

9613477.1248

LK6496
69
2

START

Lockheed Environmental Systems & Technologies Co.
Lockheed Analytical Services
975 Kelly Johnson Drive Las Vegas, Nevada 89119-3705
Telephone 702-361-0220 800-582-7605 Facsimile 702-361-8146

0045290



March 25, 1996

Ms. Joan Kessner
Bechtel Hanford, Inc.
P.O. Box 969
1022 Lee Boulevard
Richland, WA 99352



RE:	Log-in No.:	L6496
	Quotation No.:	Q400000-B
	SAF:	B96-048
	Document File No.:	0222596
	WHC Document File No.:	331
	SDG No.:	LK6496

The attached data report contains the analytical results of samples that were submitted to Lockheed Analytical Services on 22 February 1996.

The temperature of the cooler upon receipt was 2°C. Sample containers received agree with the chain-of-custody documentation. Sample containers were received intact. Samples designated for nitrate, nitrite, and phosphate analysis by method 300.0 were not received in time to meet the analytical holding time requirements.

The case narratives included in the following attachments provide a detailed description of all events that occurred during sample preparation, analysis, and data review specific to the samples and analytical methods requested.

A list of data qualifiers, chain-of-custody forms, sample receiving checklist, and log-in report are also enclosed representing the samples received within this group.

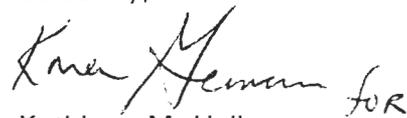
If you have any questions concerning the analysis or the data please call Kathleen M. Hall at (509) 375-4741.

Lockheed Analytical Services

Log-in No.: L6496
Quotation No.: Q400000-B
SAF: B96-048
Document File No.: 0222596
WHC Document File No.: 331
SDG No.: LK6496

" I certify that this data package is in compliance with the SOW, 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 Laboratory Manger or a designee, as verified by the following signature."

Sincerely,



Kathleen M. Hall
Client Services Representative

cc: Client Services
Document Control

Lockheed Analytical Services

Log-in No.: L6496
 Quotation No.: Q400000-B
 SAF: B96-048
 Document File No.: 0222596
 WHC Document File No.: 331
 SDG No.: LK6496

**CASE NARRATIVE
 INORGANIC NON METALS ANALYSES
 WATER**

The routine calibration and quality control analyses performed for this batch include as applicable: initial and continuing calibration verification, initial and continuing calibration blanks, method blank(s), laboratory control sample(s), matrix spike sample(s), and duplicate sample(s).

Preparation and Analysis Requirements

- One water sample was received for LK6496 and analyzed in batch 222 bh for selected analytes as requested on the chain of custody. Quality control analysis was performed on the following samples:

Client ID	LAL #		Method
BOHOV4	L6496-3	MS, DUP	300.0 Chloride, Nitrate as Nitrogen, Nitrite as Nitrogen, Orthophosphate and Sulfate
	L6496-4	MS, DUP	353.2 Nitrate-Nitrite-Nitrogen
	L6496-5	MS, DUP	9030 Sulfide
	L6496-6	MS, DUP	350.1 Ammonia

Holding Time Requirements

- All samples were analyzed within the method-specific holding times with the following exception of Method 300.0 Nitrate as Nitrogen, Nitrite as Nitrogen and Method 353.2 Nitrate-Nitrite-Nitrogen. The associated samples are flagged with an "H".

Method Blanks

- The concentration levels of all the requested analytes in the method blank were below the reporting detection limits.

Internal Quality Control

- All Internal Quality Control were within acceptance limits.

Kay McCann
 Prepared By

March 1, 1996
 Date

Lockheed Analytical Services

Log-in No.: L6496
Quotation No.: Q400000-B
SAF: B96-048
Document File No.: 0222596
WHC Document File No.: 331
SDG No.: LK6496

**CASE NARRATIVE
INORGANIC METALS ANALYSES
WATERS AND FILTERED WATER**

The routine calibration and quality control analyses performed for this batch include as applicable: instrument tune (ICP/MS only), initial and continuing calibration verification, initial and continuing calibration blanks, method blank(s), laboratory control sample(s), ICP interference check samples (ICP only), serial dilutions, analytical (post-digestion) spike samples, matrix spike (predigestion) sample(s), duplicate sample(s).

Preparation and Analysis Requirements

All samples were received on February 22, 1996. The samples were logged in as L6496 and were prepared and analyzed in batches 222 bhT for total metals and 222 bhD for dissolved metals.

Holding Time Requirements

- All samples were analyzed within the method-specific holding times.

Method Blanks

- The concentration levels of all the requested analytes in the method blank were below the reporting detection limits.

Internal Quality Control

- All Internal Quality Control were within acceptance limits with the following exception: The matrix spike recovery for aluminum (157%) was outside of acceptance limits for batch 222 bhT. The recovery based on the LCS (108.1%) supports that the analytical system was operating within control limits.

Shellee McGrath
Prepared By

March 25, 1996
Date

Lockheed Analytical Services

Log-in No.: L6496
Quotation No.: Q400000-B
SAF: B96-048
Document File No.: 0222596
WHC Document File No.: 331
SDG No.: LK6496

CASE NARRATIVE RADIOCHEMICAL ANALYSES

The routine calibration and quality control (QC) analyses performed for this batch include as applicable: instrument calibration, initial and continuing calibration verification, quench monitoring standards, instrument background analysis, method blanks, yield tracer, laboratory control samples, matrix spike samples, and duplicate samples.

NOTE: Chemical recoveries and minimum detectable activities (MDAs), where applicable, can be found on the calculation and preparation sheets of the attached raw data for each method.

Holding Time Requirements

All holding times were met.

Gas Proportional Counter

Analytical Method Gross Alpha/Beta

The gross alpha/beta analysis was performed using standard operating procedure (SOP), LAL-91-SOP-0060. The samples were analyzed in workgroup 34110. The instrument calibration verification met criteria. The method blank was within QC criteria. The laboratory control sample (LCS) and matrix spike (MS) recoveries were within QC criteria. The duplicate (DUP) recoveries were within QC criteria. The MDA exceeded the reporting detection limit due to residue weight limitations forcing a volume reduction. The associated samples are flagged with a "C" qualifier. No re-analyses were performed.

Analytical Method Strontium-90

The strontium-90 analysis was performed using SOP, LAL-91-SOP-0196. The samples were analyzed in workgroup 34046. The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS recovery was within QC criteria. The DUP recoveries were within QC criteria. No re-analyses were performed.

Lockheed Analytical Services

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Liquid Scintillation Counter*Analytical Method Carbon-14*

The carbon-14 analysis was performed using SOP, LAL-93-SOP-0209. The samples were analyzed in workgroup 34132. The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS and MS recoveries were within QC criteria. The DUP recoveries were within QC criteria. The quench value was within curve limitations. No re-analyses were performed.

Analytical Method Tritium

The tritium analysis was performed using SOP, LAL-91-SOP-0066. The samples were analyzed in workgroup 34127. The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS and MS recoveries were within QC criteria. The DUP recoveries were within QC criteria. The quench value was within curve limitations. No re-analyses were performed.

Yvonne M. Jacoby
Prepared By

March 13, 1996
Date

9613477.1254

LOCKHEED ANALYTICAL SERVICES
 LOGIN CHAIN OF CUSTODY REPORT (1n01)
 Mar 11 1996, 02:41 pm

Login Number: L6496
 Account: 596 Bechtel Hanford, Inc. * Richland, WA
 Project: BECHTEL-HANFORD Bechtel Hanford Project

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	Due PR Date
L6496-1 TEMP 2 Location: 156-017 Water 1 S SCREENING	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:18-AUG-96		
* L6496-2 TEMP 2 Location: 156RAD1-04 Water 1 S 6010 ICP METALS Water 1 S 6010 ICP TRACE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:18-AUG-96		
		Hold:18-AUG-96		
L6496-3 TEMP 2 Location: RFG10-101B Water 1 S 300.0 CHLORIDE Water 1 S 300.0 NITRATE Water 1 S 300.0 NITRITE Water 1 S 300.0 PHOSPHATE Water 1 S 300.0 SULFATE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:19-MAR-96		
		Hold:22-FEB-96		
		Hold:22-FEB-96		
		Hold:22-FEB-96		
		Hold:19-MAR-96		
L6496-4 TEMP 2 Location: RFG10-101B Water 1 S 353.2 NITRATE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:19-MAR-96		
L6496-5 TEMP 2 Location: 156V-I030 Water 1 S 9030 SULFIDE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:27-FEB-96		
L6496-6 TEMP 2 Location: RFG10-101B Water 1 S 350.1 NH3/N	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:19-MAR-96		
L6496-7 TEMP 2 Location: EXPENDED Water 1 S GR ALP/BETA LAL-0060 Water 1 S SR-90 LAL-0196	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:18-AUG-96		
		Hold:18-AUG-96		
L6496-8 TEMP 2 Location: 156-023D	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96

9613477-1255

LOCKHEED ANALYTICAL SERVICES
 LOGIN CHAIN OF CUSTODY REPORT (ln01)
 Mar 11 1996, 02:41 pm

Login Number: L6496
 Account: 596 Bechtel Hanford, Inc. * Richland, WA
 Project: BECHTEL-HANFORD Bechtel Hanford Project

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	Due PR Date
L6496-9 TEMP 2 Location: 156-023D	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-10 TEMP 2 Location: 156-023D	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-11 TEMP 2 Location: 156-023D	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-12 TEMP 2 Location: 155 Water 1 S C-14 LAL-0209 Hold:18-AUG-96 Water 1 S TRITIUM(H3) LAL-0066 Hold:18-AUG-96	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
* L6496-13 TEMP 2 Location: 156RAD1-04 Filt H2O 15 S 6010 ICP METALS Hold:18-AUG-96 Filt H2O 15 S 6010 ICP TRACE Hold:18-AUG-96	BOHOV5	20-FEB-96	22-FEB-96	28-MAR-96
L6496-14 Location: Water 1 S EDD - DISK DEL. Water 1 S INORG TYPE 2 RPT Water 1 S RAD RPT TYPE 2	REPORT TYPE	22-FEB-96	22-FEB-96	28-MAR-96

* ADDED 6010 ICP TRACE FOR PURPOSE OF ANALYSIS

Signature: R. Callahan

Date: 3-11-96

02225

9613477.1256

LOCKHEED ANALYTICAL SERVICES
 LOGIN CHAIN OF CUSTODY REPORT (ln01)
 Feb 22 1996, 07:07 pm

Login Number: L6496
 Account: 596 Bechtel Hanford, Inc. * Richland, WA
 Project: BECHTEL-HANFORD Bechtel Hanford Project

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	Due PR Date
L6496-1 TEMP 2 Location: 157 Water 1 S SCREENING	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
			Hold:18-AUG-96	
L6496-2 TEMP 2 Location: 157 Water 1 S 6010 ICP METALS	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
			Hold:18-AUG-96	
L6496-3 TEMP 2 Location: 157 Water 1 S 300.0 CHLORIDE Water 1 S 300.0 NITRATE Water 1 S 300.0 NITRITE Water 1 S 300.0 PHOSPHATE Water 1 S 300.0 SULFATE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
			Hold:19-MAR-96	
			Hold:22-FEB-96	
			Hold:22-FEB-96	
			Hold:22-FEB-96	
			Hold:19-MAR-96	
L6496-4 TEMP 2 Location: 157 Water 1 S 353.2 NITRATE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
			Hold:19-MAR-96	
L6496-5 TEMP 2 Location: 157 Water 1 S 9030 SULFIDE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
			Hold:27-FEB-96	
L6496-6 TEMP 2 Location: 157 Water 1 S 350.1 NH3/N	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
			Hold:19-MAR-96	
L6496-7 TEMP 2 Location: 157 Water 1 S GR ALP/BETA LAL-0060 Water 1 S SR-90 LAL-0196	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
			Hold:18-AUG-96	
			Hold:18-AUG-96	
L6496-8 TEMP 2 Location: 157	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96

9613477.1257

LOCKHEED ANALYTICAL SERVICES
 LOGIN CHAIN OF CUSTODY REPORT (ln01)
 Feb 22 1996, 07:07 pm

Login Number: L6496
 Account: 596 Bechtel Hanford, Inc. * Richland, WA
 Project: BECHTEL-HANFORD Bechtel Hanford Project

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	Due PR Date
L6496-9 TEMP 2 Location: 157	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-10 TEMP 2 Location: 157	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-11 TEMP 2 Location: 157	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-12 TEMP 2 Location: 157	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
Water 1 S C-14 LAL-0209			Hold:18-AUG-96	
Water 1 S TRITIUM(H3) LAL-0066			Hold:18-AUG-96	
L6496-13 TEMP 2 Location: 157	BOHOV5	20-FEB-96	22-FEB-96	28-MAR-96
Filt H2O 15 S 6010 ICP METALS			Hold:18-AUG-96	
L6496-14 Location:	REPORT TYPE	22-FEB-96	22-FEB-96	28-MAR-96
Water 1 S EDD - DISK DEL.				
Water 1 S INORG TYPE 2 RPT				
Water 1 S RAD RPT TYPE 2				

Signature: *Paul Daus*

Date: 2-22-96

0011
0223546

Bechtel Hanford, Inc.

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

L 6496

Data Turnaround
 Priority
 Normal

Collector <i>H. Rizzo / B. Whitten</i>	Company Contact Bob Raidl	Telephone (509) 372-9641
Project Designation 100-HR-3 Groundwater Sampling, Round 10, Phase 2	Sampling Location 100 D	SAF No. B96-048
Ice Chest No. <i>5ML-189</i>	Field Logbook No. <i>EC-1289</i>	Method of Shipment Federal Express
Shipped To Lockheed	Offsite Property No. <i>W96-0-0640-30</i>	Bill of Lading/Air Bill No. <i>2904651461</i>

Possible Sample Hazards/Remarks	Preservation	HNO ₃	Cool 4°C	H ₂ SO ₄	*1	H ₂ SO ₄	HNO ₃	Cool 4°C	Cool 4°C	HNO ₃
	Type of Container	G	G	P/G	P	P/G	P/G	G	P/G	G
	No. of Container(s)	1	1	1	1	1	5	1	1	1
Special Handling and/or Storage Maintain samples between 2°C and 6°C.	Volume	500mL	500mL	500mL	1L	1L	1L	1L	20mL	500mL

SAMPLE ANALYSIS	ICP Metals (Unfiltered)	Anions (IC) - Cl, SO ₄ , NO ₂ , NO ₃ , PO ₄	NO ₂ - NO ₃	Sulfide	Ammonia	Gross Alpha, Gross Beta, Sr-90	Tritium, C-14	Activity Scan	ICP Metals (Filtered)
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Sample No.	Matrix *	Date Sampled	Time Sampled	ICP Metals (Unfiltered)	Anions (IC)	NO ₂ - NO ₃	Sulfide	Ammonia	Gross Alpha, Gross Beta, Sr-90	Tritium, C-14	Activity Scan	ICP Metals (Filtered)
BOHOV4	W	<i>2-20-96</i>	<i>1115</i>	<i>Y</i>	<i>Y</i>	<i>Y</i>	<i>X</i>	<i>O</i>	<i>X</i>	<i>X</i>	<i>Y</i>	
BOHOV5	W	<i>2-20-96</i>	<i>1115</i>									<i>X</i>

CHAIN OF POSSESSION	Sign/Print Names	SPECIAL INSTRUCTIONS *1 ZnAc + NaOH	Matrix *
Relinquished By <i>R. Fazio</i>	Date/Time <i>1500</i>	Received By <i>R. Fazio</i>	Date/Time <i>1500</i>
Relinquished By <i>R. Fazio</i>	Date/Time <i>2/20/96</i>	Received By <i>B. Whitten</i>	Date/Time <i>2-20-96</i>
Relinquished By <i>B. Whitten</i>	Date/Time <i>0800</i>	Received By <i>B. Whitten</i>	Date/Time <i>2-21-96</i>
Relinquished By	Date/Time	Received By	Date/Time
Relinquished By	Date/Time	Received By	Date/Time

Sample analysis for phosphate, nitrate, and nitrite by EPA 300.0 is being requested for information only. The ERC Contractor acknowledges that the 48-hour holding time will not be met.

The Activity Scan is for all samples listed on this chain of custody.

LABORATORY SECTION	Received By <i>A. Mills</i>	Title <i>Sample Custodian</i>	Date/Time <i>2-22-96/0845</i>
FINAL SAMPLE	Disposal Method	Disposed By	Date/Time

015
265-2-96

615977
258

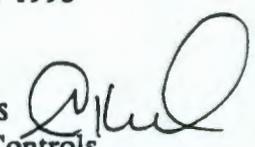
Environmental
Restoration
Contractor

ERC Team

Interoffice Memorandum

Job No. 22192
Written Response Required: NO
CCN: N/A
OU: 100-HR-3
TSD: N/A
ERA: N/A
Subject Code: 5850

TO: W. S. Thompson ~~N3-06~~ DATE: November 28, 1995
R. F. Raidl H9-03

COPIES: J. E. Parsons X0-23 FROM: S. K. De Mers 
F. G. Zwiesler X0-23 Radiological Controls
T. L. Lafreniere X0-23 T7-05/373-1913

SUBJECT: 1995 Phase 2, Round 10 sampling for 100-HR-3

There is no need to perform total activities prior to offsite shipment to NRC licensed labs of samples taken from the attached list of wells.

All wells listed in the attachment were reviewed for radiological content based on the previous 4 years of sampling data. No well listed has a β activity in excess of 100,000 pCi/l (< .1 uCi/sample based on a 1 liter sample size) nor any α activity in excess of 10,000 pCi/l (< .01 uCi/l based on a 1 liter sample). All wells show activities < 2,000 pCi/gm (< 2 nCi/gm D.O.T. limit). The highest activity in recent samples is 44,000 pCi/l β (H³) and 10 pCi/l α .

Radiological monitoring during sampling will only be required if the wells are located in radiological areas or if the wells themselves are labeled with radiological stickers. Monitoring requirements for down hole work such as pump removal will be determined based on the history of each well on a case by case basis.

Attachment - 1995 Phase 2, Round 10 well list for 100 HR-3
skd

100-HR-3 GROUNDWATER SAMPLING, PHASE 2, ROUND 10

199-D5-13
199-D8-4
199-D8-5
199-D8-6
199-D2-5
199-D2-6
199-D5-12
199-D5-14
199-D5-15
199-D5-16
199-D5-17
199-D5-18
199-D5-19
199-D5-20
199-D8-3
199-D8-53
199-D8-54A
199-D8-54B
199-D8-55
699-91-46A
699-93-48A
699-96-49
699-97-51A
699-101-48A
199-H4-9

SAMPLE CHECK-IN LIST

Date/Time Received: 2-22-96-0900

SDG#: n/a

Work Order Number: n/a

SAF #: B96-048

Shipping Container ID: Sml-159

Chain of Custody # n/a

- 1. Custody Seals on shipping container intact? Yes No
- 2. Custody Seals dated and signed? Yes No
- 3. Sample temperature 22
- 4. Vermiculite/packing materials is Wet Dry
- 5. Each sample is in a plastic bag? Yes No
- 6. Sample holding times exceeded? Yes No

7. Samples have:

<input type="checkbox"/> tape	<input type="checkbox"/> hazard labels
<input checked="" type="checkbox"/> custody seals	<input type="checkbox"/> appropriate sample labels

8. Samples are:

<input checked="" type="checkbox"/> in good condition	<input type="checkbox"/> leaking
<input type="checkbox"/> broken	<input type="checkbox"/> have air bubbles

9. Is the information on the COC and Sample bottles in agreement?
 Yes No

Notes: n/a

Sample Custodian/Laboratory: Paula Davis / LHS Date: 2-22-96
 Telephoned To: Kathleen Hale On 2-22-96 By Paula Davis
new 2-22-96

LOCKHEED MARTIN



Sample Login Login Review Checklist

Lot Number L6496

The login review should be conducted by that person logging in the samples as well as a peer. Please use this checklist to ensure that such reviews occur in a uniform basis. Please sign and date below to verify that a login review has occurred. This checklist should be affixed to each login package prior to distribution.

For effective login review, at a minimum, five reports form the login process are required. These are the COC (or equivalent), the login COC report, the sample summary report, the sample receiving checklist, and the login quotation. Before beginning review, ensure that these five components are available. Jobs with single component samples, the sample summary report may be omitted.

SAMPLE SUMMARY REPORT

	<u>YES</u>	<u>NO</u>	<u>N/A</u>	<u>Comment</u>
1. Are all sample ID's correct?	X	—	—	_____
2. Are all samples present?	X	—	—	_____
3. Are all matrices indicated correctly?	X	—	—	_____
4. Are all analyses on the COC logged in for the appropriate samples?	X	—	—	_____
5. Are all analyses logged in for the correct container?	X	—	—	_____
6. Are samples logged in according to LAS batching procedures?	X	—	—	_____

LOGIN CHAIN OF CUSTODY

	<u>YES</u>	<u>NO</u>	<u>N/A</u>	<u>Comment</u>
1. Are the collect, receive, and due dates correct for every sample?	X	—	—	_____
2. Have all appropriate comments been indicated in the comment section?	X	—	—	_____

SAMPLE RECEIVING CHECKLIST

	<u>YES</u>	<u>NO</u>	<u>N/A</u>	<u>Comment</u>
1. Are all discrepancies between the COC and the login noted (if applicable)?	—	—	X	_____

Paul D. Jones
primary review signature

2-22-96
date

Michael
secondary review signature

2-22-96 002
date

028859

Lockheed Analytical Services
Sample Receiving Checklist

290 4651 461

Client Name: *VPST, Hous*

Job No. *L6496*

Cooler ID: *11A*

COOLER CONDITION UPON RECEIPT			
Temperature of cooler upon receipt:	<i>20</i>		
temperature of temp. blank upon receipt:			
	Yes	No	* Comments/Discrepancies
custody seals intact	<input checked="" type="checkbox"/>		
chain of custody present	<input checked="" type="checkbox"/>		
blue ice (or equiv.) present/frozen	<input checked="" type="checkbox"/>		
rad survey completed	<input checked="" type="checkbox"/>		
SAMPLE CONDITION UPON RECEIPT			
	Yes	No	* Comments/Discrepancies
all bottles labeled	<input checked="" type="checkbox"/>		
samples intact	<input checked="" type="checkbox"/>		
proper container used for sample type	<input checked="" type="checkbox"/>		
sample volume sufficient for analysis	<input checked="" type="checkbox"/>		
proper pres. indicated on the COC	<input checked="" type="checkbox"/>		
VOA's contain headspace			
are samples bi-phasic (if so, indicate sample ID'S):			<i>not</i>
			<i>not</i>
MISCELLANEOUS ITEMS			
	Yes	No	* Comments/Discrepancies
samples with short holding times	<input checked="" type="checkbox"/>		<i>nitrites/poltrates</i>
samples to subcontract			<i>not</i>
ADDITIONAL COMMENTS/DISCREPANCIES			
Completed by / date: <i>Paul D. [Signature] 2-22-96</i>			
Sent to the client (date/initials):		** Client's signature upon receipt:	
Notes: * = contact the appropriate CSR of any discrepancies immediately upon receipt			
** = please review this information and return via facsimile to the appropriate CSR (702) 361-8146			

9613477-1263

5880

9613477.1264

Lockheed Analytical Laboratory
 SAMPLE SUMMARY REPORT (su02)
 Bechtel Hanford, Inc. * Richland, WA

Client Sample Number	LAL Sample Number	SDG Number	Matrix	Method
BOHOV4	L6496-1		Water	SCREENING -
	L6496-2		Water	6010 ICP METALS
	L6496-3		Water	300.0 CHLORIDE -
	L6496-3		Water	300.0 NITRATE -
	L6496-3		Water	300.0 NITRITE -
	L6496-3		Water	300.0 PHOSPHATE
	L6496-3		Water	300.0 SULFATE -
	L6496-4		Water	353.2 NITRATE -
	L6496-5		Water	9030 SULFIDE -
	L6496-6		Water	350.1 NH3/N -
	L6496-7		Water	GR ALP/BETA LAL
	L6496-7		Water	SR-90 LAL-0196
	L6496-12		Water	C-14 LAL-0209 -
L6496-12		Water	TRITIUM(H3) LAL	
BOHOV5	L6496-13		Filt H2O	6010 ICP METALS
REPORT TYPE	L6496-14		Water	EDD - DISK DEL.
	L6496-14		Water	INORG TYPE 2 R
	L6496-14		Water	RAD RPT TYPE 2

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9613477/1265

LOCKHEED MARTIN

NON-METALS

WATER

9613477.1266

LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: B0H0V4	Date Collected: 20-FEB-96
Matrix: Water	Date Received: 22-FEB-96
Percent Solids: N/A	

Constituent	Units	Method	Result	Project Reporting Limit	Data Qualifier(s)	Date Analyzed	LAS Batch ID	LAS Sample ID
Chloride	mg/L	300.0	5.6	0.020		23-FEB-96	34057	L6496-3
Nitrate-N	mg/L	300.0	0.52	0.020	H	23-FEB-96	34059	L6496-3
Nitrite-N	mg/L	300.0	< 0.002	0.010	HU	23-FEB-96	34058	L6496-3
Ortho Phosphate	mg/L	300.0	0.033	0.10	HB	26-FEB-96	34060	L6496-3
Sulfate	mg/L	300.0	65.	0.10		23-FEB-96	34061	L6496-3
Ammonia Nitrogen	mg/L	350.1	0.12	0.050		28-FEB-96	34062	L6496-6
Nitrate-Nitrite-Nitrogen	mg/L	353.2	0.54	0.050		26-FEB-96	34063	L6496-4
Sulfide	mg/L	9030	< 0.60	3.0	U	24-FEB-96	34098	L6496-5

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LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: BOHOV4	Date Collected: 20-FEB-96
Matrix: Water	Date Received: 22-FEB-96
Percent Solids: N/A	

Constituent	Units	Method	Result	MDL	RDL	Data Qual	Dilution	Date Analyzed	LAS Batch ID	LAS Sample ID
ALUMINUM, TOTAL	mg/L	6010 A	0.089	0.027	0.20	BN*	1	15-MAR-96	34692	L6496-2
BARIUM, TOTAL	mg/L	6010 A	0.093	0.016	0.20	B	1	15-MAR-96	34692	L6496-2
BERYLLIUM, TOTAL	mg/L	6010 A	< 0.0010	0.0010	0.0050	U	1	15-MAR-96	34692	L6496-2
CADMIUM, TOTAL	mg/L	6010 A	< 0.0040	0.0040	0.0050	U	1	15-MAR-96	34692	L6496-2
CALCIUM, TOTAL	mg/L	6010 A	43.	0.013	5.0		1	15-MAR-96	34692	L6496-2
CHROMIUM, TOTAL	mg/L	6010 A	0.016	0.0030	0.010		1	15-MAR-96	34692	L6496-2
COBALT, TOTAL	mg/L	6010 A	< 0.0040	0.0040	0.050	U	1	15-MAR-96	34692	L6496-2
COPPER, TOTAL	mg/L	6010 A	0.0039	0.0030	0.025	B	1	15-MAR-96	34692	L6496-2
IRON, TOTAL	mg/L	6010 A	0.070	0.0050	0.10	B	1	15-MAR-96	34692	L6496-2
MAGNESIUM, TOTAL	mg/L	6010 A	17.	0.041	5.0		1	15-MAR-96	34692	L6496-2
MANGANESE, TOTAL	mg/L	6010 A	0.065	0.0010	0.015		1	15-MAR-96	34692	L6496-2
NICKEL, TOTAL	mg/L	6010 A	< 0.014	0.014	0.040	U	1	15-MAR-96	34692	L6496-2
POTASSIUM, TOTAL	mg/L	6010 A	11.	0.40	5.0		1	15-MAR-96	34692	L6496-2
SILVER, TOTAL	mg/L	6010 A	< 0.0030	0.0030	0.010	U	1	15-MAR-96	34692	L6496-2
SODIUM, TOTAL	mg/L	6010 A	35.	0.040	5.0		1	15-MAR-96	34692	L6496-2
VANADIUM, TOTAL	mg/L	6010 A	0.035	0.0040	0.050	B	1	15-MAR-96	34692	L6496-2
ZINC, TOTAL	mg/L	6010 A	0.018	0.0030	0.020	B	1	15-MAR-96	34692	L6496-2
Antimony	mg/L	6010 A	< 0.0020	0.0020	0.060	U	1	21-MAR-96	34695	L6496-2
Arsenic	mg/L	6010 A	0.0050	0.0020	0.010	B	1	21-MAR-96	34695	L6496-2
Lead	mg/L	6010 A	< 0.0010	0.0010	0.0030	U	1	21-MAR-96	34695	L6496-2
Selenium	mg/L	6010 A	< 0.0030	0.0030	0.0050	U	1	21-MAR-96	34695	L6496-2
Thallium	mg/L	6010 A	0.0045	0.0030	0.010	B	1	21-MAR-96	34695	L6496-2

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LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: BOH0V5	Date Collected: 20-FEB-96
Matrix: Filt H2O	Date Received: 22-FEB-96
Percent Solids: N/A	

Constituent	Units	Method	Result	MDL	RDL	Data Qual	Dilution	Date Analyzed	LAS Batch ID	LAS Sample ID
ALUMINUM, DISSOLVED	mg/L	6010 A	0.030	0.027	0.20	B	1	15-MAR-96	34696	L6496-13
BARIIUM, DISSOLVED	mg/L	6010 A	0.083	0.016	0.20	B	1	15-MAR-96	34696	L6496-13
BERYLLIUM, DISSOLVED	mg/L	6010 A	< 0.0010	0.0010	0.0050	U	1	15-MAR-96	34696	L6496-13
CADMIUM, DISSOLVED	mg/L	6010 A	< 0.0040	0.0040	0.0050	U	1	15-MAR-96	34696	L6496-13
CALCIUM, DISSOLVED	mg/L	6010 A	38.	0.013	5.0		1	15-MAR-96	34696	L6496-13
CHROMIUM, DISSOLVED	mg/L	6010 A	0.0041	0.0030	0.010	B	1	15-MAR-96	34696	L6496-13
COBALT, DISSOLVED	mg/L	6010 A	< 0.0040	0.0040	0.050	U	1	15-MAR-96	34696	L6496-13
COPPER, DISSOLVED	mg/L	6010 A	0.0034	0.0030	0.025	B	1	15-MAR-96	34696	L6496-13
IRON, DISSOLVED	mg/L	6010 A	0.020	0.0050	0.10	B	1	15-MAR-96	34696	L6496-13
MAGNESIUM, DISSOLVED	mg/L	6010 A	15.	0.041	5.0		1	15-MAR-96	34696	L6496-13
MANGANESE, DISSOLVED	mg/L	6010 A	0.058	0.0010	0.015		1	15-MAR-96	34696	L6496-13
NICKEL, DISSOLVED	mg/L	6010 A	< 0.014	0.014	0.040	U	1	15-MAR-96	34696	L6496-13
POTASSIUM, DISSOLVED	mg/L	6010 A	9.6	0.40	5.0		1	15-MAR-96	34696	L6496-13
SILVER, DISSOLVED	mg/L	6010 A	< 0.0030	0.0030	0.010	U	1	15-MAR-96	34696	L6496-13
SODIUM, DISSOLVED	mg/L	6010 A	31.	0.040	5.0		1	15-MAR-96	34696	L6496-13
VANADIUM, DISSOLVED	mg/L	6010 A	0.030	0.0040	0.050	B	1	15-MAR-96	34696	L6496-13
ZINC, DISSOLVED	mg/L	6010 A	0.031	0.0030	0.020		1	15-MAR-96	34696	L6496-13
Antimony	mg/L	6010 A	< 0.0020	0.0020	0.060	U	1	21-MAR-96	34697	L6496-13
Arsenic	mg/L	6010 A	0.0037	0.0020	0.010	B	1	21-MAR-96	34697	L6496-13
Lead	mg/L	6010 A	< 0.0010	0.0010	0.0030	U	1	21-MAR-96	34697	L6496-13
Selenium	mg/L	6010 A	< 0.0030	0.0030	0.0050	U	1	21-MAR-96	34697	L6496-13
Thallium	mg/L	6010 A	0.0042	0.0030	0.010	B	1	21-MAR-96	34697	L6496-13

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LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: BOH0V4

LAL Sample ID: L6496-7

Date Collected: 20-FEB-96

Date Received: 22-FEB-96

Matrix: Water

Login Number: L6496

Constituent	Analyzed	Batch	Activity	Error	MDA	DataQual	Units
Gross Alpha	07-MAR-96	GR ALP/BETA LAL-0060_34110	3.7	2.6	3.7	C	pCi/L
Gross Beta	07-MAR-96	GR ALP/BETA LAL-0060_34110	8.7	2.6	3.5		pCi/L
Total radio-strontium	27-FEB-96	SR-90 LAL-0196_34046	0.42	0.58	0.98		pCi/L

9613477.1270

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project. (Project BECHTEL-HANFORD)

Client Sample ID: B0HOV4

LAL Sample ID: L6496-12

Date Collected: 20-FEB-96

Date Received: 22-FEB-96

Matrix: Water

Login Number: L6496

Constituent	Analyzed	Batch	Activity	Error	MDA	DataQual	Units
C-14	28-FEB-96	C-14 LAL-0209_34132	28.	85.	110		pCi/L
H-3	09-MAR-96	TRITIUM(H3) LAL-0066_34127	0	170	220		pCi/L

LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION LOG FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Date Prep Started : 3/6/96
 Workgroup Number : GR ALP/BETA LAL-0060 34110

Matrix : Water
 Prep Due Date : 03/19/96

CLIENT SAMPLE ID	LAL ID	QC	CHILD LAL ID	pH <2	ALQT VOL (L)	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	SAMPLE WEIGHT (grams)	COMMENTS
L6496-7	34110DUP1	1 DUP1	34110-01	2	210	8.5960	8.6655	.160	
Lab Ctrl Sample	34110LCS1	2 LCS1	34110-02		.250	8.6593	8.6987		
Method Blank	34110MBB	3 MBB1	34110-03		.250	8.5704	8.5704		
L6496-7	34110MS1	4 MS1	34110-04		210	8.5175	8.5915	.160	
BOHOV4	L6496-7	5 SMP1,M	34110-05		210	8.5728	8.6463	.160	
		6							
		7							
		8							
		9							
		10							
		11							
		12							
		13							
		14							
		15							
		16							
		17							
		18							
		19							
		20							
		21							
		22							
		23							
		24							

LCS Volume & RefDate	1.0 mL	8/1/90	MS Volume & RefDate	1.0 mL	1/6/96	Prep Anlst	CD
LCS Nuclide	Am-241	Sr-90	MS Nuclide	Am-241	Sr-90	Start Date	3/6/96
LCS Activity	9.81 pCi/mL	120 pCi/mL	MS Activity	8.40 pCi/mL	8.37 pCi/mL	Count Anlst	
LCS ID #	95-721-13-1		MS ID #	94-677-93-1			

Balance Number : 40020046 () Pipette Number : 71008 () LCS added by : CD
 () () () Witnessed by : NA

Comments : Did not have enough sample

Analyst : [Signature] Checked by : [Signature] Cnt Rm Custody/Date : SV 3-6-96 V95224

0055

9613477-1271

LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION LOG FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Date Prep Started : 3/6/96
 Workgroup Number : GR ALP/BETA LAL-0060 34110

Matrix : Water
 Prep Due Date : 03/19/96

CLIENT SAMPLE ID	LAL ID	QC	CHILD LAL ID	pH <2	ALQT VOL (L)	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	*	*	SAMPLE WEIGHT (grams)	COMMENTS
L6496-7	34110DUP1	1	DUP1	34110-01	2	0.160	8.5900	8.6655		0.0755	
Lab Ctrl Sample	34110LCS1	2	LCS1	34110-02	2	0.250	8.6593	8.6987		0.0394	
Method Blank	34110MBB	3	MBB1	34110-03	2	0.250	8.5704	8.5704		0.0000	
L6496-7	34110MS1	4	MS1	34110-04	2	0.160	8.5175	8.5915		0.0740	
BOHOV4	L6496-7	5	SMP1,M	34110-05	2	0.160	8.5728	8.6463		0.0735	
		6									
		7									
		8									
		9									
		10									
		11									
		12									
		13									
		14									
		15									
		16									
		17									
		18									
		19									
		20									
		21									
		22									
		23									
		24									
LCS Volume & RefDate		1.0 mL; 08/01/90			MS Volume & RefDate		1.0 mL; 01/05/96		Prep Anlst	CD	
LCS Nuclide		Am-241		Sr-90		MS Nuclide		Am-241		Sr-90	
LCS Activity		9.8 pCi/mL		12.0 pCi/mL		MS Activity		8.4 pCi/mL		8.4 pCi/mL	
LCS ID #		95-721-13-1			MS ID #		94-677-93-1				

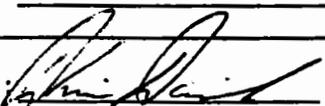
Balance Number : 40020046 ()

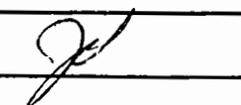
Pipette Number : 71008 ()

LCS added by: CD

Comments : _____

Witnessed by : NA

Analyst : 

Checked by: 

9613477-1272

0085

CERTIFICATE OF CALIBRATION

ALPHA STANDARD SOLUTION

Radionuclide	Am-241	Customer:	LOCKHEED ENGINEERING & SCIENCES Co.	
Half Life:	432.7 ± 0.5 years	P.O.No.:	06LAB1245	
Catalog No.:	7241	Reference Date:	November 1 1991	12:00 PST.
Source No.:	388-100-1	Contained Radioactivity:	0.997	μCi.

Description of Solution

a. Mass of solution:	5.0007	grams.
b. Chemical form:	AmCl ₃ in 0.5N HCl	
c. Carrier content:	None added	
d. Density:	1.0077	gram/ml @ 20°C.

Radioimpurities

None detected

Radioactive Daughters

None detected

Radionuclide Concentration

0.1994 μCi/gram.

Method of Calibration

Weighed aliquots of the solution were assayed using a liquid scintillation counter.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	±2.0%
b. Random uncertainty in assay:	±0.7%
c. Random uncertainty in weighing(s):	±0.0%
d. Total uncertainty at the 99% confidence level:	±2.7%

NIST Traceability

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

Notes

1. Nuclear data were taken from "Table of Isotopes", Seventh Edition, edited by Virginia S. Shirley.
2. 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)



ISOTOPE PRODUCTS LABORATORIES
 1800 No. Keystone Street.,
 Burbank, California 91504
 (818) 843 - 7000

Ray A. Gilmore
 QUALITY CONTROL

CERTIFICATE OF CALIBRATION BETA STANDARD SOLUTION

Radionuclide	Sr-90	Customer:	LOCKHEED ENGINEERING & SCIENCES Co.	
Half Life:	28.5 ± 0.2 years	P.O.No.:	06LAB1245	
Catalog No.:	7090	Reference Date:	November 1 1991	12:00 PST.
Source No.:	388-99-2	Contained Radioactivity:	1.018	μCi.

Description of Solution

a. Mass of solution:	5.0012	grams.
b. Chemical form:	SrCl ₂ in 0.1N HCl	
c. Carrier content:	None added	
d. Density:	0.9996	gram/ml @ 20°C.

Radioimpurities

None (Y-90 daughter in equilibrium)

Radioactive Daughters

Y-90 daughter in equilibrium

Radionuclide Concentration

0.203 μCi/gram.

Method of Calibration

Weighed aliquots of the solution were assayed using a liquid scintillation counter.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	±1.5%
b. Random uncertainty in assay:	±0.5%
c. Random uncertainty in weighing(s):	±0.0%
d. Total uncertainty at the 99% confidence level:	±2.0%

NIST Traceability

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

Notes

1. Nuclear data were taken from "Table of Isotopes", Seventh Edition, edited by Virginia S. Shirley.
2. 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)



ISOTOPE PRODUCTS LABORATORIES
1800 No. Keystone Street,
Berkeley, California 94704
(818) 843-7000

Mary A. Silmore
QUALITY CONTROL

0089

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	(432.7yr) (29.1yr) <u>Am-241 Sr/Y 90 MS</u>
Parent ^{Logbook} Barcode Number	<u>92-353-81-1 94-0677-92-1</u>
Vendor or Certificate I.D. # of Parent Standard:	_____
Diluted Source Logbook I.D. #:	<u>see ABOVE</u>
Balance Verification?:	<u>Yes</u>
Diluent Used:	<u>1 M HNO3</u>

Dilution	
*Diluent:	<u>1 M HNO3 + 10 ml Sr Carrier (10mg/ml)</u>
*Density of diluent (g/ml):	<u>1.0290 g/ml</u>
a: Parent Specific Activity:	<u>Am-241 Sr/Y-90 * 1002.4 1000.2 pCi/g e 1/5/96</u>
b: Amount of Source Transferred:	<u>4.070 4.065 g</u>
c: Total amount of Dilution:	<u>500.01 g</u>
d: Total Volume of Dilution:	<u>514.5 ml</u>
e: Activity of Dilution (a * b / c):	<u>Am-241 Sr/Y-90 8.16 8.13 pCi/g e 1/5/96</u>
f: Activity of Dilution (a * b / d):	<u>8.40 8.37 pCi/ml</u>
Dilution Logbook I.D. #:	<u>94-0677-93-1</u>
* Sr/Y-90 in equilibrium. Activity reported = known Sr 90 activity * 2.	
Prepared By: <u>G. C. Mord</u>	Preparation Date: <u>1/5/96</u>
Reviewed By: <u>Joe Hutchinson</u>	Review Date: <u>1/5/96</u>
*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.	

Head and Understood By

Signed _____ Date _____ Signed _____ Date _____

INITIAL STANDARD DILUTION RECORD

Standard Information:	
Isotope:	<u>Sr-90</u>
Activity of Standard Received:	<u>1.018</u> <u>5.0072</u> uCi
Weight of Standard Received (g):	<u>5.0012</u> g
Standard Activity (pCi/g):	<u>2.036E5</u> pCi/g
Halflife in Years or Days:	<u>29.1</u> yrs
Reference Date:	<u>11/1/91</u>
Vendor:	<u>IPL</u>
Vendor I.D. #	<u>—</u>
LAL I.D. #:	<u>AA0049</u>
NIST Traceable ?	<u>Yes</u>
Certificate #:	<u>388-99-2</u>
Receiver's Name:	<u>FREE</u>
Date Received:	<u>12/91</u>

Primary Dilution	
Balance Verification?:	<u>Yes</u>
Diluent Used:	<u>1 M HNO₃ (1.0290 g/ml)</u>
a: Decay Corrected Standard Activity (pCi/g):	<u>1.844 E5</u> pCi/g @ <u>1/5/96</u>
b: Weight of the Source Transferred (g):	<u>4.949</u> g
c: Total diluted weight (g):	<u>100.01</u> g
d: Total Diluted Volume (mL)	<u>97.19</u> mL
e: Activity of Dilution by Weight (pCi/g) [a * b / c]:	<u>9125.0</u> pCi/g @ <u>1/5/96</u>
f: Calculated Density of Solution (g/ml) [c / d]:	<u>9389.8 1.0290</u> g/mL
g: Activity of Dilution by Volume (pCi/mL) [e * f]:	<u>9389.8</u> pCi/mL
h. Dilution Logbook I.D. #:	<u>94-0677-91-1</u>
Prepared By: <u>A. J. M. Paul</u>	Preparation Date: <u>1/5/96</u>
Reviewed By: <u>Joe Hutchison</u>	Review Date: <u>1/5/96</u>
Purity/Cross Check Performed By: _____	Check Date: _____

Signed

Date

Signed

Date

0091

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

Isotope: Sr-90

Parent Barcode Number: AA0049

Vendor or Certificate I.D. # of Parent Standard: ~~94-0677-91-1~~ 388-99-2

Diluted Source Logbook I.D. #: 94-0677-91-1

Balance Verification?: Yes

Diluent Used: 1.0 M HNO₃

Dilution

*Diluent: 1.0 M HNO₃

*Density of diluent (g/ml): 1.0290 g/ml

a: Parent Specific Activity: 9125.0 pCi/g ca. 1/5/96

b: Amount of Source Transferred: 6.012 g

c: Total amount of Dilution: 109.70 g

d: Total Volume of Dilution: 106.61 ml

e: Activity of Dilution (a * b / c): 500.09 pCi/g 1/5/96

f: Activity of Dilution (a * b / d): 514.6 pCi/ml

Dilution Logbook I.D. #: 94-0677-92-1

Prepared By: Gj C. M. L.

Reviewed By: Joe Hutchison

Preparation Date: 1/5/96

Review Date: 1/6/96

*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.

Read and Understood By

Signed

Date

Signed

Date

Certs #	Calibr	Exp.	Ref #	Vendor	Prep	Notes
Parent Ref.	Certs. Date	Date			In	In
388-100-1	Nov 1, 1991	5/6/92	91-0225-641	IPL	JK	JK

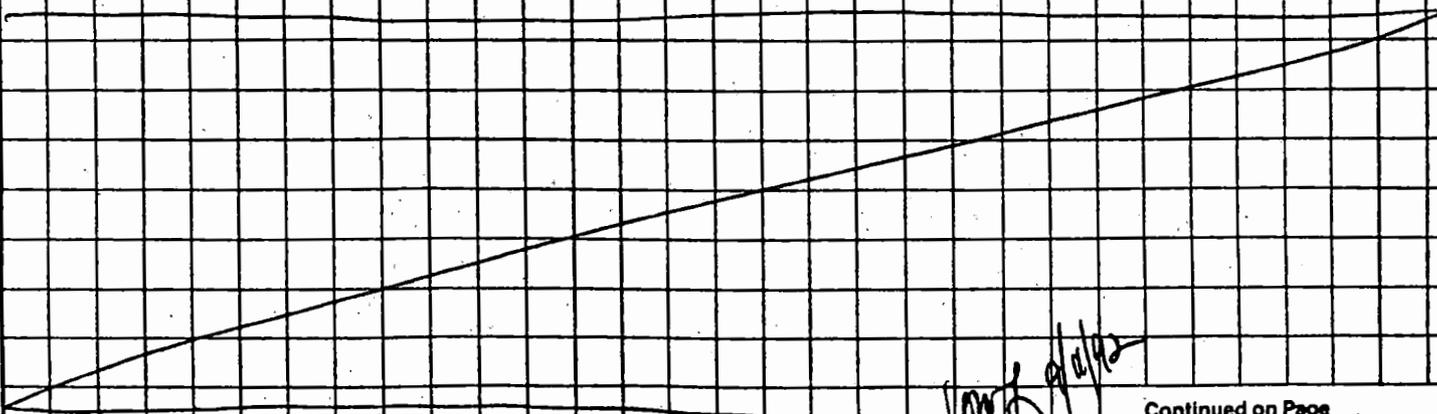
Item #	Preparation Date	Final Conc	Initial Conc	Bar Code
1	5/6/92	9,800 pCi/g	0.997 uCi/g	AA0030
		1/g	6.1994 uCi/g	

The entire standard was transferred to a 100-ml volumetric V.F. and the ²⁴¹Am⁴⁺ was diluted to 100ml with 0.5N HCl.

$\begin{array}{r} 68.4902 \\ 43.5665 \text{ g wt. V.F.} \\ \hline 4.9237 \text{ g std} \end{array}$	$\begin{array}{r} 164.01 \text{ g std + dilution} \\ 63.57 \text{ g V.F.} \\ \hline 100.44 \text{ g diluted std} \end{array}$
---	---

$$\text{Activity Std} = \frac{0.1994 \mu\text{Ci/g} \times 4.9237 \text{ g of std}}{100.44 \text{ g dilution}}$$

$$\begin{aligned} \text{Density } 0.5\text{N HCl} &= 1.003598 \text{ g/ml} && \Rightarrow 0.0097748 \mu\text{Ci/g} \times 1.003598 \text{ g/ml} \\ &= 0.0098 \mu\text{Ci/g} && = 0.009810 \mu\text{Ci/g} \\ \text{or} &= 9,800 \text{ pCi/g} && = 9810 \text{ pCi/ml} \end{aligned}$$



[Handwritten signature] 9/1/92

Continued on Page

Read and Understood By

Joe Hutchinson
Signed

5/11/92
Date

[Signature]
Signed

0093
2/13/92
Date

PROJECT

Am-241 / 6/13/76" J28 Filter & LCS

Continued From Page

ISOTOPE DILUTION RECORD

Isotope: Am-241

Secondary/Working Level Dilution

Date: 4-9-93 Preparer's Name: A. Wong

Pipet Check / Balance Wt. Check Done (✓)

Diluted Source ID (log#): 91-225-60-1

Diluent used: 0.5N HCl

A: Source activity: 21700 dpm/g (9774.8 pCi/g)

B: Amount of source transferred: 10.3235 g

C: Total amount of dilution: 100.1029 g

D: Activity of dilution (A*B/C): 2237.90 dpm/g

E: Density of Diluent: 1.0010 g/ml

*F: Activity by volume (D*E): 2240.14 dpm/ml

Dilution Log Book ID: 92-^{rw}335 92-353-81-1

Reviewed by: [Signature] Date: 4/9/93

Agnes W.
4-9-93

1.6" diameter filter LCS in Gamma Spec. (14 petri dish and sealed) JSS 5/18/93

Prepared by Nee Van Nuyen 5/10/93 - Cut Whatman Glass Micro-fiber Cellulose paper (originally 3" dia.) to 1.6" dia. - P. petted on filter

¹³⁷Cs AC-0199- 0.200 ml * 975.18 pCi/ml = 195.0 pCi (≅ 197.8 pCi 4-2-91)

⁶⁰Co AM-0225-80-1 0.200 ml * ^(998.11 pCi/ml) 970.36 pCi/ml = 194.0 pCi (≅ 259.1 pCi 4-2-91)

(same pipette amounts as p. 80R)

Read and Understood By

Agnes Wong
Signed

4-9-93
Date

[Signature]
Signed

5-18-93
Date

0094

S / d. Deleted 1/7/93 and to make 91-0225-60-1 AA0030

CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

Radionuclide: Am-241
Half Life: 432.7 ± 0.5 years
Catalog No.: 7241
Source No.: 388-100-1
Customer: LOCKHEED ENGINEERING & SCIENCES Co.
P.O.No.: 06LAB1245
Reference Date: November 1 1991 12:00 PST.
Contained Radioactivity: 0.997 μCi.

Description of Solution

a. Mass of solution: 5.0007 grams.
b. Chemical form: AmCl₃ in 0.5N HCl
c. Carrier content: None added
d. Density: 1.0077 gram/ml @ 20°C.

Radioimpurities

None detected

Radioactive Daughters

None detected

Radionuclide Concentration

0.1994 μCi/gram.

Method of Calibration

Weighed aliquots of the solution were assayed using a liquid scintillation counter.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration: ±2.0%
b. Random uncertainty in assay: ±0.7%
c. Random uncertainty in weighing(s): ±0.0%
d. Total uncertainty at the 99% confidence level: ±2.7%

NIST Traceability

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

Notes

1. Nuclear data were taken from "Table of Isotopes", Seventh Edition, edited by Virginia S. Shirley.
2. 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)



ISOTOPE PRODUCTS LABORATORIES
1800 No. Keystone Street,
Burbank, California 91504
(818) 843 - 7000

Stan A. Gilmore
QUALITY CONTROL

0096

PROJECT Preparation of Am-241 Std.

Continued From Page _____

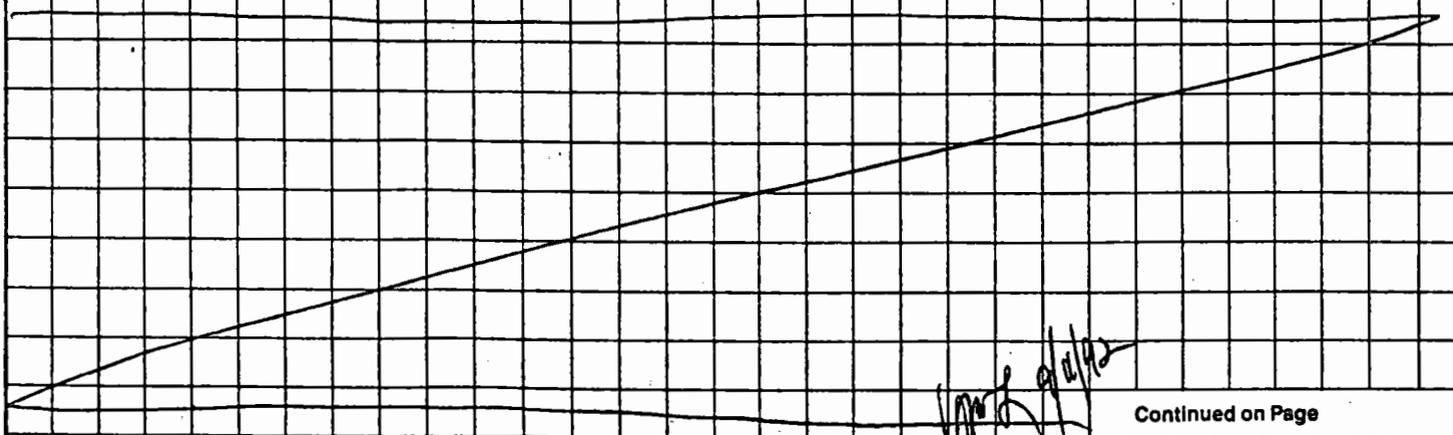
Certs #	Calibr	Exp.	Ref #	Vendor	Proj	Withn
Parent Ref.	Certs. Dts	Date			In	In
388-100-1	Nov 1, 1991	5/6/92	91-0225-64	IPL	JH	JH
Item #	Preparation Date	Final Conc	Initial Conc	Bar Code		
1	5/6/92	9,800 pCi/g	0.99746 Ci/g	AA0030		

The entire standard was transferred to a 100-ml volumetric V.F. and the ²⁴¹Am strength was diluted to 100ml with 0.5N HCl.

68.4902	164.01 g std + dilution
43.5665 g wt. V.F.	63.57 g V.F.
<u>4.9237 g std</u>	<u>100.44 g diluted std</u>

Activity Std = $\frac{0.1994 \mu\text{Ci/g} \times 4.9237 \text{ g std}}{100.44 \text{ g dilution}}$

Density 0.5N HCl = 1.003598 g/ml $\Rightarrow 0.0097748 \mu\text{Ci/g} \times 1.003598 \text{ g/ml}$
 $= 0.0098 \mu\text{Ci/g}$ $= 0.009810 \mu\text{Ci/g}^m$
 or $= 9,800 \text{ pCi/g}$ $= 9810 \text{ pCi/ml}$



Read and Understood By

Continued on Page _____

J. H. Johnson
Signed

5/11/92
Date

J. H. Johnson
Signed

0097
2/13/92
Date



THIS IS A PHOTOCOPY OF THE CERTIFICATE
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SEPARATE COVER.

National Institute of Standards & Technology

Certificate

Standard Reference Material 4919-G Radioactivity Standard

Radionuclide	Strontium-90
Source identification	4919-G
Source description	Solution in NIST borosilicate-glass ampoule ^{(1)*}
Solution composition	Strontium-90 plus yttrium-90 plus approximately 95 μg each of non-radioactive strontium and yttrium per gram of 1-molar hydrochloric acid ⁽²⁾
Mass	Approximately 5.0 grams
Radioactivity concentration	$4.514 \times 10^3 \text{ Bq g}^{-1}$
Reference time	1200 EST August 1, 1990
Overall uncertainty	1.05 percent ⁽³⁾
Photon-emitting impurities	None observed ⁽⁴⁾
Alpha-particle-emitting impurities	None observed ⁽⁵⁾
Half life	$28.5 \pm 0.2 \text{ years}$ ⁽⁶⁾
Measuring instrument	$4\pi\beta$ liquid-scintillation counter

This standard reference material was prepared in the Center for Radiation Research, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD 20899
January, 1991

William P. Reed, Acting Chief
Office of Standard Reference Materials

*Notes on back

CERT #	Calibration	Expiration	Reference	VENDOR	PREP	WITNESSES
Parent Rept #	Cert Date	Date	#		INITIALS	INITIALS
SRM #	1000	10-2-93	SRM #4919-6-A	NIST		
4919-6	Aug 1, 1990		91-0199-63			
IFEM #	Preparation Date	Final Concentration	Initial Concentration			
✓	10-2-91 1000 EST Aug 1, 1990 Aug 1, 1990	600.068599 600.685 $\mu\text{Ci/g}$	$4.514 \times 10^3 \text{ Bq/g}$			

9/10/91

Radioisotope = SR-90

Source # 4919-6

Source description: Solution in NIST Borosilicate glass ampule

Composition: # SR-90 + Y-90 plus approximately 95 mg of non radioactive Sr and yttrium per gram of 1 molar HCl.

mass approximately 5.0 grams

Radioactivity conc $4.514 \times 10^3 \text{ Bq/g}$

Reference time = 1000 EST Aug 1, 1990

$T_{1/2}$ = 28.5 to 2 years

10/2/91 Preparation

1/ weighing

100.0 ml v.f + standard of SR-90 in ampule

= 65.2000

100.0 ml v.f. (empty) (g) = 60.2814

Difference of mass (g) t.w. = 4.9186

2/ Calculations:

$$4.514 \times 10^3 \text{ Bq/g} \times 4.9186 \text{ g} = 22,202.5604 \text{ Bq}$$

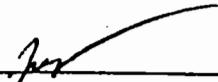
$$22,202.5604 \text{ Bq} \times 0.7027 \text{ Ci/Bq} = 600.068599 \text{ Ci}$$

(STD date Aug 1, 1990) Continued on Page

Transferred 11-19-91 Paul Fickett

(Retrieved from LAL 605-0199 pg 63)
Read and Understood By

0099


Signed

11/19/91
Date


Signed

12/4/91
Date

9613477.1287

STRONTIUM-90
LAL-91-SOP-0196

LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION LOG FOR STRONTIUM ANALYSIS

TOTAL RADIOSTRONTIUM - LAL-91-SOP-0196

Date Prep Started : 0-27-96
 WorkGroup : SR-90 LAL-0196 34046

Matrix : Water
 Prep Due Date : 02/27/96

CUSTOMER ID	PARENT LAL ID	NO	QC	CHILD LAL ID	ALIQOT VOLUME (g or L)	SR CARRIER (mL)	YTTRIUM SEP DATE	YTTRIUM SEP TIME	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	RESIDUE WEIGHT (grams)	COMMENTS
L6428-2	34046DUP1	1	DUP1	34046-01	500 ml	0.5	2-27-96	18:20	6.85880	6.86856		
Lab Ctrl Sample	34046LCS1	2	LCS1	34046-02	↓	↓	↓	18:20	6.86980	6.87845		
Method Blank	34046MBB	3	MBB1	34046-03	↓	↓	↓	18:20	6.87470	6.88442		
BOH6L5	L6428-2	4	SMP1	34046-04	↓	↓	↓	18:20	6.83943	6.84896		
BOH0V4	L6496-7	5		34046-05	↓	↓	↓	18:20	6.84333	6.85316		
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										

9613477-1288

Conc & Vol of Carrier : 0.01225g / 0.5ml ; 0.5ml
 Carrier Exp Date : 9-30-96
 Carrier ID# : 94-658-20

Act & Vol of LCS : 26.78 pCi/ml 1.0 ml
 LCS Ref Date : 4-1-94
 LCS ID# : 94-677-44-1

Prep Anlst : AW
 Start Date : 2-27-96
 Count Anlst : _____

Balance Number : 4020021 (✓)

Pipette Number : 139746 (✓)
134488 (✓)

Carrier and LCS added by : AW 2-27-96
 Witnessed by : AW 2-27-96

Comments : _____

Analyst : AW 2-27-96

Checked by : [Signature]

Cnt Rm Custody/Date : AW 2-27-96

010

LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION LOG FOR STRONTIUM ANALYSIS TOTAL RADIOSTRONTIUM - LAL-91-SOP-0196

Date Prep Started : 2/27/96

Matrix : Water

WorkGroup : SR-90 LAL-0196 34046

Prep Due Date : 02/27/96

CUSTOMER ID	PARENT LAL ID	NO	QC	CHILD LAL ID	ALIQOUT VOLUME (L)	SR CARRIER (mL)	YTTRIUM SEP DATE	YTTRIUM SEP TIME	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	RESIDUE WEIGHT (grams)	COMMENTS
L6428-2	34046DUP1	1	DUP1	34046-01	0.5	0.5	2/27/96	18:20	6.8588	6.86856	0.00976	
Lab Ctrl Sample	34046LCS1	2	LCS1	34046-02	0.5	0.5	2/27/96	18:20	6.8698	6.87845	0.00865	
Method Blank	34046MBB	3	MBB1	34046-03	0.5	0.5	2/27/96	18:20	6.8747	6.88442	0.00972	
BOH6L5	L6428-2	4	SMP1	34046-04	0.5	0.5	2/27/96	18:20	6.83943	6.84896	0.00953	
BOHOV4	L6496-7	5		34046-05	0.5	0.5	2/27/96	18:20	6.84333	6.85316	0.00983	
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
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		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										
Conc&Vol of Carrier		24.50 mg/mL; 0.5 mL			Act & Vol of LCS		26.78 pCi/mL; 1.0 mL			Prep Anlst		AW
Carrier Exp Date		30-Sep-96			LCS Ref Date		01-Apr-94			Start Date		2/27/96
Carrier ID#		94-658-20			LCS ID#		94-677-44-1			Count Anlst		LV

Balance Number : 40020021 ()

Pipette Number : 139746 ()

Carrier and LCS added by: AW

()

134488 ()

Witnessed by : DSM 2/27/96

Comments :

010

Analyst : SY FOR AW
DATA ENTRY

Checked by : [Signature]

Cnt Rm Custody\Date : _____

V86024

9613477-1289

STANDARDS



9613477.1292

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AA0046

National Institute of Standards & Technology**Certificate****Standard Reference Material 4919-G
Radioactivity Standard**

Radionuclide	Strontium-90
Source identification	4919-G
Source description	Solution in NIST borosilicate-glass ampoule ⁽¹⁾ *
Solution composition	Strontium-90 plus yttrium-90 plus approximately 95 μg each of non-radioactive strontium and yttrium per gram of 1-molar hydrochloric acid ⁽²⁾
Mass	Approximately 5.0 grams
Radioactivity concentration	$4.514 \times 10^3 \text{ Bq g}^{-1}$
Reference time	1200 EST August 1, 1990
Overall uncertainty	1.05 percent ⁽³⁾
Photon-emitting impurities	None observed ⁽⁴⁾
Alpha-particle-emitting impurities	None observed ⁽⁵⁾
Half life	$28.5 \pm 0.2 \text{ years}$ ⁽⁶⁾
Measuring instrument	$4\pi\beta$ liquid-scintillation counter

This standard reference material was prepared in the Center for Radiation Research, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD 20899
January, 1991

William P. Reed, Acting Chief
Office of Standard Reference Materials

*Notes on back

0105

NOTES

- (1) Approximately five milliliters of solution. Ampoule specifications:

body diameter	16.5 ± 0.5 mm
wall thickness	0.60 ± 0.04 mm
barium content	less than 2.5 percent
lead oxide content	less than 0.02 percent
other heavy elements	trace quantities

- (2) Solution density is 1.014 ± 0.002 g/mL at 21.5 °C.

- (3) The overall uncertainty was formed by taking three times the quadratic combination of standard deviations of the mean, or approximations thereof, for the following:

a) liquid-scintillation measurements	0.01 percent
b) gravimetric measurements	0.05 percent
c) dead time	0.10 percent
d) background	0.01 percent
e) detection efficiency	0.30 percent
f) decay-scheme data	0.10 percent
g) half life	0.01 percent
h) radionuclidic impurities	0.10 percent

- (4) The limit of detection for photon-emitting impurities is:

$$0.01 \gamma \text{ s}^{-1}\text{g}^{-1} \text{ between } 50 \text{ and } 1900 \text{ keV.}$$

- (5) The limit of detection for alpha-particle-emitting impurities is:

$$0.05 \alpha \text{ s}^{-1}\text{g}^{-1}.$$

- (6) NCRP Report No. 58, 2nd Edition, February 1985, p. 365.

For further information please contact Dr. Larry Lucas at (301) 975-5546.

NOTES ON THE USE
OF
STANDARD REFERENCE MATERIAL 4919G, STRONTIUM-90

The activity of the strontium-90 in the ampoule is given per gram of solution. If transfers are made by volume, the density given on the certificate can be used to compute the activity per unit volume. The activity given is the strontium-90 activity only. Because the strontium-90 is in equilibrium with its yttrium-90 daughter, which is also a beta-particle emitter, the activity given should be doubled to get the corresponding total beta-particle-emission rate.

If the solution is to be used for making quantitative sources, it should be kept tightly sealed so that evaporation, and the consequent change in the radioactivity concentration, is minimized. Glass containers are best for storage.

Dilute solutions of strontium-90 are often assayed by liquid-scintillation counting. We recommend that carrier solution containing approximately 1 mg of non-radioactive strontium be added first to the liquid-scintillation cocktail. We typically use a carrier solution containing 4 mg of strontium per mL of 0.5-molar hydrochloric acid. When 0.25 mL of this solution is added to 10 mL of emulsion-type liquid-scintillation cocktail, the resulting 1 mg of strontium per vial is generally sufficient to prevent the radioactive strontium-90 from plating out on the vial walls. A set of liquid-scintillation vials that cover a range of sample-solution masses should be prepared and monitored over several days to ensure that the efficiency is constant.

The beta-particle counting efficiency will be somewhat less than unity. A correction for the loss of low-energy beta particles can be computed using the integral-discriminator-extrapolation technique (G. Goldstein, *Nucleonics* 23 (1965) 67) or using the liquid-scintillation efficiency-tracing technique with tritium (B.M. Coursey et al, *Int. J. Radiat. Isotopes* 37 (1986) 403).

The activity concentration given on the certificate is as of 1200 hours Eastern Standard Time, August 9, 1990. To convert from EST to your local time, the table given below can be used.

TO CONVERT FROM EST TO:

EDT	Add	1 hour
CDT	Same as EST	
CST	Subtract	1 hour
MDT	Subtract	1 hour
MST	Subtract	2 hours
PDT	Subtract	2 hours
PST	Subtract	3 hours
UTC	Add	5 hours

ISOTOPE VOLUME DILUTION RECORD

NAFCAC

Isotope: Sr-90 Vendor: NIST Reference Date: 1200 EST 8-1-79
 Total Activity: NA Vendor ID: SRM 4919-G Receive Date: 10-30-1991
 Total wt.(g) ~5.0g NIST traceable Y/N Cert # 4919-G t½ 28.5 ± 0.2 years
 Activity UNITS/g 4.514 × 10³ Bq converted to dpm/g 2.708 × 10⁵ Receiver's Name Jimmy Morat

PRIMARY DILUTION: Prepared by volume

Date: 11/19/91 Preparer's Name: Nee Van Nuyen
 a: Decay corrected activity: 2.708 × 10⁵ dpm/g (* if < 100yr decay correct to preparation date)
 b: Wt. of Volumetric: 60.2814 g Balance wt check done
 c: Wt. Volumetric + source: 65.2000 g Diluent: 1M HCl
 d: Wt. of source transferred (c-b): 4.9186 g e: Wt. of diluent + source: N/A g
 f: Vol. of diluent + source: 100 mL g: Activity of dilution (a*d/e): N/A dpm/g
 h: Density (e/f): N/A g/mL i: Activity by volume (g*h): 13321.54 dpm/mL
 Dilution Log Book ID: 91-225-30-1 (SRM 4919G-A) 6000.69 pCi/m

Working Level Dilution: Prepared by volume

Date: 5-6-92 Preparer's Name: Joe Hutchinson
 A: Decay corrected activity: 6000.69 pCi/mL ⇒ corrected activity 5757.65 dpm/mL (* if < 100yr decay correct to preparation date)
 B: Wt. of Volumetric: N/A g Balance wt check done
 C: Wt. Volumetric + source: N/A g Diluent: 0.1N HNO₃
 D: Wt. of source transferred: N/A g E: Wt. of diluent + source: N/A g
 F: Vol. of source transferred: 1 mL G: Vol. of diluent + source: 250 mL
 H: Activity of dilution (A*F/E): N/A dpm/g I: Density (E/G): N/A g/mL
 I: Activity by volume (A*F/G), (H*I) or (A*D/E): ~~23.0~~ 46.0 pCi/mL
 Dilution Log Book ID: 91-225-63
 Log Book Transfer Reviewed by: [Signature] Date: 4/7/93

↓
 23.0 pCi/mL Sr-90
 23.0 pCi/mL Y-90

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	<u>Sr-90</u>
Parent Barcode Number	<u>Yes NA AA0046</u>
Vendor or Certificate I.D. # of Parent Standard:	<u>SRM 4919-G</u>
Diluted Source Logbook I.D. #:	<u>91-225-30-1</u>
Balance Verification?:	<u>Yes</u>
Diluent Used:	<u>1 M HCl</u>
<u>Ref Date: 8/1/90</u>	

Dilution	
*Diluent:	<u>1 M HCl</u>
*Density of diluent (g/ml):	<u>NA</u> g/ml
a: Parent Specific Activity:	<u>6000.69</u> $\frac{\text{pCi/ml}}{\text{pCi/g}}$ <u>on 8/1/90</u>
b: Amount of Source Transferred:	<u>0.5033</u> g
c: Total amount of Dilution:	<u>124.4545</u> g
d: Total Volume of Dilution:	<u>NA</u> ml
e: Activity of Dilution (a * b / c):	<u>24.27</u> $\frac{\text{pCi/g} \cdot \text{pCi/ml}}{\text{pCi/g}}$
f: Activity of Dilution (a * b / d):	<u>24.27</u> pCi/ml
Dilution Logbook I.D. #:	<u>94-0677-20-1</u>
Prepared By: <u>Joe Hutchinson</u>	Preparation Date: <u>12/6/94</u>
Reviewed By: <u>James Wong</u>	Review Date: <u>12-5-94</u>
<p>*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.</p>	

9613477.1297

KC Va 5/3/77
ACSRSI
RCS

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory-Las Vegas
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide **Strontium-90** Half-life **28.6 years**
Nominal activity **27** **nano curies**
Nominal volume **5** ml in ampoule/bottle number **94003-1**

Measurement Activity of principal radionuclide

Activity per gram of this solution

5.40 **nano curies** of **Strontium-90**
at 0400 hours PST on **April 1, 1994**

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

5.40 **nano curies** Per gram
of the daughter nuclide **Yttrium-90**

Total mass of this solution

Approximately 5.0 grams

Method of measurement

The activity of the primary solution was measured by liquid scintillation counting.

The activity of the dilution was measured by liquid scintillation counting.

Useful Life

This radionuclide has decayed through **0.0** half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after

August 1994

This dilution was prepared for the 1994 ASTM Collaborative Study of a test method for the determination of Sr-90 in water.

110
C. J. E

Purity

The manufacturer states that activities other than that of the principal nuclide and of its daughter nuclides, if any, were estimated/known to be:

- (1) less than % of the principal activity
- (2) less than % of the principal activity
- (3) less than % of the principal activity

The activity of impurity (1) is not (2) is not (3) is not included in the quoted figures of the principal activity.

Random Errors

The precision of this standard was such that the certified value of the radioactive concentration of the principal activity had a standard error (sm) not greater than $\pm 0.1\%$ (The 99.7% confidence limits are given by $t(sm)$ where t is obtained from the student t factor for the degree of freedom $(n-1)$).

The maximum uncertainty due to the assessable systematic errors (dilution, counting, and known uncertainty of the standard) is obtained by the separate arithmetic summation of the positive and negative systematic error $(+\delta - \delta')$. These have been estimated not to exceed

$+3.8\%$ or -3.8%

the overall uncertainty (often called accuracy) is an estimate of the possible divergence of the quoted result from the true value. It is a combination of random error $[t(sm)]$ at the 99.7% confidence limits and the worst case estimate of the systematic errors $(+\delta, -\delta')$. The overall uncertainty is therefore calculated on the basis of $+ [t(sm) + \delta], - [t(sm) + \delta']$ and is $+4.0\%$, -4.0% of the quoted radioactive concentration.

Decay Schemes

This standardization is based on the following assumptions of the principle nuclide, its daughter nuclides and impurities (no allowance for error in these assumptions or the assumption of quoted half-life have been included in the statement of accuracy above).

Strontium-90 decays 100 percent by beta emission to yttrium-90. Yttrium-90 also decays 100 percent by beta emission.

Chemical Composition of Solution

Carrier content per gram of solution:
30 micrograms strontium

Other components:
0.1 M HCl

Preservative:

Remarks

Date Certificate Prepared April 26, 1994

Approval Signature

Paul B. Farn 011

Sr-90

9613477-1299

INITIAL STANDARD DILUTION RECORD

Standard Information:

Isotope:	<u>Sr-90</u>	Vendor:	<u>EPA</u>
Activity of Standard Received:	2.7×10^4 uCi	Vendor I.D. #	<u>94003-1</u>
Weight of Standard Received (g):	<u>5.0</u> g	LAL I.D. #:	<u>AC5281</u>
Standard Activity (pCi/g):	5.4×10^3 pCi/g	NIST Traceable?	<u>yes</u>
Half-life in Years or Days:	<u>28.6</u> yrs	Certificate #:	<u>94003-1</u>
Reference Date:	<u>4-1-1994</u>	Receiver's Name:	<u>K. Free</u>
		Date Received:	<u>5-3-94</u>

Primary Dilution

Balance Verification?:	<u>yes</u>
Diluent Used:	<u>0.1 M HCl</u>
a: Decay Corrected Standard Activity (pCi/g):	5.4×10^3 pCi/g
b: Weight of the Source Transferred (g):	<u>4.9670</u> g
c: Total diluted weight (g):	<u>49.91</u> g
d: Total Diluted Volume (mL)	<u>50</u> mL
e: Activity of Dilution by Weight (pCi/g) [a * b / c]:	<u>537.4</u> pCi/g
f: Calculated Density of Solution (g/mL) [c / d]:	<u>0.9982</u> g/mL
g: Activity of Dilution by Volume (pCi/mL) [e * f]:	<u>536.44</u> pCi/mL
h. Dilution Logbook I.D. #:	93-494-81-1 ⁹³⁻⁴⁷⁴⁻⁸²⁻¹ <u>CP47195</u>
Prepared By: <u>Agnes Wong</u>	Preparation Date: <u>6-15-94</u>
Reviewed By: <u>Joe Hutchison</u>	Review Date: <u>6/30/94</u>
Purity/Cross Check Performed By: _____	Check Date: _____

[Handwritten signature]

0112

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	<u>Sr-90</u>
Ref. <u>4-1-94</u> Parent Barcode Number	<u>AC5281</u>
Vendor or Certificate I.D. # of Parent Standard:	<u>EPA 94003 - 1</u>
Diluted Source Logbook I.D. #:	<u>93-474 -82-1</u>
Balance Verification?:	<u>Yes</u>
Diluent Used:	<u>0.1 M HCl</u>

Dilution	
*Diluent:	<u>0.1 M HCl</u>
*Density of diluent (g/ml):	<u>N/A</u>
a: Parent Specific Activity:	<u>536.44 pCi/ml</u>
b: Amount of Source Transferred:	<u>5.0018 g</u>
c: Total amount of Dilution:	<u>100.20 g</u>
d: Total Volume of Dilution:	<u>N/A</u>
e: Activity of Dilution (a * b / c):	<u>N/A</u>
f: Activity of Dilution (a * b / d):	<u>26.78 pCi/ml</u>
Dilution Logbook I.D. #:	<u>94-677-44-1</u>
Prepared By: <u>Dynes Wong</u>	Preparation Date: <u>3-2-95</u>
Reviewed By: <u>Joe H. H.</u>	Review Date: <u>3/3/95</u>
*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.	

Signed

Date

Signed

Date

Dynes Wong 3-3-95 0113

9613477.1501

CARBON-14
LAL-93-SOP-0209

LOCKHEED ANALYTICAL LABORATORY ^{JDB}

SAMPLE PREPARATION WORKSHEET FOR C-14 ANALYSIS

SOP-0209

Prep Start Date : _____

Matrix : Water

WorkGroup : C-14 LAL-0209 34132

Prep Due Date : 14-Mar-96

CUSTOMER ID	PARENT LAL ID	NO	QC	VIAL LAL ID	FLASK +WET SOIL (grams)	FLASK EMPTY (grams)	WET SOIL NET WT. (grams)	FLASK +DRY SOIL (grams)	DRY SOIL NET WT. (grams)	DISTILLED VOLUME (L)	ALIQUOT VOLUME (L)	COMMENTS
L6496-12	34132DUP1	1		34132-01							.01	
Lab Ctrl Sample	34132LCS1	2		34132-02								
Method Blank	34132MBB	3		34132-03								
L6496-12	34132MS1	4		34132-04								
BOHOV4	L6496-12	5		34132-05								
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										
Conc & Vol of MS		1 mL 26.1 pCi/mL			Conc & Vol of LCS		1 mL 26.1 pCi/mL			Prep Analyst		NY
MS Ref Date		11/15/92			LCS Ref Date		11/15/92			Start Date		2/27/96
C-14 MS ID#		94-677-18-1			C-14 LCS ID#		94-677-18-1			Count Analyst		

Balance Number : _____ ()
 _____ ()

Pipette : _____ ()
 _____ ()

MS and LCS added by : NY
 Witnessed by : [Signature]

Comments : Cocktail - 5 mL CarboSorb / 15 mL Hionic Fluor; vial 20 mL poly. DIRECT SPIKE 10 mL Sample + 10 mL of Ultima Gold

Analyst : [Signature]

Checked by : [Signature]

Cnt Rm Custody \ Date : SV 2-27-96

V95224

0115

9613477.1302

LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION WORKSHEET FOR C-14 ANALYSIS

SOP-0209

Prep Start Date : 2/27/96
 WorkGroup : C-14 LAL-0209 34132

Matrix : Water
 Prep Due Date : 14-Mar-96

CUSTOMER ID	PARENT LAL ID	NO	QC	VIAL LAL ID	FLASK + WET SOIL (grams)	FLASK EMPTY (grams)	WET SOIL NET WT. (grams)	FLASK + DRY SOIL (grams)	DRY SOIL NET WT. (grams)	DISTILLED VOLUME (L)	ALIQOUT VOLUME (L)	COMMENTS
L6496-12	34132DUP1	1	DUP1	34132-01							0.01	
Lab Ctrl Sample	34132LCS1	2	LCS1	34132-02							0.01	
Method Blank	34132MBB	3	MBB1	34132-03							0.01	
L6496-12	34132MS1	4	MS1	34132-04							0.01	
BOHOV4	L6496-12	5	SMP1	34132-05							0.01	
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										
Conc & Vol of MS		26.10 pCi/mL; 1.0 mL			Conc & Vol of LCS		26.10 pCi/mL; 1.0 mL			Prep Analyst		MY
MS Ref Date		15-Nov-92			LCS Ref Date		15-Nov-92			Start Date		2/27/96
C-14 MS ID#		94-677-18-1			C-14 LCS ID#		94-677-18-1			Count Analyst		LV

Balance Number : _____ ()
 _____ ()

Pipette : _____ ()
 _____ ()

MS and LCS added by: MY
 Witnessed by : CD

Comments : Cocktail - 5 mL CarboSorb/15 mL HionicFluor; vial 20 mL poly.

Analyst : SR FOR MY
MA 2.27.96

Checked by : [Signature]

Cnt Rm Custody/Date : _____

V95224

0113

9615477.1016

STANDARDS

CERTIFICATE OF CALIBRATION

BETA STANDARD SOLUTION

AA014

Radionuclide	C-14	Customer:	LOCKHEED ENVIRONMENTAL
Half Life:	5730 ± 40 years	P.O.No.:	06LAB2959
Catalog No.:	7014	Reference Date:	November 15 1992 12:00 PST.
Source No.:	407-124-2	Contained Radioactivity:	1.093 μ Ci.
		Contained Radioactivity:	40.4 kBq

Description of Solution

a. Mass of solution:	5.0242	grams.
b. Chemical form:	Benzoic Acid Carboxy-C-14 in 0.1N NaOH	
c. Carrier content:	None added	
d. Density:	1.002	g/ml @ 20°C.

Radioimpurities None detected

Radioactive Daughters None

Radionuclide Concentration 0.218 μ Ci/g.

Method of Calibration

Weighed aliquots of the solution were assayed using a liquid scintillation counter.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	± 1.8%
b. Random uncertainty in assay:	± 0.5%
c. Random uncertainty in weighing(s):	± 1.0%
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. Nuclear data were taken from "Table of Radioactive Isotopes", edited by Virginia S. Shirley, 1986.
2. 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).



ISOTOPE PRODUCTS LABORATORIES
 1800 North Keystone Street
 Burbank, California 91504
 (818) 843 - 7000

Anna U. Uman

QUALITY CONTROL

Nov. 17, 1992

Date Signed

ISOTOPE WEIGHT DILUTION RECORD

Isotope: C-14 Vendor: IPL
 Total Received Activity: 1.093 μ ci Vendor ID: 407-124-2
 Wt. Received: 5.024 g NIST Traceable (Y/N) Cert. # Implicitly
 Activity in Units/g: .2175 μ ci/g Reference Date: 11-15-92
 Activity converted (dpm/g): 482,954 dpm/g Receive Date: 11/18/92
 Half-life (Yrs or days) $t_{1/2}$ = 5730 \pm 40 years Receiver's Name: Jimmy McCallister

PRIMARY DILUTION:

Balance wt. check done

a: Source activity: 482,954 dpm/g * (if $t_{1/2}$ = < 100yr decay to prep. date)
 b: Wt. of Source transferred: 4.90951 g
 Diluent used: 0.1 N₂O₄
 c: Total diluted weight: 116.53 g
 d: Activity of dilution (a*b/c): 20,347 dpm/g \pm 2.2%
 e: Calculated density of solution: 1.002 g/mL (4M HNO₃ = 1.1294 \pm .0007 g/mL)
 f: Activity by volume = (d*e): 20,388 dpm/mL
 Dilution Log Book ID: LAL-93-474-23-1 ✓
 Preparation Date: 10/27/93 Preparer's Name: M

SECONDARY OR WORKING LEVEL DILUTION

Balance wt. check done

Log Book ID of source being diluted: _____
 a: Source activity: _____ dpm/g * (if $t_{1/2}$ = < 100yr decay to prep. date)
 b: Wt. of Source transferred: _____ g
 Diluent used: _____
 c: Total diluted weight: N/A g
 d: Activity of dilution (a*b/c): _____ dpm/g
 e: Calculated density of solution: _____ g/mL (4M HNO₃ = 1.1294 \pm .0007 g/mL)
 f: Activity by volume = (d*e): _____ dpm/mL
 Dilution Log Book ID: _____

INITIAL STANDARD DILUTION RECORD

Standard Information:

Isotope:	<u>C-14</u>	Vendor:	<u>Isotope Product</u>
Activity of Standard Received:	<u>1.09 uCi</u>	Vendor I.D. #	<u></u>
Weight of Standard Received (g):	<u>5.0242 g</u>	LAL I.D. #:	<u>AA0114</u>
Standard Activity (pCi/g):	<u>2.17E+05 pCi/g</u>	NIST Traceable ?	<u>Yes</u>
Halflife in Years or Days:	<u>5730 yrs</u>	Certificate #:	<u>407-124-2</u>
Reference Date:	<u>11/15/92</u>	Preparer's Name:	<u>Mark Young</u>
		Date Received:	<u>11/18/92</u>

Primary Dilution

Balance Verification?:	<u>Yes</u>
Diluent Used:	<u>0.1 N NaOH</u>
a: Decay Corrected Standard Activity (pCi/g):	<u>2.17E+05 pCi/g</u>
b: Weight of the Source Transferred (g):	<u>4.90951 g</u>
c: Total diluted weight (g):	<u>116.53 g</u>
d: Total Diluted Volume (mL)	<u>116.3 mL</u>
e: Activity of Dilution by Weight (pCi/g) [a * b / c]:	<u>9.139E+03 pCi/g</u>
f: Calculated Density of Solution (g/ml) [c / d]:	<u>1.0020 g/mL</u>
g: Activity of Dilution by Volume (pCi/mL) [e * f]:	<u>9.157E+03 pCi/mL</u>
h. Dilution Logbook I.D. #:	<u>LAL-93-0474-23-1</u>
Prepared By: _____	Preparation Date: <u>10/27/93</u>
Reviewed By: _____	Review Date: _____
Purity/Cross Check Performed By: _____	Check Date: _____

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	C-14
Parent Barcode Number	AA0114
Vendor or Certificate I.D. # of Parent Standard:	407-124-2
Diluted Source Logbook I.D. #:	LAL-93-0474-23-1
Balance Verification?:	Yes
Diluent Used:	0.1 N NaOH

Dilution	
*Diluent:	Nanopure w/ 1 mg/ml formaldehyde
*Density of diluent (g/ml):	1.0006 g/ml
a: Parent Specific Activity:	9.14E+03 pCi/g
b: Amount of Source Transferred:	0.70 g
c: Total amount of Dilution:	250.14 g
d: Total Volume of Dilution:	250 ml
e: Activity of Dilution [a * b / c]:	2.57E+01 pCi/g
f: Activity of Dilution (a * b / d):	2.58E+01 pCi/ml
Dilution Logbook I.D. #:	LAL-94-0677-18-1
Prepared By: <u>Agnes Wong</u>	Preparation Date: <u>11/19/94</u>
Preparer Signature: _____	
Reviewed By: _____	Review Date: _____
Reviewer Signature: _____	
<small>*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.</small>	

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	<u>C-14</u>
Parent Barcode Number	<u>AA0114</u>
Vendor or Certificate I.D. # of Parent Standard:	<u>93-474-23-1</u>
Diluted Source Logbook I.D. #:	<u>93-474-23-1</u>
Balance Verification?:	<u>yes</u>
Diluent Used:	<u>DDI water in 1mg/ml formaldehyde</u>

Dilution	
*Diluent:	<u>Nanopure water with 1mg/ml formaldehyde</u>
*Density of diluent (g/ml):	<u>N/A</u> g/ml
a: Parent Specific Activity:	<u>9267.27</u> 20,388 ^{pCi/g} <u>11-19-94</u> pCi/ml
b: Amount of Source Transferred:	<u>0.7046</u> g
c: Total amount of Dilution:	<u>250.14</u> g
d: Total Volume of Dilution:	<u>N/A</u> ml
e: Activity of Dilution (a * b / c):	<u>N/A</u> pCi/g
f: Activity of Dilution (a * b / d):	<u>26.10</u> pCi/ml
Dilution Logbook I.D. #:	<u>94-677-18-1</u> ✓
Prepared By: <u>Agnes Wong</u>	Preparation Date: <u>11-19-94</u>
Reviewed By: <u>Joe Hultman</u>	Review Date: <u>12/16/94</u>
<small>*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.</small>	

TRITIUM
LAL-91-SOP-0066

LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION WORKSHEET FOR H-3 ANALYSIS

SOP-0066

Prep Start Date : 3/8/96

Matrix : Water

WorkGroup : TRITIUM(H3) LAL-0066 34127

Prep Due Date : 19-Mar-96

CUSTOMER ID	PARENT LAL ID	NO	QC	VIAL LAL ID	FLASK +WET SOIL (grams)	FLASK EMPTY (grams)	WET SOIL NET WT. (grams)	FLASK +DRY SOIL (grams)	DRY SOIL NET WT. (grams)	DISTILLED VOLUME (L)	ALIQOUT VOLUME (L)	COMMENTS	
L6496-12	34127DUP1	1		34127-01						.050	.010		
Lab Ctrl Sample	34127LCS1	2		34127-02						↓	↓		
Method Blank	34127MBB	3		34127-03						↓	↓		
L6496-12	34127MS1	4		34127-04						.051	↓	50 mL Sample, 1 mL MS	
BOHOV4	L6496-12	5		34127-05						.050	↓		
		6											
		7											
		8											
		9											
		10											
		11											
		12											
		13											
		14											
		15											
		16											
		17											
		18											
		19											
		20											
		21											
		22											
		23											
		24											
Conc & Vol of MS		226.2 pCi/ml		1.0 mL		Conc & Vol of LCS		4690 pCi/L		50 mL		Prep Analyst	GD
MS Ref Date		2/6/96				LCS Ref Date		6/3/92				Start Date	3/8/96
H-3 MS ID#		94-677-98-1				H-3 LCS ID#		721-17-1				Count Analyst	

Balance Number : _____ () Pipette : 71008 ()

MS and LCS added by : GD

Witnessed by : NR

Comments : Cocktail - Packard Ultima Gold XR; vial - 20 mL poly.

0135

Analyst : [Signature]

Checked by : [Signature]

Cnt Rm Custody/Date : [Signature] 3/8/96

V95224

9613477-1312

LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION WORKSHEET FOR H-3 ANALYSIS

SOP-0066

Prep Start Date : 3/8/96

Matrix : Water

WorkGroup : TRITIUM(H3) LAL-0066 34127

Prep Due Date : 19-Mar-96

CUSTOMER ID	PARENT LAL ID	NO	QC	VIAL LAL ID	FLASK + WET SOIL (grams)	FLASK EMPTY (grams)	WET SOIL NET WT. (grams)	FLASK + DRY SOIL (grams)	DRY SOIL NET WT. (grams)	DISTILLED VOLUME (L)	ALIQUOT VOLUME (L)	COMMENTS
L6496-12	34127DUP1	1	DUP1	34127-01							0.01	
Lab Ctrl Sample	34127LCS1	2	LCS1	34127-02							0.01	
Method Blank	34127MBB	3	MBB1	34127-03							0.01	
L6496-12	34127MS1	4	MS1	34127-04							0.01	1ml MS added to
BOHOV4	L6496-12	5	SMP1	34127-05							0.01	50ml MSS then distilled.
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										
Conc & Vol of MS		226.20 pCi/mL; 1.0 mL			Conc & Vol of LCS		4.69 pCi/mL; 10.0 mL			Prep Analyst		CD
MS Ref Date		06-Feb-96			LCS Ref Date		03-Jun-92			Start Date		3/8/96
H-3 MS ID#		94-677-98-1			H-3 LCS ID#		95-721-17-1			Count Analyst		LV

Balance Number : _____ ()
 _____ ()

Pipette : 71008 _____ ()
 _____ ()

MS and LCS added by: CD
 Witnessed by : _____

Comments : Cocktail - Packard Ultima Gold XR; vial - 20 mL poly.

0110

Analyst : Sr for CD
DATA Entry

Checked by : [Signature]

Cnt Rm Custody/Date : _____

V95224

9613477-1313

STANDARDS



U.S. DEPARTMENT OF COMMERCE
National Institute of Standards & Technology
Gaithersburg, MD 20899

REPORT OF TRACEABILITY

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada

Radionuclide	Hydrogen-3
Source identification	2606-1, prepared by EMSL
Source description	Liquid in 5-mL flame-sealed glass ampoule
Source mass	Approximately 5.0 grams
Source composition	Hydrogen-3 in water
Reference time	0700 EST June 3, 1992

	<u>NIST DATA</u>	<u>EMSL DATA</u>
Radioactivity concentration	810.5 Bq g ⁻¹	810.3 Bq g ⁻¹
Expanded uncertainty	0.64 percent ^{(1,2)*}	4.3 percent ⁽³⁾
Photon-emitting impurities	None observed ⁽⁴⁾	None observed
Measuring instrument	4 π β liquid-scintillation counters calibrated with SRM 4926D	Liquid-scintillation counting
Half life	12.43 \pm 0.05 years ⁽⁵⁾	
Difference from NIST		-0.05 percent ⁽⁶⁾

For the Director,

J.M. Robin Hutchinson, Acting Group Leader
Radioactivity Group
Physics Laboratory

Gaithersburg, MD 20899
January 1994

*Notes on next page

INITIAL STANDARD DILUTION RECORD

Standard Information:	
Isotope: <u>H-3</u>	Vendor: <u>EPA</u>
Activity of Standard Received: <u>.11 uCi</u>	Vendor I.D. # <u>2/7/95</u>
Weight of Standard Received (g): <u>5 g</u>	LAL I.D. #: <u>AC 5299</u>
Standard Activity (pCi/g): <u>21.9 nCi/g</u>	NIST Traceable? <u>Yes</u>
Half-life in Years or Days: <u>12.43 yrs</u>	Certificate #: <u>2606-1</u>
Reference Date: <u>0400, 6/3/92</u>	Receiver's Name: <u>Kevin Free</u>
	Date Received: <u>1/25/95</u>

Primary Dilution	
Balance Verification?: <u>Yes</u>	<u>Distilled</u>
Diluent Used: <u>EPA</u>	<u>ASTM Type II Water (Deion Water)</u>
a: Decay Corrected Standard Activity (pCi/g): <u>21.9 nCi/g</u>	<u>4.939 pCi/g on 6/3/92</u>
b: Weight of the Source Transferred (g): <u>4.939</u>	<u>g</u>
c: Total diluted weight (g): <u>49.377</u>	<u>g</u>
d: Total Diluted Volume (mL): <u>50</u>	<u>49.5 mL</u>
e: Activity of Dilution by Weight (pCi/g) [a * b / c]: <u>2190</u>	<u>pCi/g</u>
f: <u>Known</u> Calculated Density of Solution (g/mL) [c / d]: <u>0.99777</u>	<u>g/mL</u>
g: Activity of Dilution by Volume (pCi/mL) [e * f]: <u>2190</u>	<u>pCi/mL on 6/3/92</u>
h: Dilution Logbook I.D. #: <u>C. Poniewoz</u>	<u>LAL-95-0721-1</u>
Prepared By: <u>Joe Hutchinson / S. Morales</u>	Preparation Date: <u>2/7/95</u>
Reviewed By: <u>Joe Hutchinson</u>	Review Date: <u>2/7/95</u>
Purity/Cross Check Performed By: _____	Check Date: _____

Handwritten notes:
CROSS
P. M. W. L. M.

Signed

Date

CP 5/8/95

Signed

Date

0131

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

Isotope: H-3 LCS

Parent Barcode Number: AC5299 (exp. 2/97)

Vendor or Certificate I.D. # of Parent Standard: 2606-1 REF 6/3/92

Diluted Source Logbook I.D. #: 95-725-1

Balance Verification?: yes

Diluent Used: Deep water

9-0-1-1

Dilution

*Diluent: Deep well water

*Density of diluent (g/ml): 0.9977 g/ml

a: Parent Specific Activity: 2190 pCi/g ml

b: Amount of Source Transferred: 2 ml 12 ml gt Glass class "A" pipet

c: Total amount of Dilution: 5600 ml gt

d: Total Volume of Dilution: 5600 ml ml

e: Activity of Dilution (a * b / c): ~~2.74~~ 4.69 pCi/g ml

f: Activity of Dilution (a * b / d): ~~2.74~~ 4.69 pCi/ml EXPIRES 2/97

Dilution Logbook I.D. #: 95-0721-17-1

Prepared By: 9-0-1-1 Preparation Date: 2/1/96

Reviewed By: Walt C. Hill Review Date: 2/1/96

*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.

Read and Understood By

PROJECT #3 STANDARDS

Continued From Page 1

CERT #	Calibration or cert date	Expiration date	Reference #	VENDOR	Prep	Witness
Parent Ref # 4927D-B 4927D-A	Jan 1 1989	Aug 30, 1993	4927D-C 91-0199-5	NIST	AP	MS

ITEM #	precipitation Date	Final Concentration	Initial Concentration
1	Aug 30, 1993	59,034.81105 $\mu\text{g}/\text{ml}$	500,348.1105 $\mu\text{g}/\text{ml}$

pipet 10 ml into 100 ml vol flask

$$\frac{500,348.1105 \mu\text{g/ml} \times 10 \text{ ml}}{100 \text{ ml}} = 50,034.81105 \mu\text{g/ml}$$

$$= 50 \text{ nCi/ml}$$

~~SRM 4927D-A made from original conc - pp 11-4-91~~
~~18,515.8986 \Rightarrow 51 = 362.9980 $\mu\text{g}/\text{ml}$ - pp 10-4-91~~

(Reference page #5 LAL-LOG-0199)

Cert #	Calibration or cert date	Expiration date	Reference #	VENDOR
Parent Ref # 4927D-A	Jan 1 1989	Aug 30, 1993 pp 11-4-91 Sep 3, 1993	4927D-A2	NIST

ITEM #	precipitation Date	Final Concentration	Initial Concentration
2	SEP 3-1991	362.9980 $\mu\text{g}/\text{ml}$	18,512.8986 $\mu\text{g}/\text{ml}$

$$\frac{18,512.8986 \mu\text{g/ml}}{362.998 \times 27.027} \div 5 \text{ ml} = 362.9980 \mu\text{g/ml}$$

$$= 9,810.746 \mu\text{g/ml}$$

$$= 9.81 \text{ nCi/ml}$$

(Reference page 7 LAL-LOG-0199)

Continued on Page

Transferred 11-5-91 part present

Read and Understood By

Signed

11/19/91 Date

Signed

12/4/91⁰¹³³ Date

97 Amy

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	<u>H-3 MS</u>
Parent Barcode Number	<u>91-0225-8-1</u> EXP. <u>8/2/96</u>
Vendor or Certificate I.D. # of Parent Standard:	<u>-</u>
Diluted Source Logbook I.D. #:	<u>91-0225-8-1</u>
Balance Verification?:	<u>NA</u>
Diluent Used:	<u>Deadwater</u>

Dilution	
*Diluent:	<u>Deep well water</u>
*Density of diluent (g/ml):	<u>1</u> g/ml
a: Parent Specific Activity:	<u>33937.3 pCi/ml</u> pCi/g <u>2/6/96</u> @ <u>2/6/96</u>
b: Amount of Source Transferred:	<u>1.0</u> g
c: Total amount of Dilution:	<u>150</u> g <u>2/6/96</u>
d: Total Volume of Dilution:	<u>150</u> ml
e: Activity of Dilution (a * b / c):	<u>226.2</u> pCi/ml pCi/g <u>2/6/96</u> Pipet # <u>139746</u>
f: Activity of Dilution (a * b / d):	<u>226.2</u> pCi/ml @ <u>2/6/96</u>
Dilution Logbook I.D. #:	<u>94-0677-98-1</u>
Prepared By: <u>Amy</u>	Preparation Date: <u>2/29/96</u>
Reviewed By: <u>Joe Hutchinson</u>	Review Date: <u>2/29/96</u>

*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.

Read and Understood By

0134

Signed

Date

Signed

Date