9613477.0465

START

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

LK6230 113

0045275

LOCKHEED MARTIN

February 23, 1996

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

MAR 1996 RECEIVED Data Log In

RE:	Log-in No.:	L6230/L6263
	Quotation No.:	Q400000-B
	SAF:	B96-051
	Document File No.:	0119596/0124596
	WHC Document File No.:	320
	SDG No.:	LK6230

The attached data report contains the analytical results of samples that were submitted to Lockheed Analytical Services on January 19 and 24, 1996. The temperature of the coolers upon receipt was 2° and 4°C. Sample containers received agree with the chain-of-custody documentation. Sample containers were received intact. Samples designated for nitrate, nitrite, phosphate, and turbidity analysis were not received in time to meet the analytical holding time requirements.

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

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

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

SEP 1996 RECEIVED EDMC

MAR 08 1996

000003

Lockheed Analytical Services

Log-in No.: L6230/L6263
Quotation No.: Q400000-B
SAF: B96-051
Document File No.: 0119596/0124596
WHC Document File No.: 320
SDG No.: LK6230

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

" 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,

for

Kathleen M. Hall
Client Services Representative

cc: Client Services
Document Control

96134.7.0467

Lockheed Analytical Services

Log-in No.: L6230/L6263
Quotation No.: Q400000-B
SAF: B96-051
Document File No.: 0119596/0124596
WHC Document File No.: 320
SDG No.: LK6230

CASE NARRATIVE
INORGANIC NON METALS ANALYSES
WATER

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

Preparation and Analysis Requirements

- **Two water samples were received for L6230 and L6263 (SAF B96-051) and analyzed in batches 119 bh and 124 bh for selected analytes as requested on the chain of custody. Quality control analysis was performed on the following sample:**

Client ID	LAL #		Method
BOGZS8	L6230-4	MS, DUP	180.1 Turbidity
	L6230-3	MS, DUP	300.0 Chloride, Nitrate-Nitrogen, Nitrite-Nitrogen, Orthophosphate, Sulfate
BOXZT0	L6263-2	MS, DUP	300.0 Chloride, Nitrate-Nitrogen, Nitrite-Nitrogen, Orthophosphate, Sulfate

Holding Time Requirements

- **All samples were analyzed within the method-specific holding times with the following exceptions:**

  For sample BOGZS8 and BOGZT0 (L6230-4 and L6263-4 respectively) for Method 180.1 Turbidity, and sample BOGZS8 (L6230-3) for Method 300.0 Nitrate-Nitrogen, Nitrite-Nitrogen and Orthophosphate holding time was exceeded and the associates samples are flagged with an "H".

Method Blanks

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

Internal Quality Control

- **All Internal Quality Control were within acceptance limits.**

Kay McCann
Prepared By

January 30, 1996
Date

Lockheed Analytical Services

Log-in No.: L6230/L6263
Quotation No.: Q400000-B
SAF: B96-051
Document File No.: 0119596/0124596
WHC Document File No.: 320
SDG No.: LK6230

CASE NARRATIVE
INORGANIC METALS ANALYSES
WATERS AND FILTERED WATER

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

Preparation and Analysis Requirements

All samples were received on January 19 and 24, 1996. The samples were logged in as L6230 and L6263 and were prepared and analyzed in batches 119 bhT for total metals and 119 bhD for dissolved metals.

Holding Time Requirements

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

Method Blanks

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

Internal Quality Control

- All Internal Quality Control were within acceptance limits.

Shellee McGrath
Prepared By

February 15, 1996
Date

Lockheed Analytical Services

Log-in No.: L6230/L6263
Quotation No.: Q400000-B
SAF: B96-051
Document File No.: 0119596/0124596
WHC Document File No.: 320
SDG No.: LK6230

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, 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.

Alpha Spectrometry

Analytical Method Isotopic Uranium

The isotopic uranium analysis was performed using standard operating procedure (SOP), LAL-91-SOP-0108. The samples were analyzed in workgroup 32673. The instrument calibration verification met criteria. The method blank was within QC criteria. Yield tracer recoveries were within QC criteria for all associated samples. The laboratory control sample (LCS) recoveries were within QC criteria. The duplicate (DUP) recoveries were within QC criteria. Sample BOGZTO (L6263-5) had full width half max equal to 116 keV, however the peaks are resolvable therefore data quality is not believed to be adversely affected. No re-analyses were performed.

Gamma Spectrometry

Analytical Method Gamma Spectrometry

The gamma spectrometry analysis was performed using SOP, LAL-91-SOP-0063. The samples were analyzed in workgroups 32661 and 32929.

Workgroup 32661
The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS recoveries were within QC criteria. The DUP recoveries were within QC criteria. The MDA for cesium-137 was slightly greater than the reporting detection limit (RDL) for sample BOGZS8 (L6230-5) due to insufficient sample for the DUP. Data quality is not believed to be adversely affected. No re-analyses were performed.

Workgroup 32929
The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS recoveries were within QC criteria. The DUP recoveries were within QC criteria. The MDA for cesium-137 was greater than the RDL for sample BOGZTO (L6263-5) and the DUP (32929DUP1) due to insufficient sample volume. Data quality is not believed to be adversely affected. No re-analyses were performed.

Gas Proportional Counter

Analytical Method Gross Alpha/Beta

The gross alpha/beta analysis was performed using SOP, LAL-91-SOP-0060. The samples were analyzed in workgroups 32664 and 33771.

Workgroup 32664
The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS and matrix spike (MS) recoveries were within QC criteria. The DUP recoveries were within QC criteria. The MDA exceeded the RDL due to the residue weight limitations forcing a volume reduction, the associated samples were flagged with a "C" qualifier. Sample BOGZS8 (L6230-5) was re-analyzed in workgroup 33771 because the strontium result was significantly higher than the gross beta. The re-analysis affirms that the gross beta value is correct and the first strontium analysis is incorrect.

Workgroup 33771
The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS recoveries were within QC criteria. The associated DUP was analyzed in workgroup 32664. The MDA exceeded the RDL due to the residue weight limitations forcing a volume reduction, the associated samples were flagged with a "C" qualifier. Sample BOGZS8 (L6230-5) was originally analyzed in workgroup 32664 where the strontium result was significantly higher than the gross beta. This re-analysis affirms that the gross beta value is correct and the first strontium analysis is incorrect. Only the analysis from this workgroup is reported. No re-analyses were performed.

Analytical Method Total Strontium

The total strontium analysis was performed using SOP, LAL-92-SOP-0196. The samples were analyzed in workgroups 32666 and 33765.

Workgroup 32666
The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS recovery was within QC criteria. The DUP recoveries were within QC criteria. Sample BOGZS8 (L6230-5) was re-analyzed in workgroup 33765 because the strontium result was significantly higher than the gross beta.

Workgroup 33765
The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS recovery was within QC criteria. Sample BOGZS8 (L6230-5) was originally analyzed in workgroup 32666 where the strontium result was significantly higher than the gross beta. This re-analysis affirms that the gross beta value is correct and the first strontium analysis is incorrect. Only the analysis from this workgroup is reported. No re-analyses were performed.

Liquid Scintillation Counter

Analytical Method Carbon-14

The carbon-14 analysis was performed using SOP, LAL-93-SOP-0209. The samples were analyzed in workgroups 32660 and 32917.

Workgroup 32660
The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS and MS recoveries were within QC criteria. The DUP recoveries were within QC criteria. The quench value was within curve limitations. Analysis for sample BOGZS8 (L6230-11) consists of a straight spike of sample (10ml) into 10ml of Ultima Gold XR then counted. The sample activity (371 pCi/L) is above the RDL of 200 pCi/L. The sample spectrum was compared to the LCS spectrum to confirm that the reported activity is most likely due to carbon-14. Data quality is not believed to be adversely affected. No re-analyses were performed.

Workgroup 32917
The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS and MS recoveries were within QC criteria. The DUP recoveries were within QC criteria. The quench value was within curve limitations. Analysis for sample BOGZTO (L6263-11) consists of a straight spike of sample (10ml) into 10ml of Ultima Gold XR then counted. The sample activity (385 pCi/L) is above the RDL of 200 pCi/L. The sample spectrum was compared to the LCS spectrum to confirm that the reported activity is most likely due to carbon-14. Data quality is not believed to be adversely affected. No re-analyses were performed.

Lockheed Analytical Services

Log-in No.: L6230/L6263
Quotation No.: Q400000-B
SAF: B96-051
Document File No.: 0119596/0124596
WHC Document File No.: 320
SDG No.: LK6230

Analytical Method Tritium

The tritium analysis was performed using SOP, LAL-91-SOP-0066. The samples were analyzed in workgroup 32671. The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS and MS recoveries were within QC criteria. The DUP recoveries were within QC criteria. The quench value was within curve limitations. No re-analyses were performed.

Andrea Tippett
Prepared By

February 23, 1996
Date

9613477.0473

LOCKHEED ANALYTICAL SERVICES
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Feb 08 1996, 03:46 pm

Login Number: L6230
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
L6230-1	B0GZS8	17-JAN-96	19-JAN-96		23-FEB-96

temp 2
Location: RFG01-43A
Water 1 S SCREENING Hold:15-JUL-96

L6230-2	B0GZS8	17-JAN-96	19-JAN-96		23-FEB-96

temp 2
Location: RFG19-105C
Water 1 S 6010 ICP METALS Hold:15-JUL-96
Water 1 S 6010 ICP TRACE Hold:15-JUL-96

L6230-3	B0GZS8	17-JAN-96	19-JAN-96		23-FEB-96

temp 2
Location: RFG19-105C
Water 1 S 300.0 CHLORIDE Hold:14-FEB-96
Water 1 S 300.0 FLUORIDE Hold:14-FEB-96
Water 1 S 300.0 NITRATE Hold:19-JAN-96
Water 1 S 300.0 NITRITE Hold:19-JAN-96
Water 1 S 300.0 PHOSPHATE Hold:19-JAN-96
Water 1 S 300.0 SULFATE Hold:14-FEB-96

L6230-4	B0GZS8	17-JAN-96	19-JAN-96		23-FEB-96

temp 2
Location: RFG19-105C
Water 1 S 180.1 TURBIDITY Hold:19-JAN-96

L6230-5	B0GZS8	17-JAN-96	19-JAN-96		23-FEB-96

temp 2
Location: 150
Water 1 S GAMMA SPEC LAL-0063 Hold:15-JUL-96
Water 1 S GR ALP/BETA LAL-0060 Hold:15-JUL-96
Water 1 S SR-90 LAL-0196 Hold:15-JUL-96
Water 1 S U-ISOTOPIC LAL-0108 Hold:15-JUL-96

L6230-6	B0GZS8	17-JAN-96	19-JAN-96		23-FEB-96

temp 2
Location: 150

L6230-7	B0GZS8	17-JAN-96	19-JAN-96		23-FEB-96

temp 2
Location: 156V-093F

000014

0119596

9613477.0474

LOCKHEED ANALYTICAL SERVICES
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Feb 08 1996, 03:46 pm

Login Number: L6230
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
L6230-8	B0GZS8	17-JAN-96	19-JAN-96	23-FEB-96
temp 2				
Location: 156V-092B				
L6230-9	B0GZS8	17-JAN-96	19-JAN-96	23-FEB-96
temp 2				
Location: 156V-093F				
L6230-10	B0GZS8	17-JAN-96	19-JAN-96	23-FEB-96
temp 2				
Location: 156V-093F				
L6230-11	B0GZS8	17-JAN-96	19-JAN-96	23-FEB-96
temp 2				
Location: 156V-F033				
Water 1 S C-14 LAL-0209		Hold:15-JUL-96		
Water 1 S TRITIUM(H3) LAL-0066		Hold:15-JUL-96		
L6230-12	B0GZS9	17-JAN-96	19-JAN-96	23-FEB-96
temp 2				
Location: 122				
Filt H20 15 S 6010 ICP METALS		Hold:15-JUL-96		
Filt H20 15 S 6010 ICP TRACE		Hold:15-JUL-96		
L6230-13	REPORT TYPE	19-JAN-96	19-JAN-96	23-FEB-96
Location:				
Water 1 S EDD - DISK DEL.				
Water 1 S INORG TYPE 2 RPT +				
Water 1 S RAD RPT TYPE 2				

Signature: [illegible]

Date: 2-26-96

011959L

Bechtel Hanford, Inc.

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

L6230

Page 1 of 1

Data Turnaround
☐ Priority
■ Normal

Collector: M. Mehlhorn, B. Fahlberg	Company Contact: R. L. Biggerstaff	Telephone: (509) 372-9572
Project Designation: 100-KR-4 Groundwater Sampling - Round 9	Sampling Location: 100 K	SAF No.: B96-051
Ice Chest No.: SML-277	Field Logbook No.: EFL-1160	Method of Shipment: Federal Express
Shipped To: Lockheed	Offsite Property No.: W96-0-0640-17	Bill of Lading/Air Bill No.: 2904649684

Possible Sample Hazards/Remarks

Special Handling and/or Storage: Maintain samples between 2°C and 6°C.

SAMPLE ANALYSIS												
			Preservation	HNO_3	Cool 4°C	Cool 4°C	HNO_3	Cool 4°C	Cool 4°C		HNO_3		
			Type of Container	P/G	G	P/G	P/G	G	P/G		G		
			No. of Container(s)	1	1	1	6	1	1		1		
			Volume	500mL	500mL	250mL	1L	1L	20mL		500mL		
				ICP Metals - TAL (Unfiltered)	Anions (IC) - F, Cl, SO_4, NO_2, NO_3, PO_4	Turbidity	*1	Tritium, C-14	Activity Scan		ICP Metals - TAL (Filtered)		
Sample No.	Matrix*	Date Sampled	Time Sampled										
B0GZS8	W	1-17-96	1136	X	X	X	X	X	X				
B0GZS9	W	1-17-96	1136								X		

CHAIN OF POSSESSION	Sign/Print Names		
Relinquished By: Monty Mehlhorn	Date/Time: 1-17-96 1405	Received By: ERC B. Whitten	Date/Time: 1405 1-17-96
Relinquished By: ERC B. Whitten	Date/Time: 0900 1-18-96	Received By	Date/Time
Relinquished By	Date/Time	Received By	Date/Time
Relinquished By	Date/Time	Received By	Date/Time

SPECIAL INSTRUCTIONS

*1 Gross Alpha, Gross Beta, Sr-90, U-234/235/238, Gamma Spec.

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 Activity Scan is for all sample numbers listed on this chain of custody.

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	Date/Time
	[illegible]	Sample Custodian	1-19-96 0915
FINAL SAMPLE	Disposal Method	Disposed By	Date/Time

000016

0114S4

SAMPLE CHECK-IN LIST

Date/Time Received: 1-19-96/0915 SDG#: N/A

Work Order Number: N/A SAF #: B96-051

Shipping Container ID: SML-277 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 2°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] Date: 1-19-96

Telephoned To: Kathleen Hall On 1-19-96 By Anthony R Miller

9613477.0477

LOCKHEED MARTIN

Sample Login
Login Review Checklist

Lot Number L6230

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

[illegible signature] 1-19-96
primary review signature date

Kamala Trojer 1-20-96
secondary review signature date

000018

01195

Lockheed Analytical Services
Sample Receiving Checklist

Client Name: Westinghouse Hanford Job No. L6230 Cooler ID:

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		Nitric
samples to subcontract		X	

ADDITIONAL COMMENTS/DISCREPANCIES

Completed by / date: [illegible] 1-19-96

Sent to the client (date/initials): ** Client's signature upon receipt:

* = contact the appropriate CSR of any discrepancies immediately upon receipt

~ this information and return via facsimile to the appropriate CSR (702) 361-8146

000019

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9613477.0479

LOCKHEED ANALYTICAL SERVICES
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Feb 08 1996, 03:47 pm

Login Number: L6263
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
L6263-1	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96

temp 4
Location: 156-018
Water 1 S SCREENING Hold:20-JUL-96

L6263-2	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96

temp 4
Location: RFG19-105C
Water 1 S 300.0 CHLORIDE Hold:19-FEB-96
Water 1 S 300.0 FLUORIDE Hold:19-FEB-96
Water 1 S 300.0 NITRATE Hold:24-JAN-96
Water 1 S 300.0 NITRITE Hold:24-JAN-96
Water 1 S 300.0 PHOSPHATE Hold:24-JAN-96
Water 1 S 300.0 SULFATE Hold:19-FEB-96

L6263-3	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96

temp 4
Location: RFG19-105C
Water 1 S 6010 ICP METALS Hold:20-JUL-96
Water 1 S 6010 ICP TRACE Hold:20-JUL-96

L6263-4	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96

temp 4
Location: RFG19-105C
Water 1 S 180.1 TURBIDITY Hold:24-JAN-96

L6263-5	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96

temp 4
Location: 150
Water 1 S GAMMA SPEC LAL-0063 Hold:20-JUL-96
Water 1 S GR ALP/BETA LAL-0060 Hold:20-JUL-96
Water 1 S SR-90 LAL-0196 Hold:20-JUL-96
Water 1 S U-ISOTOPIC LAL-0108 Hold:20-JUL-96

L6263-6	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96

temp 4
Location: 156V-093F

L6263-7	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96

temp 4
Location: 156V-093F

000020

0124596

9613477.0480

LOCKHEED ANALYTICAL SERVICES
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Feb 08 1996, 03:47 pm

Login Number: L6263
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
L6263-8	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96
temp 4					
Location: 156V-093D					
L6263-9	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96
temp 4					
Location: 156V-093D					
L6263-10	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96
temp 4					
Location: 156V-093D					
L6263-11	B0GZT0	22-JAN-96	24-JAN-96		28-FEB-96
temp 4					
Location: 156V-092E					
Water 1 S C-14 LAL-0209		Hold:20-JUL-96			
Water 1 S TRITIUM(H3) LAL-0066		Hold:20-JUL-96			
L6263-12	B0GZT1	22-JAN-96	24-JAN-96		28-FEB-96
temp 4					
Location: 122					
Filt H20 15 S 6010 ICP METALS		Hold:20-JUL-96			
Filt H20 15 S 6010 ICP TRACE		Hold:20-JUL-96			
L6263-13	REPORT TYPE	24-JAN-96	24-JAN-96		28-FEB-96
Location:					
Water 1 S EDD - DISK DEL.					
Water 1 S INORG TYPE 2 RPT					
Water 1 S RAD RPT TYPE 2					

Signature: [signature]

Date: 2-26-96

000021

012596

Bechtel Hanford, Inc.

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST L6263

Page 1 of 1

Data Turnaround: ☐ Priority ■ Normal

Collector: R. Fahlberg / A. Rizzo	Company Contact: R. L. Biggerstaff	Telephone: (509) 372-9572
Project Designation: 100-KR-4 Groundwater Sampling - Round 9	Sampling Location: 100 K	SAF No.: B96-051
Ice Chest No.: SML-529	Field Logbook No.: EFL - 1K20	Method of Shipment: Federal Express
Shipped To: Lockheed	Offsite Property No.: W90-0-0690-18	Bill of Lading/Air Bill No.: 2904050016

Possible Sample Hazards/Remarks

Special Handling and/or Storage: Maintain samples between 2°C and 6°C.

SAMPLE ANALYSIS												
Preservation				HNO_3	Cool 4°C	Cool 4°C	HNO_3	Cool 4°C	Cool 4°C		HNO_3	
Type of Container				P/G	G	P/G	P/G	G	P/G		G	
No. of Container(s)				1	1	1	6	1	1		1	
Volume				500mL	500mL	~~250mL~~ 1L	1L	1L	20mL		500mL	
				ICP Metals - TAL (Unfiltered)	Anions (IC) - F, Cl, SO_4, NO_2, NO_3, PO_4	Turbidity	*1	Tritium, C-14	Activity Scan		ICP Metals - TAL (Filtered)	
Sample No.	Matrix*	Date Sampled	Time Sampled									
B0GZT0	W	1/22/96	1615	X	X	X	X	X	X			
B0GZT1	W	1/22/96	1615								X	

CHAIN OF POSSESSION — Sign/Print Names

Relinquished By	Date/Time	Received By	Date/Time
A.G. Rizzo (ERC)	1-23-96 0800	ERC B. Walton	0800 1-23-96
ERC B. Walton	0900 1-23-96		

SPECIAL INSTRUCTIONS

*1 Gross Alpha, Gross Beta, Sr-90, U-234/235/238, Gamma Spec.

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 Activity Scan is for all sample numbers listed on this chain of custody.

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: 1-24-96 / 0930

FINAL SAMPLE: Disposal Method: Disposed By: Date/Time:

220000

9616177.1481

Orchelo

SAMPLE CHECK-IN LIST

Date/Time Received: 1-24-96/0930 SDG#: NA

Work Order Number: NA SAF #: B96-051

Shipping Container ID: SML-524 Chain of Custody # 1

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: 1-24-96

Telephoned To: Kathleen Hall On 1-24-96 By Anthony R. Miller

9613477.0483

LOCKHEED MARTIN

Sample Login
Login Review Checklist

Lot Number L6263

The login review should be conducted by that person logging in the samples as well as a peer. Please use this checklist to ensur 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	

[signature] 1-24-96
primary review signature — date

[signature] 1-24-96
secondary review signature — date

0104596

Lockheed Analytical Services
Sample Receiving Checklist

Client Name: Bechtel - Hanford Job No. L6263 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		Nitrate
samples to subcontract		X	

ADDITIONAL COMMENTS/DISCREPANCIES

Completed by / date: [illegible] 1-24-96

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*

version 2.0 (11/11/94)

000025

01845

96152472 0084

LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: B0GZS8	Date Collected: 17-JAN-96
Matrix: Water	Date Received: 19-JAN-96
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	0.59	N/A	H	26-JAN-96	32883	L6230-4
Chloride	mg/L	300.0	8.0	0.020		22-JAN-96	32703	L6230-3
Fluoride	mg/L	300.0	0.070	1.0	D(1:10)B	22-JAN-96	32704	L6230-3
Nitrate-N	mg/L	300.0	3.0	0.020	H	22-JAN-96	32705	L6230-3
Nitrite-N	mg/L	300.0	< 0.002	0.010	HU	22-JAN-96	32706	L6230-3
Ortho Phosphate	mg/L	300.0	0.062	1.0	HD(1:10)B	22-JAN-96	32707	L6230-3
Sulfate	mg/L	300.0	25.	0.10		22-JAN-96	32708	L6230-3

LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: B0GZT0	Date Collected: 22-JAN-96
Matrix: Water	Date Received: 24-JAN-96
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	0.28	N/A	H	26-JAN-96	32883	L6263-4
Chloride	mg/L	300.0	9.0	0.020		24-JAN-96	32864	L6263-2
Fluoride	mg/L	300.0	< 0.007	0.10	U	24-JAN-96	32865	L6263-2
Nitrate-N	mg/L	300.0	2.1	0.020		24-JAN-96	32866	L6263-2
Nitrite-N	mg/L	300.0	< 0.002	0.010	U	24-JAN-96	32867	L6263-2
Ortho Phosphate	mg/L	300.0	0.024	0.10	B	24-JAN-96	32868	L6263-2
Sulfate	mg/L	300.0	25.	0.10		24-JAN-96	32869	L6263-2

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LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: B0GZS8	Date Collected: 17-JAN-96
Matrix: Water	Date Received: 19-JAN-96
Percent Solids: N/A	

Constituent	Units	Method	Result	IDL	RDL	Data Qual	Dilution	Date Analyzed	LAS Batch ID	LAS Sample ID
ALUMINUM, TOTAL	mg/L	6010	< 0.027	0.027	0.20	U	1	09-FEB-96	33170	L6230-2
CALCIUM, TOTAL	mg/L	6010	32.	0.013	5.0		1	09-FEB-96	33170	L6230-2
IRON, TOTAL	mg/L	6010	0.048	0.0050	0.10	B	1	09-FEB-96	33170	L6230-2
MAGNESIUM, TOTAL	mg/L	6010	9.1	0.041	5.0		1	09-FEB-96	33170	L6230-2
NICKEL, TOTAL	mg/L	6010	< 0.014	0.014	0.040	U	1	09-FEB-96	33170	L6230-2
POTASSIUM, TOTAL	mg/L	6010	4.9	0.40	5.0	B	1	09-FEB-96	33170	L6230-2
SODIUM, TOTAL	mg/L	6010	27.	0.040	5.0		1	09-FEB-96	33170	L6230-2
ZINC, TOTAL	mg/L	6010	0.0081	0.0030	0.020	B	1	09-FEB-96	33170	L6230-2
Antimony	mg/L	6010	< 0.0020	0.0020	0.060	U	1	08-FEB-96	33572	L6230-2
Arsenic	mg/L	6010	0.014	0.0020	0.010		1	08-FEB-96	33572	L6230-2
Barium	mg/L	6010	0.023	0.0010	0.20	B	1	08-FEB-96	33572	L6230-2
Beryllium	mg/L	6010	< 0.0010	0.0010	0.0050	U	1	08-FEB-96	33572	L6230-2
Cadmium	mg/L	6010	< 0.0010	0.0010	0.0050	U	1	08-FEB-96	33572	L6230-2
Chromium	mg/L	6010	0.0094	0.0010	0.010	B	1	08-FEB-96	33572	L6230-2
Cobalt	mg/L	6010	< 0.0010	0.0010	0.050	U	1	08-FEB-96	33572	L6230-2
Copper	mg/L	6010	0.0021	0.0010	0.025	B	1	08-FEB-96	33572	L6230-2
Lead	mg/L	6010	< 0.0010	0.0010	0.0030	U	1	08-FEB-96	33572	L6230-2
Manganese	mg/L	6010	< 0.0010	0.0010	0.015	U	1	08-FEB-96	33572	L6230-2
Selenium	mg/L	6010	< 0.0030	0.0030	0.0050	U	1	08-FEB-96	33572	L6230-2
Silver	mg/L	6010	< 0.0010	0.0010	0.010	U	1	08-FEB-96	33572	L6230-2
Thallium	mg/L	6010	< 0.0030	0.0030	0.010	U	1	08-FEB-96	33572	L6230-2
Vanadium	mg/L	6010	0.024	0.0010	0.050	B	1	08-FEB-96	33572	L6230-2

LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: B0GZT0	Date Collected: 22-JAN-96
Matrix: Water	Date Received: 24-JAN-96
Percent Solids: N/A	

Constituent	Units	Method	Result	IDL	RDL	Data Qual	Dilution	Date Analyzed	LAS Batch ID	LAS Sample ID
ALUMINUM, TOTAL	mg/L	6010	0.040	0.027	0.20	B	1	12-FEB-96	33170	L6263-3
CALCIUM, TOTAL	mg/L	6010	40.	0.013	5.0		1	12-FEB-96	33170	L6263-3
IRON, TOTAL	mg/L	6010	0.032	0.0050	0.10	B	1	12-FEB-96	33170	L6263-3
MAGNESIUM, TOTAL	mg/L	6010	11.	0.041	5.0		1	12-FEB-96	33170	L6263-3
NICKEL, TOTAL	mg/L	6010	< 0.014	0.014	0.040	U	1	12-FEB-96	33170	L6263-3
POTASSIUM, TOTAL	mg/L	6010	5.3	0.40	5.0		1	12-FEB-96	33170	L6263-3
SODIUM, TOTAL	mg/L	6010	17.	0.040	5.0		1	12-FEB-96	33170	L6263-3
ZINC, TOTAL	mg/L	6010	0.0087	0.0030	0.020	B	1	12-FEB-96	33170	L6263-3
Antimony	mg/L	6010	< 0.0020	0.0020	0.060	U	1	08-FEB-96	33572	L6263-3
Arsenic	mg/L	6010	0.0064	0.0020	0.010	B	1	08-FEB-96	33572	L6263-3
Barium	mg/L	6010	0.024	0.0010	0.20	B	1	08-FEB-96	33572	L6263-3
Beryllium	mg/L	6010	< 0.0010	0.0010	0.0050	U	1	08-FEB-96	33572	L6263-3
Cadmium	mg/L	6010	< 0.0010	0.0010	0.0050	U	1	08-FEB-96	33572	L6263-3
Chromium	mg/L	6010	0.031	0.0010	0.010		1	08-FEB-96	33572	L6263-3
Cobalt	mg/L	6010	< 0.0010	0.0010	0.050	U	1	08-FEB-96	33572	L6263-3
Copper	mg/L	6010	0.0019	0.0010	0.025	B	1	08-FEB-96	33572	L6263-3
Lead	mg/L	6010	< 0.0010	0.0010	0.0030	U	1	08-FEB-96	33572	L6263-3
Manganese	mg/L	6010	< 0.0010	0.0010	0.015	U	1	08-FEB-96	33572	L6263-3
Selenium	mg/L	6010	< 0.0030	0.0030	0.0050	U	1	08-FEB-96	33572	L6263-3
Silver	mg/L	6010	< 0.0010	0.0010	0.010	U	1	08-FEB-96	33572	L6263-3
Thallium	mg/L	6010	< 0.0030	0.0030	0.010	U	1	08-FEB-96	33572	L6263-3
Vanadium	mg/L	6010	0.016	0.0010	0.050	B	1	08-FEB-96	33572	L6263-3

LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: B0GZS9	Date Collected: 17-JAN-96
Matrix: Filt H20	Date Received: 19-JAN-96
Percent Solids: N/A	

Constituent	Units	Method	Result	IDL	RDL	Data Qual	Dilution	Date Analyzed	LAS Batch ID	LAS Sample ID
POTASSIUM, DISSOLVED	mg/L	6010	5.4	0.40	5.0		1	05-FEB-96	33172	L6230-12
SODIUM, DISSOLVED	mg/L	6010	24.	0.040	5.0		1	05-FEB-96	33172	L6230-12
ZINC, DISSOLVED	mg/L	6010	0.030	0.0030	0.020		1	05-FEB-96	33172	L6230-12
Aluminum	mg/L	6010	< 0.0070	0.0070	0.20	U	1	01-FEB-96	33573	L6230-12
Antimony	mg/L	6010	< 0.0020	0.0020	0.060	U	1	01-FEB-96	33573	L6230-12
Arsenic	mg/L	6010	0.0092	0.0020	0.010	B	1	01-FEB-96	33573	L6230-12
Barium	mg/L	6010	0.020	0.0010	0.20	B	1	01-FEB-96	33573	L6230-12
Beryllium	mg/L	6010	< 0.0010	0.0010	0.0050	U	1	01-FEB-96	33573	L6230-12
Cadmium	mg/L	6010	< 0.0010	0.0010	0.0050	U	1	01-FEB-96	33573	L6230-12
Calcium	mg/L	6010	30.	0.0050	5.0		1	01-FEB-96	33573	L6230-12
Chromium	mg/L	6010	0.0068	0.0010	0.010	B	1	01-FEB-96	33573	L6230-12
Cobalt	mg/L	6010	< 0.0010	0.0010	0.050	U	1	01-FEB-96	33573	L6230-12
Copper	mg/L	6010	0.0028	0.0010	0.025	B	1	01-FEB-96	33573	L6230-12
Iron	mg/L	6010	0.019	0.013	0.10	B	1	01-FEB-96	33573	L6230-12
Lead	mg/L	6010	< 0.0010	0.0010	0.0030	U	1	01-FEB-96	33573	L6230-12
Magnesium	mg/L	6010	7.9	0.010	5.0		1	01-FEB-96	33573	L6230-12
Manganese	mg/L	6010	< 0.0010	0.0010	0.015	U	1	01-FEB-96	33573	L6230-12
Nickel	mg/L	6010	< 0.011	0.011	0.040	U	1	01-FEB-96	33573	L6230-12
Selenium	mg/L	6010	< 0.0030	0.0030	0.0050	U	1	01-FEB-96	33573	L6230-12
Silver	mg/L	6010	< 0.0010	0.0010	0.010	U	1	01-FEB-96	33573	L6230-12
Thallium	mg/L	6010	< 0.0030	0.0030	0.010	U	1	01-FEB-96	33573	L6230-12
Vanadium	mg/L	6010	0.022	0.0010	0.050	B	1	01-FEB-96	33573	L6230-12

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LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: B0GZT1	Date Collected: 22-JAN-96
Matrix: Filt H20	Date Received: 24-JAN-96
Percent Solids: N/A	

Constituent	Units	Method	Result	IDL	RDL	Data Qual	Dilution	Date Analyzed	LAS Batch ID	LAS Sample ID
POTASSIUM, DISSOLVED	mg/L	6010	5.9	0.40	5.0		1	05-FEB-96	33172	L6263-12
SODIUM, DISSOLVED	mg/L	6010	15.	0.040	5.0		1	05-FEB-96	33172	L6263-12
ZINC, DISSOLVED	mg/L	6010	0.030	0.0030	0.020		1	05-FEB-96	33172	L6263-12
Aluminum	mg/L	6010	< 0.0070	0.0070	0.20	U	1	01-FEB-96	33573	L6263-12
Antimony	mg/L	6010	< 0.0020	0.0020	0.060	U	1	01-FEB-96	33573	L6263-12
Arsenic	mg/L	6010	< 0.0020	0.0020	0.010	U	1	01-FEB-96	33573	L6263-12
Barium	mg/L	6010	0.022	0.0010	0.20	B	1	01-FEB-96	33573	L6263-12
Beryllium	mg/L	6010	< 0.0010	0.0010	0.0050	U	1	01-FEB-96	33573	L6263-12
Cadmium	mg/L	6010	< 0.0010	0.0010	0.0050	U	1	01-FEB-96	33573	L6263-12
Calcium	mg/L	6010	39.	0.0050	5.0		1	01-FEB-96	33573	L6263-12
Chromium	mg/L	6010	0.027	0.0010	0.010		1	01-FEB-96	33573	L6263-12
Cobalt	mg/L	6010	< 0.0010	0.0010	0.050	U	1	01-FEB-96	33573	L6263-12
Copper	mg/L	6010	0.0011	0.0010	0.025	B	1	01-FEB-96	33573	L6263-12
Iron	mg/L	6010	0.015	0.013	0.10	B	1	01-FEB-96	33573	L6263-12
Lead	mg/L	6010	< 0.0010	0.0010	0.0030	U	1	01-FEB-96	33573	L6263-12
Magnesium	mg/L	6010	9.7	0.010	5.0		1	01-FEB-96	33573	L6263-12
Manganese	mg/L	6010	< 0.0010	0.0010	0.015	U	1	01-FEB-96	33573	L6263-12
Nickel	mg/L	6010	< 0.011	0.011	0.040	U	1	01-FEB-96	33573	L6263-12
Selenium	mg/L	6010	< 0.0030	0.0030	0.0050	U	1	01-FEB-96	33573	L6263-12
Silver	mg/L	6010	< 0.0010	0.0010	0.010	U	1	01-FEB-96	33573	L6263-12
Thallium	mg/L	6010	< 0.0030	0.0030	0.010	U	1	01-FEB-96	33573	L6263-12
Vanadium	mg/L	6010	0.015	0.0010	0.050	B	1	01-FEB-96	33573	L6263-12

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: B0GZS8 | LAL Sample ID: L6230-5

Date Collected: 17-JAN-96 | Date Received: 19-JAN-96

Matrix: Water | Login Number: L6230

SDG: LK6230

Constituent	Analyzed	Batch	Activity	Error	MDA	DataQual	Units
Ac-228(Ra-228)	23-JAN-96	GAMMA SPEC LAL-0063_32661	5.	28.	45.		pCi/L
Co-58	23-JAN-96	GAMMA SPEC LAL-0063_32661	2.5	7.4	9.2		pCi/L
Co-60	23-JAN-96	GAMMA SPEC LAL-0063_32661	2.5	4.0	11.		pCi/L
Cs-137	23-JAN-96	GAMMA SPEC LAL-0063_32661	7.9	7.5	11.		pCi/L
Eu-152	23-JAN-96	GAMMA SPEC LAL-0063_32661	-3.8	7.2	49.		pCi/L
Eu-154	23-JAN-96	GAMMA SPEC LAL-0063_32661	-13.8	7.7	44.		pCi/L
Eu-155	23-JAN-96	GAMMA SPEC LAL-0063_32661	4.	11.	18.		pCi/L
Fe-59	23-JAN-96	GAMMA SPEC LAL-0063_32661	-0.4	8.7	18.		pCi/L
Pb-212	23-JAN-96	GAMMA SPEC LAL-0063_32661	-3.	12.	17.		pCi/L
Pb-214(Ra-226)	23-JAN-96	GAMMA SPEC LAL-0063_32661	60.	17.	23.		pCi/L
Ra-226(GAMMA)	23-JAN-96	GAMMA SPEC LAL-0063_32661	80	130	190		pCi/L
Ru-106	23-JAN-96	GAMMA SPEC LAL-0063_32661	0	44.	76.		pCi/L
U-235(GAMMA)	23-JAN-96	GAMMA SPEC LAL-0063_32661	14.	32.	46.		pCi/L
Gross Alpha	15-FEB-96	GR ALP/BETA LAL-0060_33771	2.3	1.7	2.4	C	pCi/L
Gross Beta	15-FEB-96	GR ALP/BETA LAL-0060_33771	4.1	1.5	2.2		pCi/L
Total radio-strontium	20-FEB-96	SR-90 LAL-0196_33765	-0.03	0.59	1.0		pCi/L
U-233/4	12-FEB-96	U-ISOTOPIC LAL-0108_32673	1.59	0.31	0.12		pCi/L
U-235	12-FEB-96	U-ISOTOPIC LAL-0108_32673	0.143	0.089	0.039		pCi/L
U-238	12-FEB-96	U-ISOTOPIC LAL-0108_32673	1.40	0.29	0.087		pCi/L

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: B0GZS8 | LAL Sample ID: L6230-11

Date Collected: 17-JAN-96 | Date Received: 19-JAN-96

Matrix: Water | Login Number: L6230

SDG: LK6230

Constituent	Analyzed	Batch	Activity	Error	MDA	DataQual	Units
C-14	24-JAN-96	C-14 LAL-0209_32660	370	110	100		pCi/L
H-3	29-JAN-96	TRITIUM(H3) LAL-0066_32671	1040	230	200		pCi/L

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: B0GZT0 | LAL Sample ID: L6263-5

Date Collected: 22-JAN-96 | Date Received: 24-JAN-96

Matrix: Water | Login Number: L6263

SDG: LK6230

Constituent	Analyzed	Batch	Activity	Error	MDA	DataQual	Units
Ac-228(Ra-228)	26-JAN-96	GAMMA SPEC LAL-0063_32929	-10	16.	46.		pCi/L
Co-58	26-JAN-96	GAMMA SPEC LAL-0063_32929	2.4	6.5	7.9		pCi/L
Co-60	26-JAN-96	GAMMA SPEC LAL-0063_32929	4.5	4.7	9.8		pCi/L
Cs-137	26-JAN-96	GAMMA SPEC LAL-0063_32929	-1.6	8.2	11.		pCi/L
Eu-152	26-JAN-96	GAMMA SPEC LAL-0063_32929	-5.4	7.9	51.		pCi/L
Eu-154	26-JAN-96	GAMMA SPEC LAL-0063_32929	-5.	11.	45.		pCi/L
Eu-155	26-JAN-96	GAMMA SPEC LAL-0063_32929	-2.1	7.0	19.		pCi/L
Fe-59	26-JAN-96	GAMMA SPEC LAL-0063_32929	0	7.3	18.		pCi/L
Pb-212	26-JAN-96	GAMMA SPEC LAL-0063_32929	7.	12.	16.		pCi/L
Pb-214(Ra-226)	26-JAN-96	GAMMA SPEC LAL-0063_32929	87.	18.	20.		pCi/L
Ra-226(GAMMA)	26-JAN-96	GAMMA SPEC LAL-0063_32929	30	130	190		pCi/L
Ru-106	26-JAN-96	GAMMA SPEC LAL-0063_32929	56.	49.	67.		pCi/L
U-235(GAMMA)	26-JAN-96	GAMMA SPEC LAL-0063_32929	-11.	17.	43.		pCi/L
Gross Alpha	13-FEB-96	GR ALP/BETA LAL-0060_32664	1.0	1.4	2.4		pCi/L
Gross Beta	13-FEB-96	GR ALP/BETA LAL-0060_32664	4.5	1.5	2.2		pCi/L
Total radio-strontium	12-FEB-96	SR-90 LAL-0196_32666	-0.12	0.80	1.4		pCi/L
U-233/4	12-FEB-96	U-ISOTOPIC LAL-0108_32673	1.28	0.30	0.13	F	pCi/L
U-235	12-FEB-96	U-ISOTOPIC LAL-0108_32673	0.38	0.16	0.10	F	pCi/L
U-238	12-FEB-96	U-ISOTOPIC LAL-0108_32673	1.33	0.30	0.091	F	pCi/L

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: BOGZT0 | LAL Sample ID: L6263-11

Date Collected: 22-JAN-96 | Date Received: 24-JAN-96

Matrix: Water | Login Number: L6263

SDG: LK6230

Constituent	Analyzed	Batch	Activity	Error	MDA	DataQual	Units
C-14	01-FEB-96	C-14 LAL-0209_32917	390	110	100		pCi/L
H-3	29-JAN-96	TRITIUM(H3) LAL-0066_32671	1720	270	200		pCi/L

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 Date: November 8, 1991

Michael Snyder, Product Manager

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
Toll Free: 1-(800) 387-7160 (Ont/Quebec) / 1-(800) 387-7146 (rest of Canada)

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 9 M 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 (11.42 pCi/mL, 94-677-71-1) and samples were counted for 10 hours.

CHILD ID	U-232 GROSS COUNTS per 1.0 mL	U-238 GROSS COUNTS	CALCULATED U-232 VALUE IN pCi/mL
U1100395	2187	2606	9.60
U2100395	2188	2619	9.55
U3100395	2178	2558	9.72
U4100395	2204	2428	10.35
U5100395	2129	2462	9.88
U6100395	2026	2476	9.35
			9.74 pCi/mL ± 0.35 pCi/mL

The value calibrated for this tracer was 9.74 pCi/mL with a precision of ± 3.6%.

U-232 Logbook Reference # 94-677-84-1

Ref. date 10-3-95
Exp. date 10-3-97
Prep. date 10-3-95

Paynes Wong 10-4-95

Continued on Page

Read and Understood By

Paynes Wong — Signed — 10-4-95 — Date

Joe Hutchinson — Signed — 10/10/95 — Date

9613477.0497

AA9804
8/19/93

National Institute of Standards & Technology

Certificate

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

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.

9613477.0499

AA9804

Notebook No. 474-14

ISOTOPE WEIGHT DILUTION RECORD

Isotope: U-238 Vendor: NIST

Total Received Activity: ~1307 Bq Vendor ID: 4321B

Wt. Received: ~5.3 g NIST Traceable (Y)/N Cert. # SRM-4321B

Activity in Units/g: 246.7 Bq/g Reference Date: JAN 1, 1992

Activity converted (dpm/g): 14,802 dpm/g Receive Date: Aug 19, 1993

Halflife (Yrs or days) t½ = 4.47×10^9 yrs * Receiver's Name:

Bryan Wong 8-24-93

PRIMARY DILUTION: Balance wt. check done (✓)

a: Source activity: 14,802 dpm/g * (if t½ = <100yr decay to prep. date)

b: Wt. of Source transfered: 5.23707 g

Diluent used: 1 M HNO_3

c: Total diluted weight: 132.03 g

d: Activity of dilution (a*b/c): 587.13 dpm/g ± 0.87%

e: Calculated density of solution: 1.0292 g/mL (1M = 1.02924/mL ~~(1M~~ HNO_3 = 1.~~1294~~ ± .0007 g/mL) (93) 100mL Weighed the prepared 1M HNO_3 solution

f: Activity by volume = (d*e): 604.3 dpm/mL

Dilution Log Book ID: LAL-93-0474-14-1

Preparation Date: 8/20/93 Preparer's Name. [illegible]

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

Log Book ID of source being diluted: 93-0474-14-1

a: Source activity: 587.13 dpm/g * (if t½ = <100yr decay to prep. date)

b: Wt. of Source transfered: 2.60815 g

Diluent used: 1M HNO_3

c: Total diluted weight: 125.21 g

d: Activity of dilution (a*b/c): 12.23 dpm/g ± 0.87% U-238

e: Calculated density of solution: 1.0292 g/mL (1M 93 1.0292 ~~(1M~~ HNO_3 = ~~1.1294~~ ± .0007 g/mL)

f: Activity by volume = (d*e): 12.59 dpm/mL ± .9% U-238 → 12.6 ± .1

Dilution Log Book ID: 93-0474-14-2

Preparer's Name: [illegible] Preparation Date: 8/20/93

Reviewed By: Bryan Wong Review Date: 8-24-93

000101

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

Isotope:	U-238
Parent Barcode Number	AA9804
Vendor or Certificate I.D. # of Parent Standard:	
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
a: Parent Specific Activity:	272.21 pCi/ml
b: Amount of Source Transferred:	6.0648 g
c: Total amount of Dilution:	144.57 g
d: Total Volume of Dilution:	N/A
e: Activity of Dilution [a * b / c]:	N/A
f: Activity of Dilution (a * b / d):	11.42 pCi/ml
Dilution Logbook I.D. #:	94-677-71-1

Prepared By: Agnes Wong Preparation Date: 7-11-95

Reviewed By: [signature] Review Date: 7/12/95

*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.

Signed Date Signed Date

9613477.0501

AA9804
8/19/93

National Institute of Standards & Technology

Certificate

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

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

000103

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

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(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.

SRM 4321B

9613477.0503

Notebook No. 474-14

AA.9804

ISOTOPE WEIGHT DILUTION RECORD

Lynn Wong 8-24-93

Isotope: U-238 Vendor: NIST

Total Received Activity: ~1307 Bq Vendor ID: 4321B

Wt. Received: ~5.3 g NIST Traceable Y/N Cert. # SRM-4321B

Activity in Units/g: 246.7 Bq/g Reference Date: JAN 1, 1992

Activity converted (dpm/g): 14,802 dpm/g Receive Date: Aug 19, 1993

Halflife (Yrs or days) t½ = 4.47×10^9 yrs * Receiver's Name:

PRIMARY DILUTION: Balance wt. check done (✓)

a: Source activity: 14,802 dpm/g * (if t½ = <100yr decay to prep. date)

b: Wt. of Source transfered: 5.23707 g

Diluent used: 1 M HNO_3

c: Total diluted weight: 132.03 g

d: Activity of dilution (a*b/c): 587.13 dpm/g ± 0.87%

e: Calculated density of solution: 1.0292 g/mL (~~4M~~ 1M HNO_3 = ~~1.1294~~ 1.0292 g/mL ± .0007 g/mL) 100mL Weighed the prepared 1M HNO_3 solution

f: Activity by volume = (d*e): 604.3 dpm/mL

Dilution Log Book ID: LAL-93-0474-14-1

Preparation Date: 8/20/93 Preparer's Name. [signature]

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

Log Book ID of source being diluted: 93-0474-14-1

a: Source activity: 587.13 dpm/g * (if t½ = <100yr decay to prep. date)

b: Wt. of Source transfered: 2.60815 g

Diluent used: 1M HNO_3

c: Total diluted weight: 125.21 g

d: Activity of dilution (a*b/c): 12.23 dpm/g ± 0.87% U-238

e: Calculated density of solution: 1.0292 g/mL (~~4M~~ 1M HNO_3 = ~~1.1294~~ 1.0292 ± .0007 g/mL)

f: Activity by volume = (d*e): 12.59 dpm/mL ± .9% U-238 → 12.6 ± .1

Dilution Log Book ID: 93-0474-14-2

Preparer's Name: [signature] Preparation Date: 8/20/93

Reviewed By: Lynn Wong Review Date: 8-24-93

9613477.0504

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	U-238
Parent Barcode Number	AA9804
Vendor or Certificate I.D. # of Parent Standard:	
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
b: Amount of Source Transferred:	6.0185	g
c: Total amount of Dilution:	152.13	g
d: Total Volume of Dilution:	N/A	ml exp. 2-5-98
e: Activity of Dilution (a * b / c):	N/A	pCi/g
f: Activity of Dilution (a * b / d):	10.77	pCi/ml
Dilution Logbook I.D. #:	94-677-95-1	

Prepared By: Agnes Wong Preparation Date: 2-5-96

Reviewed By: _____ Review Date: _____

*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.

Client	Bechtel
Client ID	B0GZS8
Filename	326611.CHN
LAL parent ID	32661DUP1
Batch	6332661
Live Time	10800
Detector	1
Geometry	N
Aliquot (gms/L)	0.49
Count date	1/23/96 9:50
Collection Date	1/17/96
delta T to midpoint of count	6.5
Efficiency data file	N194
Background, Library files	WBKG1019

-0.01537

Nuclide	keV	WBKG cnts/sec	1 sig % err	NET Sample cnts/sec	NET 1 sig % err	Efficiency	1 sigma % Eff err	Branch
Ra-226	186.1	0.012089	5.5	0.00273	86.30	0.055308	5	0.035
U-235	185.7	0.012089	5.5	0.00273	86.30	0.055389	5	0.575
	143.8	0.002217	26.9	-0.00203	109.57	0.063815	5	0.109
	163.3	0.000767	73.3	0.00377	56.36	0.059981	5	0.05
Pb-214(Ra-226)	351.9	0.002617	17.0	0.01516	13.59	0.03237	5	0.358
	295.1	0.000892	53.0	0.00723	28.29	0.037986	5	0.185
Fe-59	1099.2	-6.4E-05	359.4	0.00008	669.93	0.011918	5	0.565
	1291.6	-4.7E-05	430.6	-0.00040	122.84	0.010338	5	0.432
Co-58	810.8	0.000125	217.7	-0.00062	52.23	0.015465	5	0.9945
Ac-228(Ra-228)	911.2	0.000981	31.7	-0.00063	179.94	0.014001	5	0.266
	969	0.000417	61.6	-0.00079	75.22	0.013285	5	0.1617
Pb-212	238.6	0.005517	10.4	0.00231	88.35	0.045721	5	0.4365
	300.1	0.00025	172.2	-0.00368	19.65	0.037416	5	0.03344
Co-60	1332.5	0.0002	106.1	0.00059	121.80	0.010051	5	0.999
	1173.3	8.33E-06	2753.2	0.00138	58.50	0.011258	5	0.999
Cs-137	661.7	-0.00027	122.8	0.00182	49.39	0.018405	5	0.8521
Eu-155	105.3	0.000964	60.8	0.00026	808.66	0.06833	5	0.218
Eu-152	1408.1	0.000225	75.7	0.00004	1884.08	0.009557	5	0.212
	344.3	8.33E-06	5266.9	-0.00022	320.35	0.033022	5	0.27
Eu-154	723.3	7.22E-05	395.5	-0.00152	29.76	0.017049	5	0.197
	1004.8	-0.00073	33.9	-0.00201	30.50	0.012878	5	0.176
	1274.5	-8.1E-05	238.5	0.00014	316.23	0.010462	5	0.355
Ru-106	621.8	-0.00028	121.9	-0.00002	5097.06	0.019424	5	0.0981
	1050.1	0.000375	64.6	-0.00048	75.76	0.012399	5	0.0146

9613977.0505

00109

Client	Bechtel
Client ID	B0GZS8
Filename	326611.CHN
LAL parent ID	32661DUP1
Batch	6332661
Live Time	10800
Detector	1
Geometry	N
Aliquot (gms/L)	0.49
Count date	1/23/96 9:50
Collection Date	1/17/96
delta T to midpoint of count	6.5
Efficiency data file	N194
Background, Library files	WBKG1019

Nuclide	keV	Bq	pCi/L	MDA pCi/L	Decay factor	Corrected pCi/L	error 1 sigma	Corrected MDA pCi/g
Ra-226	186.1	1.408183	77.59375	187.08	1.000008	77.59	67.08	187.08
U-235	185.7	0.08559	4.716205	11.37	1	4.716	4.08	11.37
	143.8	-0.292052	-16.09266	47.48	1	-16.093	17.65	47.48
	163.3	1.257186	69.27352	93.51	1	69.274	39.19	93.51
Pb-214(Ra-226)	351.9	1.308313	72.09069	19.99	1.000008	72.091	10.44	19.99
	295.1	1.028213	56.65665	37.37	1.000008	56.657	16.28	37.37
Fe-59	1099.2	0.011459	0.631408	15.46	1.104598	0.697	4.67	17.08
	1291.6	-0.089842	-4.950491	24.23	1.104598	-5.468	6.72	26.76
Co-58	810.8	-0.040236	-2.217086	8.56	1.065441	-2.362	1.24	9.12
Ac-228(Ra-228)	911.2	-0.170241	-9.38063	48.23	1.002139	-9.401	16.92	48.34
	969	-0.366381	-20.18833	83.35	1.002139	-20.232	15.25	83.53
Pb-212	238.6	0.115618	6.37081	14.86	1	6.371	5.64	14.86
	300.1	-2.93798	-161.8887	199.43	1	-161.889	32.83	199.43
Co-60	1332.5	0.058463	3.221431	9.78	1.002335	3.2290	3.94	9.81
	1173.3	0.122749	6.763707	8.56	1.002335	6.7795	3.98	8.58
Cs-137	661.7	0.116111	6.39797	9.75	1.00041	6.4006	3.18	9.76
Eu-155	105.3	0.017135	0.944187	19.17	1.002482	0.947	7.654	19.222
Eu-152	1408.1	0.018433	1.015676	55.94	1.000968	1.02	19.15	56.00
	344.3	-0.025166	-1.386716	25.26	1.000968	-1.39	4.45	25.29
Eu-154	723.3	-0.453404	-24.98347	49.04	1.001446	-25.02	7.55	49.11
	1004.8	-0.885124	-48.77216	58.17	1.001446	-48.84	15.10	58.25
	1274.5	0.037395	2.060546	23.55	1.001446	2.06	6.53	23.58
Ru-106	621.8	-8.10E-03	-4.46E-01	7.90E+01	1.01226	-0.4517	23.02	79.93
	1050.1	-2.67E+00	-1.47E+02	7.47E+02	1.01226	-148.8335	113.01	756.60

000110

96134977.0506

Client	Bechtel
Client ID	B0GZS8
Filename	326611.CHN
LAL parent ID	32661DUP1
Batch	6332661
Live Time	10800
Detector	1
Geometry	N
Aliquot (gms/L)	0.49
Count date	1/23/96 9:50
Collection Date	1/17/96
delta T to midpoint of count	6.5
Efficiency data file	N194
Background, Library files	WBKG1019

Nuclide	keV	Counting Error pCi/L	FINAL RESULT pCi/L	Total Error 2 sigma	MDA pCi/L
Ra-226	186.1	133.93	77.59	134.16	187.08
U-235	185.7	8.14	4.72	8.15	11.37
	143.8	1.70	-1.70	32.19	47.48
	163.3				93.51
Pb-214(Ra-226)	351.9	16.56	67.59	17.57	19.99
	295.1				37.37
Fe-59	1099.2	3.17	-1.31	7.67	17.08
	1291.6				26.76
Co-58	810.8	2.47	-2.36	2.48	9.12
Ac-228(Ra-228)	911.2	21.34	-15.38	22.66	48.34
	969				83.53
Pb-212	238.6	2.44	6.37	11.28	14.86
	300.1		-161.89	65.65	199.43
Co-60	1332.5	5.26	4.98	5.60	9.81
	1173.3				8.58
Cs-137	661.7	6.32	6.40	6.35	9.76
Eu-155	105.3	15.31	0.95	15.31	19.22
Eu-152	1408.1	7.99	-1.27	8.66	56.00
	344.3				25.29
Eu-154	723.3	5.66	-13.32	9.39	49.11
	1004.8				58.25
	1274.5				23.58
Ru-106	621.8	9.65	-6.366	45.123	79.93
	1050.1				756.60

RER%

Pb-214 -> $\left|\frac{60.31 - 67.59}{17.38 + 17.57}\right| = 0.21$

Co-60 -> $\left|\frac{2.48 - 4.98}{4.05 + 5.60}\right| = 0.26$

Cs-137 -> $\left|\frac{7.89 - 6.40}{7.54 + 6.35}\right| = 0.11$

FJR ~~1/26~~ 1/24/96

96134772.0507

001111

Client	Bechtel	
Client ID	B0GZS8	
Filename	326614.CHN	
LAL parent ID	L6230-5	
Batch	6332661	
Live Time	10800	
Detector	2	LAS Detector 2, GMX-30200-P, Ser. No. 30-TN10348
Geometry	N	
Aliquot (gms/L)	0.49	
Count date	1/23/96 9:51	
Collection Date	1/17/96	
delta T to midpoint of count	6.5	days
Efficiency data file	N294	
Background, Library files	WBKG2019	whc

V94093

Nuclide	keV	halflife (days)	chnl	GROSS	BKG	NET	Hand Calc NET	Sample cnts/sec	1 sig % err
Ra-226	186.1	5.84E+05	372	250	83	168		0.0155093	10.9
U-235	185.7	2.57E+11	372	250	83	168		0.0155093	10.9
	143.8	~~2.57E+11~~	288	179	140	39		0.0036111	45.8
	163.3	2.57E+11	327	149	112	37		0.0034259	43.7
Pb-214(Ra-226)	351.9	5.84E+05	704	245	75	170		0.0157407	10.5
	295.1	5.84E+05	591	171	77	94		0.0087037	16.8
Fe-59	1099.2	4.51E+01	2198	17	18	-1		-4.63E-05	1174.7
	1291.6	4.51E+01	2583	15	14	1		9.259E-05	538.5
Co-58	810.8	7.08E+01	1622	33	25	9		0.000787	89.2
Ac-228(Ra-228)	911.2	2.10E+03	1822	48	33	15		0.0014236	58.4
	969	2.10E+03	1938	39	30	9		0.0008333	92.3
Pb-212	238.6	5.11E+12	478	171	110	62		0.0056944	27.2
	300.1	5.11E+12	600	68	62	6		0.0005556	190.0
Co-60	1332.5	1924	2665	25	15	10		0.0009259	63.2
	1173.3	1924	2347	15	11	5		0.0004167	112.2
Cs-137	661.7	10950	1324	79	55	24		0.0022531	47.5
Eu-155	105.3	1810	211	132	121	11		0.001034	142.4
Eu-152	1408.1	4.64E+03	2816	11	13	-2		-0.00017	266.3
	344.3	4.64E+03	689	69	71	-2		-0.000201	546.4
Eu-154	723.3	3.11E+03	1447	21	30	-9		-0.000864	76.8
	1004.8	3.11E+03	2009	20	21	-1		-9.26E-05	640.3
	1274.5	3.11E+03	2549	13	21	-8		-0.000741	72.9
Ru-106	621.8	368.2	1244	33	33	0		3.086E-05	2431.0
	1050.1	368.2	2100	21	21	0		0	0.0

0001;

96134727.0508

Client	Bechtel
Client ID	B0GZS8
Filename	326614.CHN
LAL parent ID	L6230-5
Batch	6332661
Live Time	10800
Detector	2
Geometry	N
Aliquot (gms/L)	0.49
Count date	1/23/96 9:51
Collection Date	1/17/96
delta T to midpoint of count	6.5
Efficiency data file	N294
Background, Library files	WBKG2019

-0.01597

Nuclide	keV	WBKG cnts/sec	1 sig % err	NET Sample cnts/sec	NET 1 sig % err	Efficiency	1 sigma % Eff err	Branch
Ra-226	186.1	0.012672	5.3	0.00284	82.96	0.055571	5	0.035
U-235	185.7	0.012672	5.3	0.00284	82.96	0.055656	5	0.575
	143.8	0.0027	21.8	0.00091	245.98	0.064542	5	0.109
	163.3	0.0008	70.1	0.00263	78.32	0.060486	5	0.05
Pb-214(Ra-226)	351.9	0.003183	13.9	0.01256	16.71	0.032285	5	0.358
	295.1	0.000908	54.7	0.00780	25.07	0.03788	5	0.185
Fe-59	1099.2	-0.00017	117.9	-0.00005	1174.73	0.012002	5	0.565
	1291.6	0.000117	164.8	-0.00002	2869.63	0.010402	5	0.432
Co-58	810.8	0.000117	229.9	0.00067	144.75	0.01556	5	0.9945
Ac-228(Ra-228)	911.2	0.000927	33.7	0.00050	230.27	0.014097	5	0.266
	969	0.000917	29.0	-0.00008	1242.33	0.013378	5	0.1617
Pb-212	238.6	0.006642	8.7	-0.00095	224.66	0.045685	5	0.4365
	300.1	0.000117	385.2	0.00044	342.93	0.03731	5	0.03344
Co-60	1332.5	0.000175	121.8	0.00075	106.36	0.01011	5	0.999
	1173.3	-0.00023	106.2	0.00042	112.22	0.011335	5	0.999
Cs-137	661.7	-0.00062	52.3	0.00225	47.51	0.018483	5	0.8521
Eu-155	105.3	-0.00044	127.1	0.00103	142.39	0.068697	5	0.218
Eu-152	1408.1	2.78E-05	652.7	-0.00020	137.06	0.009607	5	0.212
	344.3	0.000328	132.8	-0.00053	125.07	0.032933	5	0.27
Eu-154	723.3	0.000178	168.6	-0.00104	34.91	0.017137	5	0.197
	1004.8	-0.00043	59.9	-0.00009	640.31	0.012969	5	0.176
	1274.5	0.000133	136.9	-0.00087	40.88	0.010528	5	0.355
Ru-106	621.8	-0.00023	146.6	0.00003	2431.05	0.019492	5	0.0981
	1050.1	-0.00051	46.4	0.00000	0.00	0.012487	5	0.0146

000122

96/34/7 .0609

Client	Bechtel
Client ID	B0GZS8
Filename	326614.CHN
LAL parent ID	L6230-5
Batch	6332661
Live Time	10800
Detector	2
Geometry	N
Aliquot (gms/L)	0.49
Count date	1/23/96 9:51
Collection Date	1/17/96
delta T to midpoint of count	6.5
Efficiency data file	N294
Background, Library files	WBKG2019

Nuclide	keV	Bq	pCi/L	MDA pCi/L	Decay factor	Corrected pCi/L	error 1 sigma	Corrected MDA pCi/g
Ra-226	186.1	1.458639	80.37398	187.77	1.000008	80.37	66.80	187.77
U-235	185.7	0.088652	4.884902	11.41	1	4.885	4.06	11.41
	143.8	0.12951	7.13625	45.83	1	7.136	17.56	45.83
	163.3	0.868282	47.84411	90.73	1	47.844	37.55	90.73
Pb-214(Ra-226)	351.9	1.086468	59.86662	22.66	1.000008	59.867	10.44	22.66
	295.1	1.112381	61.29447	33.52	1.000008	61.295	15.67	33.52
Fe-59	1099.2	-0.006827	-0.376193	15.88	1.104612	-0.416	4.88	17.54
	1291.6	-0.005357	-0.295204	23.70	1.104612	-0.326	9.36	26.18
Co-58	810.8	0.04332	2.387044	8.67	1.065449	2.543	3.68	9.24
Ac-228(Ra-228)	911.2	0.132416	7.296373	45.00	1.002139	7.312	16.84	45.10
	969	-0.038522	-2.122651	75.67	1.002139	-2.127	26.43	75.83
Pb-212	238.6	-0.0475	-2.617352	16.71	1	-2.617	5.88	16.71
	300.1	0.351776	19.38359	162.32	1	19.384	66.48	162.32
Co-60	1332.5	0.074346	4.096643	11.02	1.002335	4.1062	4.37	11.05
	1173.3	0.036796	2.027524	7.17	1.002335	2.0323	2.28	7.19
Cs-137	661.7	0.143059	7.882827	11.31	1.00041	7.8861	3.77	11.31
Eu-155	105.3	0.069041	3.804277	17.99	1.002482	3.814	5.434	18.037
Eu-152	1408.1	-0.096983	-5.343987	49.00	1.000968	-5.35	7.34	49.05
	344.3	-0.059425	-3.274423	24.62	1.000968	-3.28	4.10	24.64
Eu-154	723.3	-0.308637	-17.00654	44.00	1.001446	-17.03	6.01	44.07
	1004.8	-0.040564	-2.235161	48.16	1.001446	-2.24	14.33	48.23
	1274.5	-0.233867	-12.88656	33.77	1.001446	-12.91	5.32	33.82
Ru-106	621.8	1.61E-02	8.89E-01	7.54E+01	1.012261	0.9003	21.89	76.35
	1050.1	0.00E+00	0.00E+00	5.88E+02	1.012261	0.0000	0.00	595.06

9612477.0510

0001122

Client	Bechtel
Client ID	B0GZS8
Filename	326614.CHN
LAL parent ID	L6230-5
Batch	6332661
Live Time	10800
Detector	2
Geometry	N
Aliquot (gms/L)	0.49
Count date	1/23/96 9:51
Collection Date	1/17/96
delta T to midpoint of count	6.5
Efficiency data file	N294
Background, Library files	WBKG2019

Nuclide	keV	Counting Error pCi/L	FINAL RESULT pCi/L	Total Error 2 sigma	MDA pCi/L
Ra-226	186.1	133.36	80.37	133.61	187.77
U-235	185.7	8.11	4.88	8.12	11.41
	143.8	21.55	14.44	31.81	45.83
	163.3				90.73
Pb-214(Ra-226)	351.9	16.77	60.31	17.38	22.66
	295.1				33.52
Fe-59	1099.2	8.62	-0.40	8.66	17.54
	1291.6				26.18
Co-58	810.8	7.36	2.54	7.37	9.24
Ac-228(Ra-228)	911.2	20.77	4.59	28.41	45.10
	969				75.83
Pb-212	238.6	9.84	-2.62	11.76	16.71
	300.1		19.38	132.96	162.32
Co-60	1332.5	3.82	2.48	4.05	11.05
	1173.3				7.19
Cs-137	661.7	7.49	7.89	7.54	11.31
Eu-155	105.3	10.86	3.81	10.87	18.04
Eu-152	1408.1	6.97	-3.77	7.16	49.05
	344.3				24.64
Eu-154	723.3	7.33	-13.82	7.67	44.07
	1004.8				48.23
	1274.5				33.82
Ru-106	621.8	~~#DIV/0!~~	~~#DIV/0!~~	~~#DIV/0!~~	76.35
	1050.1	~~21.89~~ 43.17B	0.450	~~21.89~~ 43.78	595.06

TJR 1/24 TJR 1/24 TJR 1/24

TJR 1/24/96

96134772.0611

9613477.0512

EG&G ORTEC OMNIGAM (33) I3.02.27 24-JAN-96 07:54:52 Page 1
Spectrum name: 326611.CHN

Sample description
Bechtel B0GZS8 32661DUP1 06332661 N .490 1/17/96 CS

Spectrum Filename: 326611.CHN

Acquisition information
Start time 23-Jan-96 09:50:51
Live time 10800
Real time 10816
Dead time .15%
Detector/Geometry IDs 0 & 0

Detector system
LAS Detector 1, GMX-30200-P, Ser. No. 30-TN10223A

Calibration
Filename: 326611.CHN
Created: 23-Jan-96 09:50:51 &
MAESTRO calibration

Zero offset -.012 keV; Gain .500 keV/channel

Library not found or NULL library selected.

Analysis parameters
Start channel 50 for an energy of 24.99keV
Stop channel 3994 for an energy of 1997.07keV
Peak rejection level 50.000%
Activity scaling factor 1.0000E+00/ 1.0000E+00 = 1.0000E+00
Detection limit method:
MDA - EG&G ORTEC method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	YES	
Peaked background correction	NO	
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

********** U N I D E N T I F I E D P E A K S U M M A R Y *********

PEAK CENTROID CHANNEL	ENERGY	BACKGROUND COUNTS	NET AREA COUNTS	INTENSITY CTS/SEC	UNCERT 1 SIGMA %	FWHM keV	SUSPECTED NUCLIDE
92.97	46.47	287.	131.	.012	20.30	.906	PB-210
150.03	75.01	289.	52.	.005	42.54	.579	PBKA
154.39	77.19	227.	79.	.007	29.14	.895	PB-214

EG&G ORTEC OMNIGAM (33) I3.02.27 24-JAN-96 07:54:52 Page 2
Spectrum name: 326611.CHN

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
173.96	86.97	201.	40.	.004	46.44	.746	PB-214	
185.05	92.52	325.	203.	.019	13.70	1.071	TH-234	s
350.36	175.17	99.	27.	.002	49.45	.943	GD-151	
371.88	185.93	194.	172.	.016	17.32	.982	RA-226	s
477.74	238.87	159.	53.	.005	33.21	.995	PB-212	
483.93	241.96	150.	44.	.004	42.29	1.078	PB-214	
590.62	295.31	126.	95.	.009	19.61	1.000	PB-214	s
704.15	352.08	110.	184.	.017	11.22	1.431	PB-214	s
779.94	389.97	34.	26.	.002	45.95	1.195	BI-214	
1022.27	511.15	111.	142.	.013	15.32	2.433	ANN-511	s
1166.58	583.30	45.	27.	.003	43.13	1.337	TL-208	
1218.85	609.44	75.	194.	.018	11.48	1.207	BI-214	
2426.10	1213.09	4.	12.	.001	39.39	.742	-	s
2815.30	1407.69	5.	11.	.001	47.82	.680	BI-214	s

s Peak fails shape tests.

Analysis time 1.2 seconds.

EG&G ORTEC OMNIGAM (33) I3.02.27 24-JAN-96 07:54:54 Page 1
Spectrum name: 326612.CHN

Sample description
Bechtel LCS 32661LCS1 06332661 N .5 4/2/91 TJR

Spectrum Filename: 326612.CHN

Acquisition information
Start time 23-Jan-96 13:58:09
Live time 10800
Real time 10816
Dead time .15%
Detector/Geometry IDs 0 & 0

Detector system
LAS Detector 1, GMX-30200-P, Ser. No. 30-TN10223A

Calibration
Filename: 326612.CHN
Created: 23-Jan-96 13:58:09 &
MAESTRO calibration

Zero offset -.012 keV; Gain .500 keV/channel

Library not found or NULL library selected.

Analysis parameters
Start channel 50 for an energy of 24.99keV
Stop channel 3994 for an energy of 1997.07keV
Peak rejection level 50.000%
Activity scaling factor 1.0000E+00/ 1.0000E+00 = 1.0000E+00
Detection limit method:
MDA - EG&G ORTEC method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	YES	
Peaked background correction	NO	
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

PEAK CENTROID CHANNEL	ENERGY	BACKGROUND COUNTS	NET AREA COUNTS	INTENSITY CTS/SEC	UNCERT 1 SIGMA %	FWHM keV	SUSPECTED NUCLIDE
64.07	32.03	480.	58.	.005	48.26	.741	-
92.97	46.48	341.	139.	.013	20.58	.965	PB-210
126.85	63.41	347.	152.	.014	21.63	.962	TH-234

9613477.0515

EG&G ORTEC OMNIGAM (33) I3.02.27 24-JAN-96 07:54:54 Page 2
Spectrum name: 326612.CHN

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
185.32	92.65	347.	229.	.021	12.65	.932	TH-234	
371.63	185.81	208.	138.	.013	17.06	1.016	U-235	
397.14	198.57	78.	26.	.002	43.17	.673	RH-101	s
477.50	238.75	173.	74.	.007	25.24	.950	PB-212	s
703.78	351.89	148.	49.	.005	45.72	1.523	PB-214	s
986.16	493.09	36.	25.	.002	46.13	1.479	-	s
1022.71	511.36	192.	146.	.014	22.07	2.281	ANN-511	s
1323.64	661.84	97.	1118.	.104	3.38	1.415	CS-137	
1413.92	706.98	45.	28.	.003	45.22	1.088	AC-228	s
1496.85	748.45	34.	32.	.003	37.67	1.316	-	
1692.82	846.43	52.	30.	.003	45.46	1.099	CO-56	s
1909.98	955.02	21.	17.	.002	47.79	.849	-	s
2346.52	1173.30	27.	539.	.050	5.09	1.867	CO-60	
2466.70	1233.39	6.	15.	.001	39.43	1.129	-	s
2664.91	1332.50	12.	465.	.043	5.02	1.833	CO-60	
2920.27	1460.18	9.	25.	.002	32.21	1.425	K-40	s

s Peak fails shape tests.

Analysis time 1.0 seconds.

EG&G ORTEC OMNIGAM (33) I3.02.27 24-JAN-96 07:54:55 Page 1
Spectrum name: 326613.CHN

Sample description
Bechtel MBB 32661MBB1 06332661 N .5 1/23/96 TJR

Spectrum Filename: 326613.CHN

Acquisition information
Start time 23-Jan-96 13:58:05
Live time 10800
Real time 10803
Dead time .03%
Detector/Geometry IDs 0 & 0

Detector system
LAS Detector 2, GMX-30200-P, Ser. No. 30-TN10348

Calibration
Filename: 326613.CHN
Created: 23-Jan-96 13:58:05 &
MAESTRO calibration

Zero offset .072 keV; Gain .500 keV/channel

Library not found or NULL library selected.

Analysis parameters
Start channel 50 for an energy of 25.08keV
Stop channel 3994 for an energy of 1997.54keV
Peak rejection level 50.000%
Activity scaling factor 1.0000E+00/ 1.0000E+00 = 1.0000E+00
Detection limit method:
MDA - EG&G ORTEC method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	YES	
Peaked background correction	NO	
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

PEAK CENTROID CHANNEL	ENERGY	BACKGROUND COUNTS	NET AREA COUNTS	INTENSITY CTS/SEC	UNCERT 1 SIGMA %	FWHM keV	SUSPECTED NUCLIDE	
48.89	24.52	100.	73.	.007	22.70	.914	AM-241	s
92.86	46.51	243.	70.	.007	29.60	.543	PB-210	s
125.92	63.05	292.	100.	.009	23.24	.724	TH-234	s

9613477.0517

EG&G ORTEC OMNIGAM (33) I3.02.27 24-JAN-96 07:54:55 Page 2
Spectrum name: 326613.CHN

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
153.92	77.05	138.	62.	.006	35.19	.701	PB-214	s
184.61	92.40	239.	279.	.026	9.87	.881	TH-234	s
371.08	185.65	198.	72.	.007	34.23	.826	U-235	
476.79	238.52	165.	46.	.004	42.22	.664	PB-212	s
504.83	252.54	60.	35.	.003	45.16	.800	TL-208	s
1021.62	511.00	83.	161.	.015	13.41	2.254	ANN-511	s
1166.15	583.28	28.	39.	.004	29.84	1.711	TL-208	s
1218.75	609.59	42.	35.	.003	33.81	1.482	BI-214	s
2001.04	1000.82	16.	15.	.001	45.70	1.184	PA-234M	s

s Peak fails shape tests.

Analysis time .9 seconds.

EG&G ORTEC OMNIGAM (33) I3.02.27 24-JAN-96 07:54:56 Page 1
Spectrum name: 326614.CHN

Sample description
Bechtel B0GZS8 L6230-5 06332661 N .490 1/17/96 CS

Spectrum Filename: 326614.CHN

Acquisition information
Start time 23-Jan-96 09:51:58
Live time 10800
Real time 10802
Dead time .02%
Detector/Geometry IDs 0 & 0

Detector system
LAS Detector 2, GMX-30200-P, Ser. No. 30-TN10348

Calibration
Filename: 326614.CHN
Created: 23-Jan-96 09:51:58 &
MAESTRO calibration

Zero offset .072 keV; Gain .500 keV/channel

Library not found or NULL library selected.

Analysis parameters
Start channel 50 for an energy of 25.08keV
Stop channel 3994 for an energy of 1997.54keV
Peak rejection level 50.000%
Activity scaling factor 1.0000E+00/ 1.0000E+00 = 1.0000E+00
Detection limit method:
MDA - EG&G ORTEC method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	YES	
Peaked background correction	NO	
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

PEAK CENTROID CHANNEL	ENERGY	BACKGROUND COUNTS	NET AREA COUNTS	INTENSITY CTS/SEC	UNCERT 1 SIGMA %	FWHM keV	SUSPECTED NUCLIDE	
48.91	24.53	82.	34.	.003	38.42	1.329	AM-241	s
92.66	46.41	159.	76.	.007	22.39	.546	PB-210	s
125.94	63.06	348.	111.	.010	22.62	.743	TH-234	s

9613477.0519

EG&G ORTEC OMNIGAM (33) I3.02.27 24-JAN-96 07:54:56 Page 2
Spectrum name: 326614.CHN

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
153.79	76.98	217.	136.	.013	17.58	.890	PB-214	s
167.29	83.74	231.	48.	.004	47.25	.790	TH-228	s
184.67	92.43	226.	322.	.030	9.05	1.018	TH-234	s
371.33	185.78	212.	89.	.008	28.74	.938	U-235	
476.45	238.35	116.	55.	.005	27.30	.988	PB-212	
482.80	241.53	108.	46.	.004	33.17	1.247	PB-214	s
590.04	295.16	62.	109.	.010	16.53	.977	PB-214	
703.64	351.97	87.	189.	.018	10.38	1.130	PB-214	s
1020.91	510.65	130.	145.	.013	15.90	2.728	TL-208	s
1165.74	583.08	55.	42.	.004	32.76	1.248	TL-208	s
1218.34	609.38	87.	161.	.015	13.60	1.326	BI-214	
2239.63	1120.14	33.	48.	.004	25.26	1.777	BI-214	s
3528.70	1764.83	5.	40.	.004	18.54	1.599	BI-214	s

s Peak fails shape tests.

Analysis time 1.0 seconds.

329291.XLS

Client	Bechtel	
Client ID	B0GZT0	
Filename	329291.CHN	
LAL parent ID	32929DUP1	
Batch	6332929	
Live Time	10800	
Detector	1	LAS Detector 1, GMX-30200-P, Ser. No. 30-TN10223A
Geometry	N	
Aliquot (gms/L)	0.5	
Count date	1/26/96 13:09	
Collection Date	1/22/96	
delta T to midpoint of count	4.6	days
Efficiency data file	N194	
Background, Library files	WBKG1026	whc

V94093

Nuclide	keV	halflife (days)	chnl	GROSS	BKG	NET	Hand Calc NET	Sample cnts/sec	1 sig % err
Ra-226	186.1	5.84E+05	372	232	113	120		0.0110648	15.5
U-235	185.7	2.57E+11	372	232	113	120		0.0110648	15.5
	143.8	2.57E+11	288	177	131	46		0.0042593	38.2
	163.3	2.57E+11	327	137	112	25		0.0023148	63.1
Pb-214(Ra-226)	351.9	5.84E+05	704	317	72	245		0.0226852	8.1
	295.1	5.84E+05	591	235	103	132		0.0122531	13.9
Fe-59	1099.2	4.51E+01	2198	19	22	-3		-0.000293	202.6
	1291.6	4.51E+01	2583	19	18	2		0.0001389	402.8
Co-58	810.8	7.08E+01	1622	28	29	-1		-0.000108	648.1
Ac-228(Ra-228)	911.2	2.10E+03	1822	39	53	-14		-0.001285	69.1
	969	2.10E+03	1938	28	22	6		0.0005556	117.9
Pb-212	238.6	5.11E+12	478	181	87	94		0.0087037	17.4
	300.1	5.11E+12	600	81	90	-9		-0.000833	145.3
Co-60	1332.5	1924	2665	12	14	-2		-0.000139	336.7
	1173.3	1924	2347	10	20	-10		-0.00088	57.2
Cs-137	661.7	10950	1324	26	47	-21		-0.001914	41.2
Eu-155	105.3	1810	211	137	133	5		0.0004167	364.8
Eu-152	1408.1	4.64E+03	2816	17	12	5		0.0004938	100.4
	344.3	4.64E+03	689	66	90	-24		-0.002207	52.4
Eu-154	723.3	3.11E+03	1447	34	28	6		0.0005556	131.2
	1004.8	3.11E+03	2009	20	21	-1		-9.26E-05	640.3
	1274.5	3.11E+03	2549	13	21	-8		-0.000741	72.9
Ru-106	621.8	368.2	1244	30	50	-20		-0.001867	44.4
	1050.1	368.2	2100	28	13	15		0.0014043	42.1

9613477.0520

329291.XLS

Client	Bechtel
Client ID	B0GZT0
Filename	329291.CHN
LAL parent ID	32929DUP1
Batch	6332929
Live Time	10800
Detector	1
Geometry	N
Aliquot (gms/L)	0.5
Count date	1/26/96 13:09
Collection Date	1/22/96
delta T to midpoint of count	4.6
Efficiency data file	N194
Background, Library files	WBKG1026

Nuclide	keV	WBKG cnts/sec	1 sig % err	NET Sample cnts/sec	NET 1 sig % err	Efficiency	1 sigma % Eff err	Branch
Ra-226	186.1	0.011717	5.5	-0.00065	363.10	0.055308	5	0.035
U-235	185.7	0.011717	5.5	-0.00065	363.10	0.055389	5	0.575
	143.8	0.003283	18.9	0.00098	229.97	0.063815	5	0.109
	163.3	0.000567	99.5	0.00175	115.83	0.059981	5	0.05
Pb-214(Ra-226)	351.9	0.002483	17.9	0.02020	11.24	0.03237	5	0.358
	295.1	0.000619	82.1	0.01163	19.00	0.037986	5	0.185
Fe-59	1099.2	-0.00024	92.1	-0.00029	202.61	0.011918	5	0.565
	1291.6	-0.00031	61.3	0.00014	402.77	0.010338	5	0.432
Co-58	810.8	0.000353	79.7	-0.00046	90.88	0.015465	5	0.9945
Ac-228(Ra-228)	911.2	0.001015	30.0	-0.00230	25.37	0.014001	5	0.266
	969	0.00055	50.4	0.00001	16778.11	0.013285	5	0.1617
Pb-212	238.6	0.006208	9.3	0.00250	83.92	0.045721	5	0.4365
	300.1	-0.00032	143.7	-0.00083	145.30	0.037416	5	0.03344
Co-60	1332.5	0.000175	112.5	-0.00031	86.25	0.010051	5	0.999
	1173.3	0.000075	318.6	-0.00095	27.65	0.011258	5	0.999
Cs-137	661.7	-0.00054	63.3	-0.00191	41.25	0.018405	5	0.8521
Eu-155	105.3	-0.00035	162.1	0.00042	364.81	0.06833	5	0.218
Eu-152	1408.1	0.000186	86.3	0.00031	213.29	0.009557	5	0.212
	344.3	-0.0001	430.1	-0.00221	52.38	0.033022	5	0.27
Eu-154	723.3	0.000572	50.1	-0.00002	6093.94	0.017049	5	0.197
	1004.8	-0.00023	101.3	-0.00009	640.31	0.012878	5	0.176
	1274.5	-0.00014	140.1	-0.00074	72.89	0.010462	5	0.355
Ru-106	621.8	-0.00029	110.9	-0.00187	44.40	0.019424	5	0.0981
	1050.1	-0.00032	75.1	0.00140	42.13	0.012399	5	0.0146

0001134

9615477.0521

329291.XLS

Client	Bechtel
Client ID	B0GZT0
Filename	329291.CHN
LAL parent ID	32929DUP1
Batch	6332929
Live Time	10800
Detector	1
Geometry	N
Aliquot (gms/L)	0.5
Count date	1/26/96 13:09
Collection Date	1/22/96
delta T to midpoint of count	4.6
Efficiency data file	N194
Background, Library files	WBKG1026

Nuclide	keV	Bq	pCi/L	MDA pCi/L	Decay factor	Corrected pCi/L	error 1 sigma	Corrected MDA pCi/g
Ra-226	186.1	-0.336739	-18.18393	192.70	1.000005	-18.18	66.03	192.70
U-235	185.7	-0.020467	-1.105232	11.71	1	-1.105	4.01	11.71
	143.8	0.140302	7.576314	45.07	1	7.576	17.43	45.07
	163.3	0.5829	31.47658	88.77	1	31.477	36.49	88.77
Pb-214(Ra-226)	351.9	1.743298	94.1381	21.11	1.000005	94.139	11.58	21.11
	295.1	1.65548	89.39592	36.53	1.000005	89.396	17.56	36.53
Fe-59	1099.2	-0.043544	-2.351362	17.30	1.073429	-2.524	5.12	18.58
	1291.6	0.031099	1.679359	22.63	1.073429	1.803	7.26	24.29
Co-58	810.8	-0.029961	-1.617909	9.56	1.046185	-1.693	1.54	10.00
Ac-228(Ra-228)	911.2	-0.61738	-33.33853	53.52	1.001523	-33.389	8.63	53.60
	969	0.002586	0.139656	63.52	1.001523	0.140	23.47	63.61
Pb-212	238.6	0.125037	6.751985	15.14	1	6.752	5.68	15.14
	300.1	-0.666041	-35.9662	183.74	1	-35.966	52.29	183.74
Co-60	1332.5	-0.03126	-1.68805	10.43	1.001662	-1.6909	1.46	10.45
	1173.3	-0.084879	-4.583443	10.52	1.001662	-4.5911	1.29	10.54
Cs-137	661.7	-0.122015	-6.588825	10.34	1.000292	-6.5907	2.74	10.34
Eu-155	105.3	0.027972	1.51047	18.62	1.001767	1.513	5.521	18.651
Eu-152	1408.1	0.151879	8.201456	49.13	1.000689	8.21	17.51	49.16
	344.3	-0.247509	-13.3655	26.09	1.000689	-13.37	7.04	26.10
Eu-154	723.3	-0.004962	-0.267962	44.50	1.00103	-0.27	16.35	44.55
	1004.8	-0.040852	-2.206002	50.15	1.00103	-2.21	14.14	50.20
	1274.5	-0.199441	-10.76979	31.29	1.00103	-10.78	7.88	31.32
Ru-106	621.8	-9.80E-01	-5.29E+01	9.07E+01	1.008717	-53.3787	23.85	91.54
	1050.1	7.76E+00	4.19E+02	4.68E+02	1.008717	422.5725	179.29	472.37

329291.XLS

Client	Bechtel
Client ID	B0GZT0
Filename	329291.CHN
LAL parent ID	32929DUP1
Batch	6332929
Live Time	10800
Detector	1
Geometry	N
Aliquot (gms/L)	0.5
Count date	1/26/96 13:09
Collection Date	1/22/96
delta T to midpoint of count	4.6
Efficiency data file	N194
Background, Library files	WBKG1026

Nuclide	keV	Counting Error pCi/L	FINAL RESULT pCi/L	Total Error 2 sigma	MDA pCi/L
Ra-226	186.1	132.05	-18.18	132.06	192.70
U-235	185.7	8.03	-1.11	8.03	11.71
	143.8	24.86	12.02	31.45	45.07
	163.3				88.77
Pb-214(Ra-226)	351.9	17.93	92.70	19.34	21.11
	295.1				36.53
Fe-59	1099.2	3.94	-1.09	8.36	18.58
	1291.6				24.29
Co-58	810.8	3.08	-1.69	3.08	10.00
Ac-228(Ra-228)	911.2	14.91	-29.39	16.21	53.60
	969				63.61
Pb-212	238.6	9.81	6.75	11.35	15.14
	300.1		-35.97	104.58	183.74
Co-60	1332.5	1.75	-3.32	1.93	10.45
	1173.3				10.54
Cs-137	661.7	5.44	-6.59	5.48	10.34
Eu-155	105.3	11.04	1.51	11.04	18.65
Eu-152	1408.1	10.55	-10.37	13.06	49.16
	344.3				26.10
Eu-154	723.3	10.82	-7.47	12.68	44.55
	1004.8				50.20
	1274.5				31.32
Ru-106	621.8	27.57	-45.104	47.281	91.54
	1050.1				472.37

Pb-214 RER = $\frac{92.7 - 87.5}{19.3 + 18.5} = 0.14$

Cs-137 RER = $\frac{|-6.6 + 1.6|}{5.5 + 8.3} = 0.36$

CS 1-30-96

000136

96154977.0623

329294.XLS

Client	Bechtel	
Client ID	B0GZT0	
Filename	329294.CHN	
LAL parent ID	L6263-5	
Batch	6332929	
Live Time	10800	
Detector	2	LAS Detector 2, GMX-30200-P, Ser. No. 30-TN10348
Geometry	N	
Aliquot (gms/L)	0.5	
Count date	1/26/96 13:09	
Collection Date	1/22/96	
delta T to midpoint of count	4.6	days
Efficiency data file	N294	
Background, Library files	WBKG2026	whc

V94093

Nuclide	keV	halflife (days)	chnl	GROSS	BKG	NET	Hand Calc NET	Sample cnts/sec	1 sig % err
Ra-226	186.1	5.84E+05	372	239	76	163		0.015108	10.9
U-235	185.7	2.57E+11	372	239	76	163		0.015108	10.9
	143.8	2.57E+11	288	171	119	52		0.0048148	32.7
	163.3	2.57E+11	327	138	138	0		0	0.0
Pb-214(Ra-226)	351.9	5.84E+05	704	288	62	226		0.0209259	8.3
	295.1	5.84E+05	591	225	86	139		0.0128395	12.7
Fe-59	1099.2	4.51E+01	2198	14	20	-6		-0.00054	99.7
	1291.6	4.51E+01	2583	16	9	7		0.0006173	75.5
Co-58	810.8	7.08E+01	1622	27	18	10		0.0008796	70.2
Ac-228(Ra-228)	911.2	2.10E+03	1822	48	28	20		0.0018403	43.9
	969	2.10E+03	1938	24	26	-2		-0.000185	353.6
Pb-212	238.6	5.11E+12	478	208	110	99		0.0091204	18.1
	300.1	5.11E+12	600	66	70	-4		-0.00037	291.5
Co-60	1332.5	1924	2665	25	15	10		0.0009259	63.2
	1173.3	1924	2347	21	11	11		0.0009722	53.5
Cs-137	661.7	10950	1324	44	43	1		0.0001235	698.2
Eu-155	105.3	1810	211	134	137	-3		-0.000247	616.9
Eu-152	1408.1	4.64E+03	2816	21	12	9		0.0008642	61.2
	344.3	4.64E+03	689	67	71	-4		-0.000386	282.1
Eu-154	723.3	3.11E+03	1447	35	40	-5		-0.000432	185.2
	1004.8	3.11E+03	2009	13	21	-8		-0.000741	72.9
	1274.5	3.11E+03	2549	12	13	-1		-7.72E-05	598.0
Ru-106	621.8	368.2	1244	53	32	22		0.0019907	42.8
	1050.1	368.2	2100	20	15	5		0.0004475	122.7

96137 0524

329294.XLS

Client	Bechtel
Client ID	B0GZT0
Filename	329294.CHN
LAL parent ID	L6263-5
Batch	6332929
Live Time	10800
Detector	2
Geometry	N
Aliquot (gms/L)	0.5
Count date	1/26/96 13:09
Collection Date	1/22/96
delta T to midpoint of count	4.6
Efficiency data file	N294
Background, Library files	WBKG2026

Nuclide	keV	WBKG cnts/sec	1 sig % err	NET Sample cnts/sec	NET 1 sig % err	Efficiency	1 sigma % Eff err	Branch
Ra-226	186.1	0.013894	4.9	0.00121	191.67	0.055571	5	0.035
U-235	185.7	0.013894	4.9	0.00121	191.67	0.055656	5	0.575
	143.8	0.0033	18.3	0.00151	144.04	0.064542	5	0.109
	163.3	0.0011	51.1	-0.00110	51.07	0.060486	5	0.05
Pb-214(Ra-226)	351.9	0.002367	18.1	0.01856	11.64	0.032285	5	0.358
	295.1	0.001258	40.5	0.01158	18.51	0.03788	5	0.185
Fe-59	1099.2	-2.8E-05	762.9	-0.00054	99.71	0.012002	5	0.565
	1291.6	-0.00021	91.8	0.00062	75.50	0.010402	5	0.432
Co-58	810.8	0.000225	122.3	0.00065	136.38	0.01556	5	0.9945
Ac-228(Ra-228)	911.2	0.001658	17.6	0.00018	604.39	0.014097	5	0.266
	969	0.000367	76.9	-0.00055	67.57	0.013378	5	0.1617
Pb-212	238.6	0.006683	8.7	0.00244	91.56	0.045685	5	0.4365
	300.1	-0.00023	186.5	-0.00037	291.55	0.03731	5	0.03344
Co-60	1332.5	-0.00014	170.7	0.00093	63.25	0.01011	5	0.999
	1173.3	0.000158	146.0	0.00081	92.26	0.011335	5	0.999
Cs-137	661.7	0.000589	57.8	-0.00047	258.30	0.018483	5	0.8521
Eu-155	105.3	0.000333	165.1	-0.00058	167.70	0.068697	5	0.218
Eu-152	1408.1	0.000328	52.9	0.00054	130.99	0.009607	5	0.212
	344.3	0.00065	65.6	-0.00104	63.89	0.032933	5	0.27
Eu-154	723.3	-0.00043	70.7	-0.00043	185.16	0.017137	5	0.197
	1004.8	-2.5E-05	946.3	-0.00074	72.89	0.012969	5	0.176
	1274.5	-5.6E-05	338.5	-0.00008	598.00	0.010528	5	0.355
Ru-106	621.8	-0.00068	47.5	0.00199	42.76	0.019492	5	0.0981
	1050.1	0.000433	51.6	0.00001	5442.46	0.012487	5	0.0146

96134772.0525

329294.XLS

Client	Bechtel
Client ID	B0GZT0
Filename	329294.CHN
LAL parent ID	L6263-5
Batch	6332929
Live Time	10800
Detector	2
Geometry	N
Aliquot (gms/L)	0.5
Count date	1/26/96 13:09
Collection Date	1/22/96
delta T to midpoint of count	4.6
Efficiency data file	N294
Background, Library files	WBKG2026

Nuclide	keV	Bq	pCi/L	MDA pCi/L	Decay factor	Corrected pCi/L	error 1 sigma	Corrected MDA pCi/g
Ra-226	186.1	0.623952	33.69342	186.63	1.000005	33.69	64.60	186.63
U-235	185.7	0.037922	2.04779	11.34	1	2.048	3.93	11.34
	143.8	0.215323	11.62745	43.02	1	11.627	16.76	43.02
	163.3	-0.363723	-19.64105	98.60	1	-19.641	10.08	98.60
Pb-214(Ra-226)	351.9	1.605749	86.71045	20.00	1.000005	86.711	10.98	20.00
	295.1	1.652606	89.24074	35.10	1.000005	89.241	17.11	35.10
Fe-59	1099.2	-0.079651	-4.301145	17.15	1.07344	-4.617	4.61	18.41
	1291.6	0.137369	7.417935	16.73	1.07344	7.963	6.02	17.96
Co-58	810.8	0.042303	2.284375	7.58	1.046192	2.390	3.26	7.93
Ac-228(Ra-228)	911.2	0.048522	2.620163	45.68	1.001523	2.624	15.86	45.75
	969	-0.255102	-13.77553	65.09	1.001523	-13.797	9.35	65.19
Pb-212	238.6	0.122209	6.599308	16.39	1	6.599	6.05	16.39
	300.1	-0.296858	-16.03031	163.94	1	-16.030	46.74	163.94
Co-60	1332.5	0.091673	4.95032	9.79	1.001663	4.9586	3.15	9.81
	1173.3	0.071874	3.881222	8.37	1.001663	3.8877	3.59	8.38
Cs-137	661.7	-0.029552	-1.59583	11.20	1.000292	-1.5963	4.12	11.20
Eu-155	105.3	-0.038745	-2.092239	19.29	1.001767	-2.096	3.516	19.326
Eu-152	1408.1	0.263371	14.22202	51.17	1.000689	14.23	18.66	51.20
	344.3	-0.116489	-6.290412	24.64	1.000689	-6.29	4.03	24.66
Eu-154	723.3	-0.127989	-6.911426	44.75	1.00103	-6.92	12.82	44.79
	1004.8	-0.324512	-17.52366	52.31	1.00103	-17.54	12.82	52.37
	1274.5	-0.020645	-1.114833	25.38	1.00103	-1.12	6.67	25.41
Ru-106	621.8	1.04E+00	5.62E+01	6.68E+01	1.008718	56.7097	24.41	67.42
	1050.1	7.79E-02	4.21E+00	6.42E+02	1.008718	4.2420	230.87	648.08

9613477.0626

329294.XLS

Client	Bechtel
Client ID	B0GZT0
Filename	329294.CHN
LAL parent ID	L6263-5
Batch	6332929
Live Time	10800
Detector	2
Geometry	N
Aliquot (gms/L)	0.5
Count date	1/26/96 13:09
Collection Date	1/22/96
delta T to midpoint of count	4.6
Efficiency data file	N294
Background, Library files	WBKG2026

Nuclide	keV	Counting Error pCi/L	FINAL RESULT pCi/L	Total Error 2 sigma	MDA pCi/L
Ra-226	186.1	129.16	33.69	129.21	186.63
U-235	185.7	7.85	2.05	7.85	11.34
	143.8	10.91	-11.34	17.27	43.02
	163.3				98.60
Pb-214(Ra-226)	351.9	17.23	87.45	18.49	20.00
	295.1				35.10
Fe-59	1099.2	0.03	0.03	7.32	18.41
	1291.6				17.96
Co-58	810.8	6.52	2.39	6.52	7.93
Ac-228(Ra-228)	911.2	12.84	-9.56	16.11	45.75
	969				65.19
Pb-212	238.6	11.53	6.60	12.10	16.39
	300.1		-16.03	93.49	163.94
Co-60	1332.5	4.69	4.49	4.73	9.81
	1173.3				8.38
Cs-137	661.7	8.25	-1.60	8.25	11.20
Eu-155	105.3	7.03	-2.10	7.03	19.33
Eu-152	1408.1	6.18	-5.38	7.89	51.20
	344.3				24.66
Eu-154	723.3	6.77	-5.02	10.75	44.79
	1004.8				52.37
	1274.5				25.41
Ru-106	621.8	48.00	56.130	48.553	67.42
	1050.1				648.08

CS 1/30/96

96 1347 0627

00043

9613477.0528

EG&G ORTEC OMNIGAM (33) I3.02.27 30-JAN-96 10:09:01 Page 1
Spectrum name: 329291.CHN

Sample description
Bechtel B0GZT0 32929DUP1 06332929 N 0.5 1/22/96 CS

Spectrum Filename: 329291.CHN

Acquisition information
Start time 26-Jan-96 13:09:00
Live time 10800
Real time 10816
Dead time .15%
Detector/Geometry IDs 0 & 0

Detector system
LAS Detector 1, GMX-30200-P, Ser. No. 30-TN10223A

Calibration
Filename: 329291.CHN
Created: 26-Jan-96 13:09:00 &
MAESTRO calibration

Zero offset -.012 keV; Gain .500 keV/channel

Library not found or NULL library selected.

Analysis parameters
Start channel 50 for an energy of 24.99keV
Stop channel 3994 for an energy of 1997.07keV
Peak rejection level 50.000%
Activity scaling factor 1.0000E+00/ 1.0000E+00 = 1.0000E+00
Detection limit method:
MDA - EG&G ORTEC method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	YES	
Peaked background correction	NO	
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

PEAK CENTROID CHANNEL	ENERGY	BACKGROUND COUNTS	NET AREA COUNTS	INTENSITY CTS/SEC	UNCERT 1 SIGMA %	FWHM keV	SUSPECTED NUCLIDE	
49.73	24.86	870.	205.	.019	24.46	2.223	AM-241	s
93.13	46.56	301.	112.	.010	23.87	.979	PB-210	s
126.60	63.29	299.	183.	.017	15.27	.855	TH-234	

EG&G ORTEC OMNIGAM (33) I3.02.27 30-JAN-96 10:09:01 Page 2
Spectrum name: 329291.CHN

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
149.72	74.85	238.	52.	.005	36.19	.582	PB-214	s
153.91	76.94	259.	159.	.015	16.39	1.111	PB-214	s
174.72	87.35	199.	43.	.004	43.18	.966	PBKB	
185.16	92.57	360.	209.	.019	13.83	1.067	TH-234	s
288.45	144.22	167.	52.	.005	37.94	.578	RA-223	s
326.61	163.30	117.	41.	.004	42.84	.967	U-235	
371.67	185.83	158.	133.	.012	15.95	1.281	U-235	s
477.47	238.73	140.	73.	.007	23.61	.874	PB-212	
484.33	242.16	120.	63.	.006	27.50	1.029	PB-214	s
590.82	295.41	119.	147.	.014	13.83	1.041	PB-214	
703.92	351.96	118.	271.	.025	10.04	1.239	PB-214	
1022.09	511.05	103.	172.	.016	13.06	3.423	ANN-511	s
1218.88	609.45	81.	227.	.021	9.97	1.068	BI-214	s
1388.13	694.08	21.	25.	.002	40.18	1.174	CO-57	s
1536.06	768.05	44.	33.	.003	39.86	.885	BI-214	s
1828.94	914.49	10.	23.	.002	31.46	1.024	-	s
1936.85	968.45	20.	23.	.002	45.17	.799	AC-228	s
2240.84	1120.46	18.	46.	.004	21.22	.810	BI-214	s
2475.99	1238.03	17.	37.	.003	26.34	1.538	BI-214	s
2755.66	1377.88	23.	29.	.003	39.32	.730	BI-214	s
3527.45	1763.78	5.	41.	.004	21.15	1.453	BI-214	s

s Peak fails shape tests.

Analysis time .7 seconds.

9613477.0530

EG&G ORTEC OMNIGAM (33) I3.02.27 30-JAN-96 10:09:02 Page 1
Spectrum name: 329292.CHN

Sample description
Bechtel LCS 32929LCS1 06332929 N 0.5 04/02/91 LV

Spectrum Filename: 329292.CHN

Acquisition information
Start time 26-Jan-96 17:05:11
Live time 10800
Real time 10816
Dead time .15%
Detector/Geometry IDs 0 & 0

Detector system
LAS Detector 1, GMX-30200-P, Ser. No. 30-TN10223A

Calibration
Filename: 329292.CHN
Created: 26-Jan-96 17:05:11 &
MAESTRO calibration

Zero offset -.012 keV; Gain .500 keV/channel

Library not found or NULL library selected.

Analysis parameters
Start channel 50 for an energy of 24.99keV
Stop channel 3994 for an energy of 1997.07keV
Peak rejection level 50.000%
Activity scaling factor 1.0000E+00/ 1.0000E+00 = 1.0000E+00
Detection limit method:
MDA - EG&G ORTEC method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	YES	
Peaked background correction	NO	
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

PEAK CENTROID CHANNEL	ENERGY	BACKGROUND COUNTS	NET AREA COUNTS	INTENSITY CTS/SEC	UNCERT 1 SIGMA %	FWHM keV	SUSPECTED NUCLIDE	
50.60	25.29	1035.	167.	.015	28.26	1.259	AM-241	s
64.17	32.08	470.	79.	.007	35.54	.986	-	s
92.66	46.32	346.	129.	.012	22.19	.978	PB-210	s

9613477.0531

EG&G ORTEC OMNIGAM (33) I3.02.27 30-JAN-96 10:09:02 Page 2
Spectrum name: 329292.CHN

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
126.78	63.38	319.	214.	.020	15.26	.718	TH-234	
185.07	92.53	312.	219.	.020	14.07	1.014	TH-234	s
372.01	186.00	214.	126.	.012	17.98	1.151	RA-226	s
389.46	194.73	50.	19.	.002	43.26	.788	-	s
478.12	239.06	197.	70.	.006	36.94	.975	PB-212	
1023.24	511.63	137.	160.	.015	14.22	2.555	ANN-511	s
1166.28	583.15	94.	37.	.003	46.55	.911	TL-208	s
1323.87	661.95	110.	1169.	.108	3.31	1.581	CS-137	
2222.08	1111.07	55.	37.	.003	49.27	.761	AC-228	s
2346.86	1173.47	40.	557.	.052	5.15	1.848	CO-60	
2665.26	1332.67	18.	468.	.043	4.92	1.919	CO-60	

s Peak fails shape tests.

Analysis time .5 seconds.

9613477.0532

EG&G ORTEC OMNIGAM (33) I3.02.27 30-JAN-96 10:09:03 Page 1
Spectrum name: 329293.CHN

Sample description
Bechtel MBB 32929MBB1 06332929 N 0.5 1/26/96 LV

Spectrum Filename: 329293.CHN

Acquisition information
Start time 26-Jan-96 17:05:46
Live time 10800
Real time 10802
Dead time .02%
Detector/Geometry IDs 0 & 0

Detector system
LAS Detector 2, GMX-30200-P, Ser. No. 30-TN10348

Calibration
Filename: 329293.CHN
Created: 26-Jan-96 17:05:46 &
MAESTRO calibration

Zero offset .072 keV; Gain .500 keV/channel

Library not found or NULL library selected.

Analysis parameters
Start channel 50 for an energy of 25.08keV
Stop channel 3994 for an energy of 1997.54keV
Peak rejection level 50.000%
Activity scaling factor 1.0000E+00/ 1.0000E+00 = 1.0000E+00
Detection limit method:
MDA - EG&G ORTEC method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	YES	
Peaked background correction	NO	
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

PEAK CENTROID CHANNEL	ENERGY	BACKGROUND COUNTS	NET AREA COUNTS	INTENSITY CTS/SEC	UNCERT 1 SIGMA %	FWHM keV	SUSPECTED NUCLIDE	
47.81	23.98	53.	22.	.002	43.41	.846	-	s
92.87	46.52	241.	103.	.010	20.84	.549	PB-210	s
126.17	63.17	282.	134.	.012	19.72	.866	TH-234	

EG&G ORTEC OMNIGAM (33) I3.02.27 30-JAN-96 10:09:03 Page 2
Spectrum name: 329293.CHN

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
154.21	77.19	160.	48.	.004	39.61	.968	PB-214	s
184.82	92.51	256.	297.	.028	9.18	1.010	TH-234	s
370.96	185.59	143.	102.	.009	18.45	.850	U-235	
476.59	238.42	134.	57.	.005	31.87	.970	PB-212	
590.13	295.21	86.	45.	.004	35.53	1.024	PB-214	s
703.95	352.13	72.	30.	.003	49.67	1.303	PB-214	s
1022.01	511.20	122.	129.	.012	16.78	2.190	ANN-511	s
1165.86	583.14	33.	37.	.003	33.15	.699	TL-208	s
1218.06	609.24	55.	38.	.004	33.18	1.658	BI-214	s

s Peak fails shape tests.

Analysis time .4 seconds.

9613477.0534

EG&G ORTEC OMNIGAM (33) I3.02.27 30-JAN-96 10:09:03 Page 1
Spectrum name: 329294.CHN

Sample description
Bechtel BOGZTO L6263-5 06332929 N 0.5 1/22/96 CS

Spectrum Filename: 329294.CHN

Acquisition information
Start time 26-Jan-96 13:09:58
Live time 10800
Real time 10802
Dead time .02%
Detector/Geometry IDs 0 & 0

Detector system
LAS Detector 2, GMX-30200-P, Ser. No. 30-TN10348

Calibration
Filename: 329294.CHN
Created: 26-Jan-96 13:09:58 &
MAESTRO calibration

Zero offset .072 keV; Gain .500 keV/channel

Library not found or NULL library selected.

Analysis parameters
Start channel 50 for an energy of 25.08keV
Stop channel 3994 for an energy of 1997.54keV
Peak rejection level 50.000%
Activity scaling factor 1.0000E+00/ 1.0000E+00 = 1.0000E+00
Detection limit method:
MDA - EG&G ORTEC method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	YES	
Peaked background correction	NO	
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

PEAK CENTROID CHANNEL	ENERGY	BACKGROUND COUNTS	NET AREA COUNTS	INTENSITY CTS/SEC	UNCERT 1 SIGMA %	FWHM keV	SUSPECTED NUCLIDE	
48.13	24.14	82.	40.	.004	33.23	1.890	AM-241	s
92.85	46.51	269.	80.	.007	27.63	.585	PB-210	
125.97	63.07	345.	102.	.009	24.30	.746	TH-234	s

9613477.0535

EG&G ORTEC OMNIGAM (33) I3.02.27 30-JAN-96 10:09:03 Page 2
Spectrum name: 329294.CHN

Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM	Suspected	
149.47	74.82	231.	62.	.006	30.04	.758	PB-214	s
153.74	76.96	205.	183.	.017	13.32	.715	PB-214	s
185.03	92.61	314.	223.	.021	14.57	.900	TH-234	s
286.07	143.14	173.	39.	.004	49.69	.999	NP-237	s
371.02	185.62	168.	123.	.011	16.53	.930	U-235	
476.57	238.41	161.	78.	.007	25.76	.765	PB-212	
484.05	242.15	157.	52.	.005	39.17	.769	PB-214	s
590.00	295.14	99.	132.	.012	13.79	1.314	PB-214	s
703.20	351.75	137.	201.	.019	11.60	1.119	PB-214	
1021.36	510.87	146.	108.	.010	21.54	1.223	TL-208	s
1165.78	583.10	38.	27.	.002	40.91	.676	TL-208	s
1218.20	609.32	44.	234.	.022	7.91	1.436	BI-214	s
1534.21	767.36	26.	35.	.003	34.22	1.621	PA-234M	s
2240.18	1120.42	27.	39.	.004	31.31	1.417	BI-214	
2476.22	1238.47	14.	16.	.001	41.31	.627	CO-56	s
3526.86	1763.91	6.	33.	.003	25.02	1.307	BI-214	s

s Peak fails shape tests.

Analysis time .5 seconds.

9613477.0536

AA0015

Diluted to 100

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

Calibration Certificate

Description

Principal radionuclide: Cobalt-60 Half-life: 5.271 years

Nominal activity: 110 nano curies

Nominal volume: 5 ml in ampoule/bottle number 2506-2

Measurement Activity of principal radionuclide

Activity per gram of this solution

22.2 nano curies of Cobalt-60

at 0400 hours PST on April 2, 1991

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 was measured using an ionization chamber.

The activity of the dilution was measured using gamma spectroscopy.

Useful Life

This radionuclide has decayed through 0.6 half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after January 2000

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 stated	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 ± 0.42 %

(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

+2.1 % or -2.1 %

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 +3.5 %, -3.5 % 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).

Cobalt-60 decays 100 percent by beta emission followed by prompt gamma transition.

Chemical Composition of Solution

Carrier content per gram of solution:	Other components:
30 micrograms cobalt	0.1 M HCl

Preservative:

Remarks

Date Certificate Prepared May 31, 1991

Approval Signature Paul B. Hahn

Revised 1/84

CERTIFICATE OF CALIBRATION
GAMMA STANDARD SOLUTION

Radionuclide	Cs-137	Customer:	LOCKHEED ENGINEERING & SCIENCES Co.
Half Life:	30.0 ± 0.2 years	P.O.No.:	06LAB1036
Catalog No.:	7137	Reference Date:	September 1 1991 12:00 PST.
Source No.:	389-21-2	Contained Radioactivity:	1.002 µCi.

Description of Solution

a. Mass of solution: 4.9523 grams.

b. Chemical form: CsCl in 0.1N HCl

c. Carrier content: None added

d. Density: 0.9996 gram/ml @ 20°C.

Radioimpurities

None detected

Radioactive Daughters

None

Radionuclide Concentration

0.202 µCi/gram.

Method of Calibration

Weighed aliquots of the solution were assayed using gamma spectrometry:

Energy peak(s) integrated under: 662 KeV.

Branching ratio(s) used: 0.8521 gamma rays per decay.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration: ±1.0%

b. Random uncertainty in assay: ±1.1%

c. Random uncertainty in weighing(s): ±0.4%

d. Total uncertainty at the 99% confidence level: ±2.5%

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

CERT # Parent Ref #	Calibration Cert Date	Expiration Date	Reference #	VENDOR	prep INITIALS	witnessed Initials
SRM 389-21-21	Sept 1, 1991	10-4-93	SRM 389-21-281 91-0199-41	IPL		

ITEM #	Preparation Date	Final concentration	Initial concentration
3	10-4-91	975.1348	975.1348 pCi/ml

11-14-9

Continued on Page

Transferred 11-14-91 AP

Read and Understood By

Signed 11/14/91 Date Signed 12/4/9 Date

Cur # / Prev Ref #	Cert Date	Exp Date	Ref #	Vendor	Prep ID	Initials
EH2-LV # CPH 2506-2	April 2, 1991	January 2000	91-0225-804	US EPA	[illegible]	

Item #	Prep. Date	Final Conc.	Initial Conc	Bar Code
1	8/4/92	1091.1 Pci/ml	109,110.78 in Ampule Pci/only	A10025

Transferred the contents the ampoule to a preweighed 100 ml volumetric flask, reweighed, recorded the mass (g) of the solution, results are following:

Gross weight (g)	67.3178
Tare weight (g)	62.4029
Net (g)	4.9149

The solution is 0.1 M HCl with 30 Mg/g of carrier carrier.

Activity concentration of the original solution: 22,200 nano Curie/g on 29, 2000 Pci/g.
Total Activity transferred to 100.0 ml V.F.:

22,200 Pci/g × 4.9149 g ⇒ 109,110.78 Pci

Activity conc. (Pci/ml) of the solution in vol. flask:

109,110.78 Pci : 100 ml ⇒ 1091.1 Pci/ml

Convert to Bq/ml:

$\frac{1091.1 \text{ Pci/ml}}{27.027 \text{ Pci/Bq}}$ ⇒ 40.370 Bq/ml

Note:
T1/2 ⇒ 5.271 years
Cal. Date: April 2, 1991

The concentration the 100 ml V.F. was transferred to plastic bottle, labelled and sent to Standards Storeroom.

[illegible] 8/4/92

Continued on Page

Read and Understood By

000162

Signed	Date	Signed	Date
[illegible]	8/4/92	[illegible]	8/10/92

PROJECT Spec 96134375 Co-60 Continued From Page

Agnes 4-9-93

ISOTOPES DILUTION RECORD

Secondary/Working Level Dilution

10 ml volume (aqueous) in 60 ml poly bottle AC3409

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

Pipet Check / Balance Wt. Check Done (✓)

Diluent used: 0.1 M HCl

I. Isotope #1: Cs-137 ⟹ 195 pCi ^{137}Cs 7-1-91

Diluted Source ID (log#): 91-225-24-3

A: Source activity: 940.831 pCi/ml decay corrected from 975.1348 pCi/ml

B: Amount of source transferred: 0.2 ml

C: Total amount of dilution: 10 ml

D: Isotope activity (A*B/C): 188.1662 pCi/ml ⟹ 197 pCi 4-2-91

II. Isotope #2: Co-60

Diluted Source ID (log#): 91-225-80-1

E: Source activity: 998.1087 pCi/ml

F: Amount of source transferred: 0.2 ml

G: Total amount of dilution: 10 ml ⟹ 218 pCi 4-2-91

H: Isotope activity (E*F/G): 199.6217 pCi/ml decay corrected from 1091.1 pCi/ml

* Dilution Log Book ID: 92-353-79

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

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
Agnes Wong	4-9-93	[illegible]	4/9/93

Prepared LCS using 0.5 N HCL — Added 499 ml to 1 liter marinelli
pipetted 1.000 ml of ^{60}Co ^{137}Cs mixed standard (barcode no. A121VZ) ref. 92-353-79 (Lab logbook)
188.1 pCi/ml ^{60}Co on 4-8-93
used 1000λ pipette no. #71008 (lab 155)

Calibrated activities at 4-1-91 ^{137}Cs = 197 pCi
^{60}Co = 218 pCi

USE FOR GAMMA LCS

JES 4-13-94

^{238}U 200g/200 ml Tuna Can ^{238}U **LCS-1**

= 3.402 pCi/gm @ 200.09ms

Tuna Can AC2007 200.09ms/round full

R-0526-67-1

U.S. Department of Energy
New Brunswick Laboratory

New Brunswick Laboratory
Certified Reference Materials
Certificate of Analysis

CRM 105-A

Pitchblende Ore - Silica Mixture
(Uranium Standard)

COMBINATION OF 4-509 CONTAINERS

Uranium ..... 0.00102, ± 0.00002, Wt.%
(α = 0.05, df = 28)

*(Radium (calculated) ..... 3.52 × 10⁻¹⁰ Wt.%)

This reference material was prepared by milling and blending NBL CRM 6-A Pitchblende Ore (67.91 ± 0.05 Wt.% U_3O_8) with silica (99.9% SiO_2) to obtain a uniform mixture of desired uranium concentration. Characterization and certification analyses for uranium content were performed on ten (10) units selected from the packaged final product.

The certified value listed above is expressed in terms of 95% confidence limits, defined as $\bar{X} \pm t_{95}s$, where $\bar{X}$ is the pooled mean of the measurement data, s_p is the pooled standard deviation of the pooled mean, and t is the Student's t value for the indicated degrees of freedom (df) and at the 5% significance level (α).

REFERENCE METHODS OF ANALYSIS: Spectrophotometry verified with NBL Uranium Oxide (U_3O_8) and Fluorimetry verified with NBL CRM 112-A Uranium Metal.

*Calculation is based on the radium/uranium ratio of 3.44 × 10⁻⁷g Ra/g U for NBL CRM 6-A Pitchblende Ore.

$^{238}U \Rightarrow .7410$ dpm ^{238}U = 1 μg Nat U

$\frac{.741 \text{ dpm } ^{238}U}{1 \text{ m Nat } U} * \frac{10^6 \text{ μm Nat U}}{1 \text{ g Nat U}} * \frac{.0001023 \text{ g Nat U}}{1 \text{ g - pitchblende}} = 7.558$ dpm/g ^{238}U

$* \frac{1 \text{ pCi}}{2.22 \text{ dpm}} = 3.402$ pCi/g ^{238}U

February 1981
Argonne, Illinois

Carleton D. Bingham
Director

$\frac{3.5 \times 10^{-9} \text{ μCi Unshielded}}{1 \text{ M} \times 10^{-3} \text{ μCi}} \times 4$

total Unshielded ^{238}U = 1513 dpm = 25.4 dpm = 11.4 pCi

4-18-94

AC 4401

4-18-94

4-18-94 Date — Signed — Date

000164

Blue

LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION LOG FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Date Prep Started : 2/12/96
Workgroup Number : GR ALP/BETA LAL-0060_32664

Matrix : Water
Prep Due Date : 02/14/96

CLIENT SAMPLE ID	LAL ID		QC	CHILD LAL ID	pH <2	ALQT VOL (L)	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	* * *	SAMPLE WEIGHT (grams)	COMMENTS
I6263-5	32664DUP1	1	DUP1	32664-01	2	.250	8.6073	8.6868			
Lab Ctrl Sample	32664LCS1	2	LCS1	32664-02	↓	↓	8.5861	8.6261			
Method Blank	32664MBB	3	MBB1	32664-03	↓	↓	8.4899	8.4899			
I6263-5	32664MS1	4	MS1	32664-04	↓	↓	8.4598	8.5389			
B0GZS8	L6230-5	5		32664-05	↓	↓	8.7209	8.7978			
B0GZT0	L6263-5	6	SMP1,M	32664-06	✓	✓	8.7107	8.7922			
		7									
		8									
		9									
		10									
		11									
		12									
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		24									

LCS Volume & RefDate	10mL	8/1/90	MS Volume & RefDate	1.0mL	1/5/96	Prep Anlst	GD
LCS Nuclide	Am-241	Sr-90	MS Nuclide	Am-241	Sr-90	Start Date	2/12/96
LCS Activity	9.81 pCi/mL	12.0 pCi/mL	MS Activity	8.40 pCi/mL	8.37 pCi/mL	Count Anlst	
LCS ID #	95-721-13-1		MS ID #	94-671-93-1			

Balance Number : 40020046 ( )
( )

Pipette Number : 71008 ( )
( )

LCS added by: GD
Witnessed by : [illegible]

Comments :

Analyst : [signature] Checked by: [signature] 2-13-96 Cnt Rm Custody\Date : CS 2/13/96

V95224

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LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION LOG FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Date Prep Started : 2/12/96
Workgroup Number : GR ALP/BETA LAL-0060_32664

Matrix : Water
Prep Due Date : 02/14/96

CLIENT SAMPLE ID	LAL ID		QC	CHILD LAL ID	pH <2	ALQT VOL (L)	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	* * *	SAMPLE WEIGHT (grams)	COMMENTS
I6263-5	32664DUP1	1	DUP1	32664-01	2	0.250	8.6073	8.6868		0.0795	
Lab Ctrl Sample	32664LCS1	2	LCS1	32664-02	2	0.250	8.5861	8.6261		0.0400	
Method Blank	32664MBB	3	MBB1	32664-03	2	0.250	8.4899	8.4899		0.0000	
I6263-5	32664MS1	4	MS1	32664-04	2	0.250	8.4598	8.5389		0.0791	
B0GZS8	L6230-5	5		32664-05	2	0.250	8.7209	8.7978		0.0769	
B0GZT0	L6263-5	6	SMP1,M	32664-06	2	0.250	8.7107	8.7922		0.0815	
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		10									
		11									
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		13									
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		18									
		19									
		20									
		21									
		22									
		23									
		24									

LCS Volume & RefDate	1.0 mL; 08/01/90		MS Volume & RefDate	1.0 mL; 01/05/96		Prep Anlst	CD
LCS Nuclide	Am-241	Sr-90	MS Nuclide	Am-241	Sr-90	Start Date	2/12/96
LCS Activity	9.8 pCi/mL	12.0 pCi/mL	MS Activity	8.4 pCi/mL	8.4 pCi/mL	Count Anlst	
LCS ID #	95-721-13-1		MS ID #	94-677-93-1			

Balance Number : 40020046 ( )
( )

Pipette Number : 71008 ( )
( )

LCS added by: CD
Witnessed by : RB

Comments :

Analyst

Checked by: 7-13-96

V95224

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LOCKHEED ANALYTICAL LABORATORY

ALPHA ACTIVITY CALCULATIONS FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Workgroup No: GR ALP/BETA LAL-0060_32664

PARENT LAL ID	DET	PLANCHET LAL ID	CTIME (min)	COUNTS ALPHA	COUNTS ALPHA BKG	EFF ALPHA	Bkg Corr ACTIVITY pCi/L	CNT ERR 2 SIGMA pCi/L	TTL ERR 2 SIGMA pCi/L	LLD ALPHA pCi/L	MDA ALPHA pCi/L	FLAGS	COUNT DATE
32664DUP1	LB1-D3	32664-01	100	20	13.6	0.106	1.09	1.94	1.94	2.93	3.39	DUP1 C	02/13/96
32664LCS1	LB1-D1	32664-02	100	362	6.9	0.149	42.99	4.56	5.04	1.47	1.80	LCS1	02/13/96
32664MBB	LB1-A1	32664-03	100	9	6.6	0.218	0.20	0.64	0.64	0.99	1.22	MBB1	02/13/96
32664MS1	LB1-A2	32664-04	100	242	6.2	0.110	38.60	5.05	5.41	1.89	2.33	MS1	02/13/96
L6230-5	LB1-A3	32664-05	100	20	7.2	0.113	2.04	1.62	1.63	1.98	2.41		02/13/96
L6263-5	LB1-A4	32664-06	100	13	6.9	0.110	1.01	1.43	1.43	2.00	2.44	SMP1,MS	02/13/96

Comments : 32664LCS1 Alpha LCS Recovery = 43.0/38.9 = 110.5 %. 32664MS1 Alpha MS1 Recovery = 37.6/33.6 = 111.9 %.
L6263-5, 32664DUP1 RPD = 7.5 %, RER = 0.02

MBB = 0.20 pCi/L => less than RDL(HAMDC).

V95224

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Date Completed : 2-13-96

Anlst Signature : Sya Valdez

Checked by : [illegible]

LOCKHEED ANALYTICAL LABORATORY

BETA ACTIVITY CALCULATIONS FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Workgroup No: GR ALP/BETA LAL-0060_32664

PARENT LAL ID	DET	PLANCHET LAL ID	CTIME (min)	COUNTS BETA	COUNTS BETA BKG	EFF BETA	A>>B XTALK Factor	Bkg Corr ACTIVITY pCi/L	CNT ERR 2 SIGMA pCi/L	TTL ERR 2 SIGMA pCi/L	LLD BETA pCi/L	MDA BETA pCi/L	FLAGS	COUNT DATE
32664DUP1	LB1-D3	32664-01	100	222	112.2	0.405	0.260	4.81	1.59	1.61	2.19	2.31	DUP1	02/13/96
32664LCS1	LB1-D1	32664-02	100	1166	106.1	0.420	0.250	41.65	3.00	3.65	2.05	2.17	LCS1	02/13/96
32664MBB	LB1-A1	32664-03	100	124	103.7	0.430	0.258	0.83	1.24	1.24	1.98	2.10	MBB1	02/13/96
32664MS1	LB1-A2	32664-04	100	1020	101.2	0.408	0.260	37.85	2.90	3.46	2.06	2.18	MS1	02/13/96
L6230-5	LB1-A3	32664-05	100	228	102.3	0.419	0.259	5.25	1.53	1.55	2.02	2.14		02/13/96
L6263-5	LB1-A4	32664-06	100	205	101.0	0.414	0.261	4.46	1.49	1.51	2.03	2.15	SMP1,MS	02/13/96

Comments : 32664LCS1 Beta LCS Recovery = 41.6/42.1 = 99.0 %. 32664MS1 Beta MS1 Recovery = 33.4/33.4 = 100.0 %.
L6263-5, 32664DUP1 RPD = 7.6 %, RER = 0.11

MBB = 0.85 pCi/L => less than RDL(HAMDC).

V95224

Date Completed : 2-13-96
Anlst Signature : [signature]

Checked by : [signature]

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LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION LOG FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Date Prep Started : 2/15/96
Workgroup Number : GR ALP/BETA LAL-0060_33771

Repeat

Matrix : Water
Prep Due Date : 02/16/96

CLIENT SAMPLE ID	LAL ID		QC	CHILD LAL ID	pH <2	ALQT VOL (L)	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	* * *	SAMPLE WEIGHT (grams)	COMMENTS
Lab Ctrl Sample	33771LCS1	1	LCS1	33771-01	2	.250	8.6398	8.6797			
Method Blank	33771MBB	2	MBB1	33771-02	↓	↓	8.6760	8.6760			
B0GZS8	L6230-5	3		33771-03	↓	↓	8.5893	8.6625			
		4									
		5									
		6									
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LCS Volume & RefDate	1.0mL	8/1/90	MS Volume & RefDate		Prep Anlst	
LCS Nuclide	Am-241	Sr-90	MS Nuclide		Start Date	2/15/96
LCS Activity	9.81 pCi/mL	12.0 pCi/mL	MS Activity		Count Anlst	
LCS ID #	95-721-13-1		MS ID #			

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

Comments : Use bottle L6230-7

Analyst
Checked by: SV
Cnt Rm Custody\Date : SV 2-15-96

V95224

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LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION LOG FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Date Prep Started : 2/15/96
Workgroup Number : GR ALP/BETA LAL-0060_33771

Matrix : Water
Prep Due Date : 02/16/96

CLIENT SAMPLE ID	LAL ID		QC	CHILD LAL ID	pH <2	ALQT VOL (L)	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	* * *	SAMPLE WEIGHT (grams)	COMMENTS
Lab Ctrl Sample	33771LCS1	1	LCS1	33771-01	2	0.250	8.6398	8.6797		0.0399	
Method Blank	33771MBB	2	MBB1	33771-02	2	0.250	8.6760	8.6760		0.0000	
B0GZS8	L6230-5	3		33771-03	2	0.250	8.5893	8.6625		0.0732	
		4									
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		23									
		24									

LCS Volume & RefDate	1.0 mL; 08/01/90		MS Volume & RefDate		Prep Anlst	CD
LCS Nuclide	Am-241	Sr-90	MS Nuclide		Start Date	2/15/96
LCS Activity	9.8 pCi/mL	12.0 pCi/mL	MS Activity		Count Anlst	
LCS ID #	95-721-13-1		MS ID #			

Balance Number : 40020046 ( )
( )

Pipette Number : 71008 ( )
( )

LCS added by: CD
Witnessed by : TO

Comments :

Analyst : [signature] Checked by: [signature]

V95224

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LOCKHEED ANALYTICAL LABORATORY

ALPHA ACTIVITY CALCULATIONS FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Workgroup No: GR ALP/BETA LAL-0060_33771

PARENT LAL ID	DET	PLANCHET LAL ID	CTIME (min)	COUNTS ALPHA	COUNTS ALPHA BKG	EFF ALPHA	Bkg Corr ACTIVITY pCi/L	CNT ERR 2 SIGMA pCi/L	TTL ERR 2 SIGMA pCi/L	LLD ALPHA pCi/L	MDA ALPHA pCi/L	FLAGS	COUNT DATE
33771LCS1	LB1-B1	33771-01	100	381	6.6	0.150	45.01	4.64	5.16	1.44	1.76	LCS1	02/15/96
33771MBB	LB1-B2	33771-02	100	7	10.7	0.223	-0.30	0.66	0.66	1.23	1.44	MBB1	02/15/96
L6230-5	LB1-B3	33771-03	100	22	7.3	0.116	2.29	1.65	1.66	1.96	2.39	C	02/15/96

Comments : 33771LCS1 Alpha LCS Recovery = 45.0/38.9 = 115.7 %.

MBB = -0.30 pCi/L => less than RDL(HAMDC).

V95224

Date Completed : 2-15-96

Anlst Signature : [signature]

Checked by : [signature]

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LOCKHEED ANALYTICAL LABORATORY

BETA ACTIVITY CALCULATIONS FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Workgroup No: GR ALP/BETA LAL-0060_33771

PARENT LAL ID	DET	PLANCHET LAL ID	CTIME (min)	COUNTS BETA	COUNTS BETA BKG	EFF BETA	A>>B XTALK Factor	Bkg Corr ACTIVITY pCi/L	CNT ERR 2 SIGMA pCi/L	TTL ERR 2 SIGMA pCi/L	LLD BETA pCi/L	MDA BETA pCi/L	FLAGS	COUNT DATE
33771LCS1	LB1-B1	33771-01	100	1194	107.1	0.417	0.250	42.94	3.06	3.74	2.08	2.20	LCS1	02/15/96
33771MBB	LB1-B2	33771-02	100	92	99.8	0.435	0.258	-0.28	1.12	1.12	1.92	2.04	MBB1	02/15/96
L6230-5	LB1-B3	33771-03	100	207	107.6	0.421	0.257	4.10	1.49	1.50	2.07	2.18		02/15/96

Comments : 33771LCS1 Beta LCS Recovery = 42.9/42.1 = 102.1 %.

MBB = -0.32 pCi/L => less than RDL(HAMDC).

V95224

Date Completed : 2-15-96

Anlst Signature : [signature]

Checked by : [signature]

96154725 0590

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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

CERTIFICATE OF CALIBRATION
BETA STANDARD SOLUTION

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

Description of Solution

a. Mass of solution: 5.0012 grams.
b. Chemical form: SrCl2 in 0.1N HCl
c. Carrier content: None added
d. Density: 0.9996 gram/ml @ 20°C.

Radioimpurities

None (Y-90 daughter in equilibrium)

Radioactive Daughters

Y-90 daughter in equilibrium

Radionuclide Concentration

0.203 µCi/gram.

Method of Calibration

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

Uncertainty of Measurement

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

NIST Traceability

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

Notes

1. Nuclear data were taken from "Table of Isotopes", Seventh Edition, edited by Virginia S. Shirley.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay(and later NIST certification) of Standard Reference Materials. (As in NRC Regulatory Guide 4.15)

Gary A Gilmore
QUALITY CONTROL

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

9613477.0553

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

Isotope:	Am-241 (432.7 yr) & Sr/Y 90 (29.1 yr) MS
Parent ~~Barcode~~ Logbook Number	92-353-81-1 & 94-0677-92-1
Vendor or Certificate I.D. # of Parent Standard:	
Diluted Source Logbook I.D. #:	SEE ABOVE
Balance Verification?:	Yes
Diluent Used:	1 M HNO3

Dilution

*Diluent:	1 M HNO3 + 10 ml Sr Carrier (10 mg/ml)		
*Density of diluent (g/ml):	1.0290		g/ml
a: Parent Specific Activity:	Am-241: 1002.4	Sr/Y-90 *: 1000.2	pCi/g @ 1/5/96
b: Amount of Source Transferred:	4.070	4.065	g
c: Total amount of Dilution:	500.01		g
d: Total Volume of Dilution:	514.5		ml
e: Activity of Dilution [a * b / c]:	Am-241: 8.16	Sr/Y-90: 8.13	pCi/g @ 1/5/96
f: Activity of Dilution (a * b / d):	8.40	8.37	pCi/ml

Dilution Logbook I.D. #: 94-0677-93-1

* Sr/Y-90 in equilibrium. Activity reported = known Sr 90 activity * 2.

Prepared By: [signature] Preparation Date: 1/5/96

Reviewed By: Joe Hutchinson Review Date: 1/5/96

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

Page

Read and Understood By

Signed	Date	Signed	Date

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9613477.0554

INITIAL STANDARD DILUTION RECORD

Standard Information:

Isotope:	Sr-90	Vendor:	IPL
Activity of Standard Received:	~~5.001~~ 1.018 uCi	Vendor I.D. #	—
Weight of Standard Received (g):	5.0012 g	LAL I.D. #:	AAØØ49
Standard Activity (pCi/g):	2.036E5 pCi/g	NIST Traceable ?	Yes
Halflife in Years or Days:	29.1 yrs	Certificate #:	388-99-2
Reference Date:	11/1/91	Receiver's Name:	FREE
		Date Received:	12/91

Primary Dilution

Balance Verification?:	Yes	
Diluent Used:	1 M HNO_3	(1.0290 g/ml)
a: Decay Corrected Standard Activity (pCi/g):	1.844 E5	pCi/g @ 1/5/96
b: Weight of the Source Transferred (g):	4.949	g
c: Total diluted weight (g):	100.01	g
d: Total Diluted Volume (mL)	97.19	mL
e: Activity of Dilution by Weight (pCi/g) [a * b / c]:	9125.0	pCi/g @ 1/5/96
f: Calculated Density of Solution (g/ml) [c / d]:	~~9389.8~~ 1.0290	g/mL
g: Activity of Dilution by Volume (pCi/mL) [e * f]:	9389.8	pCi/mL
h. Dilution Logbook I.D. #:	94-0677-91-1	

Prepared By: [signature] Preparation Date: 1/5/96

Reviewed By: Joe Hutchison Review Date: 1/5/96

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

Signed	Date	Signed	Date

000178

9613477 0655

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

Isotope:	Sr-90
Parent Barcode Number	AA0049
Vendor or Certificate I.D. # of Parent Standard:	~~94-0677-91-1~~ 388-99-2
Diluted Source Logbook I.D. #:	94-0677-91-1
Balance Verification?:	Yes
Diluent Used:	1.0 M HNO_3

Dilution

*Diluent:	1.0 M HNO_3	
*Density of diluent (g/ml):	1.0290	g/ml
a: Parent Specific Activity:	9125.0	pCi/g @ 1/5/96
b: Amount of Source Transferred:	6.012	g
c: Total amount of Dilution:	109.70	g
d: Total Volume of Dilution:	106.61	ml
e: Activity of Dilution [a * b / c]:	500.09	pCi/g 1/5/96
f: Activity of Dilution (a * b / d):	514.6	pCi/ml
Dilution Logbook I.D. #:	94-0677-92-1	

Prepared By: [signature] Preparation Date: 1/5/96

Reviewed By: Joe Hutchison Review Date: 1/5/96

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

Read and Understood By

Signed	Date	Signed	Date

000179

Cert # / Pur# Ref.	Calib. Cert. Date	Exp. Date	Ref #	Vendor	Prep In	Witness In
388-100-1	Nov 1, 1991	5/6/94	91-0225-641	IPL	JH	[illegible]

Item #	Preparation Date	Final Conc	Initial Conc	Bar Code
1	5/6/92	9,800 pCi/g	0.9976 uCi/g ~~0.1994 uCi/g~~	AA0030

The entire standard was transferred to a 100-mL volumetric V.F. and the ~~sample~~ std was diluted to 100mL with 0.5N HCl.

68.4902
63.5665 g wt. V.F
4.9237 g std

164.01 g std + dilution
63.57 g V.F.
100.44 g diluted std

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

Density 0.5N HCl = 1.003598 g/ml ⇒ 0.0897748 uCi/g × 1.003598 g/ml
= 0.0098 uCi/g = 0.009810 uCi/g
or = 9,800 pCi/g = 9810 pCi/ml

Continued on Page

Read and Understood By

000180

Joe Hutchison 5/1/92 Signed Date

J [illegible] Signed 7/13/92 Date

PROJECT FUM-LT1/613497.0057 Filter & LCS Continued From Page _____

ISOTOPE DILUTION RECORD

Isotope: Am-241

Agn 4-9-93

Secondary/Working Level Dilution

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

Pipet Check / Balance Wt. Check Done (✓)

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

Diluent used: 0.5 N HCl

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

B: Amount of source transferred: 10.3235 g

C: Total amount of dilution: 100.1029 g

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

E: Density of Diluent: 1.0010 g/ml

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

Dilution Log Book ID: ~~92-335~~ RW 92-353-81-1

Reviewed by: EJ Date: 4/9/93

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

Prepared by Nee Van Nuyen 5/10/93 — Cut Whatman Glass Microfiber filter paper (originally 3" dia.) to 1.6" dia — Pipetted on filter

^{137}Cs	AC-0199-	0.200 ml	* 975.18 pCi/ml = 195.0 pCi	(≡ 197.8 pCi 4-2-91)
^{60}Co	AC-0225-80-1	0.200 ml	* 990.11 pCi/ml (990.3 Bq/ml) = 199.6 pCi	(≡ 259.1 pCi 4-2-91)

(same pipette amounts as p.80K)

Continued on Page N/A

Read and Understood By

Signed: Agnes Wong Date: 4-9-93

Signed: Jack S. Schatt Date: 5-18-93

PROJECT Gross Alpha/Beta 0613477.0256 J

Continued From Page _____

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

Isotope: Am-241 and Sr-90

Parent Barcode Number: AA0030 (Am-241) AA0046 (Sr-90)

Vendor or Certificate I.D. # of Parent Standard: IPL 388-100-1 (Am-241) NIST SRM 4919G (Sr-90)

Diluted Source Logbook I.D. #: 91-0225-60-1 (Am-241) 91-0225-30-2 (Sr-90)

Balance Verification?: Yes

Diluent Used: 0.1 N HNO_3

Dilution

*Diluent: 0.1 N HNO_3 + 42 mg $Sr(NO_3)_2$/mL

*Density of diluent (g/ml): NA

a: Parent Specific Activity: 9810 pCi/mL (Am-241) 6001 pCi/mL (Sr-90) on 8/1/90

b: Amount of Source Transferred: 0.5 mL (Am-241) 0.5 ~~g~~ mL (Sr-90)

c: Total amount of Dilution: 500 ~~g~~ mL

d: Total Volume of Dilution: 500 mL

e: Activity of Dilution [a * b / c]: NA

f: Activity of Dilution (a * b / d): 9.81 pCi/mL (Am-241) 12 pCi/mL (Sr-90) on 8/1/90

Dilution Logbook I.D. #: 95-721-13-1

Prepared By: Joe Hutchinson Preparation Date: 8/23/95

Reviewed By: [illegible] Review Date: 8/24/95

*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

Signed	Date	Signed	Date

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 A. Gilmore
QUALITY CONTROL

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

Cert # / Pur II Ref.	Calib. Cert. Date	Exp. Date	Ref. #	Vendor	Prep In	Witness In
388-100-1	Nov 1, 1991	5/6/94	91-0225-641	IPL	JH	[illegible]

Item #	Preparation Date	Final Conc	Initial Conc	Bar Code
1	5/6/92	9,800 pCi/g	0.9976 uCi/g in 5 g 0.1994 uCi/g	AA0030

The entire standard was transferred to a 100-mL volumetric V.F. and the "tight" was diluted to 100mL with 0.5N HCl.

68.4902
63.5665 g wt. V.F
4.9237 g std

164.01 g std + dilution
63.57 g V.F.
100.44 g diluted std

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

Density 0.5N HCl = 1.003598 g/mL ⇒ 0.0097748 uCi/g × 1.003598 g/mL
= 0.0098 uCi/g = 0.009810 uCi/g
or = 9,800 pCi/g = 9810 pCi/mL

Continued on Page

Read and Understood By

000184

Joe Hutchison 5/6/92 Signed Date

J. [illegible] 7/13/92 Signed Date

9613477.0561 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	4.514×10^9 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

000185

CERT # / Parent Ref #	Calibration Cert Date	Expiration Date	Reference #	VENDOR	PREP INITIALS	WITNESS INITIALS
SRM # 4919-6	1200 Aug 1, 1990	10-2-93	SRM #4919-6-A 91-0199-63	NIST		

ITEM #	Preparation Date	Final Concentration	Initial Concentration
1	10-2-91 ~~1200 EST~~ ~~Aug 1, 1990~~	12-7-91 ~~600,068.5999~~ 6000.685 Bq/g	4.514×10^3 Bq-1

9/10/91

Radionuclide : SR-90

Source # 4919-6

Source description Solution in NIST Borosilicate glass ampule

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

Mass approximately 5.0 grams

Radioactivity conc 4.514×10^3 Bq^{-1}

Reference Time : 1200 EST Aug. 1, 1990

T1/2 = 28.5 ±0.2 years

10/2/91 Preparation

1/ weighing 100.0 ml V.F + Standard of SR-90 in ampule = 65.2000

100.0 ml V.F. (empty) (g) = 60.2814

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

2/ Calculations :

4.514×10^3 Bq/g $\times$ 4.9186 = 22,202.5604 Bq

22,202.5604 Bq $\times$ 27.027 Pci/Bq = 600,068.5999 Pci

(STD date Aug 1, 1990) Continued on Page

Transferred 11-19-91 Paul Fabbitt

(Referenced from LAL 06 0199 pg 63)

Read and Understood By

000186

Signed 11/19/91 Date Signed 12/4/91 Date

LOCKHEED ANALYTICAL LABORATORY

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

Date Prep Started : 2-8-96 Matrix : Water

WorkGroup : SR-90 LAL-0196 32666 Prep Due Date : 02/14/96

CUSTOMER ID	PARENT LAL ID	NO	QC	CHILD LAL ID	ALIQUOT VOLUME (g or L)	SR CARRIER (mL)	YTTRIUM SEP DATE	YTTRIUM SEP TIME	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	*	RESIDUE WEIGHT (grams)	COMMENTS
L6230-5	32666DUP1	1	DUP1	32666-01	495ml	0.5	2-12-96	2:57pm	6.48458	6.49127			
Lab Ctrl Sample	32666LCS1	2	LCS1	32666-02				2:55pm	6.89336	6.90098			
Method Blank	32666MBB	3	MBB1	32666-03				2:57pm	6.81363	6.82086			
B0GZS8	L6230-5	4	SMP1	32666-04	495ml			3:00pm	6.79267	6.80017			
B0GZT0	L6263-5	5		32666-05	500ml			2:57pm	6.88616	6.89294			
		6											
		7											
		8											
		9											
		10											
		11											
		12											
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		24											

Conc&Vol of Carrier	0.01225g/0.5ml ; 0.5ml	Act & Vol of LCS	26.78 pCi/ml ; 1.0 ml	Prep Anlst	AW
Carrier Exp Date	9-3-96	LCS Ref Date	4-1-94	Start Date	2-8-96
Carrier ID#	94-658-20	LCS ID#	94-677-44-1	Count Anlst	

Balance Number : 400 20021 (✓)

Pipette Number : 134488 (✓)

139746 (✓)

Carrier and LCS added by: AW 2-8-96

Witnessed by : [illegible]

Comments :

V960

0001188

96 0247 0964

LOCKHEED ANALYTICAL LABORATORY

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

Date Prep Started : 2/8/96 Matrix : Water

WorkGroup : SR-90 LAL-0196 32666 Prep Due Date : 02/14/96

CUSTOMER ID	PARENT LAL ID	NO	QC	CHILD LAL ID	ALIQUOT VOLUME (L)	SR CARRIER (mL)	YTTRIUM SEP DATE	YTTRIUM SEP TIME	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	* * *	RESIDUE WEIGHT (grams)	COMMENTS
L6230-5	32666DUP1	1	DUP1	32666-01	0.495	0.5	2/12/96	14:57	6.48458	6.49127		0.00669	
Lab Ctrl Sample	32666LCS1	2	LCS1	32666-02	1	0.5	2/12/96	14:55	6.89336	6.90098		0.00762	
Method Blank	32666MBB	3	MBB1	32666-03	1	0.5	2/12/96	14:57	6.81363	6.82086		0.00723	
B0GZS8	L6230-5	4	SMP1	32666-04	0.495	0.5	2/12/96	15:00	6.79267	6.80017		0.0075	
B0GZT0	L6263-5	5		32666-05	0.5	0.5	2/12/96	14:57	6.88616	6.89294		0.00678	
		6											
		7											
		8											
		9											
		10											
		11											
		12											
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		23											
		24											

Conc&Vol of Carrier	24.50 mg/mL; 0.5 mL	Act & Vol of LCS	26.78 pCi/mL; 1.0 mL	Prep Anlst	AW
Carrier Exp Date	30-Sep-96	LCS Ref Date	01-Apr-94	Start Date	2/8/96
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 2/8/96

( ) 139746 ( ) Witnessed by : WF

Comments :

V960

0001189

9613472 0064

LOCKHEED ANALYTICAL LABORATORY

COUNT DATA AND CALCULATIONS FOR STRONTIUM ANALYSIS
TOTAL RADIOSTRONTIUM - LAL-91-SOP-0196

WorkGroup : SR-90 LAL-0196 32666

Det	Planchet LAL ID Sr	QC	Chem Recov	Count Time (min)	Beta Counts	Bkg Counts	EFF Sr-90	Count Start Date	Count Start Time	Yttrium Ingrow To Count	Bkg Corr Activity pCi/L	Count Error 2 Sigma	Total Error 2 Sigma	LLD pCi/L	MD/ pCi/
LB1-C1	32666-01	DUP1	0.546	150	1626	155	0.443	02/12/96	19:00	1.056	34.97	1.97	2.61	1.38	1
LB1-C2	32666-02	LCS1	0.622	150	2543	149	0.437	02/12/96	19:00	1.056	25.06	1.06	1.63	0.59	0.
LB1-C3	32666-03	MBB1	0.590	150	137	152	0.443	02/12/96	19:00	1.056	-0.16	0.36	0.36	0.62	0.
LB1-C4	32666-04	SMP1	0.612	150	1961	157	0.439	02/12/96	19:00	1.055	38.62	1.93	2.71	1.25	1
LB1-D1	32666-05		0.553	150	154	159	0.444	02/12/96	19:00	1.056	-0.12	0.80	0.80	1.36	1.

COMMENTS : 32666LCS1 Sr-Tot LCS Recovery = 25.06/25.61 = 97.8 %.
L6230-5, 32666DUP1 RPD = 9.9 %, RER = 0.69

MBB = -0.163 pCi/L => less than RDL(HAMDC).

V960

Date Completed : 2-13-96

TM

000190

LOCKHEED ANALYTICAL LABORATORY

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

Date Prep Started : 2-16-96 Repeat

Matrix : Water

WorkGroup : SR-90 LAL-0196 33765

Prep Due Date : 02/19/96

CUSTOMER ID	PARENT LAL ID	NO	QC	CHILD LAL ID	ALIQUOT VOLUME (g or L)	SR CARRIER (mL)	YTTRIUM SEP DATE	YTTRIUM SEP TIME	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	* * *	RESIDUE WEIGHT (grams)	COMMENTS
Lab Ctrl Sample	33765LCS1	1	LCS1	33765-01		0.5mL	2-20-96	2:50pm	6.58341	6.59078			
Method Blank	33765MBB	2	MBB1	33765-02		↓	↓	2:53pm	6.85496	6.86308			
B0GZS8	L6230-5	3		33765-03	500mL	↓	↓	2:50pm	6.81669	6.82534			
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		5											
		6											
		7											
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		24											

Conc&Vol of Carrier	0.01225g/0.5mL ; 0.5mL	Act & Vol of LCS	26.78 pCi/mL ; 1.0mL	Prep Anlst	W.L.
Carrier Exp Date	9-3-96	LCS Ref Date	4-1-94	Start Date	2/16/96
Carrier ID#	94-658-20	LCS ID#	94-677-44-1	Count Anlst	CS

Balance Number : 40020021 (✓) ( )

Pipette Number : 134488 (✓) 139746 (✓)

Carrier and LCS added by: W.L. 2/16/96

Witnessed by : [illegible] 2/16/96

Comments : Use bottle L6230-7

V96024

Cnt Rm Custody\Date : [illegible] 2/22/96

00091

LOCKHEED ANALYTICAL LABORATORY

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

Date Prep Started : 2/16/96 Matrix : Water

WorkGroup : SR-90 LAL-0196 33765 Prep Due Date : 02/19/96

CUSTOMER ID	PARENT LAL ID	NO	QC	CHILD LAL ID	ALIQUOT VOLUME (L)	SR CARRIER (mL)	YTTRIUM SEP DATE	YTTRIUM SEP TIME	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	* * *	RESIDUE WEIGHT (grams)	COMMENTS
Lab Ctrl Sample	33765LCS1	1	LCS1	33765-01	0.5	0.5	2/20/96	2:50	6.58341	6.59078		0.00737	
Method Blank	33765MBB	2	MBB1	33765-02	0.5	0.5	2/20/96	2:53	6.85496	6.86308		0.00812	
B0GZS8	L6230-5	3		33765-03	0.5	0.5	2/20/96	2:50	6.81669	6.82534		0.00865	
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		5											
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Conc&Vol of Carrier	24.50 mg/mL; 0.5 mL	Act & Vol of LCS	26.78 pCi/mL; 1.0 mL	Prep Anlst	WL
Carrier Exp Date	30-Sep-96	LCS Ref Date	01-Apr-94	Start Date	2/16/96
Carrier ID#	94-658-20	LCS ID#	94-677-44-1	Count Anlst	CS

Balance Number : 40020021 ( ) Pipette Number : 134488 ( ) Carrier and LCS added by: WL

( ) 139746 ( ) Witnessed by : CD

Comments :

V96024

Analyst : Checked by : Cnt Rm Custody\Date :

00192

LOCKHEED ANALYTICAL LABORATORY

COUNT DATA AND CALCULATIONS FOR STRONTIUM ANALYSIS
TOTAL RADIOSTRONTIUM - LAL-91-SOP-0196

WorkGroup : SR-90 LAL-0196 33765

Det	Planchet LAL ID Sr	QC	Chem Recov	Count Time (min)	Beta Counts	Bkg Counts	EFF Sr-90	Count Start Date	Count Start Time	Yttrium Ingrow To Count	Bkg Corr Activity pCi/L	Count Error 2 Sigma	Total Error 2 Sigma	LLD pCi/L	MDA pCi/L
LB1-D3	33765-01	LCS1	0.602	150	2966	167	0.445	02/21/96	11:02	1.304	48.15	1.89	3.02	1.03	1.08
LB1-D1	33765-02	MBB1	0.663	150	172	158	0.444	02/20/96	18:12	1.164	0.25	0.62	0.62	1.03	1.07
LB1-D3	33765-03		0.706	150	165	167	0.445	02/20/96	18:12	1.165	-0.03	0.59	0.59	0.99	1.03

COMMENTS : 33765LCS1 Sr-Tot LCS Recovery = 48.15/51.20 = 94.1 %.

MBB = 0.246 pCi/L => less than RDL(HAMDC).

V96024

Date Completed : 2-21-96

Checked by : FR

0001193

PROJECT Strontium Carrier Standardization 96137172.0569 Continued From Page

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 $Sr(NO_3)_2$ 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	~~6~~ 6550.76	6528.26 ~~6520~~
Net wt. of carrier added (mg)	12.27	12.17	12.30

AVERAGE $Sr(NO_3)_2$ ± STD DEV. = 12.25 ± 0.0681 (0.01225g ± 0.0001g per 0.5mL)

Expected mg of $Sr(NO_3)_2$ = *cert.value(≈10mgofSr/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 Lukl 10-11-95

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
WL	10-11-95	Thomas Wong	1-16-96

9613477.0530

SPEX

ISO 9001

CERTIFICATE OF ANALYSIS

Catalog Number: PLSR2-3X Lot No. G3-153SR
Element and Matrix: $Sr/HNO_3/H_2O$
Starting Material: Strontium Carbonate $SrCO_3$
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 $Pb(NO_3)_2$ 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 deionzed water and triple rinsed bottles. All glassware used is class A.

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

SPEX

Printed on Recycled Paper

SPEX INDUSTRIES, INC. 3880 PARK AVE. EDISON, N.J. 08820 908-549-7144 FAX: 908-603-9647

9613477.0571

AC5851
RCS

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

Calibration Certificate

Description

Principal radionuclide: Strontium-90 Half-life: 28.6 years

Nominal activity: 27 nano curies

Nominal volume: 5 ml in ampoule/bottle number 94003-1

Measurement Activity of principal radionuclide

Activity per gram of this solution

5.40 nano curies of Strontium-90

at 0400 hours PST on April 1, 1994

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

5.40 nano curies Per gram

of the daughter nuclide Yttrium-90

Total mass of this solution

Approximately 5.0 grams

Method of measurement

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

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

Useful Life

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

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

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

000197

C5C5

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 seperate 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. Hahn

82

PROJECT Sr-90 9613477.0573

Notebook No. 0414

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:	0.1M 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. #:	~~93-474-81-1~~ 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: _____

Signed Date Signed Date

000199

PROJECT Sr-90 9613477.0574

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: Joe Hilton 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.

Signed _____ Date _____ Signed Agnes Wong Date 3-3-95

CERTIFICATE OF CALIBRATION
BETA STANDARD SOLUTION

AA0114

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

Description of Solution

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

Radioimpurities None detected

Radioactive Daughters None

Radionuclide Concentration 0.218 µCi/g.

Method of Calibration

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

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	± 1.8%
b. Random uncertainty in assay:	± 0.5%
c. Random uncertainty in weighing(s):	± 1.0%
d. Total uncertainty at the 99% confidence level:	± 2.2%

NIST Traceability

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

Notes

1. Nuclear data were taken from "Table of Radioactive Isotopes", edited by Virginia S. Shirley, 1986.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay(and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).

Amos U. Uma

QUALITY CONTROL

Nov. 17, 1992

Date Signed

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

9613477.0576

NOTEBOOK NO. ____

AA ø 114

ISOTOPE WEIGHT DILUTION RECORD

Isotope: C-14 Vendor: IPL

Total Received Activity: 1.093 µCi Vendor ID: 407-124-2

Wt. Received: 5.024 g NIST Traceable (Y) / N Cert. # Implicitly

Activity in Units/g: .2175 µCi/g Reference Date: 11-15-92

Activity converted (dpm/g): 482,954 dpm/g Receive Date: 11/18/92

Halflife (Yrs or days) t½ = 5730 ± 40 years Receiver's Name: Jimmy Mc[illegible]

PRIMARY DILUTION: Balance wt. check done (✓)

a: Source activity: 482,954 dpm/g * (if t½ = <100yr decay to prep. date)

b: Wt. of Source transfered: 4.90951 g

Diluent used: 0.1 N NaOH

c: Total diluted weight: 116.53 g

d: Activity of dilution (a*b/c): 20,347 dpm/g ± 2.2%

e: Calculated density of solution: 1.002 g/mL (4M HNO_3 = 1.1294 ± .0007 g/mL)

f: Activity by volume = (d*e): 20,388 dpm/mL

Dilution Log Book ID: LAL-93-474-23-1 ✓

Preparation Date: 10/27/93 Preparer's Name. M

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

Log Book ID of source being diluted: ____

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

b: Wt. of Source transfered: ____ g

Diluent used: ____

c: Total diluted weight: N/A g

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

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

f: Activity by volume = (d*e): ____ dpm/mL

Dilution Log Book ID: ____

Signed	Date	Reviewed by Signed	Date
RGS	10/27/93		

000214

9613477.0577

INITIAL STANDARD DILUTION RECORD

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

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

Prepared By:		Preparation Date:	10/27/93
Reviewed By:		Review Date:	
Purity/Cross Check Performed By:		Check Date:	

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information

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

Dilution

*Diluent:	Nanopure w/ 1 mg/ml formaldehyde	
*Density of diluent (g/ml):	1.0006	g/ml
a: Parent Specific Activity:	9.14E+03	pCi/g
b: Amount of Source Transferred:	0.70	g
c: Total amount of Dilution:	250.14	g
d: Total Volume of Dilution:	250	ml
e: Activity of Dilution [a * b / c]:	2.57E+01	pCi/g
f: Activity of Dilution (a * b / d):	2.58E+01	pCi/ml
Dilution Logbook I.D. #:	LAL-94-0677-18-1	

Prepared By: Agnes Wong Preparation Date: 11/19/94

Preparer Signature: _____

Reviewed By: _____ Review Date: _____

Reviewer Signature: _____

*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.

9613477.0579

AA0114

SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

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

Dilution		
*Diluent:	Nanopure water with 1mg/ml formaldehyde	
*Density of diluent (g/ml):	N/A	g/ml
a: Parent Specific Activity: 9267.27	~~20,388~~	~~pCi/g~~ pCi/ml 11-19-94
b: Amount of Source Transferred:	0.7046	g
c: Total amount of Dilution:	250.14	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):	26.10	pCi/ml
Dilution Logbook I.D. #:	94-677-18-1 ✓	

Prepared By: Agnes Wong Preparation Date: 11-19-94

Reviewed By: Joe Hutchinson Review Date: 12/12/94

*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.

9613477.0580

RECEIVED 11/25/95 RKS

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

9613477.0581

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

PROJECT H-~~B~~13477.0582 Notebook No. 01-1

Continued From Page NA

INITIAL STANDARD DILUTION RECORD

Standard Information:

Isotope:	H-3	Vendor:	EPA
Activity of Standard Received:	.11 uCi	~~Vendor I.D. #~~ 2/7/95	—
Weight of Standard Received (g):	5 g	LAL I.D. #:	AC5299
Standard Activity (pCi/g):	21.9 ~~pCi/g~~ nCi/g 2/7/95	NIST Traceable ?	Yes
Halflife in Years or Days:	12.43 yrs	Certificate #:	2606-1
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 (Deed 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. #: C. Pomeroy LAL-95-0721-1

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

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

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

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

Carrie R. Mellow

PROJECT H-3 2CS 95 13477.0583

Notebook No. [illegible]

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
Diluent Used:	Deionized

Dilution

*Diluent:	Deep Well Water	
*Density of diluent (g/ml):	0.9977	g/ml
a: Parent Specific Activity:	2190	pCi/~~g~~ mL
b: Amount of Source Transferred:	5.0	mL ~~g~~
c: Total amount of Dilution:	~~4000~~ 3995	~~g~~ mL 11/1/95
d: Total Volume of Dilution:	4000	ml
e: Activity of Dilution [a * b / c]:	2.74	pCi/~~g~~ mL on 6/3/92
f: Activity of Dilution (a * b / d):	2.74	pCi/ml on 6/3/92
Dilution Logbook I.D. #:	95-721-16-1	

Prepared By: Joe Hutchinson Preparation Date: 11/1/95

Reviewed By: Rogers Wong Review Date: 1-2-96

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

Read and Understood By

Signed	Date	Signed	Date

9613477.0584

RECEIVE 11/25/95 RKS

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

9613477.0585

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 pe
Lead less than 3×10^{-5} per

Preservative:

Remarks

Date Certificate Prepared June 17, 1992

Approval Signature George Dulleck

000230

9613477.0586

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

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 2613477.0588

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. #~~ 2/7/95	—
Weight of Standard Received (g):	5 g	LAL I.D. #:	AC5299
Standard Activity (pCi/g):	21.9 ~~pCi/g~~ nCi/g 2/7/95	NIST Traceable ?	Yes
Halflife in Years or Days:	12.43 yrs	Certificate #:	2606-1
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 (Deed 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. #: LAL-95-0721-1

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

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

Purity/Cross Check Performed By: Check Date:

Signed Date CP 5/8/95 Signed Date

PROJECT 9613477.0689

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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:	Dead 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 6/23/92
Dilution Logbook I.D. #:	94-0677-70	

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

Reviewed By: [illegible] 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

Signed	Date	Signed	Date