START 9613444.0547

LK6090 SD 2

0044203

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

LOCKHEED MARTIN

January 19, 1996

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

JAN 1996 RECEIVED Data Log In

| | | |
|---|---|---|
| RE: | Log-in No.: | L6090 |
| | Quotation No.: | Q400000-B |
| | SAF: | B96-047 |
| | Document File No.: | 1221596 |
| | WHC Document File No.: | 310 |
| | SDG No.: | LK6090 |

The attached data report contains the analytical results of samples that were submitted to Lockheed Analytical Services on December 21, 1995. The temperature of the cooler upon receipt was 2°C. Sample containers received agree with the chain-of-custody documentation. Sample containers were received intact. Samples designated for nitrate/nitrite and phosphate analysis by method 300.0 were not received in time to meet the analytical holding time requirements.

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

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

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

JUN 1996 RECEIVED EDMC

***Lockheed Analytical Services***

Log-in No.: L6090
Quotation No.: Q400000-B
SAF: B96-047
Document File No.: 1221596
WHC Document File No.: 310
SDG No.: LK6090

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,

Karen Germann for

Kathleen M. Hall
Client Services Representative

cc: Client Services
Document Control

*Lockheed Analytical Services*

Log-in No.: L6090
Quotation No.: Q400000-B
SAF: B96-047
Document File No.: 1221596
WHC Document File No.: 310
SDG No.: LK6090

# CASE NARRATIVE
## INORGANIC NON METALS ANALYSES
## WATER

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

**Preparation and Analysis Requirements**

- **One water sample was received for LK5106 and analyzed in batch 1221 bh for selected analytes as requested on the chain of custody. Quality control analysis was performed on the following sample:**

| Client ID | LAL # | | Method |
|---|---|---|---|
| BOGZ50 | L6090-3 | MS, DUP | 300.0 Chloride, Nitrate-Nitrogen, Nitrite-Nitrogen, Orthophosphate, Sulfate |
| | L6090-6 | MS, DUP | 350.1 Ammonia |
| | L6090-4 | MS, DUP | 353.2 Nitrate-Nitrite-Nitrogen |
| | L6090-5 | MS, DUP | 9030 Sulfide |

**Holding Time Requirements**

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

**Method Blanks**

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

**Internal Quality Control**

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

Kay McCann
**Prepared By**

January 12, 1996
**Date**

*Lockheed Analytical Services*

Log-in No.: L6090
Quotation No.: Q400000-B
SAF: B96-047
Document File No.: 1221596
WHC Document File No.: 310
SDG No.: LK6090

# 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 December 21, 1995. The samples were logged in as L6090 and were prepared and analyzed in batches 1221 bhT for total metals and 1221 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**

January 18, 1996
**Date**

*Lockheed Analytical Services*

Log-in No.: L6090
Quotation No.: Q400000-B
SAF: B96-047
Document File No.: 1221596
WHC Document File No.: 310
SDG No.: LK6090

# 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.

**Gas Proportional Counter**

*Analytical Method Gross Alpha/Beta*

The gross alpha/beta analysis was performed using standard operating procedure (SOP), LAL-91-SOP-0060. The samples were analyzed in workgroup 31926. The instrument calibration verification met criteria. The method blank was within QC criteria. The laboratory control sample (LCS) and matrix spike (MS) recoveries were within QC criteria. The duplicate (DUP) recoveries were within QC criteria. The MDA exceeded the reporting detection limit (RDL) due to the residue weight limitations forcing a volume reduction, the associated samples were flagged with a "C" qualifier. 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 workgroup 31937. 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. The chemical recoveries were below QC criteria in the LCS, method blank, and sample BOGZ50 (L6090-7). Because there was no activity in the samples, and the samples were below the RDL data quality is not believed to be adversely affected. No re-analyses were performed.

***Lockheed Analytical Services***

Log-in No.: L6090
Quotation No.: Q400000-B
SAF: B96-047
Document File No.: 1221596
WHC Document File No.: 310
SDG No.: LK6090

**Liquid Scintillation Counter**

*Analytical Method Carbon-14*

The carbon-14 analysis was performed using SOP, LAL-93-SOP-0209. The samples were analyzed in workgroup 31920. The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS and MS recoveries were within QC criteria. The DUP recoveries were within QC criteria. The quench value was within curve limitations. No re-analyses were performed.

*Analytical Method Tritium*

The tritium analysis was performed using SOP, LAL-91-SOP-0066. The samples were analyzed in workgroup 31944. 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

January 16, 1996
Date

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

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

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

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

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

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

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LOCKHEED ANALYTICAL SERVICES
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Dec 21 1995, 01:52 pm

Login Number: L6090
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 |
|---|---|---|---|---|---|
| L6090-1 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| Water 1 S SCREENING | | Hold:16-JUN-96 | | | |
| L6090-2 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| Water 1 S 6010 ICP METALS | | Hold:16-JUN-96 | | | |
| L6090-3 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| Water 1 S 300.0 CHLORIDE | | Hold:16-JAN-96 | | | |
| Water 1 S 300.0 NITRATE | | Hold:21-DEC-95 | | | |
| Water 1 S 300.0 NITRITE | | Hold:21-DEC-95 | | | |
| Water 1 S 300.0 PHOSPHATE | | Hold:21-DEC-95 | | | |
| Water 1 S 300.0 SULFATE | | Hold:16-JAN-96 | | | |
| L6090-4 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| Water 1 S 353.2 NITRATE | | Hold:16-JAN-96 | | | |
| L6090-5 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| Water 1 S 9030 SULFIDE | | Hold:26-DEC-95 | | | |
| L6090-6 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| Water 1 S 350.1 NH3/N | | Hold:16-JAN-96 | | | |
| L6090-7 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| Water 1 S GR ALP/BETA LAL-0060 | | Hold:16-JUN-96 | | | |
| Water 1 S SR-90 LAL-0196 | | Hold:16-JUN-96 | | | |
| L6090-8 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |



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LOCKHEED ANALYTICAL SERVICES
LOGIN CHAIN OF CUSTODY REPORT (ln01)
Dec 21 1995, 01:52 pm

Login Number: L6090
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 |
|---|---|---|---|---|---|
| L6090-9 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| L6090-10 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| L6090-11 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| L6090-12 | B0GZ50 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| Water 1 S C-14 LAL-0209 | Hold:16-JUN-96 | | | | |
| Water 1 S TRITIUM(H3) LAL-0066 | Hold:16-JUN-96 | | | | |
| L6090-13 | B0GZ51 | 19-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| TEMP 2 | | | | | |
| Location: 157 | | | | | |
| Filt H20 15 S 6010 ICP METALS | Hold:16-JUN-96 | | | | |
| L6090-14 | REPORT TYPE | 21-DEC-95 | 21-DEC-95 | | 25-JAN-96 |
| Location: | | | | | |
| Water 1 S EDD - DISK DEL. | | | | | |
| Water 1 S INORG TYPE 2 RPT + | | | | | |
| Water 1 S RAD RPT TYPE 2 | | | | | |



Signature: Paula Davis

Date: 12-21-95 0013

1221546

Bechtel Hanford, Inc.

# CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST L6090

Page 1 of 1

Data Turnaround
☐ Priority
■ Normal

| | | |
|---|---|---|
| Collector: A. Rizza B Fehlberg | Company Contact: Bob Raidl | Telephone: (509) 372-9641 |
| Project Designation: 100-HR-3 Groundwater Sampling, Round 10, Phase 1 | Sampling Location: 100 H | SAF No.: B96-047 |
| Ice Chest No. | Field Logbook No.: EFL 1018 | Method of Shipment: Federal Express |
| Shipped To: Lockheed | Offsite Property No.: LV90-0-0640-13 | Bill of Lading/Air Bill No.: 2904648241 |

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 | $H_2SO_4$ | *1 | $H_2SO_4$ | $HNO_3$ | Cool 4°C | Cool 4°C | | $HNO_3$ |
| | | | Type of Container | G | G | P/G | P | P/G | P/G | G | P/G | | G |
| | | | No. of Container(s) | 1 | 1 | 1 | 1 | 1 | 5 | 1 | 1 | | 1 |
| | | | Volume | 500mL | 500mL | 500mL | 1L | 1L | 1L | 1L | 20mL | | 500mL |
| | | | | ICP Metals (Unfiltered) | Anions (IC) - Cl, $SO_4$, $NO_2$, $NO_3$, $PO_4$ | $NO_2$ - $NO_3$ | Sulfide | Ammonia | Gross Alpha, Gross Beta, Sr-90 | Tritium, C-14 | Activity Scan | | ICP Metals (Filtered) |
| Sample No. | Matrix* | Date Sampled | Time Sampled | | | | | | | | | | |
| B0GZ50 | W | 12-19-95 | 1330 | X | X | X | X | X | X | X | X | | |
| B0GZ51 | W | 12 19 95 | 1330 | | | | | | | | | | X |

| CHAIN OF POSSESSION | Sign/Print Names | | |
|---|---|---|---|
| Relinquished By: RE Rizza / R Fehlberg | Date/Time: 12/19/95 1432 | Received By: ERC / Bob Whitten | Date/Time: 12-19-95 1432 |
| Relinquished By: ERC / B Whitten | Date/Time: 12-20-95 0900 | Received By | Date/Time |
| Relinquished By | Date/Time | Received By | Date/Time |
| Relinquished By | Date/Time | Received By | Date/Time |

SPECIAL INSTRUCTIONS
*1 ZnAc + NaOH

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

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

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 |
|---|---|---|---|
| | Paul Dawson | Sample Custodian | 12-21-95 / 5:35 p. |
| FINAL SAMPLE DISPOSITION | Disposal Method | Disposed By | Date/Time |

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# SAMPLE CHECK-IN LIST

Date/Time Received: 12-21-95/9:35am SDG#: [illegible]

Work Order Number: [illegible] SAF #: B96-047

Shipping Container ID: ER-10 Chain of Custody # [illegible]

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 ~~[X]~~ No [X] P.D. 12-21-95

7. Samples have:
   - ____ tape
   - X custody seals
   - ____ hazard labels
   - ____ 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: Paula Davis/L&S Date: 12-21-95

~~Telephoned~~ Faxed To: Kathleen Hall On 12-21-95 By Paula Davis



0015

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**LOCKHEED MARTIN**

## Sample Login
## Login Review Checklist

**Lot Number** L6070

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

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

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

| LOGIN CHAIN OF CUSTODY | YES | NO | N/A | Comment |
|---|---|---|---|---|
| 1. Are the collect, receive, and due dates correct for every sample? | X | | | |
| 2. Have all appropriate comments been indicated in the comment section? | X | | | |

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

Paula Davis — primary review signature — 12-21-95 — date

Paula Davis — secondary review signature — 12-21-95 — date

0016

12215-96

# Lockheed Analytical Services
## Sample Receiving Checklist



Client Name: Bechtel - Hanford  Job No. L6090  Cooler ID: 1,2

| 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 | | nitr. w/ nitrates |
| samples to subcontract | | N/A | |

| ADDITIONAL COMMENTS/DISCREPANCIES |
|---|
| |
| |
| |
| |

Completed by / date: Paul Dais 12-21-95

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

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

*** = please review this information and return via facsimile to the appropriate CSR (702) 361-8146*



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

| Client Sample Number | LAL Sample Number | SDG Number | Matrix | Method |
|---|---|---|---|---|
| BOGZ50 | L6090-1 | | Water | SCREENING |
| | L6090-2 | | Water | 6010 ICP METALS |
| | L6090-3 | | Water | 300.0 CHLORIDE |
| | L6090-3 | | Water | 300.0 NITRATE |
| | L6090-3 | | Water | 300.0 NITRITE |
| | L6090-3 | | Water | 300.0 PHOSPHATE |
| | L6090-3 | | Water | 300.0 SULFATE |
| | L6090-4 | | Water | 353.2 NITRATE |
| | L6090-5 | | Water | 9030 SULFIDE |
| | L6090-6 | | Water | 350.1 NH3/N |
| | L6090-7 | | Water | GR ALP/BETA LAL- |
| | L6090-7 | | Water | SR-90 LAL-0196 |
| | L6090-12 | | Water | C-14 LAL-0209 |
| | L6090-12 | | Water | TRITIUM(H3) LAL- |
| BOGZ51 | L6090-13 | | Filt H20 | 6010 ICP METALS |
| REPORT TYPE | L6090-14 | | Water | EDD - DISK DEL. |
| | L6090-14 | | Water | INORG TYPE 2 RPT |
| | L6090-14 | | Water | RAD RPT TYPE 2 |



122596

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# LOCKHEED ANALYTICAL SERVICES

## Sample Results

| | |
|---|---|
| Client Sample ID: B0GZ50 | Date Collected: 19-DEC-95 |
| Matrix: Water | Date Received: 21-DEC-95 |
| Percent Solids: N/A | |

| Constituent | Units | Method | Result | Project Reporting Limit | Data Qualifier(s) | Date Analyzed | LAS Batch\|ID | LAS Sample\|ID |
|---|---|---|---|---|---|---|---|---|
| Chloride | mg/L | 300.0 | 2.2 | 0.020 | | 21-DEC-95 | 31784 | L6090-3 |
| Nitrate-N | mg/L | 300.0 | 0.60 | 0.020 | | 21-DEC-95 | 31781 | L6090-3 |
| Nitrite-N | mg/L | 300.0 | < 0.002 | 0.010 | U | 21-DEC-95 | 31782 | L6090-3 |
| Ortho Phosphate | mg/L | 300.0 | < 0.020 | 0.10 | U | 21-DEC-95 | 31783 | L6090-3 |
| Sulfate | mg/L | 300.0 | 14. | 0.10 | | 21-DEC-95 | 31785 | L6090-3 |
| Ammonia Nitrogen | mg/L | 350.1 | < 0.040 | 0.050 | U | 10-JAN-96 | 31872 | L6090-6 |
| Nitrate-Nitrite-Nitrogen | mg/L | 353.2 | 0.51 | 0.050 | | 09-JAN-96 | 31874 | L6090-4 |
| Sulfide | mg/L | 9030 | < 1.0 | 3.0 | U | 23-DEC-95 | 31829 | L6090-5 |

# LOCKHEED ANALYTICAL SERVICES

## Sample Results

| | |
|---|---|
| Client Sample ID: B0GZ50 | Date Collected: 19-DEC-95 |
| Matrix: Water | Date Received: 21-DEC-95 |
| 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 | 0.062 | 0.027 | 0.20 | B | 1 | 16-JAN-96 | 32131 | L6090-2 |
| ANTIMONY, TOTAL | mg/L | 6010 | < 0.055 | 0.055 | 0.060 | U | 1 | 11-JAN-96 | 32131 | L6090-2 |
| ARSENIC, TOTAL | mg/L | 6010 | < 0.078 | 0.078 | 0.20 | U | 1 | 11-JAN-96 | 32131 | L6090-2 |
| BARIUM, TOTAL | mg/L | 6010 | < 0.016 | 0.016 | 0.20 | U | 1 | 11-JAN-96 | 32131 | L6090-2 |
| BERYLLIUM, TOTAL | mg/L | 6010 | < 0.0010 | 0.0010 | 0.0050 | U | 1 | 11-JAN-96 | 32131 | L6090-2 |
| CADMIUM, TOTAL | mg/L | 6010 | < 0.0040 | 0.0040 | 0.0050 | U | 1 | 11-JAN-96 | 32131 | L6090-2 |
| CALCIUM, TOTAL | mg/L | 6010 | 25. | 0.013 | 5.0 | | 1 | 11-JAN-96 | 32131 | L6090-2 |
| CHROMIUM, TOTAL | mg/L | 6010 | 0.016 | 0.0030 | 0.010 | | 1 | 11-JAN-96 | 32131 | L6090-2 |
| COBALT, TOTAL | mg/L | 6010 | < 0.0040 | 0.0040 | 0.050 | U | 1 | 11-JAN-96 | 32131 | L6090-2 |
| COPPER, TOTAL | mg/L | 6010 | 0.030 | 0.0030 | 0.025 | | 1 | 11-JAN-96 | 32131 | L6090-2 |
| IRON, TOTAL | mg/L | 6010 | 0.084 | 0.0050 | 0.10 | B | 1 | 11-JAN-96 | 32131 | L6090-2 |
| LEAD, TOTAL | mg/L | 6010 | < 0.074 | 0.074 | 0.10 | U | 1 | 11-JAN-96 | 32131 | L6090-2 |
| MAGNESIUM, TOTAL | mg/L | 6010 | 9.1 | 0.041 | 5.0 | | 1 | 11-JAN-96 | 32131 | L6090-2 |
| MANGANESE, TOTAL | mg/L | 6010 | 0.0031 | 0.0010 | 0.015 | B | 1 | 11-JAN-96 | 32131 | L6090-2 |
| NICKEL, TOTAL | mg/L | 6010 | < 0.014 | 0.014 | 0.040 | U | 1 | 11-JAN-96 | 32131 | L6090-2 |
| POTASSIUM, TOTAL | mg/L | 6010 | 4.6 | 0.40 | 5.0 | B | 1 | 11-JAN-96 | 32131 | L6090-2 |
| SELENIUM, TOTAL | mg/L | 6010 | < 0.096 | 0.096 | 0.30 | U | 1 | 11-JAN-96 | 32131 | L6090-2 |
| SILVER, TOTAL | mg/L | 6010 | 0.0032 | 0.0030 | 0.010 | B | 1 | 11-JAN-96 | 32131 | L6090-2 |
| SODIUM, TOTAL | mg/L | 6010 | 10. | 0.040 | 5.0 | | 1 | 11-JAN-96 | 32131 | L6090-2 |
| THALLIUM, TOTAL | mg/L | 6010 | < 0.073 | 0.073 | 0.50 | U | 1 | 11-JAN-96 | 32131 | L6090-2 |
| VANADIUM, TOTAL | mg/L | 6010 | 0.041 | 0.0040 | 0.050 | B | 1 | 11-JAN-96 | 32131 | L6090-2 |
| ZINC, TOTAL | mg/L | 6010 | 0.075 | 0.0030 | 0.020 | | 1 | 11-JAN-96 | 32131 | L6090-2 |

9613444.0564

# LOCKHEED ANALYTICAL SERVICES

## Sample Results

| | |
|---|---|
| Client Sample ID: B0GZ51 | Date Collected: 19-DEC-95 |
| Matrix: Filt H20 | Date Received: 21-DEC-95 |
| Percent Solids: N/A | |

| Constituent | Units | Method | Result | IDL | RDL | Data Qual | Dilution | Date Analyzed | LAS Batch ID | LAS Sample ID |
|---|---|---|---|---|---|---|---|---|---|---|
| ALUMINUM, DISSOLVED | mg/L | 6010 | < 0.027 | 0.027 | 0.20 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| ANTIMONY, DISSOLVED | mg/L | 6010 | < 0.055 | 0.055 | 0.060 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| ARSENIC, DISSOLVED | mg/L | 6010 | < 0.078 | 0.078 | 0.20 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| BARIUM, DISSOLVED | mg/L | 6010 | < 0.016 | 0.016 | 0.20 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| BERYLLIUM, DISSOLVED | mg/L | 6010 | < 0.0010 | 0.0010 | 0.0050 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| CADMIUM, DISSOLVED | mg/L | 6010 | < 0.0040 | 0.0040 | 0.0050 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| CALCIUM, DISSOLVED | mg/L | 6010 | 28. | 0.013 | 5.0 | | 1 | 11-JAN-96 | 32132 | L6090-13 |
| CHROMIUM, DISSOLVED | mg/L | 6010 | 0.0092 | 0.0030 | 0.010 | B | 1 | 11-JAN-96 | 32132 | L6090-13 |
| COBALT, DISSOLVED | mg/L | 6010 | < 0.0040 | 0.0040 | 0.050 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| COPPER, DISSOLVED | mg/L | 6010 | < 0.0030 | 0.0030 | 0.025 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| IRON, DISSOLVED | mg/L | 6010 | < 0.0050 | 0.0050 | 0.10 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| LEAD, DISSOLVED | mg/L | 6010 | < 0.074 | 0.074 | 0.10 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| MAGNESIUM, DISSOLVED | mg/L | 6010 | 9.9 | 0.041 | 5.0 | | 1 | 11-JAN-96 | 32132 | L6090-13 |
| MANGANESE, DISSOLVED | mg/L | 6010 | 0.0023 | 0.0010 | 0.015 | B | 1 | 11-JAN-96 | 32132 | L6090-13 |
| NICKEL, DISSOLVED | mg/L | 6010 | < 0.014 | 0.014 | 0.040 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| POTASSIUM, DISSOLVED | mg/L | 6010 | 4.9 | 0.40 | 5.0 | B | 1 | 11-JAN-96 | 32132 | L6090-13 |
| SELENIUM, DISSOLVED | mg/L | 6010 | < 0.096 | 0.096 | 0.30 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| SILVER, DISSOLVED | mg/L | 6010 | < 0.0030 | 0.0030 | 0.010 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |
| SODIUM, DISSOLVED | mg/L | 6010 | 11. | 0.040 | 5.0 | | 1 | 11-JAN-96 | 32132 | L6090-13 |
| THALLIUM, DISSOLVED | mg/L | 6010 | 0.10 | 0.073 | 0.50 | B | 1 | 11-JAN-96 | 32132 | L6090-13 |
| VANADIUM, DISSOLVED | mg/L | 6010 | 0.043 | 0.0040 | 0.050 | B | 1 | 11-JAN-96 | 32132 | L6090-13 |
| ZINC, DISSOLVED | mg/L | 6010 | < 0.0030 | 0.0030 | 0.020 | U | 1 | 11-JAN-96 | 32132 | L6090-13 |

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: B0GZ50 | LAL Sample ID: L6090-7

Date Collected: 19-DEC-95 | Date Received: 21-DEC-95

Matrix: Water | Login Number: L6090

| Constituent | Analyzed | Batch | Activity | Error | MDA | DataQual | Units |
|---|---|---|---|---|---|---|---|
| Gross Alpha | 08-JAN-96 | GR ALP/BETA LAL-0060_31926 | -0.18 | 0.90 | 2.0 | C | pCi/L |
| Gross Beta | 08-JAN-96 | GR ALP/BETA LAL-0060_31926 | 3.4 | 1.5 | 2.2 | | pCi/L |
| Total radio-strontium | 10-JAN-96 | SR-90 LAL-0196_31937 | -0.72 | 0.86 | 1.6 | | pCi/L |

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. * Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: BOGZ50 | LAL Sample ID: L6090-12

Date Collected: 19-DEC-95 | Date Received: 21-DEC-95

Matrix: Water | Login Number: L6090

| Constituent | Analyzed | Batch | Activity | Error | MDA | DataQual | Units |
|---|---|---|---|---|---|---|---|
| C-14 | 29-DEC-95 | C-14 LAL-0209_31920 | 10. | 72. | 92. | | pCi/L |
| H-3 | 08-JAN-96 | TRITIUM(H3) LAL-0066_31944 | 20 | 220 | 270 | | pCi/L |

PROJECT Gross Alpha/Beta 4A 0567 (J)

Continued From Page _____

# SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

## Dilution Source Information

| | |
|---|---|
| Isotope: | Am-241 and Sr-90 |
| Parent Barcode Number | AA0030 AA0046 |
| Vendor or Certificate I.D. # of Parent Standard: | Am-241 IPL 388-100-1<br>Sr-90 NIST SRM 4919G |
| Diluted Source Logbook I.D. #: | Am-241 91-0225-60-1<br>Sr-90 91-0225-30-2 |
| Balance Verification?: | Yes |
| Diluent Used: | 0.1 N $HNO_3$ |

## Dilution

| | |
|---|---|
| *Diluent: | 0.1 N $HNO_3$ + 42mg $Sr(NO_3)_2$/mL |
| *Density of diluent (g/ml): | NA |
| a: Parent Specific Activity: | Am-241 981 pCi/mL<br>Sr-90 600 pCi/mL m 8/1/90 |
| b: Amount of Source Transferred: | Am-241 0.5 mL<br>Sr-90 0.5 ~~g~~ mL |
| 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): | Am-241 9.81 pCi/mL<br>Sr-90 12 pCi/mL m 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 |
|---|---|---|---|
| | | | |

0063

# 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

9613444.0569

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 | $4.514 \times 10^8$ 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

0066

# 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)

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# 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 |
|---|---|---|---|
| | | | |

9613444.0573

# INITIAL STANDARD DILUTION RECORD

**Standard Information:**

| | | | |
|---|---|---|---|
| Isotope: | Sr-90 | Vendor: | IPL |
| Activity of Standard Received: | ~~5.0012~~ 1.018 uCi | Vendor I.D. # | — |
| Weight of Standard Received (g): | 5.0012 g | LAL I.D. #: | AA00 49 |
| Standard Activity (pCi/g): | 2.036 E 5 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 |
|---|---|---|---|
| | | | 0071 |

PROJECT _____ Continued From Page _____

9613444.0674

# 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

0072

| Signed | Date | Signed | Date |
|---|---|---|---|

PROJECT 1111-LT 1/6 1.6 dia. filter & LCS 961344.0575 Continued From Page

# ISOTOPE DILUTION RECORD

Agnes Wo. 4-9-93

Isotope: Am-241

**Secondary/Working Level Dilution**

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

Pipet Check / Balance Wt. Check Done (✓)

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

Diluent used: 0.5 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: [signature] 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 | AL-0199- | 0.200 ml | * 975.18 pCi/ml = 195.0 pCi | (≡ 197.8 pCi 4-2-91) |
| $^{60}$Co | AL-0225-80-1 | 0.200 ml | * 990.11 pCi/ml = 198.0 pCi | (≡ 259.1 pCi 4-2-91) |

(same pipette amounts as p.80K)

Continued on Page N/A

Read and Understood By

| | | | |
|---|---|---|---|
| Agnes Wong | 4-9-93 | Jack M. Schmitt | 5-18-93 |
| Signed | Date | Signed | Date |

0074

9613444.0576

ACS 351
RKS

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

## Calibration Certificate

**Description**

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

Nominal activity: 27 nano curies

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

**Measurement** Activity of principal radionuclide

Activity per gram of this solution

5.40 nano curies of Strontium-90

at 0400 hours PST on April 1, 1994

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

5.40 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.

.0081

CSE 3C

**Purity**

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

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

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

**Random Errors**

The precision of this standard was such that the certified value of the radioactive concentration of the principal activity had a standard error (sm) not greater than ± 0.1 %

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

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

+3.8 % or -3.8 %

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

**Decay Schemes**

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

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

**Chemical Composition of Solution**

Carrier content per gram of solution: 30 micrograms strontium

Other components: 0.1 M HCl

Preservative:

**Remarks**

Date Certificate Prepared April 26, 1994

Approval Signature Paul B. Hahn

0082

Revised 1/84

PROJECT Sr-90 9613444.0578

Notebook No. 1414

Continued From Page

# INITIAL STANDARD DILUTION RECORD

**Standard Information:**

| | | | |
|---|---|---|---|
| Isotope: | Sr-90 | Vendor: | EPA |
| Activity of Standard Received: | $2.7 \times 10^4$ uCi | Vendor I.D. # | 94003-1 |
| Weight of Standard Received (g): | 5.0 g | LAL I.D. #: | AC5281 |
| Standard Activity (pCi/g): | $5.4 \times 10^3$ 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): | $5.4 \times 10^3$ pCi/g |
| b: Weight of the Source Transferred (g): | 4.9670 g |
| c: Total diluted weight (g): | 49.91 g |
| d: Total Diluted Volume (mL) | 50 mL |
| e: Activity of Dilution by Weight (pCi/g) [a • b / c ]: | 537.4 pCi/g |
| f: Calculated Density of Solution (g/ml) [c / d]: | 0.9982 g/mL |
| g: Activity of Dilution by Volume (pCi/mL) [e • f]: | 536.44 pCi/mL |
| h. Dilution Logbook I.D. #: | ~~93-494-81-1~~ 93-474-82-1 CP 4/7/95 |

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

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

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

0083

| Signed | Date | Signed | Date |
|---|---|---|---|

PROJECT Sr-90 9613444.0579

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: [illegible]  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.

Agnes Wong 3/3/95 0084

Signed _____ Date _____ Signed _____ Date _____

PROJECT Strontium Carrier Standardization

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 | ~~68~~ 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 Lutl 10-11-95

Continued on Page

Read and Understood By

| Signed | Date | Signed | Date |
|---|---|---|---|
| WL | 10-11-95 | Dennis Wong | 1-16-96 |

9613444.0591

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

0086

9213444.0502

AA0114

# CERTIFICATE OF CALIBRATION
# BETA STANDARD SOLUTION

| | | | | |
|---|---|---|---|---|
| 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).

Anna U. Una

**QUALITY CONTROL**

Nov. 17, 1992

**Date Signed**

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

Notebook No. 111



AA ϕ 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 Morales

**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:

0096

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

# 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: | |

9613444.0585

# 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.

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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~~ 11-19-94 pCi/mL |
| 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.

9613444.0587

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 nanocuries

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

**Measurement** Activity of principal radionuclide

Activity per gram of this solution

21.9 nanocuries 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

9613444.0588

**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 perc
Lead less than $3x10^{-5}$ perc

Preservative:

**Remarks**

Date Certificate Prepared June 17, 1992

Approval Signature George Dilbeck

0110

9613444.0589

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 9613444.0591

Notebook No. 0721

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 (Deced 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. Ponieważ Preparation Date: 2/7/95

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

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

0113

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

Carrie Ponieważ

PROJECT 9613444.0592

Notebook No. _____

Continued From Page _____

# 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 6/13/92 |
| 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

0114

| Signed | Date | Signed | Date |
|---|---|---|---|

9613444.0593

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

0115

9613444.0594

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-3 13444.0595

Notebook No. 0721

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~~ Given 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: _____ 0117

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

Carrie Poniewaz

PROJECT H-3 LCS 2613444.0596

Notebook No. 0721

Continued From Page

# SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

## Dilution Source Information

| | |
|---|---|
| Isotope: | H-3 LCS |
| Parent Barcode Number | AC 5299 |
| Vendor or Certificate I.D. # of Parent Standard: | 2606-1 |
| Diluted Source Logbook I.D. #: | LAL-95-721-1 |
| Balance Verification?: | Yes |
| 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 | ~~g~~ mL |
| c: Total amount of Dilution: | ~~4000 g~~ 3995 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 Hutchison Preparation Date: 11/1/95

Reviewed By: Byron 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 |
|---|---|---|---|
| | | | |