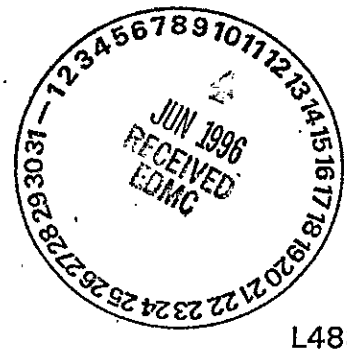
LK 4838

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

0044357

LOCKHEED MARTIN

July 31, 1995



Ms. Joan Kessner
Bechtel Hanford, Inc.
345 Hills
P.O. Box 969
Richland, WA 99352

RE:	Log-in No.:	L4838
	Quotation No.:	Q400000-B
	SAF:	B95-067
	Document File No.:	0629596
	BHC Document File No.:	242
	SDG No.:	LK4838

The attached data report contains the analytical results of samples that were submitted to Lockheed Analytical Services on 29 June 1995.

The temperature of the cooler upon receipt was 4°C. Sample containers received agree with the chain-of-custody documentation. Sample containers were received intact. Samples were 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 Hall at (509) 943-4423.

Release of this data report has been authorized by the Laboratory Director or the Director's designee as evidenced by the following signature.

Lockheed Analytical Services

Log-in No.: L4838
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" 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 Hermann for

Kathleen M. Hall
Client Services Representative

cc: Client Services
Document Control

Lockheed Analytical Services

Log-in No.: L4838
Quotation No.: Q400000-B
SAF: B95-067
Document File No.: 0520596/0525596
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CASE NARRATIVE
INORGANIC NON METALS ANALYSES

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

- One water sample was received for LK4838 and analyzed in batch 629 bh for selected analytes as requested on the chain of custody. Quality control analysis was performed on the following sample:

Client ID	LAL #		Method
BOG079	L4838-5	DUP, MS	180.1 Turbidity
BOG079	L4838-3	DUP, MS	300.0 Chloride, Fluoride, Nitrate-Nitrogen, Nitrite-Nitrogen, Orthophosphate and Sulfate
BOG079	L4838-7	DUP, MS	350.1 Ammonia
BOG079	L4838-4	DUP, MS	353.2 Nitrate-Nitrite-Nitrogen
BOG079	L4838-6	DUP, MS	9030 Sulfide

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.

Kay McCann
Prepared By

July 10, 1995
Date

Lockheed Analytical Services

Log-in No.: L4838
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CASE NARRATIVE
INORGANIC METALS ANALYSES

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

- One water sample was received in good condition on June 29, 1995 and logged in as L4838.
- The samples were prepared as LAS Batch 629BHT and analyzed for selected analytes as requested on the chain of custody. Sample BOG079 (L4838-2) was used for matrix spike and duplicate and serial dilution. All data flags due to the performance of the above-mentioned QC are associated with every sample digested with this batch.

Holding Time Requirements

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

Internal Quality Control

All internal quality control were within acceptance limits.

Hongsheng LI — 7/31/95

Prepared By — **Date**

Lockheed Analytical Services

Log-in No.: L4838
Quotation No.: Q400000-B
SAF: B95-067
Document File No.: 0520596/0525596
BHC Document File No.:242
SDG No.: LK4838

CASE NARRATIVE
INORGANIC METALS ANALYSES

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

- One water sample was received in good condition on June 29, 1995 and logged in as L4838.
- The samples were prepared as LAS Batch 629BHD and analyzed for selected analytes as requested on the chain of custody. Sample BOG080 (L4838-22) was used for matrix spike and duplicate and serial dilution. All data flags due to the performance of the above-mentioned QC are associated with every sample digested with this batch.

Holding Time Requirements

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

Internal Quality Control

All internal quality control were within acceptance limits.

Hongsheng LI — 7/31/95

Prepared By — **Date**

Log-in No.: L4838
Quotation No.: Q400000-B
SAF: B95-067
Document File No.: 0520596/0525596
BHC Document File No.:242
SDG No.: LK4838

CASE NARRATIVE
RADIOCHEMICAL ANALYSES

The routine calibration and quality control 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, duplicate samples.

Holding Time Requirements

All holding times were met.

Chemical recoveries and MDAs can be found on the preparation and calculation spreadsheets, respectively, of the attached raw data for each method.

Analytical Method Gross Alpha Beta

The gross alpha beta analysis was performed using Standard Operating Procedure (SOP), LAL-91-SOP-0060. All samples were analyzed in workgroup #24940. No problems were encountered during preparation or analysis. All QC criteria were met and no reanalyses were performed.

Analytical Method Strontium-90

The strontium-90 analysis was performed using SOP, LAL-91-SOP-0196. All samples were analyzed in workgroup #24941. No problems were encountered during preparation or analysis. All QC criteria were met and no reanalyses were performed.

Analytical Method Technetium-99

The technetium-99 analysis was performed using SOP, LAL-91-SOP-0169. All samples were analyzed in workgroup #24944. No problems were encountered during preparation or analysis. All QC criteria were met and no reanalyses were performed, with the following exception: The low LCS tracer chemical yield was elevating the LCS recovery out of limits; therefore, the average batch chemical yield was used, preventing an out-of-limits LCS.

Analytical Method Tritium

The tritium analysis was performed using SOP, LAL-91-SOP-0066. All samples were analyzed in workgroup #24943. No problems were encountered during preparation or analysis. All QC criteria were met and no reanalyses were performed.

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Analytical Method Uranium Isotopic

The uranium isotopic analysis was performed using SOP, LAL-91-SOP-0108. All samples were analyzed in workgroup #24942. No problems were encountered during preparation or analysis. All QC criteria were met and no reanalyses were performed.

Yvonne M. Jacoby
Prepared By

July 26, 1995
Date

Lockheed Analytical Services

DATA QUALIFIERS FOR INORGANIC ANALYSES

[Revised 08/28/92]

For Use on the Analytical Data Reporting Forms	
B	***For CLP Analyses Only*** -- Reported value is less than the contract required detection limit (CRDL) but greater than or equal to the instrument detection limit (IDL).
C	***For Routine, Non-CLP Analyses Only*** -- Any constituent that was also detected in the associated blank whose concentration was greater than the reporting detection limit (RDL).
D	Presence of high levels of interfering constituents required dilution of sample which increased the RDL by the dilution factor.
E	Estimated value due to presence of interference.
H	Sample analysis performed outside of method-or client-specified maximum holding time requirement.
M	***For CLP Analyses Only*** -- Duplicate injection precision criterion was not met.
N	Matrix spike recovery exceeded acceptance limits.
S	Reported value was determined from the method of standard addition.
U	***For CLP Reporting Only*** -- Constituent was analyzed for but not detected (sample quantitation must be corrected for dilution and percent moisture).
W	***For AAS Only*** -- Post-digestion spike for Furnace AAS did not meet acceptance criteria and sample absorbance is less than 50% of spike absorbance.
X, Y, or Z	Analyst-defined qualifier.
*	Relative percent difference (RPD) for duplicate analysis exceeded acceptance limits.
+	Correlation coefficient (r) for the MSA is less than 0.995.
For Use on the QC Data Reporting Forms	
a[1]	The spike recovery and/or RPD for matrix spike and matrix spike duplicates cannot be evaluated due to insufficient spiking level compared to the elevated sample analyte concentration.
b[1]	The RPD cannot be computed because the sample and/or duplicate concentration was below the RDL.

[1] Used as footnote designations on the QC summary form.

Lockheed Analytical Services

DATA QUALIFIERS FOR RADIOCHEMICAL ANALYSES

[Revised 08/28/92]

For Use on the Analytical Data Reporting Forms	
B	Any constituent that was also detected in the associated blank whose concentration was greater than the reporting detection limit (RDL) and/or minimum detectable activity (MDA).
C	Presence of high TDS in sample required reduction of sample size which increased the MDA.
D	Constituent detected in the diluted sample.
E	Constituent concentration exceeded the calibration or attenuation curve range.
F	***For Alpha Spectrometry Only***-- FWHM exceeded acceptance limits.
H	Sample analysis performed outside of method-specified maximum holding time requirement.
Y	Chemical yield exceeded acceptance limits.
For Use on the QC Data Reporting Forms	
*	QC data (i.e., percent recovery data for laboratory control standard and matrix spike; and RPD for replicate analyses) exceeded acceptance limits.
a[1]	The spike recovery and/or RPD for matrix spike and duplicates cannot be evaluated due to insufficient spiking level compared to the elevated sample analyte concentration.
b[1]	The RPD cannot be computed because the sample and/or duplicate concentration was below the MDA.

[1] Used as foot note designations on the QC summary form.

Sample Disposition Record

Control #: 95-0040
Revision #:
Date Initiated: 07/05/95

Section 1 - BACKGROUND

SAF #: B95-067
OU: 100-HR-3
Project ID: 100-HR-3 LFI
Task ID: 6
Sampling Event: 100-HR-3 Groundwater Sampling-Phase 1
Laboratory: Quanterra/Lockheed
Project Coordinator: R. C. SMith
Task Manager: R. E. Peterson

Section 2 - SAMPLE INFORMATION

Number of Samples: 4 - Qunaterra; 2 - Lockheed
ID Numbers: Q - B0G041, B0G042, B0G077, B0G078; L - B0G079, B0G080
Matrix: Water
Collection Date: 06/27/95

Section 3 - ISSUE

Class: Validation Direction
NCR Number: N/A
Type: Temperature Excursion
Description: Samples were stored for twelve hours in a refrigerator with temperatures of 7-8 degrees Celcius.

N/A
NCR Validation (Print/Sign) Date

Section 4 - DISPOSITION

Type: Use As Is
Description: With concurrence from R. E. Peterson, task lead, proceed with analyses and document excursion with this SDR.

R. C. Smith/ R C Smith 7/6/95
Project Coordinator (Print/Sign) Date

R. E. Peterson R E Peterson 7/13/95
Task Manager (Print/Sign) Date

N/A
QA (Print/Sign) Date

Section 5 - INSPECTION (Issue Class: Nonconformance Only)

Inspection Number:
Inspection Results:

014

N/A
Inspector (Print/Sign) Date

[95] From: Kenneth F Trapp at ~WHC279 6/28/95 4:07PM (1762 bytes: 1 ln)
To: Robert C (Clay) Smith at ~WHC321
cc: Kenneth F Trapp, David A St John
Subject: Samples Out of Range in Temperature.
---------- Message Contents ----------

Text item 1: Text_1

Dear Clay,

All the samples stored in Refrigerator 3 at 4701-C were exposed to out of range temperatures for a 12 hour period, from 2000 on June 27 to 0800 on June 28. The temperature ranged between 7C to 8C. Here is a list of the affected samples by SAF:

B95-067 (100-HR-3 Groundwater Sampling, Phase 1)

B0G041	Quanterra
B0G042	"
B0G077	"
B0G078	"
B0G079	Lockheed
B0G080	"

Only the analysis for Anions, NO2-NO3, Turbidity, Sulfide, and Ammonia are temperature dependent.

B95-077 (100-HR-3 Groundwater Sampling - TPH)

B0G790
B0G791
B0G792
B0G793

TPH is temperature dependent. Shipped to Quanterra.

B95-078 (116-B-5 Crib)

116-B5A-10
116-B5A-12.5
116-B5A-14.5
116-B5B-10
116-B5B-12.5
116-B5B-14.5
116-B5C-6
116-B5D-10
116-B5D-12.5
116-B5D-15
116-B5H-10
116-B5H-12.5
116-B5H-15
116-B5G-10
116-B5G-12.5
116-B5G-15

All of these samples are temperature dependent. Shipped to FAST.

LOCKHEED ANALYTICAL SERVICES
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Jun 29 1995, 01:57 pm

Login Number: L4838
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
L4838-1	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: RFG01-07B				
Water 1 S SCREENING		Hold:24-DEC-95		
L4838-2	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: RFG01-07B				
Water 1 S 6010 ICP METALS		Hold:24-DEC-95		
L4838-3	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: RFG01-07B				
Water 1 S 300.0 CHLORIDE		Hold:25-JUL-95		
Water 1 S 300.0 FLUORIDE		Hold:25-JUL-95		
Water 1 S 300.0 NITRATE		Hold:29-JUN-95		
Water 1 S 300.0 NITRITE		Hold:29-JUN-95		
Water 1 S 300.0 PHOSPHATE		Hold:29-JUN-95		
Water 1 S 300.0 SULFATE		Hold:25-JUL-95		
L4838-4	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: RFG01-07B				
Water 1 S 353.2 NITRATE		Hold:25-JUL-95		
L4838-5	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: RFG01-07B				
Water 1 S 180.1 TURBIDITY		Hold:29-JUN-95		
L4838-6	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: RFG01-07B				
Water 1 S 9030 SULFIDE		Hold:04-JUL-95		
L4838-7	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: RFG01-07B				
Water 1 S 350.1 NH3/N		Hold:25-JUL-95		
L4838-8	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
Water 1 S GR ALP/BETA LAL-0060		Hold:24-DEC-95		

017

0629596

LOCKHEED ANALYTICAL SERVICES
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Jun 29 1995, 01:57 pm

Login Number: L4838
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
Water 1 S SR-90 LAL-0196 Hold:24-DEC-95				
Water 1 S U-ISOTOPIC LAL-0108 Hold:24-DEC-95				
L4838-9	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
L4838-10	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
L4838-11	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
L4838-12	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
L4838-13	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
L4838-14	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
L4838-15	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
L4838-16	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
L4838-17	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
Water 1 S TRITIUM(H3) LAL-0066 Hold:24-DEC-95				
L4838-18	B0G079	27-JUN-95	29-JUN-95	03-AUG-95
temp 4; SAF# B95-067				
Location: 157				
Water 1 S TC-99 LAL-0169 Hold:24-DEC-95				

018

C629596

LOCKHEED ANALYTICAL SERVICES
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Jun 29 1995, 01:57 pm

Login Number: L4838
Account: 596 Bechtel Hanford, Inc. * Richland, WA
Project: BECHTEL-HANFORD Bechtel Hanford Project

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	PR	Due Date
L4838-19	B0G079	27-JUN-95	29-JUN-95		03-AUG-95
temp 4; SAF# B95-067					
Location: 157					
L4838-20	B0G079	27-JUN-95	29-JUN-95		03-AUG-95
temp 4; SAF# B95-067					
Location: 157					
L4838-21	B0G079	27-JUN-95	29-JUN-95		03-AUG-95
temp 4; SAF# B95-067					
Location: 157					
L4838-22	B0G080	27-JUN-95	29-JUN-95		03-AUG-95
temp 4; SAF# B95-067					
Location: RFG01-07B					
Filt H20 15 S 6010	ICP METALS	Hold:24-DEC-95			
L4838-23	REPORT TYPE	29-JUN-95	29-JUN-95		03-AUG-95
SAF# B95-067					
Location:					
Water 1 S	EDD - DISK DEL.				
Water 1 S	INORG TYPE 4A RPT				
Water 1 S	RAD RPT TYPE 4F				

Signature: A Smith

Date: 6-29-95 01?

0609596

Radioactive Material Screening Worksheet

6/29/95

Job Name			WHC-06295-L4838															
Sample Number	Solid or Liquid	Time (min)	Size (g or ml)		Counts		CPM		DPM		Activity (uCi/gm or ml)			Activity (uCi/sample)			RAD
			Aliq	Smp	α	β	α	β	α	β	α	β	α/β	α	β	α/β	Y or N
L4838- 1	Liquid	5	10	20	4	113	0.8	22.6	1	-8	4.28E-08	<MDA	4.28E-08	8.56E-07	<MDA	8.56E-07	NO
										Totals	4.28E-08	0.00E+00	4.28E-08	8.56E-07	0.00E+00	8.56E-07	

RDL (soil) uCi/gm	Alpha	Beta
	5.89E-05	1.60E-04
RDL (liquid) uCi/gm	Alpha	Beta
	5.89E-07	1.60E-06

Analyst's Signature: [signature] 6/29/95

Review Signature: T. Oppenborn

0029596

020

Bechtel Hanford, Inc.

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

L4838

Page 1 of 2

Data Turnaround: ☐ Priority ■ Normal

Collector: Kiee / A. Rizzo	Company Contact: R. E. Peterson	Telephone: (509) 372-9638
Project Designation: 100-HR-3 Groundwater Sampling, Round 9, Phase 1	Sampling Location: 100 H	SAF No.: B95-067
Ice Chest No.	Field Logbook No.: EFL-1018	Method of Shipment: Federal Express
Shipped To: Lockheed	Offsite Property No.: W95-0-0204-38	Bill of Lading/Air Bill No.: 290 4633 295

Possible Sample Hazards/Remarks	Preservation	HNO_3	Cool 4°C	H_2SO_4	Cool 4°C	*1	H_2SO_4	HNO_3	Cool 4°C	HCl	Cool 4°C
	Type of Container	G	G	P/G	P/G	P	P/G	P/G	G	P/G	P
	No. of Container(s)	1	1	1	1	1	1	9	1	4	1
Special Handling and/or Storage: Maintain samplings between 2°C and 6°C.	Volume	500mL	500mL	500mL	250mL	1L	1L	1L	500mL	1L	20mL
SAMPLE ANALYSIS		ICP Metals (Unfiltered)	Anions (IC) - F, Cl, SO_4, NO_2, NO_3, PO,	NO_2 - NO_3	Turbidity	Sulfide	Ammonia	Gross Alpha, Gross Beta, Sr-90, U-235/238	Tritium	Tc-99	Activity Scan

Sample No.	Matrix*	Date Sampled	Time Sampled										
B0G079	L	6-27-95	0937	X	X	X	X	X	X	X	X	X	X

CHAIN OF POSSESSION	Sign/Print Names		
Relinquished By: A. Rizzo (ERC)	Date/Time: 6-27-95 1245	Received By: K. Trapp / K. Trapp	Date/Time: 1245 6/28/95
Relinquished By: K. Trapp / K. Trapp	Date/Time: 1140 6/28/95	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:

SPECIAL INSTRUCTIONS
*1 ZnAc+NaOH
ns 6/27/95
Sample analysis for phosphate, nitrate, and nitrite by EPA 300.0; and turbidity by EPA 180.1 is being requested for information only. The ERC Contractor acknowledges that the 48-hour holding time will not be met.

The temperature was out of range for 12 hours, between 7°C and 8°C, for these samples.

Matrix*
S = Soil
SE = Sediment
SO = Solid
SL = Sludge
W = Water
O = Oil
A = Air
DS = Drum Solids
DL = Drum Liquids
T = Tissue
WI = Wipe
L = Liquid
V = Vegetation
X = Other

LABORATORY SECTION	Received By: [signature]	Title: Sample Custodian	Date/Time: 6-29-95 / 0900
FINAL SAMPLE DISPOSITION	Disposal Method	Disposed By	Date/Time

U21

Bechtel Hanford, Inc.

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

Data Turnaround: ☐ Priority ■ Normal

Collector: K. Lee / A. Rizzo	Company Contact: R. E. Peterson	Telephone: (509) 372-9638
Project Designation: 100-HR-3 Groundwater Sampling, Round 9, Phase 1	Sampling Location: 100 H	SAF No.: B95-067
Ice Chest No.	Field Logbook No.: EFL-1018	Method of Shipment: Federal Express
Shipped To: Lockheed	Offsite Property No.: W95-0-0204-39	Bill of Lading/Air Bill No.: 290-4633-295
Possible Sample Hazards/Remarks	Preservation: HNO_3	
	Type of Container: G	
	No. of Container(s): 1	
Special Handling and/or Storage: Maintain samplings between 2°C and 6°C.	Volume: 500mL	
SAMPLE ANALYSIS	ICP Metals (Filtered)	

Sample No.	Matrix*	Date Sampled	Time Sampled	
B0G080	W	6-27-95	0937	Y

CHAIN OF POSSESSION	Sign/Print Names		
Relinquished By: A. Rizzo (ERC)	Date/Time: 6/27/95 1245	Received By: K. Trapp	Date/Time: 6/28/95 1245
Relinquished By: K. Trapp	Date/Time: 6/28/95 1140	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:

SPECIAL INSTRUCTIONS

Refer to Activity Scan listed on page 1 of 2.

The samples were exposed to out of range temperatures, between 7°C and 8°C, for 12 hours.

Matrix*
- S = Soil
- SE = Sediment
- SO = Solid
- SL = Sludge
- W = Water
- O = Oil
- A = Air
- DS = Drum Solids
- DL = Drum Liquids
- T = Tissue
- WI = Wipe
- L = Liquid
- V = Vegetation
- X = Other

LABORATORY SECTION	Received By:	Title: Sample Custodian	Date/Time: 6-29-95 1040
FINAL SAMPLE DISPOSITION	Disposal Method	Disposed By	Date/Time

WELL LISTED IN THE 1995 100-HR-3 ROUND 9 SAMPLING

199-H3-1
199-H4-10
199-H4-13
199-H4-15A
199-H4-15CS
199-H4-16
199-H4-17
199-H4-45
199-H4-46
199-H4-47
199-H4-48
199-H4-49
199-H5-1A
199-H6-1
199-H4-3
199-H4-4
199-H4-5
199-H4-6
199-H4-11
199-H4-14
199-H3-2A
199-H3-2C
199-H4-12A
199-H4-12C
699-96-43
699-97-43

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: June 13, 1995

COPIES: R. L. Biggerstaff H4-91 FROM: S. K. De Mers
Radiological Controls
N3-06/376-2764

SUBJECT: **1995 Round 9 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 except one of the 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 773 pCi/l β and 50 pCi/l α.

The remaining wells are in locations that do not provide a credible path whereby they could become contaminated at the above listed levels.

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.

skd

024

0029596

SAMPLE CHECK-IN LIST

Date/Time Received: 6-29-95/0900 SDG#: N/A

Work Order Number: N/A SAF #: B95-062

Shipping Container ID: Bonhead II Chain of Custody # N/A

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

7. Samples have:
   - ____ tape
   - X custody seals
   - ____ hazard labels
   - X appropriate sample labels

8. Samples are:
   - X in good condition
   - ____ broken
   - ____ leaking
   - ____ have air bubbles

9. Is the information on the COC and Sample bottles in agreement?

   Yes [X] No [ ]

Notes: _____

Sample Custodian/Laboratory: [signature] / LAS Date: 6-29-95

Telephoned To: Kathleen Hall On 6-29-95 By Anthony Miller

025

0102596

LOCKHEED MARTIN

Sample Login
Login Review Checklist

Lot Number L4836

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

primary review signature	date	secondary review signature	date
[signature]	6-29-95	[signature]	6-29-95

026

COC 9596

Lockheed Analytical Services
Sample Receiving Checklist

Client Name: Bechtel - Hanford Job No. 24938 Cooler ID:

COOLER CONDITION UPON RECEIPT			
Temperature of cooler upon receipt:	4°C		
temperature of temp. blank upon receipt:			
	Yes	**No**	*** Comments/Discrepancies**
custody seals intact	X		
chain of custody present	X		
blue ice (or equiv.) present/frozen	X		
rad survey completed	X		
SAMPLE CONDITION UPON RECEIPT			
	Yes	**No**	*** Comments/Discrepancies**
all bottles labeled	X		
samples intact	X		
proper container used for sample type	X		
sample volume sufficient for analysis	X		
proper pres. indicated on the COC	X		
VOA's contain headspace			NA
are samples bi-phasic (if so, indicate sample ID'S):			NA
MISCELLANEOUS ITEMS			
	Yes	**No**	*** Comments/Discrepancies**
samples with short holding times		X	
samples to subcontract		X	
ADDITIONAL COMMENTS/DISCREPANCIES			
Completed by / date:		6-29-95	
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*			

0120

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

Client Sample Number	LAL Sample Number	SDG Number	Matrix	Method
B0G079 —	L4838-1		Water	SCREENING —
	L4838-2		Water	6010 ICP METALS-
	L4838-3		Water	300.0 CHLORIDE-
	L4838-3		Water	300.0 FLUORIDE -
	L4838-3		Water	300.0 NITRATE -
	L4838-3		Water	300.0 NITRITE-
	L4838-3		Water	300.0 PHOSPHATE-
	L4838-3		Water	300.0 SULFATE-
	L4838-4		Water	353.2 NITRATE -
	L4838-5		Water	180.1 TURBIDITY-
	L4838-6		Water	9030 SULFIDE -
	L4838-7		Water	350.1 NH3/N -
	L4838-8		Water	GR ALP/BETA LAL-
	L4838-8		Water	SR-90 LAL-0196 -
	L4838-8		Water	U-ISOTOPIC LAL-0
	L4838-17		Water	TRITIUM(H3) LAL-
	L4838-18		Water	TC-99 LAL-0169 -
B0G080 —	L4838-22		Filt H20	6010 ICP METALS -
REPORT TYPE —	L4838-23		Water	EDD - DISK DEL.—
	L4838-23		Water	INORG TYPE 4A RP
	L4838-23		Water	RAD RPT TYPE 4F

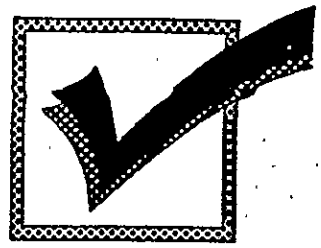
LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: B0G079	Date Collected: 27-JUN-95
Matrix: Water	Date Received: 29-JUN-95
Percent Solids: N/A	

Constituent	Units	Method	Result	Project Reporting Limit	Data Qualifier(s)	Date Analyzed	LAS Batch ID	LAS Sample ID
Turbidity	NTU	180.1	0.61	N/A		29-JUN-95	24771	L4838-5
Chloride	mg/L	300.0	5.6	0.020		29-JUN-95	24769	L4838-3
Fluoride	mg/L	300.0	0.27	0.10		29-JUN-95	24772	L4838-3
Nitrate-N	mg/L	300.0	3.0	0.020		29-JUN-95	24766	L4838-3
Nitrite-N	mg/L	300.0	< 0.002	0.010	U	29-JUN-95	24767	L4838-3
Ortho Phosphate	mg/L	300.0	0.034	0.10	B	29-JUN-95	24768	L4838-3
Sulfate	mg/L	300.0	32.	0.10		29-JUN-95	24770	L4838-3
Ammonia Nitrogen	mg/L	350.1	< 0.020	0.050	U	06-JUL-95	24789	L4838-7
Nitrate-Nitrite-Nitrogen	mg/L	353.2	3.3	0.050		05-JUL-95	24790	L4838-4
Sulfide	mg/L	9030	< 1.0	3.0	U	01-JUL-95	24793	L4838-6

Nonmetals Analytical Data Technical Review Checklist (Analyst)



Analyst Name *(Print)*: Paul Lacks	**Analysis Date:** 06/29/95
Client(s) Name:	**LAL Batch ID:** 629-bh
Method No: 300.0 (Anions: F⁻, PO₄³⁻)	**Instrument:** IC-Sys 1&2

Description	Yes	No	Comments
Completeness Review 1. Was required method/SOP followed?	✓		
2. Are all raw data available and labeled properly (e.g., methods used, units, sample IDs, dilution factors, reruns)?	✓		
3. Are all nonconformities in the raw data noted and/or explained?	✓		
4. Were all the client samples analyzed for all constituents and QC as specified on the LAL Bench Sheets?	✓		
Data Quality Assessment 5. Were samples properly preserved and analyzed within the method-specified holding time?	✓		
6. Are instrument calibration criteria met?	✓		
7. Are initial and continuing calibration verification data (bracketing the samples of interest) within criteria?	✓		
8. Are bracketing initial and continuing calibration blank data within criteria?	✓		
9. Are matrix spike and/or matrix spike duplicate (if required) recovery data within criteria?	✓		
10. Are method blank data within criteria?	✓		
11. Are duplicate precision data within criteria?	✓		
12. Are laboratory control sample data within criteria?	✓		
13. Has spike verification been performed adequately?	✓		*LAL ID(s):* L4838-3 *SVP Initials:* AB
14. Has the *status* been updated in the ACS?	✓		

Notes and comments:

I certify, to the best of my knowledge, that the data are acceptable and in compliance with the laboratory policies and client requests, except as noted above.

Analyst's Signature/Date: 06/30/95

Secondary Reviewer's Initials/Date: GK 7/3/95

Lockheed Analytical Laboratory

Nonmetals Analytical Data Technical Review Checklist (Analyst)

Analyst Name *(Print)*: Paul Lopez	Analysis Date: 07/06/95
Client(s) Name:	LAL Batch ID: 629-6h
Method No: 350.1 Manual	Instrument: 350 Autoan

Description	Yes	No	Comments
Completeness Review			
1. Was required method/SOP followed?	✓		
2. Are all raw data available and labeled properly (e.g., methods used, units, sample IDs, dilution factors, reruns)?	✓		
3. Are all nonconformities in the raw data noted and/or explained?	✓		
4. Were all the client samples analyzed for all constituents and QC as specified on the LAL Bench Sheets?	✓		
Data Quality Assessment			
5. Were samples properly preserved and analyzed within the method-specified holding time?	✓		
6. Are instrument calibration criteria met?	✓		
7. Are initial and continuing calibration verification data (bracketing the samples of interest) within criteria?	✓		
8. Are bracketing initial and continuing calibration blank data within criteria?	✓		
9. Are matrix spike and/or matrix spike duplicate (if required) recovery data within criteria?	✓		
10. Are method blank data within criteria?	✓		
11. Are duplicate precision data within criteria?	✓		
12. Are laboratory control sample data within criteria?	✓		
13. Has spike verification been performed adequately?	✓		LAL ID(s): N/ SVP Initials: L4838-7
14. Has the *status* been updated in the ACS?	✓		

Notes and comments:

I certify, to the best of my knowledge, that the data are acceptable and in compliance with the laboratory policies and client requests, except as noted above.

07/06/95
Analyst's Signature/Date

7/7/95
Secondary Reviewer's Initials/Date

SULFIDE

Method: 9030 Reactive, Total
Batch: 629–fw1, 629–bh

Analyst: Mike Nys
Analysis Date: 7/1/95

Sample Analysis:

Sample ID	Titrant Vol.(mL)	Sample Vol.(mL)	Iodine (mL)	Sample Dilution	Sample Amt. (g or mL)	Sulfide Conc. / Units	QC RECOVERIES
ICV	7.30	100	10.0	1		10.954 mg/L	96.6% REC
ICB	10.05	100	10.0	1		0.000 mg/L	
pb	10.05	100	10.0	1		0.000 mg/L	
lcs	8.00	100	10.0	1		8.165 mg/L	102.6% REC
L4839–14	10.00	200	10.0	4	50 mL	0.398 mg/L	
L4839–14D	10.10	200	10.0	4	50 mL	–0.398 mg/L	b RPD
L4838–6	10.00	200	10.0	1	200 mL	0.100 mg/L	
L4838–6D	10.00	200	10.0	1	200 mL	0.100 mg/L	b RPD
L4838–6S	8.00	200	10.0	1	200 mL	4.083 mg/L	102.6% REC
CCV	10.20	100	15.0	1		19.418 mg/L	97.6% REC
CCB	10.10	100	10.0	1		–0.199 mg/L	

Q.C. Standards:

True Value of LCS = 7.96 mg/L from 1.00 mL stock #95136 at 796 mg/L.
True Value of ICV = 11.34 mg/L from 1.50 mL stock #95298 at 756 mg/L.
True Value of CCV = 19.9 mg/L from 2.50 mL stock #95136.
True Value of MS = 3.98 mg/L from 1.00 mL stock #95136 diluted to 200 mL.

Calculations:

Sulfide (mg/L) = [(A*B)–(C*D) * 16,000] / mL sample * 4

Where:
A = mL iodine added;
B = normality of iodine;
C = mL titration;
D = normality titrant;
4 = The dilution factor from the reactivity part of the analysis
(50 mL sample to 50 mL of scrubber solution, then diluted to 200 mL)

Sulfide (mg/kg) = [(A*B)–(C*D) * 16,000] / g sample * 1.333

Where:
A = mL iodine added;
B = normality of iodine;
C = mL titration;
D = normality titrant;
1.333 = The correction factor from the titrimetric part of the analysis
(final volume of scrubber solution is 200 mL, but only 150 mL
is used for the sulfide analysis [200/150 = 1.333].)

Standardization of Thiosulfate:

Wt. KIO3 (g)	/ Volume	= ml's used	= Wt. KIO3 used
1.0123	100.0	1.0	0.010123

Titration:

ml's	Ave.	Thiosulfate
11.40	11.400	Normality:
11.40		0.02489
11.40		

Standardization of Iodine:

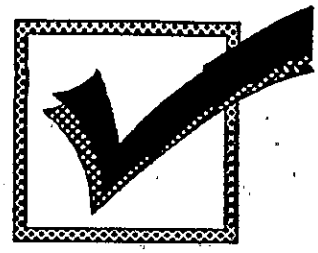
10.00 ml

Titration:

ml's	Ave.	Iodine
10.05	10.050	Normality:
10.05		0.02502
10.05		

Lockheed Analytical Laboratory

Nonmetals Analytical Data Technical Review Checklist (Analyst)



Analyst Name *(Print)*: Paul Lacks	Analysis Date: 07/05/95
Client(s) Name:	LAL Batch ID: 629-bh
Method No: 353.2 NITRATE	Instrument: 3590 ALPKEM

Description	Yes	No	Comments	
Completeness Review				
1. Was required method/SOP followed?	✓			
2. Are all raw data available and labeled properly (e.g., methods used, units, sample IDs, dilution factors, reruns)?	✓			
3. Are all nonconformities in the raw data noted and/or explained?	✓			
4. Were all the client samples analyzed for all constituents and QC as specified on the LAL Bench Sheets?	✓			
Data Quality Assessment				
5. Were samples properly preserved and analyzed within the method-specified holding time?	✓			
6. Are instrument calibration criteria met?	✓			
7. Are initial and continuing calibration verification data (bracketing the samples of interest) within criteria?	✓			
8. Are bracketing initial and continuing calibration blank data within criteria?	✓			
9. Are matrix spike and/or matrix spike duplicate (if required) recovery data within criteria?	✓			
10. Are method blank data within criteria?	✓			
11. Are duplicate precision data within criteria?	✓			
12. Are laboratory control sample data within criteria?	✓			
13. Has spike verification been performed adequately?	✓		*LAL ID(s):* L4838-4	*SVP Initials:* ELM
14. Has the *status* been updated in the ACS?	✓			
Notes and comments:				

I certify, to the best of my knowledge, that the data are acceptable and in compliance with the laboratory policies and client requests, except as noted above.

Analyst's Signature/Date: 07/06/95

Secondary Reviewer's Initials/Date: GP 7/7/95

CLP

1

INORGANIC ANALYSES DATA SHEET

CLIENT ID NO.: BOG080

Lab Name: L.A.S. Contract: BECHTEL_HA

Lab Code: LOCK Case No.: 629BHD SAS No.: _____ SDG No.: LK4838

Matrix (soil/water): WATER Lab Sample ID: L4838-22

Level (low/med): LOW Date Received: 06/29/95

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	29.0	U		P
7440-36-0	Antimony	58.0	U		P
7440-38-2	Arsenic	98.0	U		P
7440-39-3	Barium	25.8	B		P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	5.0	U		P
7440-70-2	Calcium	43400			P
7440-47-3	Chromium	9.1	B		P
7440-48-4	Cobalt	6.0	U		P
7440-50-8	Copper	3.0	U		P
7439-89-6	Iron	13.7	B		P
7439-92-1	Lead	56.0	U		P
7439-95-4	Magnesium	10300			P
7439-96-5	Manganese	2.0	U		P
7440-02-0	Nickel	15.0	U		P
7440-09-7	Potassium	4960	B		P
7782-49-2	Selenium	108	B		P
7440-22-4	Silver	4.0	U		P
7440-23-5	Sodium	14800			P
7440-28-0	Thallium	50.0	U		P
7440-62-2	Vanadium	10.0	B		P
7440-66-6	Zinc	4.0	U		P

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments:

FORM I - IN

CLP

1

INORGANIC ANALYSES DATA SHEET

CLIENT ID NO.

BOG079

Lab Name: L.A.S. Contract: BECHTEL_HA

Lab Code: LOCK Case No.: 629BHT SAS No.: SDG No.: LK4838

Matrix (soil/water): WATER Lab Sample ID: L4838-2

Level (low/med): LOW Date Received: 06/29/95

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	31.9	B		P
7440-36-0	Antimony	58.0	U		P
7440-38-2	Arsenic	98.0	U		P
7440-39-3	Barium	27.0	B		P
7440-41-7	Beryllium	1.0	U		P
7440-43-9	Cadmium	5.0	U		P
7440-70-2	Calcium	42800			P
7440-47-3	Chromium	14.5			P
7440-48-4	Cobalt	6.0	U		P
7440-50-8	Copper	3.0	U		P
7439-89-6	Iron	144			P
7439-92-1	Lead	56.0	U		P
7439-95-4	Magnesium	10600			P
7439-96-5	Manganese	5.3	B		P
7440-02-0	Nickel	15.0	U		P
7440-09-7	Potassium	4980	B		P
7782-49-2	Selenium	87.0	U		P
7440-22-4	Silver	4.0	U		P
7440-23-5	Sodium	15300			P
7440-28-0	Thallium	50.0	U		P
7440-62-2	Vanadium	10.5	B		P
7440-66-6	Zinc	7.6	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

FORM I - IN

Lockheed Analytical Laboratory
Metals Analytical Data
Technical Review Checklist
(Analyst)

Analyst Name (Print): J. Lindner	Instrument: TJA ICP 61E	Method: 6010

Batch Number	Client Name	Code Comments	Bench Sheet included Y/N	ACS updated Y/N
706cas	[redacted]	(Dilutions) - OK for Na	Y	Y
706tl	[redacted]	13 & 12 (see notes). 10 (306 ppb - Zn) REDIGEST REQUIRED!		
6296hT	Bechtel Hanford Inc		Y	Y
6296hD	" " "		Y	Y

CODE ANOMALY
10 Prep Blank data was not within criteria
11 Laboratory Control Sample was not within criteria
12 Duplicate Precision was not met
13 Matrix Spike recovery was not within criteria
00 Other

Description	Yes	No	Comments
Completeness Review 1. Were the standard operating procedures (SOP) followed?	✓		
2. Are all raw data available and labeled properly (e.g., methods used, units, sample IDs, dilution factors, reruns)?	✓		
3. Are all abnormalities in the raw data noted and/or explained?	✓		
4. Were all the client samples analyzed for all constituents and QC as specified on the LAL Bench Sheets?	✓		
Data Quality Assessment 5. Was the sample properly preserved and analyzed within the method-specified holding time?	✓		
6. Were the instrument calibration criteria met?	✓		
7. Are the initial and continuing calibration verification samples data bracketing the samples of interest within criteria?	✓		
8. Are the bracketing initial and continuing calibration blank data within criteria?	✓		
9. *For ICP Only:* Are the interference check standard recovery data within criteria?	✓		

Notes and comments:

(13) Pb (169%) & (12) Pb (22%) Due to sample texture (medium) & non-uniformity

(10) Prep Blank - 306 ppb Zn

I certify, to the best of my knowledge, that the data are acceptable and in compliance with the laboratory policies and client requests, except as noted above.

13 Jul 95
Analyst Signature/Date
for J. Lindner

14 JUL 95
Secondary Reviewer Initials/Date
for I. Heitschmidt

Lockheed

ICP RUN LOG

Date: 12 Jul 95 **Start Time:** 1648

Analyst: J. Lindner **End Time:** 2232

Sensitivity Check (10 ppm Mn / 10 ppm Cu): 2.38

ICP File Folder: J951934.08F

QC REFERENCE PAGE:	306

BATCH #	COMMENTS
706 cds	(Dilutions) OK for Na — Complete
706 lt	Redigest Required — 306 ppb Zn in prep blank
6296hT	OK - Complete
6296hD	OK -- Complete

lrl 13 Jul 95

ANALYST: for J. Lindner **DATE:** 13 Jul 95

The sample loading lists are kept in a 3-ring binder next to the instrument and will be bound as needed.

REVIEWER: _____ **DATE:** _____

ICP RUN LOG - QC REFERENCE PAGE

306

	SOURCE	LOT NUMBER	PREPARATION DATE	EXPIRATION DATE
ICV	NIST/Inorganic Ventures*	95066A	3/1/95	10/1/95
MICV	NIST	95118	4/28/95	9/1/96
CRI	Inorganic Ventures	95118	4/28/95	9/1/96
ICSA	"	9101876417	-	4/1/96
ICSAB	"	9101875433	-	9/1/95
STD A	"	95062	5/3/95	9/1/95
STD B	"	95073443	7/6/95	9/1/95

* 2nd source.

SPIKE A	Inorganic Ventures	95089	3/30/95	9/1/95
SPIKE B	Plasma-Chem. Assoc.	9101876027	-	2/28/96
SPIKE C	Inorganic Ventures	95089	3/30/95	11/1/95
AFCEE Spike	"	95123	5/3/95	9/1/95
TCLP Spike	"	95118	4/28/95	9/1/95

Page prepared by: _____ **Date:** 07 Jul 95

Reviewer: _____ **Date:** _____

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: B0G079 LAL Sample ID: L4838-8

Date Collected: 27-JUN-95 Date Received: 29-JUN-95

Matrix: Water Login Number: L4838

Constituent	Analyzed	Batch	Activity	Error	MDA	DataQual	Units
Gross Alpha	19-JUL-95	GR ALP/BETA LAL-0060_24940	1.3	1.4	2.3	C	pCi/L
Gross Beta	19-JUL-95	GR ALP/BETA LAL-0060_24940	5.1	1.7	2.4		pCi/L
Total radio-strontium	11-JUL-95	SR-90 LAL-0196_24941	-0.14	0.52	0.92		pCi/L
U-233/4	12-JUL-95	U-ISOTOPIC LAL-0108_24942	1.47	0.38	0.17		pCi/L
U-235	12-JUL-95	U-ISOTOPIC LAL-0108_24942	0.45	0.21	0.11		pCi/L
U-238	12-JUL-95	U-ISOTOPIC LAL-0108_24942	1.05	0.32	0.17		pCi/L

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: B0G079 LAL Sample ID: L4838-17

Date Collected: 27-JUN-95 Date Received: 29-JUN-95

Matrix: Water Login Number: L4838

Constituent	Analyzed	Batch	Activity	Error	MDA	DataQual	Units
H-3	21-JUL-95	TRITIUM(H3) LAL-0066_24943	520	240	250		pCi/L

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: B0G079 LAL Sample ID: L4838-18

Date Collected: 27-JUN-95 Date Received: 29-JUN-95

Matrix: Water Login Number: L4838

Constituent	Analyzed	Batch	Activity	Error	MDA	DataQual	Units
Tc-99	19-JUL-95	TC-99 LAL-0169_24944	5.3	8.6	10.		pCi/L

Rec. 19 Aug 1993

National Institute of Standards & Technology

Certificate

THIS IS A PHOTOCOPY OF THE CERTIFICA
WHICH IS BEING MAILED TO YOU UNDER
SEPARATE COVER.

Standard Reference Material 4321B
Alpha-Particle Solution Standard

Radionuclide	Natural Uranium
Source identification	SRM 4321B
Source description	Liquid in 5-mL flame-sealed glass ampoule
Source mass	Approximately 5.3 grams
Solution composition	Natural uranium in 1-molar nitric acid
Uranium concentration	0.01998 g g^{-1}
Reference time	1200 EST January 1, 1992
Radioactivity concentration	U-238: 246.7 Bq g^{-1} U-235: 11.35 Bq g^{-1} U-234: 237.6 Bq g^{-1}
Overall uncertainty	U-238: 0.87 percent [1] * U-235: 0.96 percent U-234: 1.86 percent
Measuring instrument	Mass spectrometer, silicon surface-barrier detector, and $4\pi(\alpha+\beta)$ liquid-scintillation counter [2]
Half life	U-238: $(4.468 \pm 0.005) \times 10^9$ years [3] U-235: $(7.037 \pm 0.011) \times 10^8$ years U-234: $(2.454 \pm 0.006) \times 10^5$ years

Total U = 495.7 Bq/g

This standard reference material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD
February, 1992

William P. Reed, Chief
Standard Reference Materials Program

*Notes on back

NOTES

(1) Individual uncertainties have the significance of one standard deviation of the mean, or an approximation thereof. The combined uncertainty is the individual uncertainties shown below added in quadrature. The overall uncertainty is taken to be three times the combined uncertainty.

SOURCE OF UNCERTAINTY	UNCERTAINTY (%)		
	U-238	U-235	U-234
a) uranium assay of SRM 960	0.02	0.02	0.02
b) uranium atom ratio	0.01	0.07	0.50
c) quantitative dissolution	0.25	0.25	0.25
d) gravimetric measurements	0.10	0.10	0.10
e) half life	0.11	0.16	0.24
Combined uncertainty	0.29	0.32	0.62
	x 3	x 3	x 3
Overall uncertainty	0.87	0.96	1.86

(2) SRM 4321 was prepared by quantitatively dissolving a carefully cleaned and weighed piece of well-characterized natural uranium metal. This natural uranium metal was formerly issued by the National Bureau of Standards as SRM 960. The solution in SRM 4321B was carfully examined using thermal-ionization mass spectrometry, silicon surface-barrier alpha-particle spectrometry, and $4\pi(\alpha+\beta)$ liquid-scintillation counting. The values that we recommend for the U-234/U-238 atom ratio and alpha-particle-emission-rate ratio in SRM 4321B are $(5.29 \pm 0.02) \times 10^{-5}$ and 0.963 ± 0.003, respectively. (See the Information for Users of SRM 4321 and SRM 4321B, Natural Uranium Solution.)

(3) **Table of Radioactive** Isotopes, E. Browne and R.B. Firestone, John Wiley and Sons, Inc., **New York (1986).**

For further information please contact Dr. L.L. Lucas, (301) 975-5546; or J.M. Calhoun, (301) 975-5538.

NOTES

(1) Individual uncertainties have the significance of one standard deviation of the mean, or an approximation thereof. The combined uncertainty is the individual uncertainties shown below added in quadrature. The overall uncertainty is taken to be three times the combined uncertainty.

Source of uncertainty	Uncertainty (%)		
	U-238	U-235	U-234
a) original calibration of SRM 960	0.01	0.05	0.28
b) quantitative dissolution	0.07	0.07	0.07
c) gravimetric measurements	0.07	0.07	0.07
d) half life	0.07	0.07	0.41
Combined uncertainty	0.12	0.13	0.51
	* 3	* 3	* 3
Overall uncertainty	0.36	0.39	1.53

(2) SRM 4321 was prepared by quantitatively dissolving a piece of natural uranium metal (SRM 960) that had been characterized by quantitative assay and by mass spectrometry.

(3) Radioactive Decay Data Tables, D.C. Kocher, DOE/TIC-11026 (1981).

For further information call Larry Lucas at (301) 975-5546.

SRM 4321

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

Dear Customer:

The Standard Reference Material(s) (SRM'(s)) for which you have requested a Material Safety Data Sheet (MSDS), 4321B, U-238 is excluded from coverage in our regular MSDS system of more than 100 sheets for one or more of the following reasons:

1 ☐ The SRM is an article, as that word is defined in paragraph (c) of section 1910.1200 of title 29 of the Code of Federal Regulations which does not release or otherwise result in exposure to a hazardous chemical, under normal conditions of use.

2 ☐ The SRM has been determined to be non-hazardous by the National Institute of Standards and Technology under paragraph (d) of section 1910.1200 of title 29 of the Code of Federal Regulations. The SRM will not release or otherwise result in exposure to a hazardous chemical under normal conditions of use.

3 ☐ The SRM is a pesticide or hazardous waste labeled according to regulations issued by the Environmental protection Agency.

4 ☐ The SRM is a food, food additive, or drug labeled according to regulations issued by the Food and Drug Administration.

5 ☐ The SRM is a wine labeled according to regulations issued by the Bureau of Alcohol, Tobacco, and Firearms.

6 ☒ The SRM is a radioactive material labeled according to regulations issued by the Nuclear Regulatory Commission. The Shipper's Declaration form included with the shipment states chemical form, physical state, and activity of SRM.

7 ☐ The SRM is a tobacco or tobacco product, wood, or wood product which is exempted by paragraph (b) (5) (ii) and (iii) of section 1910.1200 of title 29 of the Code of Federal Regulations from the provisions of that section.

If we can be of assistance to you in regard to this matter, or any issue related to SRMs, please do not hesitate to write to me.

Sincerely,

Stanley D. Rasberry

Stanley D. Rasberry
Chief
Office of Standard Reference Materials

AA9804

INITIAL STANDARD DILUTION RECORD

Standard Information:			
Isotope:	U-238	Vendor:	NIST
Activity of Standard Received:	0.035338 uCi	Vendor I.D. #	
Weight of Standard Received (g):	5.3 g	LAL I.D. #:	AA9804
Standard Activity (pCi/g):	6.67E+03 pCi/g	NIST Traceable ?	yes
Halflife in Years or Days:	4.468E+09 yrs	Certificate #:	SRM4321B
Reference Date:	1/1/92	Receiver's Name:	Kevin Free
		Date Received:	8/19/93

Primary Dilution		
Balance Verification?:	yes	
Diluent Used:	1 M HNO3	
a: Decay Corrected Standard Activity (pCi/g):	6.67E+03	pCi/g
b: Weight of the Source Transferred (g):	5.23707	g
c: Total diluted weight (g):	132.03	g
d: Total Diluted Volume (mL)	128.28	mL
e: Activity of Dilution by Weight (pCi/g) [a * b / c]:	2.645E+02	pCi/g
f: Calculated Density of Solution (g/ml) [c / d]:	1.029E+00	g/mL
g: Activity of Dilution by Volume (pCi/mL) [e * f]:	2.722E+02	pCi/mL
h. Dilution Logbook I.D. #:	LAL-93-474-14-1	

Prepared By: _____ Preparation Date: 8/20/93

Reviewed By: _____ Review Date: _____

Purity/Cross Check Performed By: _____ Check Date: _____

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PROJECT U-238 Notebook No. 677

Continued From Page

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	U-238
Parent Barcode Number	AA9804
Vendor or Certificate I.D. # of Parent Standard:	SRM 4321B
Diluted Source Logbook I.D. #:	93-474-14-1
Balance Verification?:	yes
Diluent Used:	1M HNO3

Dilution		
*Diluent:	1M HNO3	
*Density of diluent (g/ml):	N/A	g/ml
a: Parent Specific Activity:	272.21	~~pCi/g~~ pCi/ml AW 1-21-95
b: Amount of Source Transferred:	5.9495	g
c: Total amount of Dilution:	141.58	g
d: Total Volume of Dilution:	N/A	ml
e: Activity of Dilution [a * b / c]:	N/A	pCi/g
f: Activity of Dilution (a * b / d):	11.44	pCi/ml
Dilution Logbook I.D. #:	94-677-30-1	

Prepared By: Agnes Wong Preparation Date: 1-21-95

Reviewed By: Joe Hutchinson Review Date: 1/26/95

*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

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Signed Date Signed Date

CALIBRATION OF U-232

2 mL of U-232 at 6635 dpm/mL (91-225-36-1, AA0078) was run through the AG1-X8 column in 9M HCl for removal of daughter products. U-232 was stripped off with 0.5 M HCl at the end of the procedure. This solution was taken down to dryness. It was then brought up in 2 M HNO_3 to 500 mL. Calibration of this tracer was performed with 0.5 mL U-238 (11.44 pCi/mL, 94-677-30-1) and samples were counted for 10 hours.

CHILD ID	U-232 GROSS COUNTS per 0.5 mL	U-238 GROSS COUNTS	CALCULATED U-232 VALUE IN pCi/0.5mL
U160595	1727.7	1956.6	5.05
U260595	1806.8	2007.8	5.15
U360595	1720.9	1911.2	5.15
U460595	1568.8	1869.1	4.80
U560595	1557.7	1888.8	4.72
U660595	1413.9	1660.8	4.87
			4.96 pCi ± 0.18 pCi/mL

The value calibrated for this tracer was 9.92 pCi/mL with a precision of ±3.6%

U-232 Logbook Reference # 95-721-11-1

Agnes Wong 6-6-95

Read and Understood By:

Agnes Wong — Signed
6-6-95 — Date
Signed
Date

AA0078

Radioactive Source Test Report

Model No.: NA Radioisotope: U-232 Nominal activity: 10 kBq

Product Code No.: 92/232/19

Description: U-232 alpha tracer solution Capsule: NA

ANSI Classification NA Special Form Certificate No.: NA

Classifications are based on the testing of specimen sources and give the levels expected from production sources.

Recommended working life: NA

See other side for explanation

Source Serial number	Measurement		Leakage test		Contamination test
	U-232 Activity Concentration kBq/g	date	type	type	type
			See other side for description of tests		
			date passed	date passed	date passed
AE 5292	2.04 ± 0.02	12 June 1981	NA	NA	NA

Notes · 5 ml (nominal) tracer solution of Uranium-232/Th-228 Solution in 2 M HNO_3

$\frac{\text{Th-228}}{\text{U-232}}$ Activity ratio 1.00 ± 0.01 on 11 September 1981

AMERSHAM IS ACCREDITED BY THE NATIONAL MEASUREMENT ACCREDITATION SERVICE (NAMAS) IN THE UK. REFERENCE SOURCES SUPPLIED BY ACCREDITED LABORATORIES ARE FULLY TRACEABLE TO STANDARDS HELD BY NATIONAL LABORATORIES. RADIATION MEASUREMENT DATA REPORTED IN THIS CERTIFICATE IS TRACEABLE TO THE NATIONAL PHYSICAL LABORATORY (NPL) IN TEDDINGTON, ENGLAND. NPL IS TRACEABLE TO THE U.S. NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) THROUGH THE BUREAU INTERNATIONAL DES POIDS ET MESURES (BIPM).

Customer: Lockheed Analytical Labs Customer's Order No.: 06LAB1244

Amersham Order No.: 66610

Signed: Michael Snyder

Michael Snyder, Product Manager Date: November 8, 1991

Amersham Corporation
2636 South Clearbrook Drive, Arlington Heights, IL 60005
1-(800) 323-6695 (Toll Free)

Amersham Canada Limited
1166 South Service Road West, Oakville, ONT L6L 5T7 1-(416) 847-1166

Amersham

CALIBRATION OF U-232

2 mL of U-232 at 6635 dpm/mL (91-225-36-1, AA0078) was run through the AG1-X8 column in 9M HCl for removal of daughter products. U-232 was stripped off with 0.5 M HCl at the end of the procedure. This solution was taken down to dryness. It was then brought up in 2 M HNO_3 to 500 mL. Calibration of this tracer was performed with 0.5 mL U-238 (11.44 pCi/mL, 94-677-30-1) and samples were counted for 10 hours.

CHILD ID	U-232 GROSS COUNTS per 0.5 mL	U-238 GROSS COUNTS	CALCULATED U-232 VALUE IN pCi/0.5mL
U160595	1727.7	1956.6	5.05
U260595	1806.8	2007.8	5.15
U360595	1720.9	1911.2	5.15
U460595	1568.8	1869.1	4.80
U560595	1557.7	1888.8	4.72
U660595	1413.9	1660.8	4.87
			4.96 pCi ± 0.18 pCi/mL

The value calibrated for this tracer was 9.92 pCi/mL with a precision of ±3.6%

U-232 Logbook Reference # 95-721-11-1

Dagnes Wong 6-6-95

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
Dagnes Wong	6-6-95		

Rcvd 5/31/94
ACS 351
RKS

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 nanocuries 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.

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C52300

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 equal to	%	of the principal activity
(2)	less than equal to	%	of the principal activity
(3)	less than equal to	%	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 ± 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

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Date Certificate Prepared: April 26, 1994

Approval Signature: Paul B. Hahn

PROJECT Sr-90 Notebook No. 0474

Continued From Page _____

INITIAL STANDARD DILUTION RECORD

Standard Information:

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

Primary Dilution

Balance Verification?:	Yes
Diluent Used:	0.1 M HCl
a: Decay Corrected Standard Activity (pCi/g):	5.4×10^3 pCi/g
b: Weight of the Source Transferred (g):	4.9670 g
c: Total diluted weight (g):	49.91 g
d: Total Diluted Volume (mL)	50 mL
e: Activity of Dilution by Weight (pCi/g) [a * b / c]:	537.4 pCi/g
f: Calculated Density of Solution (g/ml) [c / d]:	0.9982 g/mL
g: Activity of Dilution by Volume (pCi/mL) [e * f]:	536.44 pCi/mL
h. Dilution Logbook I.D. #:	~~93-474-81-1~~ 93-474-82-1 CP 4/7/95

Prepared By: Dynes Wong Preparation Date: 6-15-94

Reviewed By: Joe Hutchison Review Date: 6/30/94

Purity/Cross Check Performed By: _____ Check Date: _____

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Signed	Date	Signed	Date

PROJECT Gross Alpha/Beta LCS

Notebook No. 0474

Continued From Page

SECONDARY / WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

Isotope:	Am-241 and Sr-90
From NIST traceable standard?:	Yes
Vendor or Certificate I.D. # of parent standard:	Am-241 IPL - 388-100-1 Sr-90 NIST SRM 4919G
Diluted source logbook I.D. #:	Am-241 91-0225-60-1 Sr-90 91-0225-30-2
Balance verification?:	Yes
Diluent used:	0.1 N HNO_3

Dilution

*Diluent:	0.1 N HNO_3 + 42mg $Sr(NO_3)_2$/mL
*Density of diluent (g/ml):	NA
a. Parent standard activity:	Am-241 9810 pCi/mL Sr-90 6000 pCi/mL on 8/1/90
b. Amount of standard transferred:	Am-241 0.5 mL Sr-90 0.5 mL
c. Total amount of dilution:	500 mL
d. Activity of dilution [a * b / c]:	Am-241 9.81 pCi/mL Sr-90 6.0 pCi/mL on 8/1/90 10.1 pCi/mL on 8/1/94
Dilution logbook I.D. #:	93-0474-94

Prepared by: Joe Hutchison — Preparation date: 8/16/94

Reviewed by: Nancy Wong — Review date: AW 10-4-94

*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.

LAL-91-SOP-0174

Continued on Page

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Read and Understood By

Signed	Date	Signed	Date
	9/20/95		

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:	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)

Gary F. Gilmore
QUALITY CONTROL

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

480

5 ml. Diluted to 10 ml to make 91-6225-60-1 AM

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOLUTION

Radionuclide	Am-241	Customer:	LOCKHEED ENGINEERING & SCIENCES C
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:	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)

Gary T. Gilmore
QUALITY CONTROL

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

S/d. Diluted to 100 ml to make 91-0225-60-1 AMDD

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:	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)

Gary A Gilmore
QUALITY CONTROL

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

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LB4000.1 Am-241 Gross Alpha Calibration Data (Filename gacal193.lb1)

ID	Desc	Count Time	Alpha Counts	Beta Counts	Hi Voltage	Time	Date	CPM Alpha	CPM Beta	EFF Alpha	EFF Beta	Net Weight	A>>B X-Talk	EFF Fit (qd-exp)	X-T Fit (qd-exp)
A1	ACAL01	25	0	24	1417.5	14:06:25	7-12-94	0.00	0.96	0.0000	0.0000	0.0010			
A1	ACAL14	25	12947	4934	1417.5	13:06:32	7-13-94	517.88	197.36	0.1990	0.0755	0.0001	0.3792	0.2173	0.2579
A1	ACAL02	25	14521	3695	1417.5	14:41:54	7-14-94	580.84	147.80	0.2232	0.0564	0.0090	0.2528	0.1987	0.2546
A1	ACAL03	25	11434	2909	1417.5	13:52:40	7-14-94	457.36	116.36	0.1758	0.0444	0.0188	0.2523	0.1804	0.2521
A1	ACAL04	25	11807	3006	1417.5	13:24:15	7-14-94	472.28	120.24	0.1815	0.0458	0.0190	0.2526	0.1801	0.2521
A1	ACAL05	25	9909	2343	1417.5	12:29:47	7-14-94	396.36	93.72	0.1523	0.0356	0.0374	0.2340	0.1512	0.2503
A1	ACAL06	25	8523	2047	1417.5	12:02:21	7-14-94	340.92	81.88	0.1310	0.0311	0.0555	0.2374	0.1282	0.2521
A1	ACAL07	25	7210	1930	1417.5	11:24:13	7-14-94	288.40	77.20	0.1108	0.0293	0.0738	0.2644	0.1093	0.2577
A1	ACAL08	25	7008	1799	1417.5	10:50:44	7-14-94	280.32	71.96	0.1077	0.0273	0.0739	0.2533	0.1092	0.2578
A1	ACAL09	25	5435	1528	1417.5	16:53:15	7-13-94	217.40	61.12	0.0836	0.0231	0.0931	0.2767	0.0932	0.2679
A1	ACAL10	25	5319	1487	1417.5	15:51:27	7-13-94	212.76	59.48	0.0818	0.0225	0.1070	0.2751	0.0835	0.2783
A1	ACAL11	25	4838	1442	1417.5	15:18:33	7-13-94	193.52	57.68	0.0744	0.0218	0.1284	0.2931	0.0711	0.3000
A1	ACAL12	25	5221	1527	1417.5	14:50:59	7-13-94	208.84	61.08	0.0803	0.0231	0.1283	0.2879	0.0712	0.2998
A1	ACAL13	25	3770	1299	1417.5	14:00:15	7-13-94	150.80	51.96	0.0580	0.0196	0.1467	0.3382	0.0625	0.3249

Efficiency Regression Output:

Constant		-1.5253
Std Err of Y Est		0.07579
R Squared		0.97426
No. of Observations		13
Degrees of Freedom		10
X Coefficient(s)	-10.1580	11.2837
Std Err of Coef.	1.6846	11.3911

X-T Regression Output:

Constant		-1.3552
Std Err of Y Est		0.0293
R Squared		0.9239
No. of Observations		10
Degrees of Freedom		7
X Coefficient(s)	-1.6119	21.7165
Std Err of Coef.	0.8114	5.3127

Regressions for all efficiency curves & the A1 crosstalk curve are quadratic exponential fits.

ACAL14, ACAL05, & ACAL06 were not used for the crosstalk curve – poor data points.

Am-241 standard is 1.0 mL of LAL-93-LOG-474-86, 2602 dpm/mL on date of calibration.

THIS IS A PHOTOCOPY OF THE CERTIFICATE
WHICH IS BEING MAILED TO YOU UNDER
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	4.514×10^3 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 ± 0.2 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
[illegible]uary, 1991

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

*Notes on back

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:

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

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

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

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

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

4919-G

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

ACS851
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 assayed 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.

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CSZ 300

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 equal to	%	of the principal activity
(2)	less than equal to	%	of the principal activity
(3)	less than equal to	%	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 ± 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:	Other components:
30 micrograms strontium	0.1 M HCl

Preservative:

Remarks

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Date Certificate Prepared April 26, 1994

Approval Signature Paul B. Hahn

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PROJECT Sr-90

Notebook No. [illegible]

Continued From Page _____

INITIAL STANDARD DILUTION RECORD

Standard Information:

Isotope:	Sr-90	Vendor:	EPA
Activity of Standard Received:	2.7×10^4 uCi	Vendor I.D. #	94003-1
Weight of Standard Received (g):	50 g	LAL I.D. #:	AC5281
Standard Activity (pCi/g):	5.4×10^3 pCi/g	NIST Traceable ?	yes
Halflife in Years or Days:	28.6 yrs	Certificate #:	94003-1
Reference Date:	4-1-1994	Receiver's Name:	K Free
		Date Received:	5-3-94

Primary Dilution

Balance Verification?:	Yes
Diluent Used:	0.1M HCl
a: Decay Corrected Standard Activity (pCi/g):	5.4×10^3 pCi/g
b: Weight of the Source Transferred (g):	4.9670 g
c: Total diluted weight (g):	49.91 g
d: Total Diluted Volume (mL)	50 mL
e: Activity of Dilution by Weight (pCi/g) [a * b / c]:	537.4 pCi/g
f: Calculated Density of Solution (g/ml) [c / d]:	0.9982 g/mL
g: Activity of Dilution by Volume (pCi/mL) [e * f]:	536.44 pCi/mL
h. Dilution Logbook I.D. #:	~~93-494-81-1~~ 93-474-82-1 CP 4/7/95

Prepared By: Agnes Wong Preparation Date: 6-15-94

Reviewed By: Joe Hutchison Review Date: 6/30/94

Purity/Cross Check Performed By: _____ Check Date: _____

6/30/94

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Signed	Date	Signed	Date

PROJECT Sr-90 Notebook No. _____

Continued From Page _____

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

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

Dilution

*Diluent:	0.1 M HCl
*Density of diluent (g/ml):	N/A
a: Parent Specific Activity:	536.44 pCi/ml
b: Amount of Source Transferred:	5.0018 g
c: Total amount of Dilution:	100.20 g
d: Total Volume of Dilution:	N/A
e: Activity of Dilution (a * b / c):	N/A
f: Activity of Dilution (a * b / d):	26.78 pCi/ml
Dilution Logbook I.D. #:	94-677-44-1

Prepared By: Agnes Wong Preparation Date: 3-2-95

Reviewed By: Jon Hutton Review Date: 3/3/95

*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.

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Signed Date Signed Agnes Wong 3-3-95 Date

AA0047

CERTIFICATE OF CALIBRATION
BETA STANDARD SOLUTION

Radionuclide	Tc-99	Customer:	LOCKHEED ENGINEERING & SCIENCES Co.
Half Life:	(2.13 ± 0.05) x 10^5 years	P.O.No.:	06LAB1036
Catalog No.:	7099	Reference Date:	September 1 1991 12:00 PST.
Source No.:	389-22-1	Contained Radioactivity:	1.003 µCi.

Description of Solution

a. Mass of solution:	4.9929	grams.
b. Chemical form:	NH_4TcO_4 in 0.1M NH_4OH	
c. Carrier content:	None added	
d. Density:	0.9974	gram/ml @ 20°C.

Radioimpurities

None detected

Radioactive Daughters

None

Radionuclide Concentration

0.201 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:	±2.1%
b. Random uncertainty in assay:	±1.0%
c. Random uncertainty in weighing(s):	±0.0%
d. Total uncertainty at the 99% confidence level:	±3.1%

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)

QUALITY CONTROL

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

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AA009//

CERTIFICATE OF CALIBRATION
BETA STANDARD SOLUTION

Radionuclide	Tc-99	Customer:	LOCKHEED ENGINEERING & SCIENCES Co.
Half Life:	(2.13 ± 0.05) x 10^5 years	P.O.No.:	06LAB1036
Catalog No.:	7099	Reference Date:	September 1 1991 12:00 PST.
Source No.:	389-22-1	Contained Radioactivity:	1.003 µCi.

Description of Solution

a. Mass of solution:	4.9929	grams.
b. Chemical form:	NH_4TcO_4 in 0.1M NH_4OH	
c. Carrier content:	None added	
d. Density:	0.9974	gram/ml @ 20°C.

Radioimpurities

None detected

Radioactive Daughters

None

Radionuclide Concentration

0.201 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:	±2.1%
b. Random uncertainty in assay:	±1.0%
c. Random uncertainty in weighing(s):	±0.0%
d. Total uncertainty at the 99% confidence level:	±3.1%

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)

QUALITY CONTROL

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

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HH0041 AA0041

ISOTOPE WEIGHT DILUTION RECORD

Isotope: Tc - 99 Vendor: IPL

Total Received Activity: ~1 µci Vendor ID: 389-22-1

Wt. Received: ~5 g NIST Traceable (Y) N Cert. # implicitly

Activity in Units/g: ~~0.20~~ 0.201 µCi/g Reference Date: 9-1-91

Activity converted (dpm/g): _____ dpm/g Receive Date: ~~N/A~~ 10-30-95

Halflife (Yrs or days) t½ = 2.13 X 10^5 years Receiver's Name: ~~N/A~~ Jimmy Mral

PRIMARY DILUTION: Balance wt. check done (✓)

a: Source activity: 2.01 X 10^5 pCi/g ~~dpm/g~~ (if t½ = <100yr decay to prep. date)

b: Wt. of Source transfered: 4.9320 g

Diluent used: 0.1 M NH4OH

c: Total diluted ~~weight~~ volume 100 ml

d: Activity of dilution (a*b/c): N/A dpm/g

e: Calculated density of solution: N/A g/mL (4M HNO_3 = 1.1294 ± .0007 g/mL)

f: Activity by volume = (d*e): 9910 pCi/ml ~~dpm/mL~~

Dilution Log Book ID: 91-225-41-1

Preparation Date: 1-23-92 Preparer's Name. Joe Hutchinson

SECONDARY OR WORKING LEVEL DILUTION Balance wt. check done (__)

Log Book ID of source being diluted: 91-225-42-1

a: Source activity: 9910 pCi/mL dpm/g * (if t½ = <100yr decay to prep. date)

b: Wt. of Source transfered: 1.0051 g

Diluent used: 0.1m NH4OH

c: Total diluted weight: 50.621 g

d: Activity of dilution (a*b/c): N/A dpm/g

e: Calculated density of solution: ~~.997 g/mL~~ g/mL (4M HNO_3 = 1.1294 ± .0007 g/mL)

f: Activity by volume = ~~(d*e)~~ axb/c 196.8 ~~dpm/mL~~ pCi/mL

Dilution Log Book ID: 91-225-42-1

Preparer's Name: Joe Hutchinson Preparation Date: 1-27-92

Reviewed By : [signature] Review Date: 6/8/93

AA0047

SECONDARY / WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

Isotope:	Tc-99
From NIST traceable standard?:	Implicitly
Vendor or Certificate I.D. # of parent standard:	AA0047
Diluted source logbook I.D. #:	91-225-41-1
Balance verification?:	yes
Diluent used:	0.1M NH_4OH

Dilution

*Diluent:	0.1 M NH_4OH
*Density of diluent (g/ml):	N/A
a. Parent standard activity:	990 pCi/ml
b. Amount of standard transferred:	2.8759 g
c. Total amount of dilution:	254.69 g
d. Activity of dilution [a * b / c]:	111.90 pCi/ml as of 9-1
Dilution logbook I.D. #:	93-474-96-1

Prepared by: Agnes Wong Preparation date: 8-17-94

Reviewed by: Joe Hatchett Review date: 8/25/94

*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.

LAL-91-SOP-0174

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SECONDARY / WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

Isotope:	Tc-99
From NIST traceable standard?:	Implicitly
Vendor or Certificate I.D. # of parent standard:	AA004T
Diluted source logbook I.D. #:	91-225-41-1
Balance verification?:	yes
Diluent used:	0.1 M NH_4OH

Dilution

*Diluent:	0.1 M NH_4OH
*Density of diluent (g/ml):	N/A
a. Parent standard activity:	9910 pCi/ml
b. Amount of standard transferred:	1.9605 g
c. Total amount of dilution:	166.25 g
d. Activity of dilution [a * b / c]:	116.86 pCi/ml as of 9-1-1991
Dilution logbook I.D. #:	93-474-97-1

Prepared by: Byron Wong Preparation date: 8-17-94

Reviewed by: Joe Hutchison Review date: 8/25/94

*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.

LAL-91-SOP-0174

U. S. Department of Commerce
Malcolm Baldrige
Secretary
National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 4288

Radioactivity Standard

Radionuclide	Technetium-99
Source identification	4288-83
Source description	Liquid in NBS borosilicate-glass ampoule
Solution composition	59.31 μg of Tc(VII) as potassium pertechnetate per gram of approximately 0.001 molar KOH (1)*
Mass	4.910 grams
Radioactivity concentration	3.759×10^4 Bq g^{-1}
Reference time	November, 1982
Measuring instrument	Liquid-scintillation counter (2)
Random uncertainty	0.27 percent (3)
Systematic uncertainty	1.35 percent (4)
Total uncertainty (Random plus systematic)	1.62 percent
Photon-emitting impurities	None observed (5)
Half life	$(2.111 \pm 0.036) \times 10^5$ years (6)

This Standard Reference Material was prepared in the Center for Radiation Research, Nuclear Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Washington, D.C. 20234
November, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

*Notes on back

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FOOTNOTES

(1) The $KTcO_4$ was prepared by M.W. Heitzmann of the U.S. Food and Drug Administration from NH_4TcO_4 obtained from Oak Ridge National Laboratory. The solution density is 0.998 g cm^{-3} at 21.8°C, and the $KTcO_4$ concentration is 0.00060 molar. The UV spectrum of this material exhibited only the characteristic doublets at 243 and 287 nm [A].≠

(2) Two liquid-scintillation counters were calibrated using the method of J.A.B. Gibson [B,C,D]. Three different radionuclides were used as the standard: ^3H, ^{14}C, and ^{60}Co. The results obtained using the three radionuclides agreed to within 0.32 percent. The ^{14}C result was used for confirmation only. The value given here is the unweighted mean of the ^3H and ^{60}Co results.

(3) Half the 99-percent confidence interval for the average of the ^3H result and the ^{60}Co result. The standard deviation of the mean of the ^3H result is 0.15 percent based on 6 degrees of freedom, and the standard deviation of the mean of the ^{60}Co result is 0.09 percent based on 9 degrees of freedom.

(4) The systematic uncertainty is the average of that for the ^3H result, 1.20 percent, and that for the ^{60}Co result, 1.49 percent. These values are linear sums of estimated upper limits of uncertainties due to the following:

	^3H	^{60}Co
a) reference material for standard radionuclide	0.63	0.68
b) source preparation	0.07	0.17
c) theoretical model	0.30	0.20
d) gamma-ray contribution to beta-particle detector		0.24
e) quenching	0.10	0.10
f) interpolation from calibration curve	0.10	0.10
	1.20	1.49

(5) The master solution from which these standards were prepared was examined with germanium gamma-ray spectrometers and no impurity was found. Limits of detection as a ratio of gamma-ray-emission rate to technetium-99 activity are

1×10^{-6} between 90 and 300 keV
1×10^{-7} between 300 and 1900 keV.

(6) NBS-measured half life based on the formula $T_{\frac{1}{2}} = N \ln(2)/A$, where N is the number of atoms, computed using an atomic mass for technetium-99 of 98.906254 ± 0.000002 grams and the gravimetrically determined mass of technetium-99, and A is the activity determined by liquid-scintillation counting. The value recommended by the Oak Ridge Nuclear Data Project is $(2.13 \pm 0.05) \times 10^5$ years. [E]

≠ References on last page

The following individuals and organizations contributed to the characterization of this Standard Reference Material.

J.A.B. Gibson
Atomic Energy Research Establishment
Environmental and Medical Sciences Division
Harwell
United Kingdom

M.W. Heitzmann
U.S. Food and Drug Administration
Division of Drug Chemistry
Washington, D.C.

J.C. Leak
U.S. Food and Drug Administration
Division of Oncology and
Radiopharmaceutical Drug Products
Rockville, MD

For further information please contact Dr. Bert M. Coursey at (301) 921-2383.

REFERENCES

A. Boyd, G.E., J. Chem. Ed., 36, 3 (1959).

B. Gale, H.J. and Gibson, J.A.B., Atomic Energy Research Establishment Report AERE-R5067 (1965), Harwell, United Kingdom.

C. Gibson, J.A.B. and Marshall, M., Int. J. Appl. Radiat. Isotopes, 23, 321 (1972).

D. Gibson, J.A.B., Computed counting efficiencies as a function of merit figure for 14 beta-particle-emitting radionuclides (July, 1980). Unpublished data.

E. Kocher, D.C., Radioactive Decay Data Tables DOC/TIC-11026, p. 108 (1981). Available from NTIS, Springfield, VA.

ISOTOPE WEIGHT DILUTION RECORD

Isotope: Tc-99 Vendor: NIST

Total Received Activity: 1.855 Bq Vendor ID: SRM 4288.

Wt. Received: 4.91 (0.00 in g mKOH) NIST Traceable Y / N Source Cert. # 4288-83

Activity in Units/g: 3.759 X 10^4 Bq/g Reference Date: NOV 1982

x 60/2.22 = 1.016 E6 pCi/g

Activity converted (dpm/g): 4.988 X 10^6 pCi dpm/g Total Receive Date: 3-30-1992 RW 1-27-93 3-25-92

Halflife (Yrs or days) t½ = 2.111 E5 Yrs * Receiver's Name: J. Morales

PRIMARY DILUTION: Balance wt. check done (✓)

a: Source activity: 1.016 E6 pCi/g dpm/g * (if t½ = <100yr decay to prep. date)

b: Wt. of Source transfered: 4.869 g

AA0128 Diluted

Diluent used: 0.1 m NH4OH

c: Total diluted weight: 146.81 g

d: Activity of dilution (a*b/c): 3.374 pCi/g dpm/g rgs

100 mL = 99.56 g

e: Calculated density of solution: .9956 g/mL 4M HNO3

f: Activity by volume = (d*e): 3.355 E4 pCi/mL dpm/mL rgs

U.S. Department of Commerce
National Institute of Standards and Technology AA0128
99Tc Radioactivity Standard
Amount 3.759 x 10^4 Bq g^-1
Date November 1, 1982
SRM 4288
CAUTION
RADIOACTIVE

Dilution Log Book ID: LAL: 92-353-100-1

Preparation Date: 6/16/93 Preparer's Name: [signature]

SECONDARY OR WORKING LEVEL DILUTION Balance wt. check done (✓)

Log Book ID of source being diluted: LAL 92-353-100-1

a: Source activity: 3.355 E 4 pCi/mL dpm/g rgs (if t½ = <100yr decay to prep. date)

b: Wt. of Source transfered: 2.3211 g

Diluent used: 0.1 m NH4OH

c: Total diluted weight: 71.89 g

d: Activity of dilution (a*b/c): N/A dpm/g

e: Calculated density of solution: N/A g/mL (4M HNO_3 = 1.1294 ± .0007 g/mL)

f: Activity by volume = (d*e): 1083 pCi/mL dpm/mL rgs

Dilution Log Book ID: LAL 92-353-100-2

Preparer's Name: [signature] Preparation Date: 6/16/93

Reviewed By: [signature] Review Date: 6/16/93

AA0012

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	Tc-99
Parent Barcode Number	AA0128
Vendor or Certificate I.D. # of Parent Standard:	SRM 4288
Diluted Source Logbook I.D. #:	92-353-100-1
Balance Verification?:	yes
Diluent Used:	0.1 M NH4OH

Dilution		
*Diluent:	0.1 M NH4OH	
*Density of diluent (g/ml):	0.9956	g/ml
a: Parent Specific Activity:	3.355 E4	~~pCi/g~~ BW 11-16-94 pCi/ml
b: Amount of Source Transferred:	36.0938	g
c: Total amount of Dilution:	123.36	g
d: Total Volume of Dilution:	N/A	ml
e: Activity of Dilution (a * b / c):	N/A	pCi/g
f: Activity of Dilution (a * b / d):	9816.37	pCi/ml
Dilution Logbook I.D. #:	94-677-17-1	

Prepared By: Agnes Wong Preparation Date: 11-16-94

Reviewed By: Joe Hutchison Review Date: 11/17/94

*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.

NOTES

(1) The uncertainty analysis methodology and nomenclature used for the reported uncertainties are based on uniform NIST guidelines and are compatible with those adopted by the principal international metrology standardization bodies [cf., B.N. Taylor and C.E. Kuyatt, *NIST Technical Note 1129* (1993)].

(2) The combined standard uncertainty, u_c = 0.32 percent, is the quadratic combination of the standard deviation (or standard deviation of the mean where appropriate), or approximations thereof, for the following component uncertainties:

a)	11 liquid-scintillation measurements on each of 4 vials	0.11 percent
b)	gravimetric	0.05 percent
c)	calibration of SRM 4926D	0.29 percent
d)	background	0.00 percent
e)	half life	0.03 percent

The expanded uncertainty, U = 0.64 percent, is obtained by multiplying u_c by a coverage factor of k = 2 and is assumed to provide an uncertainty interval of at least 95% confidence.

(3) Overall uncertainty reported by EMSL.

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

0.08 $\gamma\ s^{-1}g^{-1}$ for energies between 90 and 2700 keV.

(5) Unterweger, M.P., Coursey, B.M., Schima, F.J., and Mann, W.B., Int. J. Appl. Radiat. Isot., 31, 611 (1980).

(6) This result demonstrates the traceability of EMSL to NIST, for this measurement, to within five percent as specified in the appendix, Traceability Studies, of the EPA-NIST interagency agreement of April 1976, as amended.

For further information call Larry Lucas at 301-975-5546 or Jeffrey Cessna at 301-975-5539.

PROJECT H-3 Notebook No. 0121

Continued From Page NA

INITIAL STANDARD DILUTION RECORD

Standard Information:

Isotope:	H-3	Vendor:	EPA
Activity of Standard Received:	.11 uCi	~~Vendor I.D. #~~ 8/4/95	
Weight of Standard Received (g):	5 g	LAL I.D. #:	AC5299
Standard Activity (pCi/g):	21.9 nCi/g pCi/g 2/7/95	NIST Traceable ?	Yes
Halflife in Years or Days:	12.43 yrs	Certificate #:	2666-1
Reference Date:	0400, 6/3/92	Receiver's Name:	Kevin Free
		Date Received:	1/25/95

Primary Dilution

Balance Verification?: Yes

Diluent Used: EPA Distilled ASTM Type II Water (Dead Water)

a: Decay Corrected Standard Activity (pCi/g): ~~4.939~~ 21.9 nCi/g 2/7/95 pCi/g on 6/3/92

b: Weight of the Source Transferred (g): 4.939 g

c: Total diluted weight (g): 49.377 g

d: Total Diluted Volume (mL) ~~50~~ 49.5 2/7/95 mL

e: Activity of Dilution by Weight (pCi/g) [a * b / c]: 2190 pCi/g

f: ~~Calculated~~ Known Density of Solution (g/ml) [c / d]: 0.99777 g/mL

g: Activity of Dilution by Volume (pCi/mL) [e * f]: 2190 pCi/mL on 6/3/92

h. Dilution Logbook I.D. #: CAL-95-0721-1

Prepared By: Joe Hutchinson / J. Morales / C. Ponieway Preparation Date: 2/7/95

Reviewed By: Joe Hutchinson Review Date: 2/7/95

Purity/Cross Check Performed By: _____ Check Date: _____

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Signed _____ Date _____ CP 5/8/95 Signed _____ Date _____

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PROJECT H-3 LCS

Notebook No. 0721

Continued From Page _____

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

Isotope:	H-3 LCS
Parent Barcode Number	AC 5299
Vendor or Certificate I.D. # of Parent Standard:	2606-1
Diluted Source Logbook I.D. #:	LAL-95-721-1
Balance Verification?:	~~Yes~~ Yes
Diluent Used:	Dead water

Dilution

*Diluent:	EPA Dead Water
*Density of diluent (g/ml):	0.99
a: Parent Specific Activity:	2190 pCi/ml
b: Amount of Source Transferred:	5.0 ml ~~g~~ Glass Class A pipet
c: Total amount of Dilution:	4000 ml ~~g~~
d: Total Volume of Dilution:	4000 ml
e: Activity of Dilution (a * b / c):	2.710 pCi/ml @ 6/3/92
f: Activity of Dilution (a * b / d):	
Dilution Logbook I.D. #:	95-721-12-1

Prepared By: [signature] Preparation Date: 6/26/95

Reviewed By: Joe Hutchison Review Date: 6/26/95

*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

662

Signed	Date	Signed	Date

SECONDARY/WORKING LEVEL
STANDARD DILUTION RECORD

Dilution Source Information

Isotope:	H-3 ~~LCS~~ MS
Parent Barcode Number	AC5299
Vendor or Certificate I.D. # of Parent Standard:	
Diluted Source Logbook I.D. #:	95-0721-1
Balance Verification?:	Yes
Diluent Used:	Deod Water

Dilution

*Diluent:	Low Bkg Water	
*Density of diluent (g/ml):	1	g/ml
a: Parent Specific Activity:	2190	pCi/g
b: Amount of Source Transferred:	10.0	g
c: Total amount of Dilution:	100	g
d: Total Volume of Dilution:	100	ml
e: Activity of Dilution [a * b / c]:		pCi/g
f: Activity of Dilution (a * b / d):	219	pCi/ml on 6/23/95
Dilution Logbook I.D. #:	94-0677-70	

Prepared By: Joe Hutchison Preparation Date: 6/23/95

Reviewed By: J. A. Mc Review Date: 6/23/95

*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

663

Signed	Date	Signed	Date

AES277

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

Calibration Certificate

Description

Principal radionuclide: Tritium (H-3) Half-life: 12.43 years

Nominal activity: 110 nano curies

Nominal volume: 5 ml in ampoule/bottle number: 2606-1

Measurement

Activity of principal radionuclide

Activity per gram of this solution: 21.9 nano curies of Tritium

at 0400 hours PST on: June 3, 1992

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

curies Per gram

of the daughter nuclide

Total mass of this solution

APPROX. 5.0 grams

Method of measurement

The activity of the primary solution and this dilution were measured by liquid scintillation counting.

Counting efficiencies for both standardizations were determined by counting solutions directly traceable to the National Institute of Standards & Technology (NIST).

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 December 1999

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) none	less than equal to	%	of the principal activity
(2)	less than equal to	%	of the principal activity
(3)	less than equal to	%	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 ± 0.4 %

(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

+2.9 % or -2.9 %

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 +4.3 %, -4.3 % 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).

Tritium decays 100 percent by beta emission. The maximum energy is 18.6 Kev, the average is 5.68 Kev.

Chemical Composition of Solution

Carrier content per gram of solution:

100 percent H_2O

Other components:

Barium less than 0.004 p
Lead less than 3×10^{-5} pe

Preservative:

Remarks

Date Certificate Prepared: June 17, 1992

Approval Signature: George Tilleck

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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

	NIST DATA	EMSL DATA
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	$4\pi\beta$ liquid-scintillation counters calibrated with SRM 4926D	Liquid-scintillation counting
Half life	12.43 ± 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

AA0017

National Institute of Standards & Technology

Certificate

Standard Reference Material 4927D
Radioactivity Standard

Radionuclide	Hydrogen-3
Source identification	SRM 4927-D
Source description	^{3}H-water flame-sealed in NBS glass ampoule (1)*
Volume	3 mL
Radioactivity concentration	6.286×10^{5} Bq g^{-1}
Reference time	1200 EST January 1, 1989
Overall uncertainty	0.82 percent (2)
Measuring instrument	$4\pi\beta$ liquid-scintillation counter (3)
Half life	12.43 ± 0.05 years (4)

This Standard Reference Material was prepared in the Center for Radiation Research, Nuclear Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD 20899
January, 1989

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

*Notes on back

ISOTOPE SECONDARY/WORKING LEVEL DILUTION RECORD

^{3}H - Tritium

$t_{1/2}$ = 12.43 yr

Secondary/Working Level Dilution

Date: 6/15/93 Preparer's Name: RJS

(Volumetric) / (Gravimetric) Method (Circle One) Double checked rgs

Pipet Check / Balance Wt. Check Done (✓)

Diluted Source ID (log#): 91-225-1 NIST 1st Primary Dil from SRM-4927

Diluent used: D.I. Water

Ref. Date JAN 1, 1989

A: Source activity: 0.5 μci = 5.00348 x 10^{5} pCi/mL

B: Amount of source transferred: 3.7708 g

C: Total amount of dilution: 1003.00 g

D: Activity of dilution (A*B/C): 1881 pCi/mL

Dilution Log Book ID: 92-353-98-1

Reviewed by: rgs/cs Date: 6/15/93

Decayed to 6/15/93 1881 pCi/mL (.7798)

$e^{-\lambda t}$ = .7798

= 1467 pCi/mL

= 3256 dpm/mL on 6-15-93.