

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

LK6572

0045292

LOCKHEED MARTIN 

March 21, 1996

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



RE: Log-in No: L6572  
Quotation No: Q400000-B  
Document File No: 0307596  
BHI Document Control No: 332  
SDG No.: LK6572

The attached data report contains the analytical results of samples that were submitted to Lockheed Analytical Services on 7 March 1996.

The temperature of the cooler upon receipt was 2°C. Sample containers received agree with the chain-of-custody documentation. Sample containers were received intact. Samples were received in time to meet the analytical holding time requirements.

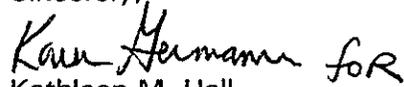
The case narratives included in the following attachments provide a detailed description of all events that occurred during sample preparation, analysis, and data review specific to the samples and analytical methods requested.

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 M. Hall at (509) 375-4741.

"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 Manager or a designee, as verified by the following signature."

Sincerely,



Kathleen M. Hall  
Client Services Representative

cc: Client Services  
Document Control

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**CASE NARRATIVE  
RADIOCHEMICAL ANALYSES**

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

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

**Holding Time Requirements**

All holding times were met.

**Gas Proportional Counter**

*Analytical Method Strontium-90*

The strontium-90 analysis was performed using standard operating procedure, LAL-91-SOP-0196. The samples were analyzed in workgroups 34864 and 35021.

Workgroup 34864: The laboratory control sample (LCS) was out of QC criteria; therefore the samples were re-analyzed in workgroup 35021. No data from workgroup 34864 is reported.

Workgroup 35021: The calibration verification met criteria. The method blank was within QC criteria. The LCS recovery was within QC criteria. The duplicate recoveries were within QC criteria. No re-analyses were performed.

Yvonne M. Jacoby  
Prepared By

March 21, 1996  
Date

*Lockheed Analytical Services*  
**DATA QUALIFIERS FOR RADIOCHEMICAL ANALYSES**  
 [Revised 08/28/92]

<b>For Use on the Analytical Data Reporting Forms</b>	
<b>B</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).
<b>C</b>	Presence of high TDS in sample required reduction of sample size which increased the MDA.
<b>D</b>	Constituent detected in the diluted sample.
<b>E</b>	Constituent concentration exceeded the calibration or attenuation curve range.
<b>F</b>	<i>For Alpha Spectrometry Only--</i> FWHM exceeded acceptance limits.
<b>H</b>	Sample analysis performed outside of method-specified maximum holding time requirement.
<b>Y</b>	Chemical yield exceeded acceptance limits.
<b>For Use on the QC Data Reporting Forms</b>	
<b>*</b>	QC data (i.e., percent recovery data for laboratory control standard and matrix spike; and RPD for replicate analyses) exceeded acceptance limits.
<b>a<sup>1</sup></b>	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>b<sup>1</sup></b>	The RPD cannot be computed because the sample and/or duplicate concentration was below the MDA.

<sup>1</sup> Used as foot note designations on the QC summary form.

LOCKHEED ANALYTICAL SERVICES  
 LOGIN CHAIN OF CUSTODY REPORT (Ln01)  
 Mar 07 1996, 01:04 pm

Login Number: L6572  
 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
L6572-1 TEMP 2 Location: 157 Water 1 S SCREENING	BOH791	05-MAR-96	07-MAR-96	22-MAR-96
		Hold:01-SEP-96		
L6572-2 TEMP 2 Location: 157 Water 1 S SR-90 LAL-0196	BOH791	05-MAR-96	07-MAR-96	22-MAR-96
		Hold:01-SEP-96		
L6572-3 TEMP 2 Location: 157	BOH791	05-MAR-96	07-MAR-96	22-MAR-96
L6572-4 TEMP 2 Location: 157	BOH791	05-MAR-96	07-MAR-96	22-MAR-96
L6572-5 TEMP 2 Location: 157	BOH791	05-MAR-96	07-MAR-96	22-MAR-96
L6572-6 Location: Water 1 S EDD - DISK DEL. Water 1 S GERMANN Water 1 S RAD RPT TYPE 2	REPORT TYPE	07-MAR-96	07-MAR-96	22-MAR-96

Signature: Paul D. Davis  
 Date: 3-07-96

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Bechtel Hanford, Inc.		CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST					L6572		Page <u>1</u> of <u>1</u>	
Collector <i>A. Rizzo M. Mehlhorn</i>		Company Contact J.V. Borghese			Telephone (509) 373-4790			Data Turnaround <input checked="" type="checkbox"/> Priority <input type="checkbox"/> Normal		
Project Designation 100-NR-2 Monthly Performance Monitoring - March		Sampling Location 100 N			SAF No. B96-036					
Ice Chest No. <i>GWS-2AG</i>		Field Logbook No. <i>EFL-1056</i>			Method of Shipment Hand Delivered					
Shipped To Lockheed		Offsite Property No. <i>W96-0-0640-31</i>			Bill of Lading/Air Bill No. <i>2904652466</i>					
Possible Sample Hazards/Remarks		Preservation				HNO <sub>3</sub>	Cool 4°C			
		Type of Container				P/G	P/G			
		No. of Container(s)				4	1			
		Special Handling and/or Storage Maintain samples between 2°C and 6°C.		Volume				1L	20mL	
SAMPLE ANALYSIS						Sr-90	Activity Scan			
Sample No.	Matrix*	Date Sampled	Time Sampled							
BOH791	W	<i>3-5-96</i>	<i>1225</i>			<i>ρ ρ</i>				
CHAIN OF POSSESSION		Sign/Print Names				SPECIAL INSTRUCTIONS				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
Relinquished By <i>M. Mehlhorn</i>	Date/Time <i>3-5-96</i>	Received By <i>EFL</i>	Date/Time <i>1326</i>							
Relinquished By <i>EFL</i>	Date/Time <i>0830</i>	Received By <i>B. Whitte</i>	Date/Time <i>3-5-96</i>							
Relinquished By	Date/Time	Received By	Date/Time							
Relinquished By	Date/Time	Received By	Date/Time							
LABORATORY SECTION	Received By <i>Amill</i>	Title <i>Sample Custodian</i>		Date/Time <i>3-7-96 / 0915</i>						
FINAL SAMPLE	Disposal Method	Disposed By		Date/Time						

# SAMPLE CHECK-IN LIST

Date/Time Received: 3-7-96 / 0915 SDG#: N/A

Work Order Number: N/A SAF #: 896-036

Shipping Container ID: GWS-2AG Chain of Custody #: N/A

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

7. Samples have:

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

8. Samples are:

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

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

Notes: \_\_\_\_\_  
\_\_\_\_\_

Sample Custodian/Laboratory: Paula Davis / LAS Date: 3-7-96  
Faxes  
Telephoned To: Kathleen Hall On 3-07-96 By Paula Davis  
PWS 3-07-96

# LOCKHEED MARTIN



## Sample Login Login Review Checklist

Lot Number L6572

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

### SAMPLE SUMMARY REPORT

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

### LOGIN CHAIN OF CUSTODY

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

### SAMPLE RECEIVING CHECKLIST

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

Paula Davis  
primary review signature

3-02-96  
date

Amelia  
secondary review signature

3-7-96  
date

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Sample Receiving Checklist

Client Name: <sup>pcv 3-07-96</sup> L6572 Bechtel-Hanford Job No. L 6572

Cooler ID: N/A

COOLER CONDITION UPON RECEIPT

Temperature of cooler upon receipt: 2°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		N/A	
are samples bi-phasic (if so, indicate sample ID'S):		N/A	

MISCELLANEOUS ITEMS

	Yes	No	* Comments/Discrepancies
samples with short holding times		X	
samples to subcontract		N/A	

ADDITIONAL COMMENTS/DISCREPANCIES

Completed by / date: Paul D. Over 3-07-96

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

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# **SAMPLE RESULT FORMS**

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. \* Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: 80H791

LAL Sample ID: L6572-2

Date Collected: 05-MAR-96

Date Received: 07-MAR-96

Matrix: Water

Login Number: L6572

Constituent	Analyzed	Batch	Activity	Error	MVA	Count/Sec	Units
Sr-89,90	20-MAR-96	SR-90 LAL-0196_35021	2820	140	1.0		pCi/L

011

# QA/QC SUMMARY FORMS

LOCKHEED ANALYTICAL SERVICES

RADIOCHEMISTRY ANALYTES

QC Data Summary For Reagent Blank Analysis

Login Number: L6572

Analyte	Batch ID	MDA	Acceptance Limit	Date Analyzed	Reagent Blank Result	Data Qualifier
Sr-89,90	35021	0.988	2	03/20/96	-0.0495	

LOCKHEED ANALYTICAL SERVICES

RADIOCHEMISTRY ANALYTES

QC Data Summary For Laboratory Control Sample Analysis

Login Number: L6572

Analyte	Batch ID	Date Analyzed	LCS Result	Error 2 Sigma	True Value	(%) Recovery	Data Qualifiers
Sr-89,90	35021	03/20/96	52.5	3.16	51.1	103	

LOCKHEED ANALYTICAL SERVICES

RADIOCHEMISTRY ANALYTES

QC Data Summary For Duplicate Sample Analysis

Login Number: L6572

Analyte	Batch ID	Client ID	LAL ID	Date Analyzed	Sample Result	Error 2 Sigma	Duplicate Result	Error 2 Sigma	RER	RPD	Q
Sr-89,90	35021	80H791	L6572-2	03/20/96	2820	139	2330	115	1.94	19	

**STRONTIUM-90**  
**LAL-91-SOP-0196**

# LOCKHEED ANALYTICAL LABORATORY

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

Date Prep Started : 3-19-96

Matrix : Water

WorkGroup : SR-90 LAL-0196 35021

Prep Due Date : 03/20/96

CUSTOMER ID	PARENT LAL ID	NO	QC	CHILD LAL ID	ALIQUT VOLUME (g or L)	SR CARRIER (g/mL)	YTTRIUM SEP DATE	YTTRIUM SEP TIME	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	RESIDUE WEIGHT (grams)	COMMENTS
L6572-2	35021DUP1	1	DUP1	35021-01	500ml	50.5	3-20-96	2:30pm	6.50098	6.51002		
Lab Ctrl Sample	35021LCS1	2	LCS1	35021-02	↓	↓	↓	2:25pm	6.61435	6.62470		
Method Blank	35021MBB	3	MBB1	35021-03	↓	↓	↓	2:26pm	6.54296	6.55241		
BOH791	L6572-2	4	SMP1	35021-04	↓	↓	↓	2:29pm	6.60015	6.60965		
		5										
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
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		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										
Conc & Vol of Carrier	0.01225g / 0.5ml ; 0.5 ml			Act & Vol of LCS		26.78 µg/ml ; 1.0 ml		Prep Anlst		RW		
Carrier Exp Date	9-30-96			LCS Ref Date		4-1-96		Start Date		3-19-96		
Carrier ID#	94-658-20			LCS ID#		94-677-48-		Count Anlst				

Balance Number : 40020021 (1)

Pipette Number : 134488 (1)  
139746 (1)

Carrier and LCS added by: RW 3-19-96  
Witnessed by: SR 3-19-96

Comments :

01

Analyst : RW 3-20-96

Checked by: [Signature]

Cnt Rm Custody/Date : CS 3/21/96

# LOCKHEED ANALYTICAL LABORATORY

## SAMPLE PREPARATION LOG FOR STRONTIUM ANALYSIS

TOTAL RADIOSTRONTIUM - LAL-91-SOP-0196

Date Prep Started : 3/19/96

Matrix : Water

WorkGroup : SR-90 LAL-0196 35021

Prep Due Date : 03/20/96

CUSTOMER ID	PARENT LAL ID	NO	QC	CHILD LAL ID	ALIQOT VOLUME (L)	SR CARRIER (mL)	YTTRIUM SEP DATE	YTTRIUM SEP TIME	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	* * *	RESIDUE WEIGHT (grams)	COMMENTS
L6572-2	35021DUP1	1	DUP1	35021-01	0.5	0.5	3/20/96	14:30	6.50098	6.51002		0.00904	
Lab Ctrl Sample	35021LCS1	2	LCS1	35021-02	0.5	0.5	3/20/96	14:25	6.61435	6.6247		0.01035	
Method Blank	35021MBB	3	MBB1	35021-03	0.5	0.5	3/20/96	14:26	6.54296	6.55241		0.00945	
BOH791	L6572-2	4	SMP1	35021-04	0.5	0.5	3/20/96	14:30	6.60015	6.60965		0.0095	
		5											
		6											
		7											
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		24											
Conc&Vol of Carrier	24.50 mg/mL; 0.5 mL			Act & Vol of LCS	26.78 pCi/mL; 1.0 mL			Prep Anlst	AW				
Carrier Exp Date	30-Sep-96			LCS Ref Date	01-Apr-94			Start Date	3/19/96				
Carrier ID#	94-658-20			LCS ID#	94-677-44-1			Count Anlst	LV				

Balance Number : 40020021 ( )

Pipette Number : 134488 ( )

Carrier and LCS added by: AW

139746 ( )

Witnessed by : SR

Comments :

Analyst : L. Schroeder for A.W. (data entry) Checked by : FR

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# STANDARDS

## INITIAL STANDARD DILUTION RECORD

## Standard Information:

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

## Primary Dilution

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

Signed

Date

Signed

Date

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## SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

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

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

*Agnes Wong*  
3-3-95 01!

**Strontium Carrier Standardization**

Strontium Carrier (10 mg/mL):

Use commercially available 10,000 µg Sr/mL ICP Standard or equivalent. Alternately, Dissolve 24.16 g of Sr(NO<sub>3</sub>)<sub>2</sub> in water and dilute to 1 L in a volumetric flask with water.

Perform calibration check on a 0.5 mL pipet and then carefully pipet 3 - 0.5 mL portions of the strontium carrier solution into separate cleaned dried and tared planchets. Dry the planchet under a drying lamp. Cool the planchets in a desiccator and weigh.

	Calib # 1	Calib # 2	Calib # 3
Carrier plus planchet wt. (mg)	6865.84	6562.93	6540.56
Tare wt. of planchet (mg)	6853.57	<del>68</del> 6550.76	6528.26 <del>6520</del>
Net wt. of carrier added (mg)	12.27	12.17	12.30

AVERAGE Sr(NO<sub>3</sub>)<sub>2</sub> ± STD DEV. = 12.25 ± 0.0681 (0.01225g ± 0.0001g per 0.5ml)

Expected mg of Sr(NO<sub>3</sub>)<sub>2</sub> = cert. value (≈10mg of Sr/mL) \* 0.5 mL \* 2.41

Within 3% of expected (12.08 mg/0.5 mL) value (yes/no) yes

Initial and Date: WL 10-5-95

# 94-658-20

Walter Lutz 10-11-95

Continued on Page \_\_\_\_\_

Read and Understood By

WL  
Signed

10-11-95  
Date

James Wany  
Signed

1-16-96  
Date



# CERTIFICATE OF ANALYSIS

Catalog Number: PLSR2-3X Lot No. G3-153SR  
 Element and Matrix: Sr/HNO<sub>3</sub>/H<sub>2</sub>O  
 Starting Material: Strontium Carbonate SrCO<sub>3</sub>  
 Starting Material Lot Number: 05941D

Trace Metallic Impurities in the actual solution via ICP of the concentrate.

Element	PPM	Element	PPM	Element	PPM
Ag	<.05	Cu	<.05	P	<.05
Al	<.05	Fe	<.05	Pb	.06
As	<.05	Ga	<.05	Sb	<.10
B	<.05	In	<.05	Si	<.05
Ba	<.05	K	<.05	Sn	<.10
Be	<.05	Li	<.05	Ti	<.05
Bi	<.05	Mg	<.05	Tl	<.05
Ca	<.05	Mn	<.05	V	<.05
Cd	<.05	Mo	<.10	Zn	<.05
Co	<.05	Na	<.05	Zr	<.10
Cr	<.05	Ni	<.05		

### Traceability Documentation For Solution Standard:

1. Classical Wet Assay: 10,050 ppm.

Titrimetry: EDTA titration using Methyl Thymol Blue as indicator. EDTA standardized against NIST Pb(NO<sub>3</sub>)<sub>2</sub> SRM 928.

2. Instrumentation Analysis By Inductively Coupled Plasma Spectrometer[ICP]: 10,009 ppm via NIST SRM 3153a.

3. Balances are calibrated with NIST weight sets N.J. #92589 and #92550, according to NIST circular 547 3.4.3.

SPEX plasma solution standards are guaranteed stable and accurate to ± 0.5% of labeled concentration for one year from date of shipment. This value is the sum of cumulative errors associated with analytical determinations, pipetting and diluting to final volume. For these solutions we use high purity acids, 18 megohm double deionized water and triple rinsed bottles. All glassware used is class A.

Signed by: N. Kocherakota, Chemical Production Manager, Date: SEP 95



Printed on Recycled Paper

KCvd 513177  
ACSA  
RIS

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 the solution

**5.40** **nano curies** of **Strontium-90**

at 0400 hours PST on **April 1, 1994**

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

**5.40** **nano curies** Per gram

of the daughter nuclide **Yttrium-90**

Total mass of this solution

**Approximately 5.0** grams

Method of measurement

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

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

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

We recommend that this solution should not be used after **August 1994**

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

022  
C57

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  $\pm 0.1\%$  (The 99.7% confidence limits are given by  $t(sm)$  where  $t$  is obtained from the student  $t$  factor for the degree of freedom  $(n-1)$ ).

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

$+3.8\%$  or  $-3.8\%$

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

The overall uncertainty is therefore calculated on the basis of  $+ [t(sm) + \delta], - [t(sm) + \delta]$  and is  $+4.0\%, -4.0\%$  of the quoted radioactive concentration.

Decay Schemes

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

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

Chemical Composition of Solution

Carrier content per gram of solution:  
30 micrograms strontium

Other components:  
0.1 M HCl

Preservative:

Remarks

Date Certificate Prepared April 26, 1994

Approval Signature

*Paul B. Fahn* 023