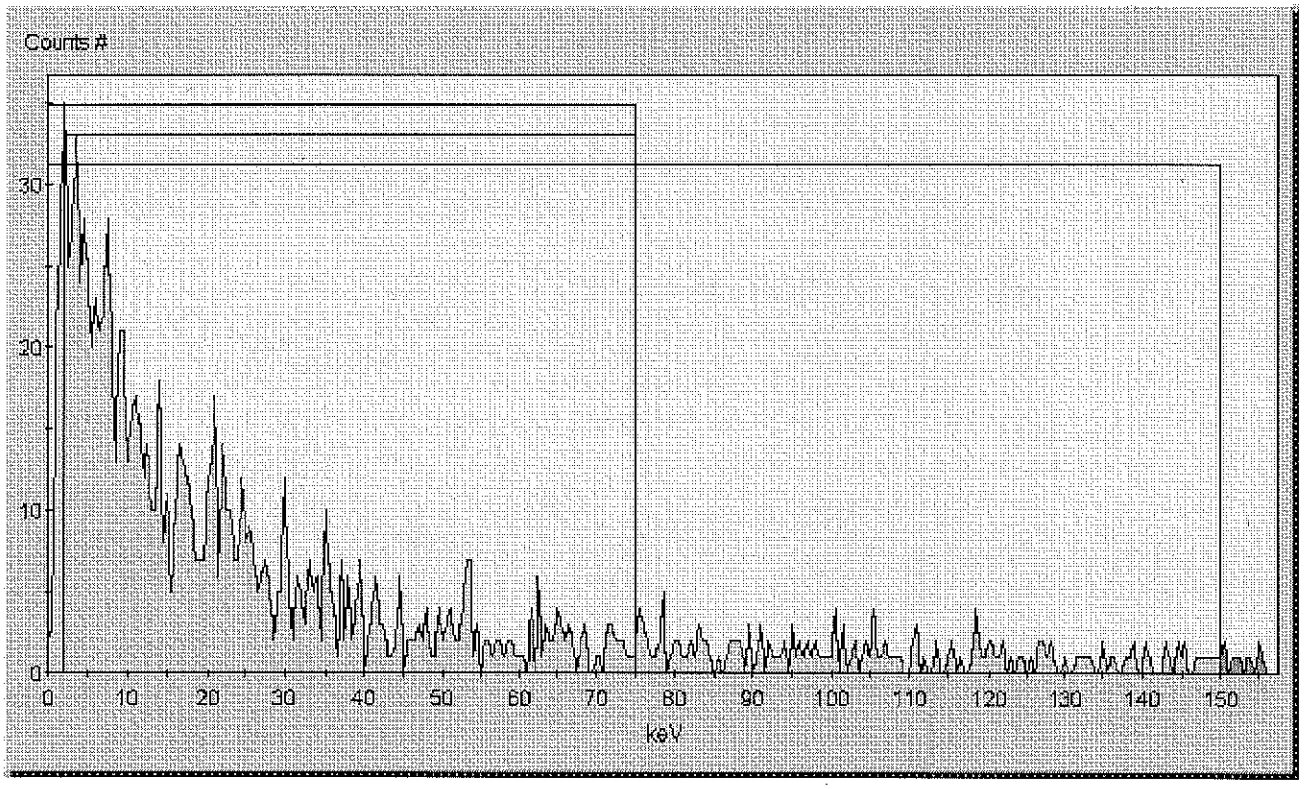

16-06111-1-N63-03S 21 13 3 3442.8 3304.9 4537.8 216.11 60.00
7/8/2016 6:20:29 PM

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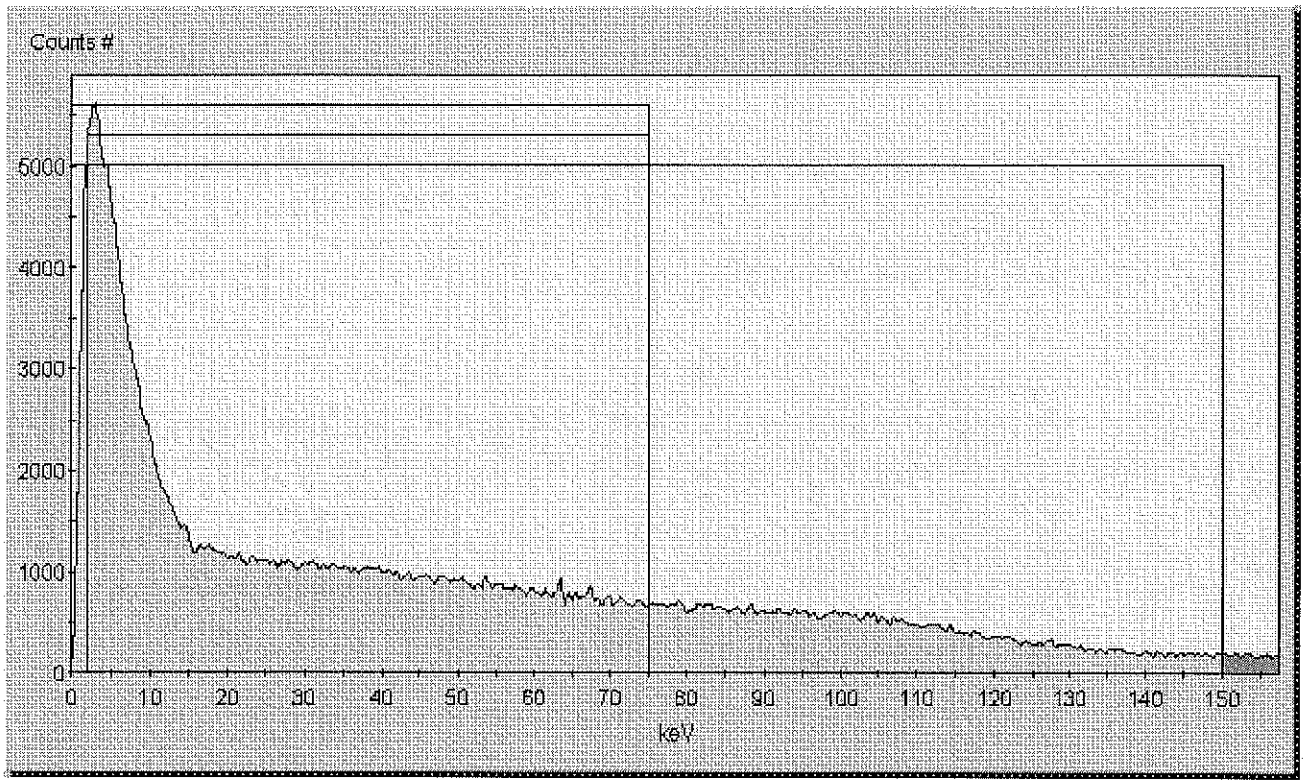

16-06111-1-N63-04S 21 13 4 5437.7 5240.9 7239.4 207.40 60.00
7/8/2016 7:23:40 PM

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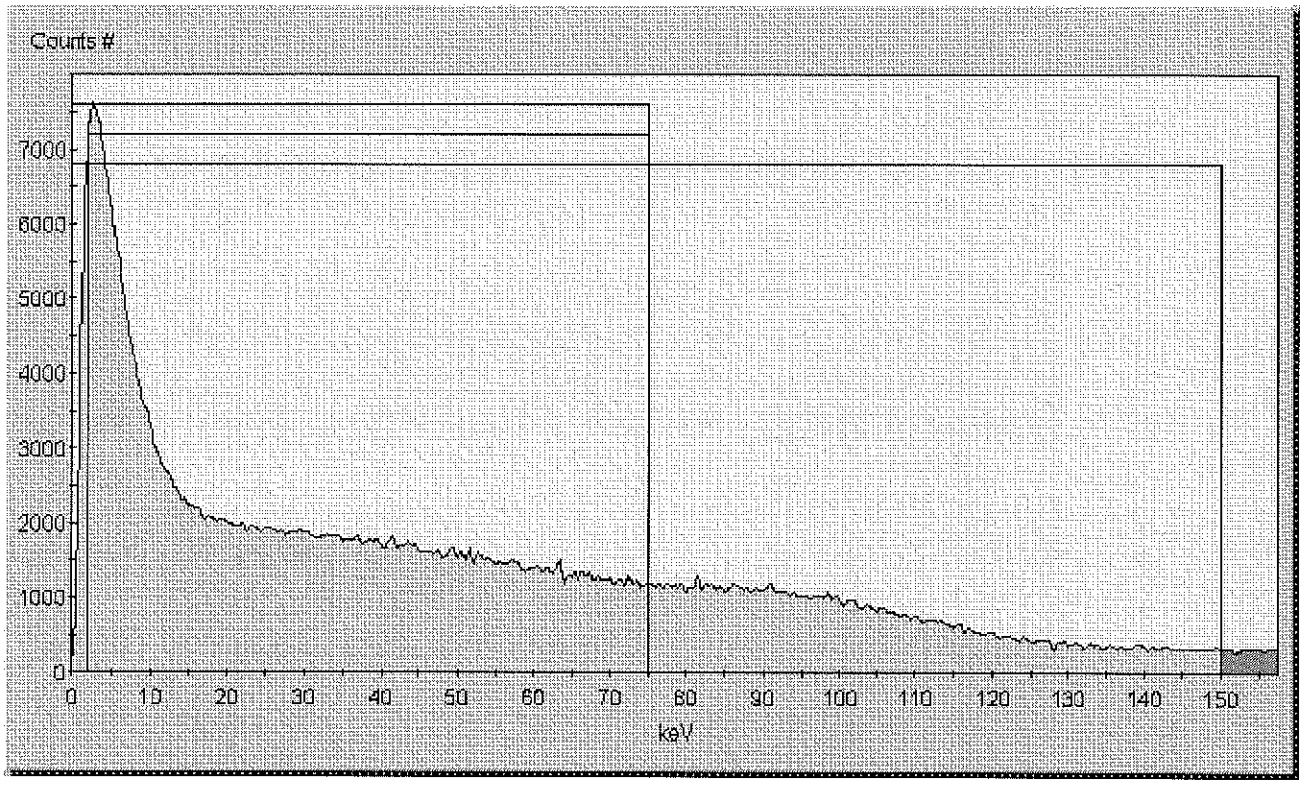

16-06111-1-N63-05S	21	13	5	7954.9	7622.1	8221.3	47.57	60.00

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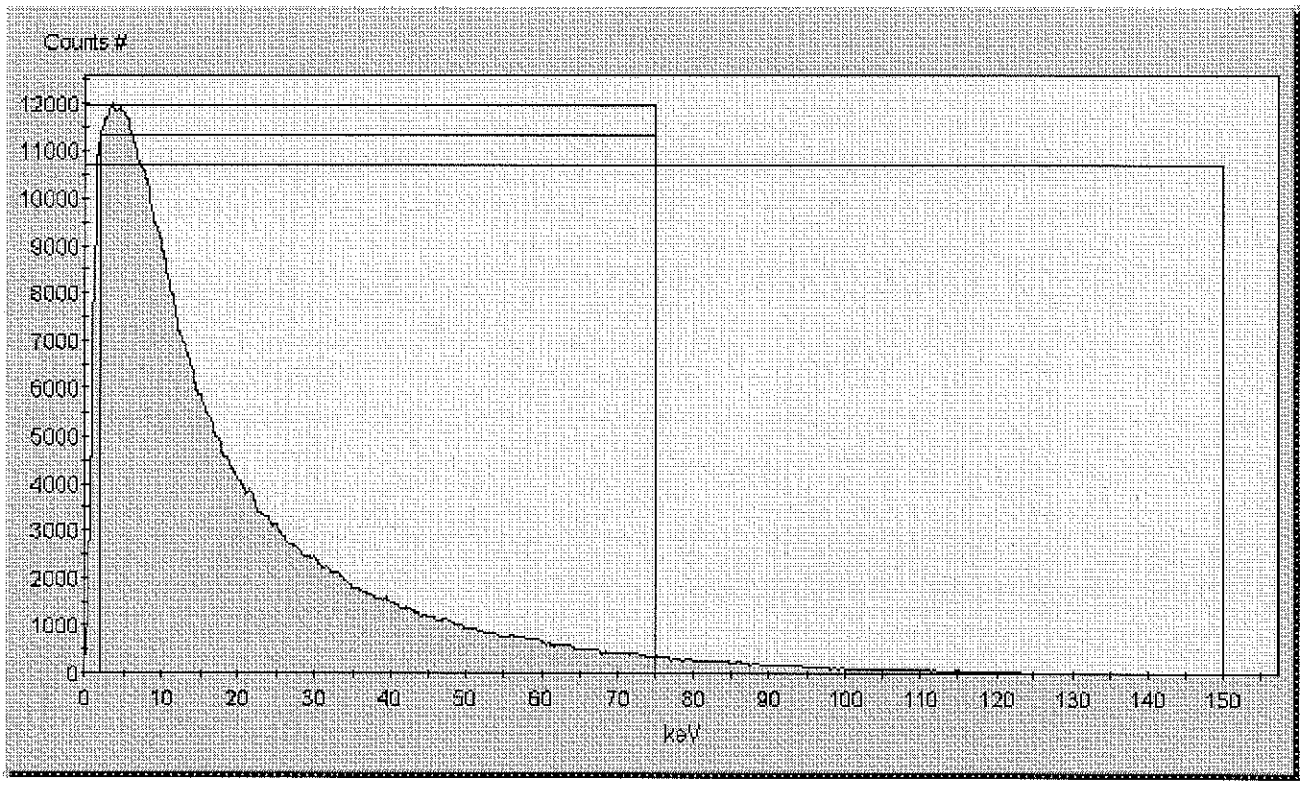

Sample #6	21	13	6	19.4	18.6	22.6	247.64	60.00

7/8/2016 9:30:37 PM

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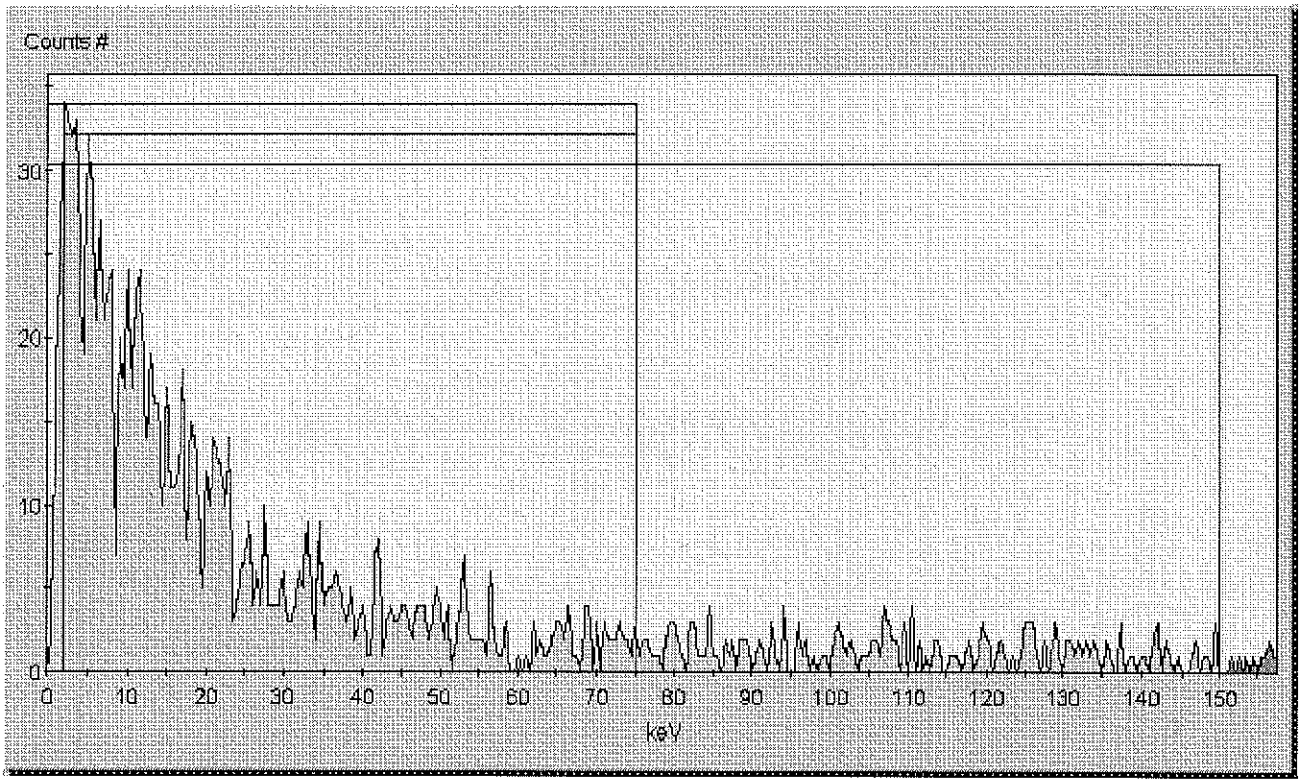

Sample #7	21	13	7	1862.2	1657.8	1864.7	213.21	60.00

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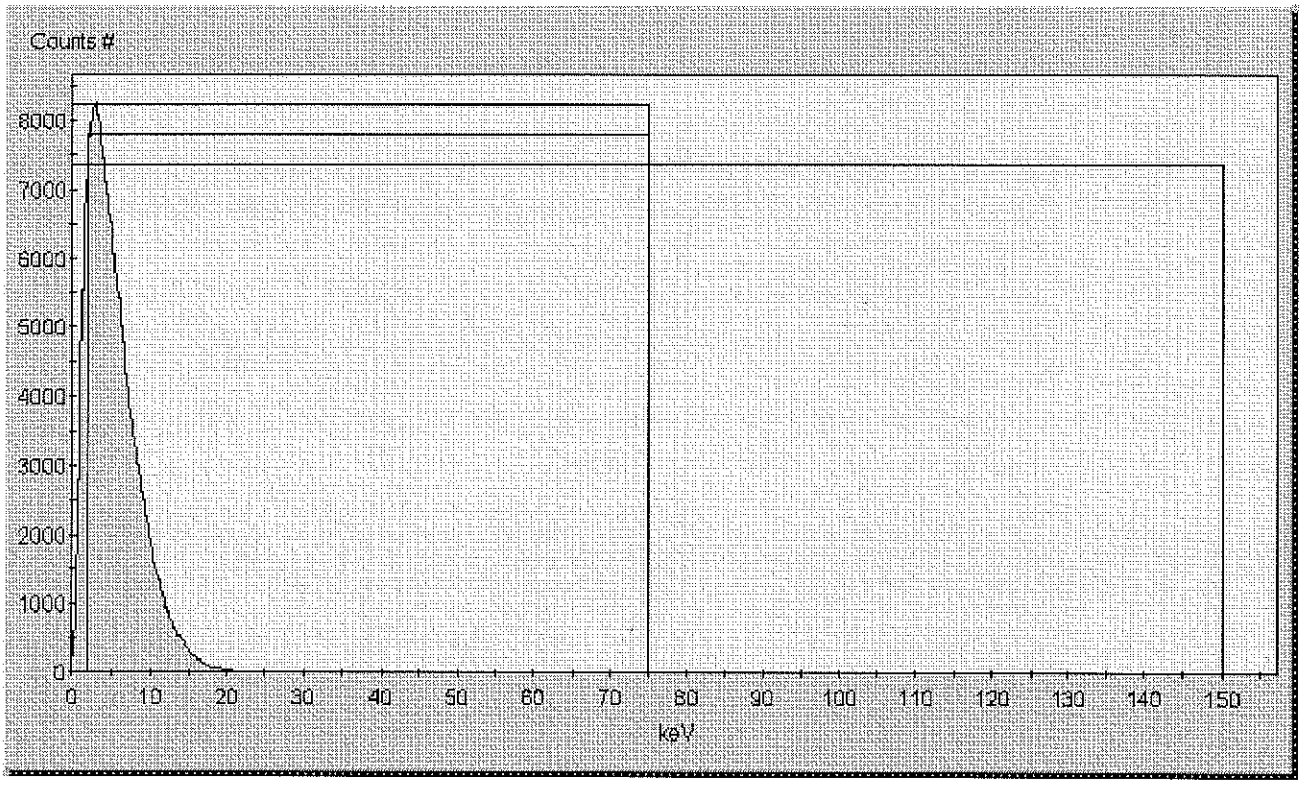
Counts #
8000
7000
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
keV

SNC Protocol

Calibration Information
Software Version IC: 2.11
Software Version EC: 2.02
Instrument Model: Tri-Carb 3100TR
Instrument Serial Number: 426825
3H Chi Square: 20.48 Date Processed: 7/8/2016 5:16:02 AM
14C Chi Square: 8.07 Date Processed: 7/8/2016 5:16:02 AM
3H E^2/B (1-18.6 keV): 275.16 Date Processed: 7/8/2016 5:16:02 AM
14C E^2/B (4-156 keV): 527.18 Date Processed: 7/8/2016 5:16:02 AM
3H Efficiency (0-18.6 keV): 60.53 Date Processed: 7/8/2016 5:16:02 AM
14C Efficiency (0-156 keV): 95.56 Date Processed: 7/8/2016 5:16:02 AM
IPA Background Date Processed: 7/8/2016 5:16:02 AM
3H Background CPM (0-18.6 keV): 13.35 Date Processed: 7/8/2016 5:16:02 AM
14C Background CPM (0-156 keV): 20.73 Date Processed: 7/8/2016 5:16:02 AM
3H Calibration DPM: 183600
3H Reference Date: 2/27/2007
14C Calibration DPM: 136900