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TMA
Thermo Analytical Inc.

TMA/Norcal
2030 Wright Avenue
P. O. Box 4040
Richmond, CA 94804-0040
(510) 235-2633 Fax No. (510) 235-0438

RECORD COPY

NOV 1992
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OSM DMO

November 11, 1992

SENT BY FEDERAL EXPRESS

Ref. TMA/Norcal N2-11-024-7115

Mr. John Bourgeault
Westinghouse Hanford Company
2355 Stevens Drive
Richland, WA 99352

Dear Mr. Bourgeault:

Enclosed on the Summary Data Section, are the gamma scan results for the concrete sample from Riverland and 100 Area Location, we received 2 November 1992. The QA/QC results are also given in the Summary Data Section.

The Summary Data Section is paginated 1 through 26 and Appendices 1 through 17 are paginated 27 through 79.

Please call if you have any questions concerning this data.

Sincerely,

D. P. Kharkar

Dinkar P. Kharkar, Ph.D.
Manager, Nuclear Programs

DPK/ss

Enclosures: Section 1 and 2
Appendices 1 through 17

JUN 1995
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SECTION 1 Case Narrative

SDG 7115 Contact Dinkar P. Kharkar	Client Westinghouse Hanford Contract MBH-SVV-069262

CASE NARRATIVE

1.0 GENERAL

The result of the concrete sample from Riverland and 100 Area Location (TMA/Norcal Group 7115) are reported herein. TMA/Norcal Group 7115 is comprised of the one sample listed on the Chain-of-Custody documents and is identified as Sample 1.

1.1 CHAINS-OF-CUSTODY

This report includes data from samples delivered under Chain-of-Custody documents Field Logbook No. WHC-N-205-21.

1.2 SAMPLE VOLUME

250 mL bottles of sample were received for the analyses.

1.3 MISSING SAMPLES

The sample was accounted for in an undamaged condition.

1.4 HOLDING TIMES

The collections were made on 10/29/92 and the sample processing was initiated within 180 days of collection.

2.0 QUALITY CONTROL

The internal quality control consisted of one sample each of a laboratory control, a blank, and a replicate. All original analyses were performed with QC samples 7115-2, 3, and 4.

The QC samples were prepared and labelled by the quality control officer. Copies of The QC notebook pages are included in the data package.

2.1 LABORATORY CONTROL SAMPLES

LCS recoveries for the gamma nuclides used in the spike were good. The MDA for ^{59}Fe was higher than the RDL because of the short half life of ^{59}Fe. The quoted LLD was at the time of count while MDA was at the time of collection.

2.2 BLANKS

MDA's for the gamma nuclides meet the RDL requirement.

DATA

SDG 7115	Client Westinghouse Hanford
Contact Dinkar P. Kharkar	Contract MBH-SVV-069262

CASE NARRATIVE

2.3 REPLICATES

Results were satisfactory for the replicate analysis. The MDA's of gamma nuclides in the original and the replicate sample were higher due to the small aliquot available for gamma analysis.

3.0 ANALYTICAL NOTES

3.1 Gamma Scan Analyses: Gamma scan analysis did not find positive concentrations of gamma nuclides. The MDA's for ^{59}Fe, ^{60}Co, ^{137}Cs, and europium isotopes were higher than the required MDL because only 132 g was available for gamma analysis instead of 750 g required by MDA calculations. The MDA's for ^{59}Fe are higher than the RDL in all samples because of the short half life of ^{59}Fe.

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SECTION 2 Summary Data Including QC's

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TMA NORCAL
REPORTING GROUP 7115

SDG	7115
Contact	Dinkar Kharkar

Client	Westinghouse Hanford
Contract	MBH-SVV-069262

SUMMARY DATA SECTION

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Lab id	TMAN
Protocol	WHC-HEIS
Version	Ver 1.0
Form	DVD-TOC
Version	2.20
Report date	11/11/92

TMA NORCAL
REPORTING GROUP 7115

SDG 7115
Contact Dinkar Kharkar

REPORT GUIDE

Client Westinghouse Hanford
Contract MBH-SVV-069262

ABOUT THE DATA SUMMARY SECTION

The Data Summary Section of a Data Package has all data, in several useful orders, necessary for first level, routine review of the data package for a Sample Delivery Group (SDG). This section follows the Data Package Narrative, which has an overview of the data package and a discussion of special problems. It is followed by the Raw Data Section, which has full details.

The Data Summary Section has several groups of reports:

SAMPLE SUMMARIES

The Sample Summary Reports (variously titled LAB, SAMPLE, DEPARTMENT and QC SUMMARY to reflect the sort order) show all samples, including QC samples, reported in one SDG. These reports cross-reference client and lab sample identifiers.

PREPARATION BATCH SUMMARY

The Preparation Batch Summary Report shows all preparation batches (lab groupings reflecting how work was organized) relevant to the reported SDG with information necessary to check the completeness and consistency of the SDG.

WORK SUMMARY

The Work Summary Report shows all samples and work done on them relevant to the reported SDG.

REAGENT BLANKS

The Reagent Blank Reports, one for each Reagent Blank relevant to the SDG, show all results and primary supporting information for the blanks.

LAB CONTROL SAMPLES

The Lab Control Sample Reports, one for each Lab Control Sample relevant to the SDG, show all results, recoveries and primary supporting information for these QC samples.

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-RG
Version 2.20
Report date 11/11/92

ABOUT THE DATA SUMMARY SECTION

REPLICATES

The Replicate Reports, one for each Replicate and Original sample pair relevant to the SDG, show all results, differences and primary supporting information for these QC samples.

MATRIX SPIKES

The Matrix Spike Reports, one for each Spiked and Original sample pair relevant to the SDG, show all results, recoveries and primary supporting information for these QC samples.

DATA SHEETS

The Data Sheet Reports, one for each client sample in the SDG, show all results and primary supporting information for these samples.

RESULT SUMMARIES

The Result Summary Reports, one for each test used in the SDG, show all results and QC for one parameter on one page. (A test is a short code for the method used to do certain work to the client's specification.)

METHOD SUMMARIES

The Method Summary Reports, one for each test used in the SDG, show performance data for each method on one page.

REPORT GUIDES

The Report Guides, one for each of the above groups of reports, have documentation on how to read the associated reports.

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TMA NORCAL

REPORTING GROUP 7115

SAMPLE SUMMARY

SDG 7115
Contact Dinkar Kharkar

Client Westinghouse Hanford
Contract MBH-SVV-069262

CLIENT SAMPLE ID	MATRIX	CHAIN OF CUSTODY	COLLECTED	RECEIVED	SAMPLE WT/VOL	% MOIST	LAB SAMPLE ID	DEPARTMENT SAMPLE ID	QC BATCH
B01932	CONCRETE	002556	10/29/92	11/02/92			N211024-01	7115-001	7115
Reagent Blank	CONCRETE						N211024-03	7115-003	7115
Lab Control Sample	CONCRETE						N211024-02	7115-002	7115
Replicate (N211024-01)	CONCRETE		10/29/92				N211024-04	7115-004	7115

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-CS
Version 2.20
Report date 11/11/92

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TMA NORCAL

REPORTING GROUP 7115

SDG 7115
Contact Dinkar Kharkar

PREP BATCH SUMMARY

Client Westinghouse Hanford
Contract MBH-SVV-069262

TEST	MATRIX	METHOD	PREPARATION BATCH	PREP ERROR	PLANCHETS ANALYZED CLIENT	BLANK	LCS	REP/ORIG	MS/ORIG	QUALIFIERS
Gamma Spectroscopy										
GAM	CONCRETE	Gamma Scan	2713-176	15.0	1	1	1	1/1		

Replicates and Matrix Spikes are those with original (Client) sample in this Sample Delivery Group.
Blank and LCS planchets are those in the same preparation batch as some Client, Replicate or Spike sample.

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-PBS
Version 2.20
Report date 11/11/92

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TMA NORCAL

REPORTING GROUP 7115

WORK SUMMARY

SDG 7115
Contact Dinkar Kharkar

Client Westinghouse Hanford
Contract MBH-SVV-069262

CLIENT SAMPLE ID / MATRIX / CUSTODY	LAB SAMPLE ID / COLLECTED / RECEIVED	PLANCHET	TEST	SUF-FIX	ANALYZED	METHOD	REFERENCE
B01932 / CONCRETE / 002556	N211024-01 / 10/29/92 / 11/02/92	7115-001	GAM		11/05/92	Gamma Scan	
Reagent Blank / CONCRETE	N211024-03	7115-003	GAM		11/05/92	Gamma Scan	
Lab Control Sample / CONCRETE	N211024-02	7115-002	GAM		11/05/92	Gamma Scan	
Replicate (N211024-01) / CONCRETE / 002556	N211024-04 / 10/29/92 / 11/02/92	7115-004	GAM		11/05/92	Gamma Scan	

COUNTS OF TESTS BY SAMPLE TYPE

TEST	CLIENT	BLANK	LCS	REP SPIKE		TOTALS
GAM	1	1	1	1		4
TOTALS	1	1	1	1	0	4

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-CWS
Version 2.20
Report date 11/11/92

N211024-03

TMA NORCAL
REPORTING GROUP 7115

REAGENT BLANK

Reagent Blank

SDG 7115
Contact Dinkar Kharkar
Client Westinghouse Hanford
Contract MBH-SVV-069262

Lab sample id N211024-03
Dept sample id 7115-003
% moisture
Matrix CONCRETE
Material

PARAMETER	CAS NO	RESULT pCi/G	2σ ERR (COUNT)	MDA pCi/G	RDL pCi/G	QUALI-FIERS	TEST
GAMMA SCAN ANALYTES							
Potassium 40	13966-00-2	U		0.36		U	GAM
Iron 59		U		0.031	0.050	U	GAM
Chromium 51	14392-02-0	U		0.13		U	GAM
Cobalt 60	10198-40-0	U		0.024	0.050	U	GAM
Zinc 65	17982-39-3	U		0.039		U	GAM
Ruthenium 106	13967-48-1	U		0.19		U	GAM
Cesium 134	17967-70-9	U		0.023		U	GAM
Cesium 137	10045-97-3	U		0.021	0.050	U	GAM
Europium 152	14683-23-9	U		0.032	0.10	U	GAM
Europium 154	15585-10-1	U		0.022	0.10	U	GAM
Radium 226	13982-67-7	U		0.042	0.10	U	GAM
Thorium 228	14274-82-9	U		0.030		U	GAM
Thorium 232	7440-29-1	U		0.11		U	GAM

RDLs taken from WHC1\soil

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-DS
Version 2.20
Report date 11/11/92

N211024-02

TMA NORCAL

REPORTING GROUP 7115

LAB CONTROL SAMPLE

LAB CONTROL SAMPLE

SDG 7115
Contact Dinkar Kharkar

Client Westinghouse Hanford
Contract MBH-SVV-069262

Lab sample id N211024-02
Dept sample id 7115-002
% moisture

Matrix CONCRETE
Material

PARAMETER	RESULT pCi/G	2σ ERR (COUNT)	MDA pCi/G	RDL pCi/G	QUALI-FIERS	TEST	ADDED pCi/G	2σ ERR pCi/G	REC %	3σ LMTS (TOTAL)	PROTOCOL LIMITS
GAMMA SCAN ANALYTES											
Potassium 40	U		0.31		U	GAM					
Iron 59	U		0.053	0.050	U	GAM					
Chromium 51	U		0.16		U	GAM					
Cobalt 60	0.12	0.041		0.050		GAM	0.169	0.007	71	60-140	
Zinc 65	U		0.064		U	GAM					
Ruthenium 106	U		0.19		U	GAM					
Cesium 134	U		0.029		U	GAM					
Cesium 137	0.13	0.039		0.050		GAM	0.166	0.007	78	60-140	
Europium 152	U		0.036	0.10	U	GAM					
Europium 154	U		0.025	0.10	U	GAM					
Radium 226	U		0.050	0.10	U	GAM					
Thorium 228	U		0.032		U	GAM					
Thorium 232	U		0.13		U	GAM					

RDLs taken from WHC1\soil

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-LCS
Version 2.20
Report date 11/11/92

N211024-04

TMA NORCAL

REPORTING GROUP 7115

REPLICATE

B01932

SDG	7115			Client	Westinghouse Hanford
Contact	Dinkar Kharkar			Contract	MBH-SVV-069262
	REPLICATE		ORIGINAL		
Lab sample id	N211024-04	Lab sample id	N211024-01	Client sample id	B01932
Dept sample id	7115-004	Dept sample id	7115-001	Matrix	CONCRETE
		Received	11/02/92	Collected	10/29/92
% moisture		% moisture		Chain of custody id	002556

PARAMETER	REPLICATE pCi/G	2σ ERR (COUNT)	MDA pCi/G	RDL pCi/G	QUALI-FIERS	TEST	ORIGINAL pCi/G	2σ ERR (COUNT)	MDA pCi/G	QUALI-FIERS	RPD %	3σ TOT	PROT LIMIT
GAMMA SCAN ANALYTES													
Potassium 40	7.4	1.8				GAM	6.9	1.8			7	62	
Iron 59	U		0.35	0.050	U	GAM	U		0.26	U	-		
Chromium 51	U		1.0		U	GAM	U		1.1	U	-		
Cobalt 60	U		0.23	0.050	U	GAM	U		0.18	U	-		
Zinc 65	U		0.46		U	GAM	U		0.32	U	-		
Ruthenium 106	U		1.2		U	GAM	U		1.2	U	-		
Cesium 134	U		0.16		U	GAM	U		0.15	U	-		
Cesium 137	U		0.15	0.050	U	GAM	U		0.15	U	-		
Europium 152	U		0.26	0.10	U	GAM	U		0.54	U	-		
Europium 154	U		0.18	0.10	U	GAM	U		0.48	U	-		
Radium 226	0.52	0.41		0.10		GAM	0.54	0.24			4	138	
Thorium 228	0.35	0.19				GAM	0.67	0.21			63	90	
Thorium 232	U		0.74		U	GAM	0.50	0.48			39	216	

RDLs taken from WHC1\soil

Lab id	TMAN
Protocol	WHC-HEIS
Version	Ver 1.0
Form	DVD-REP
Version	2.20
Report date	11/11/92

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N211024-01

TMA NORCAL
REPORTING GROUP 7115

DATA SHEET

B01932

SDG	7115	Client	Westinghouse Hanford
Contact	Dinkar Kharkar	Contract	MBH-SVV-069262
Lab sample id	N211024-01	Client sample id	B01932
Dept sample id	7115-001	Matrix	CONCRETE
Received	11/02/92	Collected	10/29/92
% moisture		Chain of custody id	002556

PARAMETER	CAS NO	RESULT pCi/G	2σ ERR (COUNT)	MDA pCi/G	RDL pCi/G	QUALI-FIERS	TEST
GAMMA SCAN ANALYTES							
Potassium 40	13966-00-2	6.9	1.8				GAM
Iron 59		U		0.26	0.050	U	GAM
Chromium 51	14392-02-0	U		1.1		U	GAM
Cobalt 60	10198-40-0	U		0.18	0.050	U	GAM
Zinc 65	17982-39-3	U		0.32		U	GAM
Ruthenium 106	13967-48-1	U		1.2		U	GAM
Cesium 134	17967-70-9	U		0.15		U	GAM
Cesium 137	10045-97-3	U		0.15	0.050	U	GAM
Europium 152	14683-23-9	U		0.54	0.10	U	GAM
Europium 154	15585-10-1	U		0.48	0.10	U	GAM
Radium 226 Ra	13982-67-7	0.54	0.24		0.10		GAM
Thorium 228	14274-82-9	0.67	0.21				GAM
Thorium 232	7440-29-1	0.50	0.48				GAM

RDLs taken from WHC1\soil

Ra
Th

QUALITY DATA
REPORT

Lab id	TMAN
Protocol	WHC-HEIS
Version	Ver 1.0
Form	DVD-DS
Version	2.20
Report date	11/11/92

TMA NORCAL

REPORTING GROUP 7115

Test GAM Matrix CONCRETE
SDG 7115
Contact Dinkar Kharkar

RESULT SUMMARY

GAMMA SCAN

GAMMA SPECTROSCOPY

Client Westinghouse Hanford
Contract MBH-SVV-069262

CLIENT SAMPLE ID	LAB SAMPLE ID	SUF-FIX	PLANCHET	Cobalt 60	Cesium 137
Preparation batch 2713-176 Prep error 15.0 %					
B01932	N211024-01		7115-001	U	U
Blank (Stnd=9703)	N211024-03		7115-003	U	U
LCS (Stnd=9702)	N211024-02		7115-002	ok	ok
Replicate (N211024-01)	N211024-04		7115-004	- U	- U
Nominal values and limits from method			RDLs (pCi/G)	0.050	0.050
			RDLs taken from WHC1\soil		

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-CRS
Version 2.20
Report date 11/11/92

9513554.0940

TMA NORCAL

REPORTING GROUP 7115

Test GAM Matrix CONCRETE
SDG 7115
Contact Dinkar Kharkar

METHOD SUMMARY

GAMMA SCAN

GAMMA SPECTROSCOPY

Client Westinghouse Hanford
Contract MBH-SVV-069262

CLIENT SAMPLE ID	LAB SAMPLE ID	RAW TEST	SUF-FIX	PLANCHET	MAX MDA pCi/G	ALIQUOT G	RESID mg	YIELD %	COUNT min	FWHM keV	DAYS HELD	PREPARED	ANAL-YZED	DETECTOR
Preparation batch 2713-176 Prep error 15.0 %														
B01932	N211024-01			7115-001	0.26	132			101		8		11/05/92	JR,05,00
Blank (Stnd=9703)	N211024-03			7115-003	0.031	750			101				11/05/92	JR,01,00
LCS (Stnd=9702)	N211024-02			7115-002	0.053	750			100				11/05/92	JR,01,00
Replicate (N211024-01)	N211024-04			7115-004	0.35	135			100		8		11/05/92	JR,01,00
Nominal values and limits from method					0.050	750	-	-	100		180			

PROCEDURES RC-30 Ge(Li) Preparation

AVERAGES ± 2 SD FOR 4 SAMPLES
MDA 0.17 ± 0.31
YIELD ____ ± ____
FWHM ____ ± ____

SUMMARY DATA REPORT

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-CMS
Version 2.20
Report date 11/11/92

9513554.0941

TMA NORCAL

REPORTING GROUP 7115

QC SUMMARY

SDG 7115
Contact Dinkar Kharkar

Client Westinghouse Hanford
Contract MBH-SVV-069262

QC BATCH	CHAIN OF CUSTODY	CLIENT SAMPLE ID	MATRIX	COLLECTED	RECEIVED	SAMPLE WT/VOL	% MOIST	LAB SAMPLE ID	DEPARTMENT SAMPLE ID
7115	002556	B01932	CONCRETE	10/29/92	11/02/92			N211024-01	7115-001
		Reagent Blank	CONCRETE					N211024-03	7115-003
		Lab Control Sample	CONCRETE					N211024-02	7115-002
		Replicate (N211024-01)	CONCRETE	10/29/92				N211024-04	7115-004

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-QS
Version 2.20
Report date 11/11/92

TMA NORCAL
REPORTING GROUP 7115

SDG 7115
Contact Dinkar Kharkar

REPORT GUIDE

Client Westinghouse Hanford
Contract MBH-SVV-069262

SAMPLE SUMMARY

The Sample Summary Reports (variously titled LAB, SAMPLE, DEPARTMENT and QC SUMMARY to reflect the sort order) show all samples, including QC samples, reported in one Sample Delivery Group (SDG).

The following notes apply to this report:

* LAB SAMPLE ID is the lab's primary identification for a sample.

* DEPARTMENT SAMPLE ID is an alternate lab id, for example one assigned by a radiochemistry department in a lab.

* CLIENT SAMPLE ID is the client's primary identification for a sample. It includes any sample preparation done by the client that is necessary to identify the sample.

* QC BATCH is a lab assigned code that groups samples to be processed and QCed together. These samples should have similar matrices.

  QC BATCH is not necessarily the same as SDG, which reflects samples received and reported together.

* All Lab Control Samples, Reagent Blanks, Replicates and Matrix Spikes are shown that QC any of the samples. Due to possible reanalyses, not all results for all these QC samples may be relevant to the SDG. The Lab Control Sample, Reagent Blank, Replicate, Matrix Spike and Result Summary Reports detail these relationships.

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-RG
Version 2.20
Report date 11/11/92

TMA NORCAL
REPORTING GROUP 7115

SDG 7115
Contact Dinkar Kharkar

REPORT GUIDE

Client Westinghouse Hanford
Contract MBH-SVV-069262

PREPARATION BATCH SUMMARY

The Preparation Batch Summary Report shows all preparation batches in one Sample Delivery Group (SDG) with information necessary to check the completeness and consistency of the SDG.

The following notes apply to this report:

* The preparation batches are shown in the same order as the Report and Method Summary Reports are printed.

* Only analyses of planchets relevant to the SDG are counted.

* Each preparation batch should have at least one Reagent Blank and LCS in it to validate other results.

* The QUALIFIERS shown are all qualifiers other than U, J and B that occur on any analysis in the preparation batch. The Result Summary Report has these qualifiers on a per sample basis.

  These qualifiers should be reviewed as follows:

  X Some data has been manually entered or modified. Transcription errors are possible.

  P One or more results are 'preliminary'. The data is not ready for final reporting.

  2 There were two or more results for one parameter on one planchet imported at one time. The results in DVD may not be the same as on the raw data sheets.

  Other lab defined qualifiers may occur. In general, these should be addressed in the SDG narrative.

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-RG
Version 2.20
Report date 11/11/92

TMA NORCAL
REPORTING GROUP 7115

SDG 7115
Contact Dinkar Kharkar

REPORT GUIDE

Client Westinghouse Hanford
Contract MBH-SVV-069262

WORK SUMMARY

The Work Summary Report shows all samples, including QC samples, and all relevant analyses in one Sample Delivery Group (SDG).

The following notes apply to this report:

* TEST is a code for the method used to measure related parameters. Results and related information for each parameter are on the Data Sheet Report. In special cases, a test code used in the summary data section is not the same as in associated raw data. In this case, both codes are shown on the Work Summary.

* SUFFIX is the lab's code to distinguish multiple analyses (recounts, reworks, reanalyses) of a fraction of the sample. The suffix indicates which result is being reported. An empty suffix normally identifies the first attempt to analyze the sample.

* The LAB SAMPLE ID, TEST and SUFFIX uniquely identify all supporting data for a result. The Method Summary Report for each TEST has method performance data, such as yield, for each lab sample id and suffix and procedures used in the method.

* PLANCHET is an alternate lab identifier for work done for one test. It, combined with the TEST and SUFFIX, may be the best link to raw data.

* For QC samples, only analyses that directly QC some regular sample are shown. The Lab Control Sample, Reagent Blank, Replicate, Matrix Spike and Result Summary Reports detail these relationships.

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-RG
Version 2.20
Report date 11/11/92

TMA NORCAL
REPORTING GROUP 7115

SDG 7115
Contact Dinkar Kharkar

REPORT GUIDE

Client Westinghouse Hanford
Contract MBH-SVV-069262

DATA SHEET

The Data Sheet Report shows all results and primary supporting information for one client sample or Reagent Blank. This report corresponds to both the CLP Inorganics and Organics Data Sheet.

The following notes apply to this report:

* TEST is a code for the method used to measure a parameter. If the TEST is empty, no data is available; the parameter was not analyzed for.

* The LAB SAMPLE ID and TEST uniquely identify work within the Summary Data Section of a Data Package. The Work Summary and Method Summary Reports further identify raw data that underlies this work.

  The Method Summary Report for each TEST has method performance data, such as yield, for each Lab Sample ID and a list of procedures used in the method.

* ERRORs can be labeled TOTAL or COUNT. TOTAL implies a preparation (non-counting method) error has been added (as sum of squares) to the counting error denoted by COUNT. The preparation errors, which may vary by preparation batch, are shown on the Method Summary Report.

* A RESULT can be 'N.R.' (Not Reported). This means the lab did this work but chooses not to report it now, possibly because it was reported at another time.

* When reporting a Reagent Blank a RESULT can be 'N.A.' (Not Applicable). This means there is no reported client sample work in the same preparation batch as the Blank's result. This is likely to occur when the Reagent Blank is associated with reanalyses of selected work for a few samples in the SDG.

The following qualifiers are defined by the DVD system:

U The RESULT is less than the MDA (Minimum Detectable Activity). If the MDA is blank, the ERROR is used as the limit.

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Protocol WHC-HEIS
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Version 2.20
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DATA SHEET

J — If the RESULT is less than the RDL (Required Detection Limit) and no U qualifier is assigned.

B — Some Reagent Blank that QC's this sample had a non-U result and, after correcting for possibly different aliquots, that result is greater than or equal to the MDA for this sample.

For each sample result, all Reagent Blank results in the same preparation batch are compared. The Result Summary Report documents this relationship.

P — The RESULT is 'preliminary'.

X — Some data necessary to compute the RESULT, ERROR or MDA was manually entered or modified.

2 — There were two or more results available for this parameter. The reported result may not be the same as in the raw data.

Other qualifiers are lab defined. Definitions should be in the SDG narrative.

The following values are underlined to indicate possible problems:

* An MDA is underlined if it is bigger than its RDL.

* An ERROR is underlined if the 2 sigma counting error is bigger than both the MDA and the RESULT, implying that the MDA may not be a good estimate of the 'real' minimum detectable activity.

* A negative RESULT is underlined if it is less than the negative of its 2 sigma counting ERROR.

TMA NORCAL
REPORTING GROUP 7115

SDG 7115
Contact Dinkar Kharkar

REPORT GUIDE

Client Westinghouse Hanford
Contract MBH-SVV-069262

LAB CONTROL SAMPLE

The Lab Control Sample Report shows all results, recoveries and primary supporting information for one Lab Control Sample.

The following notes apply to this report:

* All fields in common with the Data Sheet Report have similar usage. Refer to its Report Guide for details.

* Amounts ADDED are the lab's estimate of the actual amount spiked into this sample with their ERROR an estimate of the error of this amount.

  An amount is underlined if its ratio to the corresponding RDL is outside protocol specified limits.

* REC (Recovery) is RESULT divided by ADDED expressed as a percent.

* The first, computed limits for the recovery reflect:

  1. The error of RESULT, including that introduced by rounding the result prior to printing.

     If the limits are labeled (TOTAL), they include preparation error in the result. If labeled (COUNT), they do not.

  2. The error of ADDED.

  3. A lab specified, per parameter bias. The bias changes the center of the computed limit range.

* The second limits are protocol defined upper and lower QC limits for the recovery.

* The recovery is underlined (out of spec) if it is outside either of these ranges.

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REPLICATE

The Replicate Report shows all results, differences and primary supporting information for one Replicate and associated Original sample.

The following notes apply to this report:

* All fields in common with the Data Sheet Report have similar usage. This applies both to the Replicate and Original sample data. Refer to the Data Sheet Report Guide for details.

  If the Replicate has data for a TEST and the lab did not do this test to the Original, the Original's RESULTs are underlined.

* The RPD (Relative Percent Difference) is the absolute value of the difference of the RESULTs divided by their average expressed as a percent.

  If both RESULTs are less than their MDAs, no RPD is computed and a '-' is printed.

  For a parameter, if the lab did work for both samples but has data for only one, the MDA from the sample with data is used as the other's result in the RPD.

* The first, computed limit is the (quadratic) sum of the errors of the results divided by the average result as a percent, hence the relative error of the difference rather than the error of the relative difference. The errors including that introduced by rounding the RESULTs prior to printing.

  If this limit is labeled TOT, it includes the preparation error in the RESULTs. If labeled CNT, it does not.

  This value reported for this limit is at most 999.

* The second limit for the RPD is the larger of:

  1. A fixed percentage specified in the protocol.

  2. A protocol factor (typically 2) times the average MDA as

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REPLICATE

a percent of the average result. This limit applies when the results are close to the MDAs.

* The RPD is underlined (out of spec) if it is greater than either limit.

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MATRIX SPIKE

The Matrix Spike Report shows all results, recoveries and primary supporting information for one Matrix Spike and associated Original sample.

The following notes apply to this report:

* All fields in common with the Data Sheet Report have similar usage. This applies both to the Spiked and Original sample data. Refer to the Data Sheet Report Guide for details.

  If the Spike has data for a TEST and the lab did not do this test to the Original, the Original's RESULTs are underlined.

* Amounts ADDED are the lab's estimate of the actual amount spiked into the Spike sample with their ERROR an estimate of the error of this amount.

  An amount is underlined if its ratio to the corresponding RDL is outside protocol specified limits.

* REC (Recovery) is the Spike RESULT minus the Original RESULT divided by ADDED expressed as a percent.

* The first, computed limits for the recovery reflect:

  1. The errors of the RESULTs, including that introduced by rounding them prior to printing.

     If the limits are labeled (TOTAL), they include preparation error in the result. If labeled (COUNT), they do not.

  2. The error of ADDED.

  3. A lab specified, per parameter bias. The bias changes the center of the computed limit range.

* The second limits are protocol defined upper and lower QC limits for the recovery.

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GUIDE, cont.

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MATRIX SPIKE

These limits are left blank if the Original RESULT is more than a protocol defined factor (typically 4) times ADDED. This is a way of accounting for that when the spike is small compared to the amount in the original sample, the recovery is unreliable.

* The recovery is underlined (out of spec) if it is outside either of these ranges.

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RESULT SUMMARY

The Result Summary Report shows up to four results measured using one method. There is one report for each TEST, as used on the Data Sheet Report. The corresponding Method Summary Report has method performance data.

The following notes apply to this report:

* Each per method report is subdivided into sections, one for each preparation batch. A preparation batch should be work done over a restricted period of time by a small group of people in a defined area of the lab.

  There should be Lab Control Sample and Reagent Blank results in each preparation batch since this close correspondence makes the QC meaningful. Depending on lab polcy, Replicates need not occur in each batch since they QC sample dependencies such as matrix effects.

* If a result is less than both its MDA and RDL, it is replaced by just 'U' on this report. If it is greater than or equal to the RDL but less than the MDA, the result is shown with a 'U' flag.

  The J and X flags are as on the data sheet.

* Non-U results for Reagent Blanks are underlined to indicate possible contamination of other samples in the preparation batch. The Reagent Blank Report has supporting data.

* Lab Control Sample and Matrix Spike results are shown as: ok, No data, LOW or HIGH, with the last two underlined. 'No data' means no amount ADDED was specified. 'LOW' and 'HIGH' correspond to when the recovery is underlined on the Lab Control Sample or Matrix Spike Report. See it for supporting data.

* Replicate sample results are shown as: ok, No data, or OUT, with the last two underlined. 'No data' means there was no original sample data found for this replicate. 'OUT' corresponds to when the RPD is underlined on the Replicate Report. See it for supporting data.

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RESULT SUMMARY

For some methods, ratios as percentages and error estimates for them are computed for pairs of results. A ratio column header like '1÷3' means the ratio of the first result column and the third result column.

The error estimate for a ratio reflects the errors of RESULTs, including errors introduced by rounding the RESULTs prior to printing and the preparation error if one is shown for the preparation batch.

> The preparation error is included once, not once for each result, since preparation errors for the results should be highly correlated.

The ratio is underlined (out of spec) if the absolute value of its difference from a nominal value is greater than its error estimate.

Average ratios are computed. These do not include ratios from Lab Control Sample, Reagent Blank or Matrix Spike results since their matrices are not necessarily similar to normal sample's.

For Gross Alpha or Gross Beta results, there may be a column showing the sum of other Alpha or Beta emitters. This sum includes all relevant results in the DVD database, whether reported or not. Results in the sum are weighted by a particles/decay value specified by the lab for each relevant parameter. Results less than their MDA are not included. No sums are computed for QC Samples since their various planchets may not be physically related.

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Protocol WHC-HEIS
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REPORT GUIDE

Client Westinghouse Hanford
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METHOD SUMMARY

The Method Summary Report shows performance data for one method. There is one report for each TEST, as used on the Data Sheet Report.

The following notes apply to this report:

* Each per method report is subdivided into sections, one for each preparation batch. A preparation batch should be work done over a restricted period of time by a small group of people in a defined area of the lab.

  There should be Lab Control Sample and Reagent Blank results in each preparation batch since this close correspondence makes the QC meaningful. Depending on lab policy, Replicates need not occur in each batch since they QC sample dependencies such as matrix effects.

* The RAW TEST column shows the test code used in the raw data to identify a particular analysis if it is different than the test code in the header of the report. This occurs in special cases due to method specific details about how the lab labels work.

  The Lab Sample or Planchet ID combined with the (Raw) Test Code and Suffix uniquely identify the raw data for each analysis.

* If the MDA column is labeled 'MAX MDA', there was more than one result measured by the reported method and the MDA shown is the largest MDA. If not all these results have the same RDL, the MAX MDA reflects only those results with RDL equal to the smallest one.

  MDAs are underlined if greater than the RDL; the smallest RDL if there is more than one.

* Aliquots are underlined if less than a nominal value specified for the method.

* Residues are underlined if outside a range specified for the method.

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METHOD SUMMARY

* Yields, which may be a gravimetric yield, chemical recovery or detector efficiency depending on the method, are underlined if outside a range specified for the method.

* Count times are underlined if less than a nominal value specified for the method.

* Resolutions (as FWHM; Full Width at Half Max) are underlined if greater than a method specified limit.

* Days Held are underlined if greater than a holding time specified in the protocol.

* Analysis dates are underlined if before their sample's preparation date.

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-RG
Version 2.20
Report date 11/11/92

95135554.0956

APPENDIX 1

COPIES OF CHAINS-OF-CUSTODY

9513554.0957

Westinghouse Hanford Company	CHAIN OF CUSTODY	002556

Custody Form Initiator C E Zerby

Company Contact C E Heiden — Telephone 509-376-2640

Project Designation/Sampling Locations Riverland and 100 area — Collection Date 10-29-92

Ice Chest No. — Field Logbook No. Lottenzos #21

Bill of Lading/Airbill No. 252156 8555 — Offsite Property No.

Method of Shipment airlifted via Emery Air Express

Shipped to TMA / NORCAL

Possible Sample Hazards/Remarks none Known. See analysis Request for bottle size and analysis. SAF. 92-313 Priority Turnaround

Sample Identification

B01932 (2) bottles

B01938 (1) Bottles

B01940 (1) Bottle

CEZ 10-30-92

☐ Field Transfer of Custody — CHAIN OF POSSESSION — (Sign and Print Names)

Relinquished by:	Received by:	Date/Time:
C E Zerby C E Zerby	Kermit Blum	11-2-92 0800 *
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

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Final Sample Disposition

Disposal Method:	Disposed by:	Date/Time:

Comments:

* Received @ TMA / NORCAL 10-31-92 ; opened 11-2-92 . KB

A-6000-407 (12/90)

9513354.0958

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

COC 002556

Collector C.E. Zerby / M.L. Myers Date 10-30-92

Company Contact C.E. Heiden Telephone (509) 376-2640

Sample Number	*	Date Collected	Time Collected	Number and Type of Sample Containers/Analysis Requested
B01932	X	10-29-92	0927	(1) 250ml aG TPH Diesel Range SW-846 8015m
B01932	X	10-29-92	0927	(1) 250 ml aG Gamma Spec. RL-4303 RL-4304
B01938	S	10-29-92	1245	(1) 250 ml aG NO2 NO3 EPA 353.2
B01940	S	10-29-92	1415	(1) 500 ma G Herbicides SW-846 8150 / PCB / Pesticides CLP

CEZ 10-30-92

*Type of Sample: A = Air; DL = Drum Liquids; DS = Drum Solids; L = Liquid; O = Oil; S = Soil; SE = Sediment; SL = Sludge; SO = Solid; T = Tissue; W = Water; WI = Wipe; X = Other

Field Information X = Concrete S.A.F. 92-313
Priority Turnaround Protocols Cercla

Special Handling and/or Storage CEZ 10-30-92 Sample Tube Kept at 4°c until Analysis

Possible Sample Hazards none Known

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A-6000-406 (06/91)

FORM OF PAYMENT

Check ☐ GBL ☐ FCCOD ☐

Bill to Shipper XX Bill to Consignee ☐ Third Party Billing ☐

Shipper's Account Number: E A502815B5

EMERY WORLDWIDE — A CF Company

SERVICES **

UNITED STATES / CANADA: Same Day (Extra Charges) ☐ AM ☐ PM ☐ Second Day ☐ Saturday Delivery XX

INTERNATIONAL: Express ☐ Standard Plus ☐ Preferred ☐ Standard ☐ Business Documents ☐ Customs Clearance ☐ Delivery ☐

Date: 10-30-92 Origin: PSC Shipment Number: 252156855 5

From:
WESTINGHOUSE SHIPPING DEPT (509) 376-6666
U.S. DEPARTMENT OF ENERGY C/O
WESTINGHOUSE HANFORD
BLDG 1163
2355 STEVENS DRIVE
RICHLAND WA
Canada ☐
Customer's Reference Numbers: W12410 PB42G W93-0-0002#34
Zip: 99352

To:
DELORES SANCHEZ
TMA/NORCAL
2030 WRIGHT AVENUE
RICHMOND CA
Hold for Pick Up ☐ Canada ☐
Consignee's Account Number: E
94804

Tariff Dest. | Gateway

Check to Shipper $

EMERY WORLDWIDE will accept Consignee's check with all risks being assumed by Shipper, including but not limited to non-payment, fraud and misrepresentation.

Description	Pcs.	L	W	H	Total Pieces	Total Weight (in Lbs.)
1 COOLER PNL-BLT-11 SAMPLES B01932,B01938, B01940 SAMPLES	1	20	11	17	1	9

FOR INFORMATION OR RATES CALL 1-800 44 EMERY (1-800-443-6379)

Declared Value $

2 5 2 1 5 6 8 5 5 5

Remarks: SATURDAY DELIVERY

Shipper's Signature X J. Lemaunt 11/2

Zip Ship ☐ For shipments within the 50 United States Shipper has the option to check this box and, by checking, agrees that the Zip Ship conditions, described in the area to the right, apply.

Mark if Emery Packaging is used: Urgent Letter 9X12 ☐ Urgent Pack 12X15 ☐

International Shipments: Free Domicile ☐ Commodity Code

Third Party Account Number mandatory for Third Party Billing. Third Party Account Number: E

International Customs Value | International Insurance

Base Charge

Total Transportation Charges | Other Charges/Advance at Origin ☐ OC/AO- $

1-OAK 5A

Terms and Conditions on Back

9913534*0959

62 29

9513554.0960

APPENDIX 2

ANALYTICAL METHODS USED

ANALYTICAL METHODS USED - SOIL AND PLANT MATERIAL

1. Gross Alpha and Gross Beta: Approximately 5 gram of soil was dissolved by $HF-HNO_3-HCl$ treatment. The dissolved solution was made to a known volume. A volume equivalent to 0.1 gram of soil was uniformly deposited on a stainless steel planchet, weighted, and counted on a low background proportional counter for gross alpha and gross beta determination.

2. Carbon-14 Analysis: An aliquot of soil is combusted in the furnace at 925°C in the presence of oxygen and CuO. The Co_2 is absorbed in $BaCl_2$ to form $BaCo_3$, filtered and placed in a scintillation vial and counted in the LSC counter in the presence of the scintillator.

3. Strontium-90: ^{90}Sr was determined on a 1 gram aliquot. Approximately 3 gram dry soil was dissolved completely by $HF-HNO_3-HCl$ treatment and made to a known volume. One gram aliquot was taken for ^{90}Sr determination. Yttrium carrier was added Yttrium was extracted by HDEHP extraction. Yttrium was converted to yttrium oxide and beta counted.

4. Isotopic Uranium, Plutonium, Americium, and Curium: U, Pu, Am, and Cm were determined by adding appropriate tracers in the dissolved sample and purified by selective ion exchange procedures. Am and Cm are further purified with a DDCP extraction procedure and coprecipitated with a yttrium scavenge. The purified extract is electrodeposited on a stainless steel disc for alpha pulse height spectroscopy. The plutonium plate is striped with HNO_3 and ^{241}Pu is counted in a liquid scintillation counter with an appropriate cocktail.

5. Technetium-99: Approximately 2 gram was ashed at 500°C with ^{99m}Tc tracer and ammonia. The ash was leached with H_2SO_4 and $K_2S_2O_8$. The leached sample is filtered. H_2SO4 and $K_2S_2O_8$ was added to a 10 mL aliquot of water. The water and the leached sample of soil was extracted with TBP and purified by coprecipitation and anion exchange procedure. The purified Tc was electroplated on a stainless steel disc and counted on a gamma detector to determine yield. After decay of ^{99m}Tc, the disc was counted on a low background beta counter.

6. Gamma-Scan: Approximately 200 to 750 gram dry soil was placed in an appropriate geometry and counted on a Ge(Li) detector.

9513354.0962

APPENDIX 3

ALIQUOT INFORMATION

176 11-05-92 7115 "RUSH" 11-05-92

TMA #	Customer I.D.	T°	RECEIVED wt. G	T	N	Bond By	DRIED wt. G	N
7115-1	B01932	10-29-92	308.52 g	16.46	292.06		283.01	266.55 g
-2	QC.LCS		NA	NA	NA		NA	NA
	9702							
-3	QC. Blank							
	9703							
-4	QC. Dup #1	10-29-92						
	9704							
-5								
11-05-92								

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11-05-92

...t.		Done	Chem	DRIED		Done	Checked	Aligned	Geom	Done	Checked
	N	By	By G	N	N	By	By	GLS	GLS	By	By
6	292.06	11-05-92	283.01		266.55 g	11-05-92		131.50 g	JR	11-05-92	
	NA		NA		NA			1.05 mpl.	JR.		
								1.0 smpl.	JR.		
								135.05 g	JR		

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7115 - WORK RECORD

Analyst Date	Samples	Analysis	Procedure	Steps.
JH 11-05-92	1 → 4	(GLS)	EP-2 soil prep. & digesting	all

9513354.0966

APPENDIX 4

PREPARATION LOG FOR QC SAMPLES

QC Number	TMA/Norcal Number	Date	Analysis Required	Requestor (Program)	Recd By	Spike Wt.	SPIKE: Volume & ID of Spike Tracer	Total Activity (dpm)	% Error	Activity Date	Spike Wt. (g)	INFORMATION: Matrix	Container	Remarks	Date Recd	From	Analysis OK	ANALYSTS: NK	CK
9687	9439-6	11/4/92	DK/C 80	DK/C	RP	✓	—	—			—	10ml 1N HCl	50ml Beaker						
9688	6	"	U^{233}	"	RP	✓	—	—			—	10ml 1N HNO_3	"						
9689	6	"	Ra^{226}	"	RP	✓	—	—			—	10ml 1N HCl	"						
9690	6	"	H^3 dic	"	RP	✓	—	—			—	5ml H_2O	LSC vial						
9691	9440-5	"	H^3 dic	"	RP	✓	—	—			—	"	"						
9692	5	"	80	"	RP	✓	—	—			—	10ml 1N HCl	50ml Beaker						
9693	5	"	U^{235}	"	RP	✓	—	—			—	"	"						
9694	9436-8	"	80	"	RP	✓	2ml Am^{241} FI-E 1ml Sr^{90} MI-D(2)	40.04 β=36.42	2.0 "	10-92 "	2.00 1.00	10ml 1N HCl	50ml Beaker						
9695	8	"	H^3	"	RP	✓	200 H^3 TI	212.2	"	"	.20	5ml H_2O	LSC vial						
9696	8	"	U^{238}	"	RP	✓	1ml U^{238} EI-E	9.640	"	"	1.02	10ml 1N HNO_3	50ml Beaker						
9697	8	"	Ra^{226}	"	RP	✓	500µl Ra^{226} FI-C(2)	11.70	"	"	.50	10ml 1N HCl	"						
9698	9441-6	"	80	"	RP	✓	2ml Am^{241} FI-E 1ml Sr^{90} MI-D(2)	40.04 β: 36.42	" "	" "	2.00 1.00	"	"						
9699	6	"	H^3	"	RP	✓	200µl H^3 TI	212.2	"	"	.20	5ml H_2O	LSC vial						
9700	6	"	U^{238}	"	RP	✓	1ml U^{238} EI-E	9.640	"	"	1.02	10ml 1N HNO_3	50ml beaker						
9701	6	"	Ra^{226}	"	RP	✓	500µl Ra^{226} FI-C(2)	11.70	"	"	.50	10ml 1N HCl	"						
9702	7115-2	"	GLY	DK/E	RP	✓	1.5 Cs^{137} FI-A-H 1ml Co^{60} EI-B	281.1 315.4	" "	" "	1.52 1.00	"	"						
9703	3	"	GLY	"	RP	✓	—	—			—	"	"						
9704	4	"	GLY	"			Dup of 7115-1												

9513554.0968

APPENDIX 13

GAMMA SCAN SPIKE

9513354.0969

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

Co^{60} E1

Calibration Certificate

Description

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

Nominal activity: 90.2 nano curies

Nominal volume: 5 ml in ampoule/bottle number: 2506-1

Measurement Activity of principal radionuclide

Activity per gram of this solution

18.04 nano curies of Cobalt-60

at 0400 hours PST on July 19, 1988

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

Useful Life

This radionuclide has decayed through 0.02 half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after January 1999

Co^{60} E1

$18.0 \frac{nCi}{g} \times 4.9584 g \times 2220 \frac{dpm}{nCi} \times \frac{1}{100 ml} = 1986. dpm\ Co^{60}/ml \pm 0.842.$ @ 201.500-88

Carrier Content = 0.0265 mg Co/ml 0.1 N HCl Prep'd by K. Yamamoto 2/24/92

Rec'd 2/11/91 K. Yamamoto

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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 ± 0.40%. (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

+1.22% or -1.22%

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 +2.52%, -2.52% 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 transitions.

Chemical Composition of Solution

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

Preservative:

Remarks

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Date Certificate Prepared January 10, 1991

Approval Signature Paul B. Hahn

Revised 1/84

4 FEB 92 — Preparation of U^{232} F-G1-B-(4) — MCS/NM

KY — Transferred the remainder, ~225 ml, of U^{232} F-G1-B-(1) into an 8oz PB.

5,164 dpm U^{232}/ml ± 0.3% @ 206,842-91

K. Yamamoto

4 FEB 92 — Preparation of Th^{227} B-C1-B-(11) — MCS/NM

KY — Transferred ~250ml of Th^{227} B-C1-B-(8) into an 8oz PB.

9,647 dpm Ac^{227}-Th^{227}/ml ± 0.7% @ 144,655-90

K. Yamamoto

24 FEB 92 — Preparation of Co^{60} E1

KY

Gross	84.2915 g	Tared a 100ml vol flask with top using the Balance A (Mettler H10). Broke off the tips of the sealed vial (EPA ampoule no. 2506-1, 18.04nCi Co^{60}/g at 0400 hrs PST on 7/19/88)
Tare	79.3331	
Net	4.9584 g	

Transferred the Co^{60} solution to the tared flask. Weighed the flask + top + Co^{60} solution. Pipetted 250µl of ~~Co~~ KY 2/24/92 Co Carrier F1 (10.00mg Co/ml) into the flask. Diluted to mark with 0.1N HCl. Transferred to a 4oz PB.

From Certificate: KY 2/24/92

$$\frac{18.04\,nCi}{g} \times 4.9584\,g \times \frac{2220\,nCi/g\ dpm}{nCi} \times \frac{1}{100\,ml} = 1986\ dpm\ Co^{60}/ml \pm 0.84\%$$

@ 201,500-88

Carrier Content:

$$\left(\left[4.9584\,g \times \frac{0.030\,mg\,Co}{g}\right] + \left[0.250\,ml \times \frac{10.00\,mg\,Co}{ml}\right]\right) \times \frac{1}{100\,ml} = 0.0265\,mg\,Co/ml$$

MCS 2/24/92

K. Yamamoto

1/27/92 RP — Prep of Am^{243} H-E2-C-(3)

Pipetted 25ml of Am^{243} H-E2 into a 250ml vol flask, adjusted to 250ml with 1N HCl, transferred to 8oz PB.

99.58 dpm/ml ± 0.7% 262.000-91

R Brenton

1/27/92 RP — Prep of Am^{243} H-E2-C-(4)

Transferred 100ml of Am^{243} H-E2-C(3) into 4oz PB

99.08 dpm/ml Am^{243} ± 0.7% 262.000-91

R Brenton

1/27/92 RP — Dilution (Back of Am^{243} H-E2-C-(3) DD8 (112, 113)

Pipetted 500µl Am^{243} H-E2-C(3) and 1ml Am^{241} A-F3-A into 2 each 50ml beakers Cont TS-AM-1 4/88/Rev1, Step 2-9.

R Brenton

1/27/92 RP — Prep of Co^{60} E1-B

Pipetted 25ml of Co^{60} E1 into 100ml vol flask, add 200µl of Co G1 (1000mg/ml) carrier, adjusted to mark with 1N HCl, transferred to 4oz PB.

496.5 dpm/ml Co^{60} ± 0.9% @ 201.500-89

38

$\left[(.0265\,\frac{mg\,Co}{ml} \times 25ml) + .2ml \times 10.00\,\frac{mg\,Co}{ml}\right] \frac{1}{100ml} = .0266\ mg\,Co/ml$

R Brenton

9513554.0973

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

Calibration Certificate

Cs^{137} F1

Description

Principal radionuclide: CESIUM-137 Half-life: 30.17 years

Nominal activity: 45.8 nano curies

Nominal volume: 5 ml in ampoule/bottle number: 2437-2

Measurement Activity of principal radionuclide

Activity per gram of this solution

9.16 nano curies of Cesium-137

at 0400 hours PST on September 21, 1988

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

8.67 nano curies Per gram

of the daughter nuclide Barium-137m

Total mass of this solution

APPROX. 5.0 grams

Method of measurement

The activity of the primary solution was measured using four pi efficiency tracing.

The activity of the dilution was measured using gamma spectroscopy counting.

39

Useful Life

This radionuclide has decayed through 0.07 half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after January 1995

Cs^{137} F1 Prep'd 2/5/90 by K. Yamamoto

$9.16 \frac{nCi}{g} \times 4.9682 g \times 2220 \frac{dpm}{nCi} \times \frac{1}{100ml} = 1010.$ dpm Cs^{137}/ml ± 1.0% @ 265,500-88

0.1N HCl Cs Carrier Conc = 111. µg Cs/ml or 281 µg Cs_2PtCl_6/ml

Rec'd. 3/24/89
K. Yamamoto

Fe Yields Bal. A Mettler HD

9-30-92 RP	Fe + Cu discs Gross wt	Cu discs tare wt	Fe° wts	Fe + Cu discs + krylon gross wt	Krylon wt
1015- 17	.8255	.8131	12.4 mg	.8281	.0150
18	.8471	.8331	14.0 mg	.8496	.0165
-19	.8297	.8164	13.3 mg	.8322	.0158
20	.7953	.7782	17.1 mg	.7983	.0201
21	.8387	.8187	20.0 mg	.8418	.0231
22	.8387 10/2/92 RP	.8154	23.1 mg	.8430	.0276
-23	.8548	.8304	24.4 mg	.8581	.0277
24	.8508	.8236	27.2 mg	.8544	.0308

*~~20~~ #19 power supply on plater amps fluxsurated found at 350 ma 10-2-92 RP
un 10-2-92 RP

9-28-92 RP

Prep of Cs^{137} F1-A-(4)
Pippetted 20ml Cs^{137}F1 into 100ml vol flask. Added 290µl Cs carrier B-10A 10-B1 into flask. Diluted to mark with 1N HCl. Transfer to 8oz PB. Repeated same aliquot combined to 8oz PB = 200mls of Cs^{137} F1-A (4)

202.0 dpm/ml Cs^{137} ± 1.0% @ 265.500-88

.164 mg CsPtCl₆/ml

R Brenton

APPENDIX 16

PRIMARY CALIBRATION REFERENCES, INCLUDED ARE CERTIFICATES OF CALIBRATION FOR THE FOLLOWING DETECTORS:

LBG Beta Counters
LB4000 Gas Proportional Counters
LB4000 GPC for Gross Alpha/Beta
Gamma Spectrometers G1, G2, G3, G4, and G5 for Efficiency Versus Energy

Certificate of Calibration		TMA/*Norcal*
Calibration: ^{90}Y	Instrument: LBG beta counters	Type: Gas Flow Geiger Counter

Calibration Standard:

^{90}Y - Solution SRM 4234-38 from NBS (^{90}Sr)

Status	Date	Reference Document
Original Calibration:	March, 1980	CAL 7902
Verification:		

Summary of Results

Standard Efficiency = 56.85%
P-Factor = 1.759

Self Absorption Correction Table
Spline fit

Planchet area = 3.30 sq cm
T = Sample thickness in mg/sq cm = total weight/3.30
PPT = Self absorption divisor

T	PPT	T	PPT	T	PPT	T	PPT
0.00	0.9450	3.05	0.9990	6.09	0.9888	9.14	0.9779
0.14	0.9531	3.18	0.9990	6.23	0.9883	9.28	0.9774
0.27	0.9613	3.32	0.9990	6.37	0.9878	9.41	0.9769
0.41	0.9694	3.45	0.9985	6.50	0.9873	9.55	0.9764
0.54	0.9775	3.59	0.9977	6.64	0.9868	9.68	0.9760
0.68	0.9849	3.72	0.9972	6.77	0.9864	9.82	0.9755
0.81	0.9895	3.86	0.9967	6.91	0.9859	9.95	0.9750
0.95	0.9940	4.00	0.9962	7.04	0.9854	10.09	0.9745
1.08	0.9967	4.13	0.9958	7.18	0.9849	10.23	0.9740
1.22	0.9982	4.27	0.9953	7.31	0.9844	10.36	0.9735
1.35	0.9995	4.40	0.9948	7.45	0.9840	10.50	0.9730
1.56	1.0010	4.60	0.9941	7.65	0.9832	10.70	0.9723
1.69	1.0010	4.74	0.9936	7.79	0.9828	10.83	0.9718
1.83	1.0010	4.88	0.9931	7.92	0.9823	10.97	0.9713
1.96	1.0010	5.01	0.9926	8.06	0.9818	11.11	0.9709
2.10	1.0010	5.15	0.9921	8.19	0.9813	11.24	0.9704
2.23	1.0000	5.28	0.9917	8.33	0.9808	11.38	0.9699
2.37	1.0000	5.42	0.9912	8.46	0.9803	11.51	0.9694
2.51	1.0000	5.55	0.9907	8.60	0.9798	11.65	0.9689
2.64	0.9997	5.69	0.9902	8.74	0.9794	11.78	0.9684
2.78	0.9994	5.82	0.9897	8.87	0.9789	11.92	0.9679
2.91	0.9992	5.96	0.9893	9.01	0.9784	12.05	0.9675

Certificate of Calibration		TMA/*Norcal*
Calibration: ^{90}Y	Instrument: LB4000 (2")	Type: 2" Gas Proportional Counter
Calibration Standard: ^{90}Y - Solution 2454-2 from EPA - EMSL		
Status	**Date**	**Reference Document**
Original Calibration:	January, 1991	TLW 6229
Verification:		
Summary of Results	Standard Efficiency = 63.57% P-Factor = 1.573	

Self Absorption Correction Table
Spline fit

Planchet area = 3.30 sq cm
T = Sample thickness in mg/sq cm = total weight/3.30
PPT = Self absorption divisor

T	PPT	T	PPT	T	PPT	T	PPT
0.00	1.0400	3.05	0.9999	6.09	0.9879	9.14	0.9758
0.14	1.0372	3.18	0.9994	6.23	0.9873	9.28	0.9752
0.27	1.0343	3.32	0.9989	6.37	0.9868	9.41	0.9746
0.41	1.0314	3.45	0.9983	6.50	0.9863	9.55	0.9740
0.54	1.0285	3.59	0.9978	6.64	0.9857	9.68	0.9735
0.68	1.0263	3.72	0.9972	6.77	0.9852	9.82	0.9729
0.81	1.0250	3.86	0.9967	6.91	0.9846	9.95	0.9723
0.95	1.0231	4.00	0.9962	7.04	0.9841	10.09	0.9717
1.08	1.0200	4.13	0.9956	7.18	0.9836	10.23	0.9711
1.22	1.0169	4.27	0.9951	7.31	0.9830	10.36	0.9705
1.35	1.0161	4.40	0.9946	7.45	0.9825	10.50	0.9700
1.49	1.0152	4.54	0.9940	7.58	0.9820	10.63	0.9694
1.63	1.0136	4.67	0.9935	7.72	0.9814	10.77	0.9688
1.76	1.0118	4.81	0.9930	7.86	0.9809	10.90	0.9682
1.90	1.0102	4.94	0.9924	7.99	0.9804	11.04	0.9676
2.03	1.0089	5.08	0.9919	8.13	0.9798	11.17	0.9671
2.17	1.0075	5.21	0.9913	8.26	0.9793	11.31	0.9665
2.30	1.0062	5.35	0.9908	8.40	0.9787	11.44	0.9659
2.44	1.0048	5.49	0.9903	8.53	0.9782	11.58	0.9653
2.57	1.0030	5.62	0.9897	8.67	0.9777	11.71	0.9647
2.71	1.0013	5.76	0.9892	8.80	0.9771	11.85	0.9642
2.84	1.0006	5.89	0.9887	8.94	0.9766	11.99	0.9636
2.98	1.0002	6.03	0.9881	9.07	0.9761	12.12	0.9630

Certificate of Calibration		TMA/*Norcal*
Calibration: Gross Alpha, Beta	Instrument: LB4000 (2")	Type: 2" Gas Proportional Counter

Calibration Standard:

^{241}Am - Solution S3/46/30 from Amersham Corporation
^{90}Sr - Solution SRM 4919-E from National Bureau of Standards

Status	Date	Reference Document
Original Calibration:	March, 1990	TLW 6227
Verification:		

Summary of Results

Tabulated Data For Efficiency and Correction Curves

mg	Gross Alpha % eff	% Alpha In Beta Channel	Gross Beta % Eff	% Beta In Alpha Channel
0	28.0	35.7	44.0	0.650
10	22.7	23.3	43.5	0.645
20	20.5	23.9	43.0	0.641
30	18.5	24.8	42.5	0.636
40	16.5	25.4	42.3	0.632
50	15.0	26.0	42.2	0.627
60	13.5	26.9	42.0	0.623
70	12.5	27.6	41.8	0.618
80	11.0	28.3	41.5	0.613
90	10.5	29.4	41.3	0.609
100	9.5	30.2	41.0	0.604
110	9.0	31.3	40.8	0.600
120	8.5	32.1	40.6	0.595
130	7.7	33.0	40.5	0.590
140	7.4	34.0	40.4	0.586
150	7.0	35.0	40.2	0.581
160	6.8	35.9	40.0	0.577
170	6.5	36.8	40.0	0.572
180	6.0	37.5	40.0	0.568
190	5.8	38.3	40.0	0.563
200	5.6	39.2	40.0	0.558
210	5.4	40.5	40.0	0.554
220	5.2	41.9	40.0	0.549
230	5.0	43.1	40.0	0.545
240	5.0	44.9	40.0	0.540
250	5.0	46.5	40.0	0.536

Certificate of Calibration		TMA/*Norcal*
Calibration: Efficiency vs Energy	Instrument: G1	Type: Germanium Gamma Spectrometer
Calibration Standard: Multi-gamma standard solution R9/10/135 from Amersham Corporation		

Status	Date	Reference Document
Original Calibration:	March, 1989	*1989 Ge(Li) Calibration, G1*
Verification:		

Summary of Results

The following geometries were calibrated:

60-ml Petri Dish	PD
2" Stainless Steel Planchet	ST
Nylon Planchet	NY,PL
Gamma Well Vial	GW
Small Petri Dish	SP
125-ml Plastic Jar	JR
1" Stainless Steel Cup	CP
3 Filter Papers	FL

Complete efficiency curves can be found in the above referenced document.

Certificate of Calibration		TMA/*Norcal*
Calibration: Efficiency vs Energy	Instrument: G2	Type: Germanium Gamma Spectrometer
Calibration Standard: Multi-gamma standard solution R9/10/135 from Amersham Corporation		
Status	**Date**	**Reference Document**
Original Calibration:	March, 1989	*1989 Ge(Li) Calibration, G2*
Verification:		

Summary of Results

The following geometries were calibrated:

Marinelli Beaker	MB
60-ml Petri Dish	PD
2" Stainless Steel Planchet	ST
Nylon Planchet	NY,PL
Gamma Well Vial	GW
Small Petri Dish	SP
125-ml Plastic Jar	JR
1" Stainless Steel Cup	CP
3 Filter Papers	FL
1" Stainless Steel Cup (0.1g)	CL

Complete efficiency curves can be found in the above referenced document.

Certificate of Calibration		TMA/*Norcal*
Calibration: Efficiency vs Energy	Instrument: G3	Type: Germanium Gamma Spectrometer
Calibration Standard: Multi-gamma standard solution R9/10/135 from Amersham Corporation		

Status	Date	Reference Document
Original Calibration:	March, 1989	*1989 Ge(Li) Calibration, G3*
Verification:		

Summary of Results

The following geometries were calibrated:

Marinelli Beaker	MB
60-ml Petri Dish	PD
2" Stainless Steel Planchet	ST
Nylon Planchet	NY,PL
Gamma Well Vial	GW
Small Petri Dish	SP
125-ml Plastic Jar	JR
1" Stainless Steel Cup	CP
3 Filter Papers	FL
1" Stainless Steel Cup (0.1g)	CL

Complete efficiency curves can be found in the above referenced document.

Certificate of Calibration		TMA/*Norcal*
Calibration: Efficiency vs Energy	Instrument: G4	Type: Germanium Gamma Spectrometer
Calibration Standard: Multi-gamma standard solution R9/10/135 from Amersham Corporation		
Status	**Date**	**Reference Document**
Original Calibration:	March, 1989	*1989 Ge(Li) Calibration, G4*
Verification:		

Summary of Results

The following geometries were calibrated:

Marinelli Beaker	MB
60-ml Petri Dish	PD
2" Stainless Steel Planchet	ST
Nylon Planchet	NY,PL
Small Petri Dish	SP
125-ml Plastic Jar	JR
1" Stainless Steel Cup	CP
3 Filter Papers	FL
1" Stainless Steel Cup (0.1g)	CL

Complete efficiency curves can be found in the above referenced document.

Certificate of Calibration		TMA/*Norcal*
Calibration: Efficiency vs Energy	Instrument: G5	Type: Germanium Gamma Spectrometer
Calibration Standard: Multi-gamma standard solution R9/10/135 from Amersham Corporation		
Status	**Date**	**Reference Document**
Original Calibration:	March, 1989	*1989 Ge(Li) Calibration, G5*
Verification:		
Summary of Results		

The following geometries were calibrated:

Marinelli Beaker	MB
60-ml Petri Dish	PD
2" Stainless Steel Planchet	ST
Nylon Planchet	NY,PL
Gamma Well Vial	GW
Small Petri Dish	SP
125-ml Plastic Jar	JR
1" Stainless Steel Cup	CP
3 Filter Papers	FL
1" Stainless Steel Cup (0.1g)	CL

Complete efficiency curves can be found in the above referenced document.

9513354.0984

APPENDIX 17

COPIES OF RAW DATA SHEETS

DK 11/10 RUSH

NUCLIDE	DPM/GRAM	PCI /GRAM	+/- ACT ERR 2 sigma	%ERR 2 sigma
B01932		00001488	TMA # (GLS) 7115	1
TZERO = 303.334 1992			131.5000 GRAM	Aliquot
K 40	1.522E+01	(6.854 +/- 1.820) E+00		26.6%
Cr 51	< 2.399E+00	< 1.080E+00		DET LIM
Mn 54	< 3.102E-01	< 1.398E-01		DET LIM
Co 58	< 2.792E-01	< 1.258E-01		DET LIM
Fe 59	< 5.695E-01	< 2.565E-01		DET LIM
Co 60	< 3.904E-01	< 1.759E-01		DET LIM
Zn 65	< 7.190E-01	< 3.239E-01		DET LIM
Nb 94	< 3.203E-01	< 1.443E-01		DET LIM
Ru106	< 2.619E+00	< 1.180E+00		DET LIM
Cs134	< 3.394E-01	< 1.529E-01		DET LIM
Cs137	< 3.261E-01	< 1.469E-01		DET LIM
Eu152	< 1.207E+00	< 5.437E-01		DET LIM
Eu154	< 1.075E+00	< 4.842E-01		DET LIM
Eu155	< 7.421E-01	< 3.343E-01		DET LIM
Ra226	1.194E+00	(5.379 +/- 2.449) E-01		45.5%
Th228	1.485E+00	(6.691 +/- 2.105) E-01		31.5%
Th232	1.120E+00	(5.045 +/- 4.763) E-01		94.4%
QC-9702 LCS		00001489	TMA # (GLS) 7115	2
TZERO = 311.012 1992			1.0000 SMPL	Aliquot
K 40	< 5.173E+02	< 2.330E+02		DET LIM
Cr 51	< 2.624E+02	< 1.182E+02		DET LIM
Mn 54	< 4.661E+01	< 2.099E+01		DET LIM
Co 58	< 4.081E+01	< 1.838E+01		DET LIM
Fe 59	< 8.823E+01	< 3.974E+01		DET LIM
Co 60	2.027E+02	(9.129 +/- 3.086) E+01		33.8%
Zn 65	< 1.067E+02	< 4.805E+01		DET LIM
Nb 94	< 3.580E+01	< 1.613E+01		DET LIM
Ru106	< 3.132E+02	< 1.411E+02		DET LIM
Cs134	< 4.753E+01	< 2.141E+01		DET LIM
Cs137	2.241E+02	(1.009 +/- 0.293) E+02		29.0%
Eu152	< 5.967E+01	< 2.688E+01		DET LIM
Eu154	< 4.183E+01	< 1.884E+01		DET LIM
Eu155	< 7.314E+01	< 3.295E+01		DET LIM
Ra226	< 8.362E+01	< 3.766E+01		DET LIM
Th228	< 5.267E+01	< 2.372E+01		DET LIM
Th232	< 2.216E+02	< 9.982E+01		DET LIM

QC-9702 (7115-2)	Added pCi	2σ	F/A	2σ
Co-60	127.1	(±4.2)	0.718	(±34.2)
Cs-137	124.2	(±4.2)	0.812	(±29.2)

Ky 11/10/92

TMA/Norcal

Q.C. Sample Log Sheet DUPLICATE SAMPLE

Group No. 7115 — 7115-4 is a duplicate of 7115-1

Prepared by: Ky

Date: 11/10/92

Program Mgr: DPK

Q.C.#	Smp#	Nuclide (303.334-92)	pCi/gram ± 2σ % error Found	Added	Found/Added
9704	4	K-40	7.415 (24.2%)	6.854 (26.6%)	1.082 (± 36.7%)
		Cr-51	See attached	data sheets	—
		Co-60			—
		Zn-65			—
		Cs-134			—
		Cs-137	<0.1491	<0.1469	—
		Ra-226	0.5248 (78.6%)	0.5379 (45.5%)	0.976 (± 91.7%)
		Th-228	0.3452 (54.1%)	0.6691 (31.5%)	0.516 (± 63.7%)
		Th-232	<0.7437	0.5045 (94.4%)	~~1.474 (±~~ — Ky 11/10/92

Entered: Ky Date: 11/10/92 Entered: Ky Date: 11/10/92

NOTE: Reference times are normally time of count (blanks) or first of the year (spikes). If different times are used, list them below.

Comments:

TMA/NORCAL GE(LI) ANALYSIS REPORT

06-NOV-92

DLC 11/10

NUCLIDE	DPM/GRAM	PCI /GRAM	+/- ACT ERR 2 sigma	%ERR 2 sigma
QC-9703 BLANK		00001490	TMA # (GLS) 7115	3
TZERO = 311.033 1992			1.0000 SMPL	Aliquot
K 40	< 5.988E+02	< 2.697E+02		DET LIM
Cr 51	< 2.248E+02	< 1.012E+02		DET LIM
Mn 54	< 3.226E+01	< 1.453E+01		DET LIM
Co 58	< 3.326E+01	< 1.498E+01		DET LIM
Fe 59	< 5.225E+01	< 2.353E+01		DET LIM
Co 60	< 3.997E+01	< 1.801E+01		DET LIM
Zn 65	< 6.562E+01	< 2.956E+01		DET LIM
Nb 94	< 3.469E+01	< 1.562E+01		DET LIM
Ru106	< 3.096E+02	< 1.395E+02		DET LIM
Cs134	< 3.812E+01	< 1.717E+01		DET LIM
Cs137	< 3.464E+01	< 1.561E+01		DET LIM
Eu152	< 5.380E+01	< 2.423E+01		DET LIM
Eu154	< 3.641E+01	< 1.640E+01		DET LIM
Eu155	< 6.854E+01	< 3.087E+01		DET LIM
Ra226	< 6.943E+01	< 3.127E+01		DET LIM
Th228	< 4.920E+01	< 2.216E+01		DET LIM
Th232	< 1.805E+02	< 8.132E+01		DET LIM

QC-9703 : Added = 0 KY 11/10/92

QC-9704 DUP #1		00001491	TMA # (GLS) 7115	4
TZERO = 303.334 1992			135.0500 GRAM	Aliquot
K 40	1.646E+01	(7.415 +/- 1.792) E+00		24.2%
Cr 51	< 2.316E+00	< 1.043E+00		DET LIM
Mn 54	< 3.367E-01	< 1.517E-01		DET LIM
Co 58	< 3.477E-01	< 1.566E-01		DET LIM
Fe 59	< 7.813E-01	< 3.519E-01		DET LIM
Co 60	< 5.192E-01	< 2.339E-01		DET LIM
Zn 65	< 1.011E+00	< 4.553E-01		DET LIM
Nb 94	< 3.653E-01	< 1.645E-01		DET LIM
Ru106	< 2.738E+00	< 1.233E+00		DET LIM
Cs134	< 3.524E-01	< 1.587E-01		DET LIM
Cs137	< 3.309E-01	< 1.491E-01		DET LIM
Eu152	< 5.859E-01	< 2.639E-01		DET LIM
Eu154	< 4.059E-01	< 1.829E-01		DET LIM
Eu155	< 6.398E-01	< 2.882E-01		DET LIM
Ra226	1.165E+00	(9.248 +/- 4.127) E-01		78.6%
Th228	7.664E-01	(3.452 +/- 1.869) E-01		54.1%
Th232	< 1.651E+00	< 7.437E-01		DET LIM

95133354.0988

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7115 GLS 1 G-5 JR 310.967 92 100.58 MIN 131.50000 GR 076

LIBR=ARLI REF TIME= 303.334 92

****

Gro 11/6/92

SPECIAL ANALYSIS

PK-ENERGY-GAMMA KEV	BRANCH FRAC	EFFICIENCY FRAC	CPM CORR CNTG DECAY	DPM NOW	ERROR PCT	PCI/GRAM AT TZERO
K 40 4.602E+11 DAYS		LAMBDA= 1.506E-12		DECAY= 1.000E+00 1G		
1461 (1460.85)	0.110000	0.00331	0.729	2.001E+03 s	13.28%	6.854E+00
Cr 51 2.772E+01 DAYS		LAMBDA= 2.501E-02		DECAY= 8.262E-01 1G		
**** (320.03)	0.102000	0.01434	0.381	2.606E+02 s	<	1.080E+00
Mn 54 3.125E+02 DAYS		LAMBDA= 2.218E-03		DECAY= 9.832E-01 2G		
**** (834.83)	1.000000	0.00570	0.229	4.011E+01 s	<	1.398E-01
Co 57 2.700E+02 DAYS		LAMBDA= 2.567E-03		DECAY= 9.806E-01 10G		
122 (122.06)	0.852000	0.02804	0.966	4.042E+01 s	20.89%	1.412E-01
**** (136.47)	0.111000	0.02770	0.518	1.683E+02 s	<	5.880E-01
Co 58 7.130E+01 DAYS		LAMBDA= 9.722E-03		DECAY= 9.285E-01 4G		
**** (810.76)	0.990000	0.00587	0.198	3.409E+01 s	<	1.258E-01
Fe 59 4.460E+01 DAYS		LAMBDA= 1.554E-02		DECAY= 8.881E-01 6G		
**** (1099.22)	0.565000	0.00434	0.163	6.651E+01 s	<	2.565E-01
**** (1291.56)	0.432000	0.00373	0.162	1.004E+02 s	<	3.871E-01
Co 60 1.921E+03 DAYS		LAMBDA= 3.608E-04		DECAY= 9.972E-01 4G		
1172 (1173.21)	0.999200	0.00408	0.124	3.035E+01 s	60.80%	1.043E-01
**** (1332.48)	1.000000	0.00362	0.185	5.120E+01 s	<	1.759E-01
Zn 65 2.440E+02 DAYS		LAMBDA= 2.841E-03		DECAY= 9.785E-01 1G		
**** (1115.52)	0.507500	0.00428	0.201	9.252E+01 s	<	3.239E-01
Nb 94 7.414E+06 DAYS		LAMBDA= 9.349E-08		DECAY= 1.000E+00 3G		
**** (871.10)	1.000000	0.00546	0.230	4.212E+01 s	<	1.443E-01
**** (1573.70)	1.000000	0.00308	0.092	2.995E+01 s	<	1.026E-01
Ru106 3.670E+02 DAYS		LAMBDA= 1.889E-03		DECAY= 9.857E-01 41G		
**** (621.80)	0.097600	0.00763	0.253	3.395E+02 s	<	1.180E+00
**** (1050.10)	0.014500	0.00453	0.177	2.694E+03 s	<	9.363E+00
I 131 8.040E+00 DAYS		LAMBDA= 8.621E-02		DECAY= 5.178E-01 9G		
**** (364.50)	0.820000	0.01272	0.277	2.654E+01 s	<	1.756E-01
Ba133 3.981E+03 DAYS		LAMBDA= 1.741E-04		DECAY= 9.987E-01 10G		
**** (276.30)	0.075000	0.01654	0.366	2.954E+02 s	<	1.013E+00
**** (302.70)	0.196000	0.01512	0.373	1.258E+02 s	<	4.316E-01
**** (355.90)	0.621000	0.01300	0.372	4.614E+01 s	<	1.583E-01
**** (383.70)	0.094000	0.01215	0.329	2.878E+02 s	<	9.871E-01
Cs134 7.531E+02 DAYS		LAMBDA= 9.204E-04		DECAY= 9.930E-01 9G		
**** (475.30)	0.015000	0.00989	0.289	1.948E+03 s	<	6.718E+00
**** (604.60)	0.980000	0.00784	0.263	3.425E+01 s	<	1.182E-01
**** (795.80)	0.880000	0.00598	0.233	4.432E+01 s	<	1.529E-01
Cs137 1.102E+04 DAYS		LAMBDA= 6.290E-05		DECAY= 9.995E-01 3G		
**** (661.64)	0.851000	0.00718	0.262	4.287E+01 s	<	1.469E-01

Eu152	4.821E+03 DAYS		LAMBDA= 1.438E-04		DECAY= 9.989E-01 48G			
122	(121.78)	0.254000	0.02804	0.966	1.356E+02	s20.89%		4.649E-01
344	(344.31)	0.245000	0.01340	0.270	8.230E+01	s56.16%		2.822E-01
****	(778.87)	0.120000	0.00611	0.243	3.318E+02	s	<	1.138E+00
****	(963.36)	0.132000	0.00493	0.207	3.187E+02	s	<	1.093E+00
****	(1112.04)	0.124000	0.00429	0.229	4.303E+02	s	<	1.476E+00
****	(1408.02)	0.198000	0.00343	0.195	2.874E+02	s	<	9.855E-01
Eu154	3.105E+03 DAYS		LAMBDA= 2.232E-04		DECAY= 9.983E-01 48G			
122	(123.07)	0.390000	0.02805	0.966	8.825E+01	s20.89%		3.028E-01
****	(723.26)	0.202000	0.00658	0.238	1.795E+02	s	<	6.158E-01
****	(873.16)	0.117000	0.00544	0.216	3.398E+02	s	<	1.166E+00
****	(1004.75)	0.170000	0.00473	0.170	2.120E+02	s	<	7.275E-01
****	(1274.49)	0.336000	0.00378	0.179	1.411E+02	s	<	4.842E-01
Eu155	1.812E+03 DAYS		LAMBDA= 3.825E-04		DECAY= 9.971E-01 6G			
****	(86.54)	0.320000	0.02463	0.637	8.080E+01	s	<	2.776E-01
****	(105.30)	0.200000	0.02733	0.532	9.730E+01	s	<	3.343E-01
Ta182	1.150E+02 DAYS		LAMBDA= 6.027E-03		DECAY= 9.550E-01 33G			
****	(67.80)	0.410000	0.01666	0.651	9.535E+01	s	<	3.420E-01
****	(100.10)	0.144000	0.02701	0.591	1.521E+02	s	<	5.454E-01
****	(1121.30)	0.358000	0.00426	0.264	1.728E+02	s	<	6.199E-01
****	(1189.05)	0.166000	0.00403	0.170	2.545E+02	s	<	9.130E-01
****	(1221.40)	0.277000	0.00393	0.208	1.911E+02	s	<	6.854E-01
****	(1231.01)	0.117000	0.00390	0.147	3.227E+02	s	<	1.157E+00
Ra226	5.851E+05 DAYS		LAMBDA= 1.185E-06		DECAY= 1.000E+00 48G			
185	(186.10)	0.040000	0.02394	0.453	4.727E+02	s57.70%		1.619E+00
****	(242.00)	0.078000	0.01899	0.588	3.968E+02	s	<	1.359E+00
****	(351.96)	0.393000	0.01313	0.480	9.309E+01	s	<r	3.189E-01
610	(609.32)	0.484000	0.00778	0.592	1.570E+02	s22.76%		5.379E-01
1208	(1207.50)	0.004800	0.00398	0.103	5.422E+03	67.68%		1.857E+01
Th228	6.987E+02 DAYS		LAMBDA= 9.921E-04		DECAY= 9.925E-01 31G			
239	(238.62)	0.448000	0.01928	1.675	1.939E+02	s15.73%		6.691E-01
****	(583.17)	0.287000	0.00812	0.333	1.429E+02	s	<r	4.933E-01
Th232	5.113E+12 DAYS		LAMBDA= 1.356E-13		DECAY= 1.000E+00 41G			
****	(338.40)	0.104000	0.01361	0.396	2.795E+02	s	<	9.573E-01
911	(911.10)	0.250000	0.00521	0.192	1.473E+02	s47.20%		5.046E-01
****	(968.90)	0.150000	0.00490	0.224	3.040E+02	s	<r	1.041E+00
U 235	2.571E+11 DAYS		LAMBDA= 2.696E-12		DECAY= 1.000E+00 34G			
****	(143.78)	0.132600	0.02732	0.560	1.545E+02	s	<	5.293E-01
185	(185.72)	0.540000	0.02398	0.453	3.496E+01	s57.70%		1.198E-01
****	(205.31)	0.050000	0.02206	0.488	4.426E+02	s	<	1.516E+00

DATA

9513354.0990

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*********************************************************************
7115   GLS   1        G-5 JR 310.967 92  100.58 MIN   131.50000 GR      076
LIBR=ARLI   REF TIME= 303.334 92
*********************************************************************

*********************************************************************
* Group..........................  7115 * Time of count          310.967 1992 *
* Sample.........................     1 * Reference GMT........  303.334 1992 *
* Element........................       * Elapsed Live Tm.......... 100.5833 *
* Type code......................   GLS * Dead Time Pct........... 0.016567 *
* ID.............................B01932 * Background GMT.......  306.070 1992 *
* Geometry, detector.........   JR-5 * Standard GMT........  305.308 1992 *
* Aliquot........................ 131.5 * Days since TO............ 7.633697 *
* Unit of Aliquot.............   GRAM * Time on.........  15:12 PST  5-NOV *
* Data Sheet Units........ PCI /GRAM * Time off.........  16:53 PST  5-NOV *
* Library........................  ARLI * Calc Time.........  04:20 06-NOV-92 *
*********************************************************************
* Slope.......................  1.00432 * Width slope............... 0.001925 *
* Intercept...................-9.64963 * Width offset............. 5.148355 *
* X**2 TERM.........  0.18724812E-06 * Sensitivity..................... 4. *
  NP:[7,67]076.GSP                    20 PEAKS

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PK	IT	ENRG	LEFT	WD	BKGND	FWHM	AREA	CHAN	CPM	ERR	EFF	K	FIT
1	5	14.3	19	32	21	8.25	451	23.8	4.48E+00	5.40	.017	0	6.50
2	5	37.8	19	32	130	8.25	129	47.2	1.28E+00	14.50	.323	0	0.00
3	0	76.2	80	10	250	2.30	97	85.5	9.62E-01	33.3	1.99	0	0.00
4	0	92.5	98	7	165	1.42	52	101.7	5.14E-01	44.9	2.59	0	0.00
5	0	122.2	129	7	88	2.70	97	131.3	9.66E-01	20.9	2.80	0	0.00
6	0	185.2	188	12	157	2.70	64	194.0	6.39E-01	40.6	2.40	0	0.00
7	0	239.3	243	12	110	2.56	197	247.9	1.96E+00	13.3	1.92	0	0.00
8	0	295.5	300	9	80	1.97	61	303.8	6.11E-01	31.0	1.58	0	0.00
9	0	344.3	349	7	65	2.28	27	352.4	2.70E-01	56.2	1.34	0	0.00
10	0	352.1	358	6	28	2.44	61	360.2	6.02E-01	19.1	1.31	0	0.00
11	0	510.3	512	13	56	2.64	62	517.6	6.15E-01	29.8	0.923	0	0.00
12	0	583.8	588	8	19	2.76	30	590.8	2.98E-01	34.1	0.813	0	0.00
13	0	609.5	612	11	24	2.33	66	616.4	6.54E-01	20.4	0.779	0	0.00
14	0	741.7	746	6	4	1.55	12	748.0	1.19E-01	45.3	0.646	0	0.00
15	0	911.5	911	9	12	2.17	23	917.0	2.33E-01	38.4	0.525	0	0.00
16	0	969.2	972	6	4	2.38	12	974.4	1.19E-01	47.0	0.492	0	0.00
17	0	1011.3	1012	10	5	1.18	14	1016.4	1.35E-01	45.3	0.470	0	0.00
18	0	1172.4	1173	9	12	1.98	15	1176.7	1.54E-01	48.9	0.410	0	0.00
19	0	1208.3	1210	7	8	1.31	11	1212.5	1.06E-01	65.8	0.398	0	0.00
PK	IT	ENRG	LEFT	WD	BKGND	FWHM	AREA	CHAN	CPM	ERR	EFF	K	FIT
20	0	1460.9	1459	12	7	2.52	77	1463.9	7.67E-01	12.5	0.332	0	0.00

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*********************************************************************
BACKGROUND INFO 7115     GLS    1          310.967 92 G- 5      BG DATE 306.070 92
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v--------PEAK---------v			v------BACKGROUND------v			v------NET-----v	
ENERGY	CPM	%ERROR	ENERGY	CPM	%ERROR	CPM	%ERROR
92.50	0.5142	44.87	92.00	0.2524	0.00	0.2619	88.11R
185.23	0.6392	40.56	186.00	0.1865	16.94	0.4527	57.70
239.34	1.9627	13.26	238.60	0.2882	14.16	1.6745	15.73
295.50	0.6111	31.03	295.20	0.0345	40.30	0.5766	32.97
352.14	0.6020	19.12	351.90	0.0771	21.41	0.5249	22.15
510.26	0.6154	29.78	511.00	0.5055	7.10	0.1100	169.85R
583.81	0.2985	34.13	583.10	0.0678	36.44	0.2307	45.44
609.50	0.6537	20.45	609.30	0.0622	26.22	0.5915	22.76

```
 911.46    0.2326 38.36      911.10  0.0406 38.88        0.1920 47.20
 969.15    0.1193 46.96      968.90  0.0292 82.99        0.0901 67.70
1172.36    0.1539 48.93     1173.20  0.0301  0.00        0.1239 60.80
1460.94    0.7666 12.51     1460.80  0.0374 36.11        0.7292 13.28
    2 PEAKS REJECTED BY BACKGROUND

*****************************************************************************
INTERFERING ISOTOPE ANALYSIS 7115     GLS   1        310.967 92 G- 5
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RA226      609.32  0.4840                CALC FROM REF PEAK

v-----------PEAK-----------------v     v--CALCULATED--v     v-----NET--------v
ENERGY      CPM        DPM  %ERROR       ENERGY   CPM            CPM  %ERROR

 295.50     0.577     181.9 32.97       295.20  0.4971        0.0795279.18 R
 352.14     0.525     101.7 22.15       351.96  0.8092       -0.2843-76.63 R
 609.50     0.592     156.8 22.76       609.32  0.5915    <-reference peak->
1208.33     0.106    5579.1 65.77      1207.50  0.0030        0.1035 67.68 S

TH228      238.62  0.4480                CALC FROM REF PEAK

v-----------PEAK-----------------v     v--CALCULATED--v     v-----NET--------v
ENERGY      CPM        DPM  %ERROR       ENERGY   CPM            CPM  %ERROR

 239.34     1.675     194.8 15.73       238.62  1.6745    <-reference peak->
 583.81     0.231      98.9 45.44       583.17  0.4543       -0.2237-56.73 R

AC228      911.10  0.2500                CALC FROM REF PEAK

v-----------PEAK-----------------v     v--CALCULATED--v     v-----NET--------v
ENERGY      CPM        DPM  %ERROR       ENERGY   CPM            CPM  %ERROR

 911.46     0.192     146.3 47.20       911.10  0.1920    <-reference peak->
 969.15     0.090     122.2 67.70       968.90  0.1080       -0.0178****** R

BI214/PB214 RATIO      1.5415E+00+/-     8.25%

WT PCT U235    3.17820 +/-    62.03%      DAUT
RGF SENT DATA FROM NP:[7,67]923107045.GTX          TO GSTOR 076
GLB WRITES THE FOLLOWING TO NP:[7,67]GYDCSVT02.DAT
 7115=GROUP          1=SAMPL        =ELM     GLS=TYP
    0=LRW            0=LRA       ARLI=LIBR
JLYKTL PARAMETERS
       JELYKTL READ
GEODET
       Old Effs replaced (forced)
EFFICIENCY FILE NP:[25,4]GELIO5JR0.EFF
       Effs fetched  33.000    90
FETCH CAL LINE
       Cal line fetched305.308     1992
BKG FETCH ROUTINE GETS BG FOR  306.070 1992 IERR=    0
SPANF
        FETCHING SPANF
WHDTR CALLED
       HDR WRITTEN IN
GSTFIL
       PKFIL UPDATED
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SUMMARY DATA REPORT

QC USED IN DATA REDUCTION OF SAMPLE 7115 1 GLS RUN AT 310.967/1992

BACKGROUND FOR GELI DETECTOR 5 OF 306.070/1992

ENERGY	CPM	ERROR	ENERGY	CPM	ERROR	ENERGY	CPM	ERROR
62.0	0.0000	0.00	511.0	0.5055	7.10	1120.3	0.0144	20.21
92.0	0.2524	0.00	583.1	0.0678	36.44	1173.2	0.0301	0.00
143.0	0.0000	0.00	609.3	0.0622	26.22	1238.1	0.0213	0.00
186.0	0.1865	16.94	661.6	0.0000	0.00	1332.5	0.0192	11.48
198.0	0.0421	0.00	727.2	0.0549	0.00	1377.7	0.0000	0.00
238.6	0.2882	14.16	846.0	0.0319	29.17	1460.8	0.0374	36.11
279.0	0.0000	0.00	860.4	0.0000	0.00	1586.0	0.0000	0.00
295.2	0.0345	40.30	911.1	0.0406	38.88	1591.3	0.0262	0.00
338.4	0.0650	0.00	968.9	0.0292	82.99	1729.6	0.0194	0.00
351.9	0.0771	21.41	1001.0	0.0153	0.00	1764.5	0.0175	4.00

GELI STANDARD EFFICIENCY QC FOR DETECTOR G- 5 ON 11/ 6/92

HIGH RADIUM STANDARD

GMT	YEAR	NORMALISED CPM	% ERROR	LENGTH IN MINUTES
235.141	92	1.1357	3.034	10.
249.263	92	1.1248	3.215	10.
256.273	92	1.1268	3.828	13.
263.254	92	1.1184	3.658	21.
270.268	92	1.1224	2.290	11.
277.220	92	1.1318	3.427	11.
284.197	92	1.1225	3.729	16.
291.286	92	1.1256	3.289	11.
298.267	92	1.1128	3.211	10.
305.308	92	1.1147	3.145	11.
AVERAGE		1.1235	0.007	

LOW RADIUM STANDARD

GMT	YEAR	NORMALISED CPM	% ERROR	LENGTH IN MINUTES
0.000	0	0.0000	0.000	0.
193.726	90	1.0656	17.337	63.
201.976	90	1.0026	7.798	28.
267.756	90	0.9958	17.344	100.
143.966	91	0.9928	3.560	34.
161.682	91	1.0972	1.613	19.
162.972	91	1.0585	1.586	16.
180.971	91	1.0568	2.669	22.
207.975	91	1.0647	2.084	11.
213.856	91	1.1437	10.869	44.
AVERAGE		1.0531	0.050	

CALIBRATION LINE FROM STANDARD FOR G- 5 OF 305.308 92
ENERGY= -9.649626 + 1.0043198*CH + 1.872481E-07*CH**2
FWHM =SQRT(5.1484 + 0.001925*ENERGY) (CO60= 2.777)

EFFICIENCIES FOR GEOMETRY JR5 CALIBRATED 33.000 1990

ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*
55.0	0.900*	110.0	2.750*	170.0	2.560*	400.0	1.170*	1200.0	0.400*
60.0	1.200*	120.0	2.800*	200.0	2.250*	500.0	0.940*	1500.0	0.323*
80.0	2.240*	130.0	2.800*	220.0	2.090*	600.0	0.790*	2000.0	0.245*
90.0	2.550*	140.0	2.750*	250.0	1.830*	800.0	0.595*	2500.0	0.198*
100.0	2.700*	150.0	2.700*	350.0	1.320*	1000.0	0.475*	3000.0	0.167*

7115 1 GLS GSTOR 076

	PK	ENERGY	CPM	%ERR	COMMENT			
	1	14.3	4.48	5.4				
	2	37.8	1.28	14.5				
	3	76.2	0.96	33.3				
	5	122.2	0.97	20.9		Eu154s	Eu152s	Co 57s
b	6	185.2	0.45	57.7		Cs137c	U 235s	Ra226s
b	7	239.3	1.67	15.7				Th228s
	9	344.3	0.27	56.2				Eu152s
b	13	609.5	0.59	22.8	NO GEN.		Ru103	Ra226s
	14	~~741.7~~	~~0.12~~	~~45.3~~				
b	15	911.5	0.19	47.2	Ac228 NO GEN.			Th232s
	17	~~1011.3~~	~~0.13~~	~~45.3~~				
b	18	1172.4	0.12	60.8				Co 60s
n	19	1208.3	0.10	67.7	Ra226			
b	20	1460.9	0.73	13.3				K 40s
			REJECTED PEAKS					
B	4	92.5	0.26	88.1				
B	11	510.3	0.11	99.9	Ac228 Th228		La140	Na 22
bN	8	295.5	0.08	99.9	Ra226		Ru103	Ir192s
bN	10	352.1	-0.28	99.9				Ra226s
bN	12	583.8	-0.22	99.9				Th228s
bN	16	969.2	-0.02	99.9	Ac228		Sb124	Th232s

9513354.0994

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7115 GLS 2 G-1 JR 311.012 92 100.13 MIN 1.00000 SM 080

LIBR=ARLI REF TIME= 311.012 92

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Corr 11/6/95

SPECIAL ANALYSIS

PK-ENERGY-GAMMA KEV	BRANCH FRAC	EFFICIENCY FRAC	CPM CORR CNTG DECAY	DPM NOW	ERROR PCT	PCT/SMPL AT TZERO
K 40 4.602E+11 DAYS		LAMBDA= 1.506E-12		DECAY= 1.000E+00		1G
**** (1460.85)	0.110000	0.00353	0.201	5.173E+02 s	<	2.330E+02
Cr 51 2.772E+01 DAYS		LAMBDA= 2.501E-02		DECAY= 1.000E+00		1G
**** (320.03)	0.102000	0.01685	0.451	2.624E+02 s	<	1.182E+02
Mn 54 3.125E+02 DAYS		LAMBDA= 2.218E-03		DECAY= 1.000E+00		2G
**** (834.83)	1.000000	0.00622	0.290	4.661E+01 s	<	2.099E+01
Co 58 7.130E+01 DAYS		LAMBDA= 9.722E-03		DECAY= 1.000E+00		4G
**** (810.76)	0.990000	0.00641	0.259	4.081E+01 s	<	1.838E+01
Fe 59 4.460E+01 DAYS		LAMBDA= 1.554E-02		DECAY= 1.000E+00		6G
**** (1099.22)	0.565000	0.00472	0.235	8.823E+01 s	<	3.974E+01
**** (1291.56)	0.432000	0.00400	0.162	9.375E+01 s	<	4.223E+01
Co 60 1.921E+03 DAYS		LAMBDA= 3.608E-04		DECAY= 1.000E+00		4G
1174 (1173.21)	0.999200	0.00442	0.959	2.170E+02 s	13.55%	9.776E+01
1333 (1332.48)	1.000000	0.00388	0.786	2.027E+02 s	16.90%	9.129E+01
Zn 65 2.440E+02 DAYS		LAMBDA= 2.841E-03		DECAY= 1.000E+00		1G
**** (1115.52)	0.507500	0.00465	0.252	1.067E+02 s	<	4.805E+01
Nb 94 7.414E+06 DAYS		LAMBDA= 9.349E-08		DECAY= 1.000E+00		3G
**** (871.10)	1.000000	0.00596	0.213	3.580E+01 s	<	1.613E+01
**** (1573.70)	1.000000	0.00326	0.118	3.623E+01 s	<	1.632E+01
Ru106 3.670E+02 DAYS		LAMBDA= 1.889E-03		DECAY= 1.000E+00		41G
**** (621.80)	0.097600	0.00848	0.259	3.132E+02 s	<	1.411E+02
662 (661.20)	0.000150	0.00795	1.514	1.271E+06	14.50%	5.723E+05
**** (1050.10)	0.014500	0.00495	0.277	3.867E+03 s	<	1.742E+03
I 131 8.040E+00 DAYS		LAMBDA= 8.621E-02		DECAY= 1.000E+00		9G
**** (364.50)	0.820000	0.01473	0.400	3.307E+01 s	<	1.490E+01
Ba133 3.981E+03 DAYS		LAMBDA= 1.741E-04		DECAY= 1.000E+00		10G
**** (276.30)	0.075000	0.01951	0.425	2.908E+02 s	<	1.310E+02
**** (302.70)	0.196000	0.01781	0.484	1.386E+02 s	<	6.242E+01
**** (355.90)	0.621000	0.01512	0.422	4.497E+01 s	<	2.026E+01
**** (383.70)	0.094000	0.01392	0.370	2.825E+02 s	<	1.272E+02
Cs134 7.531E+02 DAYS		LAMBDA= 9.204E-04		DECAY= 1.000E+00		9G
**** (475.30)	0.015000	0.01114	0.389	2.326E+03 s	<	1.048E+03
**** (604.60)	0.980000	0.00873	0.338	3.947E+01 s	<	1.778E+01
**** (795.80)	0.880000	0.00654	0.273	4.753E+01 s	<	2.141E+01
Cs137 1.102E+04 DAYS		LAMBDA= 6.290E-05		DECAY= 1.000E+00		3G
662 (661.64)	0.851000	0.00794	1.514	2.241E+02 s	14.50%	1.009E+02
Eu152 4.821E+03 DAYS		LAMBDA= 1.438E-04		DECAY= 1.000E+00		48G
**** (121.78)	0.254000	0.03943	0.598	5.967E+01 s	<	2.688E+01

60

****	(344.31)	0.245000	0.01566	0.404	1.052E+02	s	< 4.738E+01
****	(778.87)	0.120000	0.00668	0.245	3.049E+02	s	< 1.373E+02
****	(963.36)	0.132000	0.00540	0.214	3.000E+02	s	< 1.351E+02
****	(1112.04)	0.124000	0.00467	0.254	4.395E+02	s	< 1.980E+02
****	(1408.02)	0.198000	0.00366	0.211	2.915E+02	s	< 1.313E+02

Eu154 3.105E+03 DAYS LAMBDA= 2.232E-04 DECAY= 1.000E+00 48G

****	(123.07)	0.390000	0.03923	0.640	4.183E+01	s	< 1.884E+01
****	(723.26)	0.202000	0.00723	0.251	1.720E+02	s	< 7.749E+01
****	(873.16)	0.117000	0.00595	0.224	3.214E+02	s	< 1.448E+02
****	(1004.75)	0.170000	0.00518	0.275	3.130E+02	s	< 1.410E+02
****	(1274.49)	0.336000	0.00406	0.148	1.086E+02	s	< 4.892E+01

Eu155 1.812E+03 DAYS LAMBDA= 3.825E-04 DECAY= 1.000E+00 6G

****	(86.54)	0.320000	0.04364	0.646	4.628E+01	s	< 2.085E+01
****	(105.30)	0.200000	0.04218	0.617	7.314E+01	s	< 3.295E+01

Ta182 1.150E+02 DAYS LAMBDA= 6.027E-03 DECAY= 1.000E+00 33G

****	(67.80)	0.410000	0.04383	0.703	3.912E+01	s	< 1.762E+01
****	(100.10)	0.144000	0.04279	0.658	1.067E+02	s	< 4.807E+01
****	(1121.30)	0.358000	0.00463	0.249	1.501E+02	s	< 6.761E+01
****	(1189.05)	0.166000	0.00436	0.216	2.982E+02	s	< 1.343E+02
****	(1221.40)	0.277000	0.00424	0.177	1.506E+02	s	< 6.786E+01
****	(1231.01)	0.117000	0.00421	0.216	4.396E+02	s	< 1.980E+02

Ra226 5.851E+05 DAYS LAMBDA= 1.185E-06 DECAY= 1.000E+00 48G

****	(186.10)	0.040000	0.02913	0.558	4.786E+02	s	< 2.156E+02
****	(242.00)	0.078000	0.02236	0.499	2.862E+02	s	< 1.289E+02
****	(351.96)	0.393000	0.01531	0.421	7.003E+01	s	< 3.154E+01
****	(609.32)	0.484000	0.00866	0.350	8.362E+01	s	< 3.766E+01

Th228 6.987E+02 DAYS LAMBDA= 9.921E-04 DECAY= 1.000E+00 31G

****	(238.62)	0.448000	0.02269	0.535	5.267E+01	s	<r 2.372E+01
****	(583.17)	0.287000	0.00906	0.331	1.272E+02	s	< 5.729E+01

Th232 5.113E+12 DAYS LAMBDA= 1.356E-13 DECAY= 1.000E+00 41G

****	(338.40)	0.104000	0.01594	0.427	2.577E+02	s	< 1.161E+02
****	(911.10)	0.250000	0.00570	0.316	2.216E+02	s	< 9.982E+01
****	(968.90)	0.150000	0.00536	0.254	3.153E+02	s	< 1.420E+02

9513354.0996

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*****************************************************************************
7115   GLS   2        G-1 JR 311.012 92  100.13 MIN     1.00000 SM      080
LIBR=ARLI   REF TIME= 311.012 92
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* Group.......................... 7115 * Time of count          311.012 1992 *
* Sample.......................... 2 * Reference GMT........ 311.012 1992 *
* Element.......................... * Elapsed Live Tm........... 100.1333 *
* Type code..................... GLS * Dead Time Pct........... 0.331785 *
* ID.................... QC-9702 LCS * Background GMT....... 307.022 1992 *
* Geometry, detector........... JR-1 * Standard GMT......... 310.781 1992 *
* Aliquot.......................... 1. * Days since TO.................... 0.0 *
* Unit of Aliquot............... SMPL * Time on.......... 16:17 PST  5-NOV *
* Data Sheet Units........ PCI /SMPL * Time off......... 17:58 PST  5-NOV *
* Library....................... ARLI * Calc Time......... 05:14 06-NOV-92 *
*****************************************************************************
* Slope..................... 1.003744 * Width slope.............. 0.004017 *
* Intercept.................. -9.2931 * Width offset............ 9.668065 *
* X**2 TERM.......... 0.10451683E-06 * Sensitivity..................... 4. *
  NP:[7,67]080.GSP                    7 PEAKS

*****************************************************************************
 PK IT   ENRG LEFT WD BKGND FWHM   AREA   CHAN        CPM  ERR  EFF  K  FIT
  1  3   13.9   19 33    32 5.63    546   23.1  5.45E+00  4.70.016  0  3.17
  2  3   31.3   19 33   300 6.49    177   40.5  1.77E+00 22.20.184  0  0.00
  3  0  239.4  244  9    82 1.53     37  247.8  3.67E-01 51.0 2.26  0  0.00
  4  0  511.3  515  9    66 3.25     17  518.7  1.71E-01 86.6 1.04  0  0.00
  5  0  662.1  662 15    62 4.00    154  668.8  1.54E+00 14.20.801  0  0.00
  6  0 1173.9 1172 15    15 5.52     98 1178.7  9.79E-01 13.30.443  0  0.00
  7  0 1333.2 1329 17    21 3.39     81 1337.2  8.09E-01 16.30.390  0  0.00

*****************************************************************************
BACKGROUND INFO 7115    GLS   2        311.012 92 G- 1      BG DATE 307.022 92
*****************************************************************************

v--------PEAK---------v      v------BACKGROUND------v      v------NET----v
ENERGY      CPM  %ERROR      ENERGY      CPM  %ERROR          CPM  %ERROR

 239.40    0.3670 51.04      238.60  0.1778 22.39          0.1893101.20R
 511.34    0.1709 86.63      511.00  0.4919  8.86         -0.3210 48.06R
 662.10    1.5425 14.23      661.60  0.0283  0.00          1.5142 14.50
1173.93    0.9787 13.28     1173.20  0.0201  0.00          0.9586 13.55
1333.15    0.8087 16.30     1332.50  0.0230 69.10          0.7857 16.90
    2 PEAKS REJECTED BY BACKGROUND

*****************************************************************************
INTERFERING ISOTOPE ANALYSIS 7115    GLS   2        311.012 92 G- 1
*****************************************************************************
NONE FOUND

RGF SENT DATA FROM NP:[7,67]923107491.GTX          TO GSTOR 080
GLB WRITES THE FOLLOWING TO NP:[7,67]GYDCSV.TO2.DAT
 7115=GROUP          2=SAMPL       =ELM     GLS=TYP
    0=LRW            0=LRA       ARLI=LIBR
JELYKTL PARAMETERS
       JELYKTL READ
GEODET
       Old Effs replaced (forced)
EFFICIENCY FILE NP:[25,41]GELI01JRO.EFF
       Effs fetched  33.000   90
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9513354.0997

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FETCH CAL LINE
      Cal line fetched310.781     1992
BKG FETCH ROUTINE GETS BG FOR  307.022 1992 IERR=    0
SPANF
          FETCHING SPANF
WHDTR CALLED
        HDR WRITTEN IN
GSTFIL
        PKFIL UPDATED
```

62-A

9513464 0998

QC USED IN DATA REDUCTION OF SAMPLE 7115 2 GLS RUN AT 311.012/1992

BACKGROUND FOR GELI DETECTOR 1 OF 307.022/1992

ENERGY	CPM	ERROR	ENERGY	CPM	ERROR	ENERGY	CPM	ERROR
62.0	0.3167	0.00	511.0	0.4919	8.86	1120.3	0.0236	0.00
92.0	0.4645	0.00	583.1	0.0641	49.77	1173.2	0.0201	0.00
143.0	0.0807	0.00	609.3	0.0532	10.71	1238.1	0.0171	0.00
186.0	0.2406	24.11	661.6	0.0283	0.00	1332.5	0.0230	69.10
198.0	0.0656	0.00	727.2	0.0365	0.00	1377.7	0.0272	0.00
238.6	0.1778	22.39	846.0	0.0639	0.00	1461.0	0.1559	16.94
279.0	0.0000	0.00	860.4	0.0114	0.00	1586.0	0.0000	0.00
295.2	0.0395	0.00	911.1	0.0810	26.54	1591.0	0.0301	0.00
338.4	0.0238	0.00	968.9	0.0290	0.00	1729.6	0.0105	0.00
351.9	0.0871	49.25	1001.0	0.0177	0.00	1764.5	0.0339	49.31

GELI STANDARD EFFICIENCY QC FOR DETECTOR G- 1 ON 11/ 6/92

HIGH RADIUM STANDARD

GMT	YEAR	NORMALISED CPM	% ERROR	LENGTH IN MINUTES
286.012	92	1.0490	3.672	11.
289.186	92	0.9990	2.625	21.
291.266	92	1.0281	4.669	10.
297.712	92	0.9578	2.600	10. NG
300.678	92	0.9486	2.303	10. NG
302.755	92	0.9620	3.233	14. NG
303.036	92	1.0485	3.558	14.
305.703	92	1.0410	3.007	10.
307.832	92	1.0296	3.695	10.
310.781	92	1.0489	2.886	10.
AVERAGE		1.0349	0.018	

LOW RADIUM STANDARD

GMT	YEAR	NORMALISED CPM	% ERROR	LENGTH IN MINUTES
121.680	92	0.9942	2.816	69.
157.845	92	0.9834	1.693	23.
236.820	92	1.0004	1.735	15.
240.879	92	0.9957	1.667	18.
247.724	92	0.9273	2.961	11.
256.251	92	0.9850	4.793	15.
280.000	92	1.0064	1.922	22.
294.709	92	0.9629	4.149	14.
302.739	92	0.9701	2.117	20.
303.048	92	0.9965	1.124	11.
AVERAGE		0.9883	0.014	

CALIBRATION LINE FROM STANDARD FOR G- 1 OF 310.781 92
ENERGY= -9.293097 + 1.0037440*CH + 1.045168E-07*CH**2
FWHM =SQRT(9.6681 + 0.004018*ENERGY) (CO60= 3.876)

EFFICIENCIES FOR GEOMETRY JR1 CALIBRATED 33.000 1990

ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*
55.0	4.380*	110.0	4.150*	170.0	3.150*	400.0	1.330*	1200.0	0.432*
60.0	4.380*	120.0	3.970*	200.0	2.720*	500.0	1.060*	1500.0	0.343*
80.0	4.380*	130.0	3.820*	220.0	2.470*	600.0	0.880*	2000.0	0.255*
90.0	4.350*	140.0	3.650*	250.0	2.160*	800.0	0.650*	2500.0	0.202*
100.0	4.280*	150.0	3.450*	350.0	1.540*	1000.0	0.520*	3000.0	0.168*

9515554.0999

****

7115 2 GLS GSTOR 080

****

	PK	ENERGY	CPM	%ERR	COMMENT
	1	13.9	5.45	4.7	
	2	31.3	1.77	22.2	
b	5	662.1	1.51	14.5	Cs137s
b	6	1173.9	0.96	13.6	Cs134+ Co 60s
b	7	1333.2	0.79	16.9	Ag110 Co 60s
			REJECTED PEAKS		
B	3	239.4	0.19	99.9	Th228s
B	4	511.3	-0.32	48.1	Th228 La140 Ru106 Na 22

9513354.1000

****

7115 GLS 3 G-1 JR 311.083 92 100.60 MIN 1.00000 SM 087

LIBR=ARLI REF TIME= 311.083 92

****

Gro 11/6/92

SPECIAL ANALYSIS

PK-ENERGY-GAMMA KEV	BRANCH FRAC	EFFICIENCY FRAC	CPM CORR CNTG DECAY	DPM NOW	ERROR PCT	PCI/SMPL AT TZERO
K 40 4.602E+11 DAYS		LAMBDA= 1.506E-12		DECAY= 1.000E+00	1G	
**** (1460.85)	0.110000	0.00353	0.232	5.988E+02 s		<r 2.697E+02
Cr 51 2.772E+01 DAYS		LAMBDA= 2.501E-02		DECAY= 1.000E+00	1G	
**** (320.03)	0.102000	0.01685	0.386	2.248E+02 s		< 1.012E+02
Mn 54 3.125E+02 DAYS		LAMBDA= 2.218E-03		DECAY= 1.000E+00	2G	
**** (834.83)	1.000000	0.00622	0.201	3.226E+01 s		< 1.453E+01
Co 58 7.130E+01 DAYS		LAMBDA= 9.722E-03		DECAY= 1.000E+00	4G	
**** (810.76)	0.990000	0.00641	0.211	3.326E+01 s		< 1.498E+01
Fe 59 4.460E+01 DAYS		LAMBDA= 1.554E-02		DECAY= 1.000E+00	6G	
**** (1099.22)	0.565000	0.00472	0.139	5.225E+01 s		< 2.353E+01
**** (1291.56)	0.432000	0.00400	0.206	1.192E+02 s		< 5.370E+01
Co 60 1.921E+03 DAYS		LAMBDA= 3.608E-04		DECAY= 1.000E+00	4G	
**** (1173.21)	0.999200	0.00442	0.179	4.053E+01 s		< 1.826E+01
**** (1332.48)	1.000000	0.00388	0.155	3.997E+01 s		< 1.801E+01
Zn 65 2.440E+02 DAYS		LAMBDA= 2.841E-03		DECAY= 1.000E+00	1G	
**** (1115.52)	0.507500	0.00465	0.155	6.562E+01 s		< 2.956E+01
Nb 94 7.414E+06 DAYS		LAMBDA= 9.349E-08		DECAY= 1.000E+00	3G	
**** (871.10)	1.000000	0.00596	0.207	3.469E+01 s		< 1.562E+01
**** (1573.70)	1.000000	0.00326	0.092	2.830E+01 s		< 1.275E+01
Ru106 3.670E+02 DAYS		LAMBDA= 1.889E-03		DECAY= 1.000E+00	41G	
**** (621.80)	0.097600	0.00848	0.256	3.096E+02 s		< 1.395E+02
**** (1050.10)	0.014500	0.00495	0.210	2.932E+03 s		< 1.321E+03
I 131 8.040E+00 DAYS		LAMBDA= 8.621E-02		DECAY= 1.000E+00	9G	
**** (364.50)	0.820000	0.01473	0.369	3.054E+01 s		< 1.376E+01
Ba133 3.981E+03 DAYS		LAMBDA= 1.741E-04		DECAY= 1.000E+00	10G	
**** (276.30)	0.075000	0.01951	0.386	2.638E+02 s		< 1.188E+02
**** (302.70)	0.196000	0.01781	0.424	1.215E+02 s		< 5.471E+01
**** (355.90)	0.621000	0.01512	0.365	3.884E+01 s		< 1.750E+01
**** (383.70)	0.094000	0.01392	0.333	2.541E+02 s		< 1.144E+02
Cs134 7.531E+02 DAYS		LAMBDA= 9.204E-04		DECAY= 1.000E+00	9G	
**** (475.30)	0.015000	0.01114	0.322	1.925E+03 s		< 8.670E+02
**** (604.60)	0.980000	0.00873	0.271	3.164E+01 s		< 1.425E+01
**** (795.80)	0.880000	0.00654	0.219	3.812E+01 s		< 1.717E+01
Cs137 1.102E+04 DAYS		LAMBDA= 6.290E-05		DECAY= 1.000E+00	3G	
**** (661.64)	0.851000	0.00794	0.234	3.464E+01 s		< 1.561E+01
Eu152 4.821E+03 DAYS		LAMBDA= 1.438E-04		DECAY= 1.000E+00	48G	
**** (121.78)	0.254000	0.03943	0.539	5.380E+01 s		< 2.423E+01
**** (344.31)	0.245000	0.01566	0.354	9.215E+01 s		< 4.151E+01

****	(779.87)	0.120000	0.00668	0.228	2.845E+02	s	< 1.282E+02
****	(963.36)	0.132000	0.00540	0.215	3.024E+02	s	< 1.362E+02
****	(1112.04)	0.124000	0.00467	0.180	3.104E+02	s	< 1.398E+02
****	(1408.02)	0.198000	0.00366	0.158	2.173E+02	s	< 9.788E+01

Eu154 3.105E+03 DAYS LAMBDA= 2.232E-04 DECAY= 1.000E+00 48G

****	(123.07)	0.390000	0.03923	0.557	3.641E+01	s	< 1.640E+01
****	(723.26)	0.202000	0.00723	0.290	1.986E+02	s	< 8.944E+01
****	(873.16)	0.117000	0.00595	0.188	2.698E+02	s	< 1.215E+02
****	(1004.75)	0.170000	0.00518	0.212	2.405E+02	s	< 1.083E+02
****	(1274.49)	0.336000	0.00406	0.168	1.234E+02	s	< 5.560E+01

Eu155 1.812E+03 DAYS LAMBDA= 3.825E-04 DECAY= 1.000E+00 6G

****	(86.54)	0.320000	0.04364	0.571	4.088E+01	s	< 1.841E+01
****	(105.30)	0.200000	0.04218	0.578	6.854E+01	s	< 3.087E+01

Ta182 1.150E+02 DAYS LAMBDA= 6.027E-03 DECAY= 1.000E+00 33G

****	(67.80)	0.410000	0.04383	0.609	3.390E+01	s	< 1.527E+01
****	(100.10)	0.144000	0.04279	0.602	9.767E+01	s	< 4.399E+01
****	(1121.30)	0.358000	0.00463	0.145	8.727E+01	s	< 3.931E+01
****	(1189.05)	0.166000	0.00436	0.160	2.205E+02	s	< 9.933E+01
****	(1221.40)	0.277000	0.00424	0.189	1.607E+02	s	< 7.240E+01
****	(1231.01)	0.117000	0.00421	0.208	4.229E+02	s	< 1.905E+02

Ra226 5.851E+05 DAYS LAMBDA= 1.185E-06 DECAY= 1.000E+00 48G

****	(186.10)	0.040000	0.02913	0.504	4.327E+02	s	< 1.949E+02
****	(242.00)	0.078000	0.02236	0.439	2.518E+02	s	< 1.134E+02
****	(351.96)	0.393000	0.01531	0.432	7.179E+01	s	< 3.234E+01
****	(609.32)	0.484000	0.00866	0.291	6.943E+01	s	< 3.127E+01

Th228 6.987E+02 DAYS LAMBDA= 9.921E-04 DECAY= 1.000E+00 31G

****	(238.62)	0.448000	0.02269	0.500	4.920E+01	s	< 2.216E+01
****	(583.17)	0.287000	0.00906	0.310	1.192E+02	s	< 5.370E+01

Th232 5.113E+12 DAYS LAMBDA= 1.356E-13 DECAY= 1.000E+00 41G

****	(338.40)	0.104000	0.01594	0.343	2.072E+02	s	< 9.332E+01
****	(911.10)	0.250000	0.00570	0.257	1.805E+02	s	< 8.132E+01
****	(968.90)	0.150000	0.00536	0.192	2.380E+02	s	< 1.072E+02

9513554.1002

```
*****************************************************************************
7115   GLS   3      G-1 JR 311.083 92  100.60 MIN     1.00000 SM      087
LIBR=ARLI   REF TIME= 311.083 92
*****************************************************************************

*****************************************************************************
* Group.......................... 7115 * Time of count          311.083 1992 *
* Sample......................... 3 * Reference GMT........ 311.083 1992 *
* Element.......................... * Elapsed Live Tm.............. 100.6 *
* Type code..................... GLS * Dead Time Pct............ 0.494559 *
* ID.................. QC-9703  BLANK * Background GMT........ 307.022 1992 *
* Geometry, detector........... JR-1 * Standard GMT......... 310.781 1992 *
* Aliquot....................... 1. * Days since TO.................. 0.0 *
* Unit of Aliquot.............. SMPL * Time on.......... 17:59 PST  5-NOV *
* Data Sheet Units........ PCI /SMPL * Time off......... 19:40 PST  5-NOV *
* Library....................... ARLI * Calc Time.......... 06:28 06-NOV-92 *
*****************************************************************************
* Slope..................... 1.003744 * Width slope............... 0.004017 *
* Intercept................... -9.2931 * Width offset............. 9.668065 *
* X**2 TERM.......... 0.10451683E-06 * Sensitivity..................... 4. *
  NP:[7,67]087.GSP                    5 PEAKS

*****************************************************************************
 PK  IT   ENRG  LEFT  WD  BKGND  FWHM    AREA    CHAN        CPM   ERR   EFF  K   FIT
  1   0   16.5    19  20    151  5.52     577    25.7   5.74E+00  6.90.027   0  0.00
  2   0   59.8    64  13    235  6.91      20    68.9   1.94E-01166.5 4.38   0  0.00
  3   0  361.6   367   9     36  2.52      23   369.5   2.28E-01 55.3 1.49   0  0.00
  4   0  511.3   510  19     38  4.63      67   518.6   6.62E-01 22.2 1.04   0  0.00
  5   0 1461.0  1457  15      0  4.24      22  1464.5   2.19E-01 32.20.353   0  0.00

*****************************************************************************
BACKGROUND INFO 7115    GLS   3        311.083 92 G- 1      BG DATE 307.022 92
*****************************************************************************

v---------PEAK----------v     v-------BACKGROUND-------v     v-------NET-----v
ENERGY        CPM   %ERROR      ENERGY        CPM   %ERROR        CPM   %ERROR

 511.27     0.6620 22.16        511.00   0.4919  8.86          0.1701 89.99R
1460.96     0.2187 32.18       1461.00   0.1559 16.94          0.0628119.62R
    2 PEAKS REJECTED BY BACKGROUND

*****************************************************************************
INTERFERING ISOTOPE ANALYSIS 7115    GLS   3        311.083 92 G- 1
*****************************************************************************
NONE FOUND

RGF SENT DATA FROM NP:[7,67]923108201.GTX          TO GSTOR 087
GLS WRITES THE FOLLOWING TO NP:[7,67]GYDCSVT02.DAT
 7115=GROUP          3=SAMPL        =ELM     GLS=TYP
    0=LRW            0=LRA        ARLI=LIBR
JLYKTL PARAMETERS
       JELYKTL READ
GEDDET
       Old Effs replaced (forced)
EFFICIENCY FILE NP:[25,41]GELI01JR0.EFF
       Effs fetched  33.000    90
FETCH CAL LINE
       Cal line fetched310.781     1992
BKG FETCH ROUTINE GETS BG FOR  307.022 1992 IERR=    0
SPANF
       FETCHING SPANF
```

WHDTR CALLED

HDR WRITTEN IN GSTFIL

PKFIL UPDATED

9513354.1004

QC USED IN DATA REDUCTION OF SAMPLE 7115 3 GLS RUN AT 311.083/1992

BACKGROUND FOR GELI DETECTOR 1 OF 307.022/1992

ENERGY	CPM	ERROR	ENERGY	CPM	ERROR	ENERGY	CPM	ERROR
62.0	0.3167	0.00	511.0	0.4919	8.86	1120.3	0.0236	0.00
92.0	0.4645	0.00	583.1	0.0641	49.77	1173.2	0.0201	0.00
143.0	0.0807	0.00	609.3	0.0532	10.71	1238.1	0.0171	0.00
186.0	0.2406	24.11	661.6	0.0283	0.00	1332.5	0.0230	69.10
198.0	0.0656	0.00	727.2	0.0365	0.00	1377.7	0.0272	0.00
238.6	0.1778	22.39	846.0	0.0639	0.00	1461.0	0.1559	16.94
279.0	0.0000	0.00	860.4	0.0114	0.00	1586.0	0.0000	0.00
295.2	0.0395	0.00	911.1	0.0810	26.54	1591.0	0.0301	0.00
339.4	0.0238	0.00	968.9	0.0290	0.00	1729.6	0.0105	0.00
351.9	0.0871	49.25	1001.0	0.0177	0.00	1764.5	0.0339	49.31

GELI STANDARD EFFICIENCY QC FOR DETECTOR G- 1 ON 11/ 6/92

HIGH RADIUM STANDARD

GMT	YEAR	NORMALISED CPM	% ERROR	LENGTH IN MINUTES
286.012	92	1.0490	3.672	11.
289.186	92	0.9990	2.625	21.
291.266	92	1.0281	4.669	10.
297.712	92	0.9578	2.600	10. NG
300.678	92	0.9486	2.303	10. NG
302.755	92	0.9620	3.233	14. NG
303.036	92	1.0485	3.558	14.
305.703	92	1.0410	3.007	10.
307.832	92	1.0296	3.695	10.
310.781	92	1.0489	2.886	10.
AVERAGE		1.0349	0.018	

LOW RADIUM STANDARD

GMT	YEAR	NORMALISED CPM	% ERROR	LENGTH IN MINUTES
121.680	92	0.9942	2.816	69.
157.845	92	0.9834	1.693	23.
236.820	92	1.0004	1.735	15.
240.879	92	0.9957	1.667	18.
247.724	92	0.9273	2.961	11.
256.251	92	0.9850	4.793	15.
280.000	92	1.0064	1.922	22.
294.709	92	0.9629	4.149	14.
302.739	92	0.9701	2.117	20.
303.048	92	0.9965	1.124	11.
AVERAGE		0.9883	0.014	

CALIBRATION LINE FROM STANDARD FOR G- 1 OF 310.781 92
ENERGY= -9.293097 + 1.0037440*CH + 1.045168E-07*CH**2
FWHM =SQRT(9.6681 + 0.004018*ENERGY) (C060= 3.876)

EFFICIENCIES FOR GEOMETRY JR1 CALIBRATED 33.000 1990

ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*
55.0	4.380*	110.0	4.150*	170.0	3.150*	400.0	1.330*	1200.0	0.432*
60.0	4.380*	120.0	3.970*	200.0	2.720*	500.0	1.060*	1500.0	0.343*
80.0	4.380*	130.0	3.820*	220.0	2.470*	600.0	0.880*	2000.0	0.255*
90.0	4.350*	140.0	3.650*	250.0	2.160*	800.0	0.650*	2500.0	0.202*
100.0	4.280*	150.0	3.450*	350.0	1.540*	1000.0	0.520*	3000.0	0.168*

```
*****************************************************************************
7115   3          GLS                                          GSTOR 087
*****************************************************************************

    PK   ENERGY     CPM  %ERR      COMMENT
     1    16.5    5.74   6.9 ..............................................
     3   361.6    0.23  55.3 ..............................................
                   REJECTED PEAKS
B    4   511.3    0.17  90.0 Th228 ......................... La140 Ru106 Na 22
B    5  1461.0    0.06  99.9 ............................................ K  40s
     2    59.8    0.19  99.9 ............................................ Am241
```

9513354.1006

```
*****************************************************************************
7115    GLS    4        G-1 JR 311.154 92  100.22 MIN    135.05000 GR        090
LIBR=ARLI  REF TIME= 303.334 92
*****************************************************************************
```

Gnd 11/6/92

SPECIAL ANALYSIS

PK-ENERGY-GAMMA KEV	BRANCH FRAC	EFFICIENCY FRAC	CPM CORR CNTG DECAY	DPM NOW	ERROR PCT	PCI/GRAM AT TZERO
K 40 4.602E+11 DAYS		LAMBDA= 1.506E-12		DECAY= 1.000E+00 1G		
1461 (1460.85)	0.110000	0.00353	0.862	2.223E+03	s12.09%	7.414E+00
Cr 51 2.772E+01 DAYS		LAMBDA= 2.501E-02		DECAY= 8.224E-01 1G		
**** (320.03)	0.102000	0.01685	0.442	2.572E+02 s	<	1.043E+00
Mn 54 3.125E+02 DAYS		LAMBDA= 2.218E-03		DECAY= 9.828E-01 2G		
**** (834.83)	1.000000	0.00622	0.278	4.469E+01 s	<	1.517E-01
Co 58 7.130E+01 DAYS		LAMBDA= 9.722E-03		DECAY= 9.268E-01 4G		
**** (810.76)	0.990000	0.00641	0.276	4.351E+01 s	<	1.566E-01
Fe 59 4.460E+01 DAYS		LAMBDA= 1.554E-02		DECAY= 8.856E-01 6G		
**** (1099.22)	0.565000	0.00472	0.249	9.344E+01 s	<	3.519E-01
**** (1291.56)	0.432000	0.00400	0.219	1.264E+02 s	<	4.760E-01
Co 60 1.921E+03 DAYS		LAMBDA= 3.608E-04		DECAY= 9.972E-01 4G		
**** (1173.21)	0.999200	0.00442	0.300	6.797E+01 s	<	2.274E-01
**** (1332.48)	1.000000	0.00388	0.271	6.992E+01 s	<	2.339E-01
Zn 65 2.440E+02 DAYS		LAMBDA= 2.841E-03		DECAY= 9.780E-01 1G		
**** (1115.52)	0.507500	0.00465	0.315	1.335E+02 s	<	4.553E-01
Nb 94 7.414E+06 DAYS		LAMBDA= 9.349E-08		DECAY= 1.000E+00 3G		
**** (871.10)	1.000000	0.00596	0.294	4.933E+01 s	<	1.645E-01
**** (1573.70)	1.000000	0.00326	0.144	4.423E+01 s	<	1.475E-01
Ru106 3.670E+02 DAYS		LAMBDA= 1.889E-03		DECAY= 9.853E-01 41G		
511 (511.80)	0.205000	0.01035	0.282	1.328E+02	79.73%	4.496E-01
**** (621.80)	0.097600	0.00848	0.301	3.644E+02 s	<	1.233E+00
**** (1050.10)	0.014500	0.00495	0.219	3.050E+03 s	<	1.033E+01
I 131 8.040E+00 DAYS		LAMBDA= 8.621E-02		DECAY= 5.095E-01 9G		
**** (364.50)	0.820000	0.01473	0.451	3.733E+01 s	<	2.444E-01
Ba133 3.981E+03 DAYS		LAMBDA= 1.741E-04		DECAY= 9.986E-01 10G		
**** (276.30)	0.075000	0.01951	0.501	3.426E+02 s	<	1.144E+00
**** (302.70)	0.196000	0.01781	0.474	1.358E+02 s	<	4.534E-01
**** (355.90)	0.621000	0.01512	0.539	5.736E+01 s	<	1.916E-01
**** (383.70)	0.094000	0.01392	0.330	2.518E+02 s	<	8.411E-01
Cs134 7.531E+02 DAYS		LAMBDA= 9.204E-04		DECAY= 9.928E-01 9G		
**** (475.30)	0.015000	0.01114	0.349	2.089E+03 s	<	7.019E+00
**** (604.60)	0.980000	0.00873	0.450	5.256E+01 s	<	1.766E-01
**** (795.80)	0.880000	0.00654	0.272	4.725E+01 s	<	1.587E-01
Cs137 1.102E+04 DAYS		LAMBDA= 6.290E-05		DECAY= 9.995E-01 3G		
**** (661.64)	0.851000	0.00794	0.302	4.467E+01 s	<	1.491E-01
Eu152 4.821E+03 DAYS		LAMBDA= 1.438E-04		DECAY= 9.989E-01 48G		
**** (121.78)	0.254000	0.03943	0.792	7.904E+01 s	<	2.639E-01

****	(344.31)	0.245000	0.01566	0.523	1.363E+02	s	<	4.552E-01
411	(411.13)	0.020000	0.01292	0.176	6.805E+02	64.83%		2.272E+00
****	(778.87)	0.120000	0.00668	0.356	4.443E+02	s	<	1.483E+00
****	(963.36)	0.132000	0.00540	0.286	4.017E+02	s	<	1.341E+00
****	(1112.04)	0.124000	0.00467	0.264	4.566E+02	s	<	1.525E+00
****	(1408.02)	0.198000	0.00366	0.221	3.047E+02	s	<	1.018E+00

Eu154 3.105E+03 DAYS LAMBDA= 2.232E-04 DECAY= 9.983E-01 48G

****	(123.07)	0.390000	0.03923	0.837	5.473E+01	s	<	1.829E-01
511	(511.20)	0.000600	0.01036	0.282	4.533E+04	79.73%		1.514E+02
****	(723.26)	0.202000	0.00723	0.347	2.380E+02	s	<	7.952E-01
****	(873.16)	0.117000	0.00595	0.291	4.188E+02	s	<	1.399E+00
****	(1004.75)	0.170000	0.00518	0.297	3.377E+02	s	<	1.128E+00
****	(1274.49)	0.336000	0.00406	0.204	1.493E+02	s	<	4.989E-01

Eu155 1.812E+03 DAYS LAMBDA= 3.825E-04 DECAY= 9.970E-01 6G

****	(86.54)	0.320000	0.04364	0.887	6.354E+01	s	<	2.126E-01
****	(105.30)	0.200000	0.04218	0.727	8.614E+01	s	<	2.882E-01

Ta182 1.150E+02 DAYS LAMBDA= 6.027E-03 DECAY= 9.540E-01 33G

****	(67.80)	0.410000	0.04383	0.897	4.992E+01	s	<	1.746E-01
****	(100.10)	0.144000	0.04279	0.723	1.174E+02	s	<	4.105E-01
****	(1121.30)	0.358000	0.00463	0.285	1.719E+02	s	<	6.012E-01
****	(1189.05)	0.166000	0.00436	0.232	3.202E+02	s	<	1.120E+00
****	(1221.40)	0.277000	0.00424	0.209	1.777E+02	s	<	6.212E-01
****	(1231.01)	0.117000	0.00421	0.213	4.334E+02	s	<	1.515E+00

Ra226 5.851E+05 DAYS LAMBDA= 1.185E-06 DECAY= 1.000E+00 48G

****	(186.10)	0.040000	0.02913	0.707	6.064E+02	s	<	2.023E+00
****	(242.00)	0.078000	0.02236	0.727	4.168E+02	s	<	1.390E+00
****	(351.96)	0.393000	0.01531	0.622	1.034E+02	s	<	3.448E-01
609	(609.32)	0.484000	0.00866	0.659	1.573E+02	s39.32%		5.248E-01
1764	(1764.50)	0.166000	0.00290	0.104	2.157E+02	62.87%		7.195E-01

Th228 6.987E+02 DAYS LAMBDA= 9.921E-04 DECAY= 9.923E-01 31G

239	(238.62)	0.448000	0.02269	1.044	1.027E+02	s27.06%		3.452E-01
511	(510.69)	0.076600	0.01037	0.282	3.547E+02	79.73%		1.192E+00
****	(583.17)	0.287000	0.00906	0.404	1.553E+02	s	<	5.221E-01

Th232 5.113E+12 DAYS LAMBDA= 1.356E-13 DECAY= 1.000E+00 41G

****	(338.40)	0.104000	0.01594	0.511	3.081E+02	s	<	1.028E+00
781	(782.00)	0.004700	0.00666	0.188	5.996E+03	49.63%		2.000E+01
****	(911.10)	0.250000	0.00570	0.318	2.230E+02	s	<	7.437E-01
969	(968.90)	0.150000	0.00536	0.142	1.770E+02	s64.97%		5.904E-01

```
*****************************************************************************
7115    GLS   4        G-1 JR 311.154 92  100.22 MIN   135.05000 GR        090
LIBR=ARLI  REF TIME= 303.334 92
*****************************************************************************

*****************************************************************************
* Group........................ 7115 * Time of count          311.154 1992 *
* Sample........................... 4 * Reference GMT........ 303.334 1992 *
* Element...........................  * Elapsed Live Tm........... 100.2167 *
* Type code....................... GLS * Dead Time Pct............ 0.677238 *
* ID................... QC-9704 DUP #1 * Background GMT....... 307.022 1992 *
* Geometry, detector........... JR-1 * Standard GMT......... 310.781 1992 *
* Aliquot...................... 135.05 * Days since T0............. 7.820709 *
* Unit of Aliquot............... GRAM * Time on........... 19:41 PST  5-NOV *
* Data Sheet Units........ PCI /GRAM * Time off......... 21:22 PST  5-NOV *
* Library....................... ARLI * Calc Time......... 08:22 06-NOV-92 *
*****************************************************************************
* Slope..................... 1.003744 * Width slope............... 0.004017 *
* Intercept................. -9.2931 * Width offset............. 9.668065 *
* X**2 TERM........... 0.10451683E-06 * Sensitivity..................... 4. *
  NP:[7,67]090.GSP                  13 PEAKS
```

PK	IT	ENRG	LEFT	WD	BKGND	FWHM	AREA	CHAN	CPM	ERR	EFF	K	FIT
1	6	14.2	19	23	57	5.90	621	23.4	6.20E+00	4.90	.017	0	2.73
2	6	27.5	19	23	190	5.90	116	36.7	1.16E+00	22.10	.125	0	0.00
3	0	39.9	44	9	281	2.46	68	49.0	6.81E-01	46.60	.381	0	0.00
4	0	76.1	80	13	553	3.58	125	85.1	1.25E+00	39.7	4.38	0	0.00
5	0	239.0	242	11	180	2.06	122	247.4	1.22E+00	22.9	2.27	0	0.00
6	0	400.4	403	13	98	8.45	21	408.2	2.07E-01	107.9	1.33	0	0.00
7	0	411.1	418	6	27	1.89	18	418.8	1.76E-01	64.8	1.30	0	0.00
8	0	511.5	511	18	86	1.69	78	518.8	7.74E-01	28.5	1.04	0	0.00
9	0	609.1	606	19	85	4.08	71	616.1	7.13E-01	36.4	0.868	0	0.00
10	0	780.9	784	7	16	1.44	19	787.2	1.88E-01	49.6	0.669	0	0.00
11	0	968.9	972	8	21	2.71	17	974.5	1.71E-01	54.0	0.538	0	0.00
12	0	1461.0	1455	18	0	4.26	102	1464.5	1.02E+00	9.9	0.353	0	0.00
13	0	1764.2	1764	10	1	1.91	14	1766.5	1.38E-01	45.8	0.293	0	0.00

```
*****************************************************************************
BACKGROUND INFO 7115    GLS   4        311.154 92 G- 1      BG DATE 307.022 92
*****************************************************************************
```

PEAK ENERGY	PEAK CPM	PEAK %ERROR	BACKGROUND ENERGY	BACKGROUND CPM	BACKGROUND %ERROR	NET CPM	NET %ERROR
239.00	1.2218	22.90	238.60	0.1778	22.39	1.0441	27.06
511.47	0.7737	28.49	511.00	0.4919	8.86	0.2818	79.73
609.13	0.7127	36.37	609.30	0.0532	10.71	0.6594	39.32
968.91	0.1714	53.99	968.90	0.0290	0.00	0.1424	64.97
1460.96	1.0178	9.90	1461.00	0.1559	16.94	0.8619	12.09
1764.16	0.1377	45.83	1764.50	0.0339	49.31	0.1038	62.87

```
    0 PEAKS REJECTED BY BACKGROUND
```



```
*****************************************************************************
INTERFERING ISOTOPE ANALYSIS 7115    GLS   4        311.154 92 G- 1
*****************************************************************************
NONE FOUND

RGF SENT DATA FROM NP:[7,67]923108911.GTX          TO GSTOR 090
GLB WRITES THE FOLLOWING TO NP:[7,67]GYDCSVT01.DAT
 7115=GROUP          4=SAMPL       =ELM     GLS=TYP
```

9513554.1009

```
   O=LRW            O=LRA      ARLI=LIBR
JLYKTL PARAMETERS
       JELYKTL READ
GEODET
       Old Effs replaced (forced)
EFFICIENCY FILE NP:[25,4]GELI01JR0.EFF
       Effs fetched  33.000   90
FETCH CAL LINE
       Cal line fetched310.781    1992
BKG FETCH ROUTINE GETS BG FOR  307.022 1992 IERR=   0
SPANF
        FETCHING SPANF
WHDTR CALLED
       HDR WRITTEN IN
GSTFIL
       PKFIL UPDATED
```

DATA

9513354.1010

QC USED IN DATA REDUCTION OF SAMPLE 7115 4 GLS RUN AT 311.154/1992

BACKGROUND FOR GELI DETECTOR 1 OF 307.022/1992

ENERGY	CPM	ERROR	ENERGY	CPM	ERROR	ENERGY	CPM	ERROR
62.0	0.3167	0.00	511.0	0.4919	8.86	1120.3	0.0236	0.00
92.0	0.4645	0.00	583.1	0.0641	49.77	1173.2	0.0201	0.00
143.0	0.0807	0.00	609.3	0.0532	10.71	1238.1	0.0171	0.00
186.0	0.2406	24.11	661.6	0.0283	0.00	1332.5	0.0230	69.10
198.0	0.0656	0.00	727.2	0.0365	0.00	1377.7	0.0272	0.00
238.6	0.1778	22.39	846.0	0.0639	0.00	1461.0	0.1559	16.94
279.0	0.0000	0.00	860.4	0.0114	0.00	1586.0	0.0000	0.00
295.2	0.0395	0.00	911.1	0.0810	26.54	1591.0	0.0301	0.00
338.4	0.0238	0.00	968.9	0.0290	0.00	1729.6	0.0105	0.00
351.9	0.0871	49.25	1001.0	0.0177	0.00	1764.5	0.0339	49.31

GELI STANDARD EFFICIENCY QC FOR DETECTOR G- 1 ON 11/ 6/92

HIGH RADIUM STANDARD					LOW RADIUM STANDARD				
GMT	YEAR	NORMALISED CPM	% ERROR	LENGTH IN MINUTES	GMT	YEAR	NORMALISED CPM	% ERROR	LENGTH IN MINUTES
286.012	92	1.0490	3.672	11.	121.680	92	0.9942	2.816	69.
289.186	92	0.9990	2.625	21.	157.845	92	0.9834	1.693	23.
291.266	92	1.0281	4.669	10.	236.820	92	1.0004	1.735	15.
297.712	92	0.9578	2.600	10.NG	240.879	92	0.9957	1.667	18.
300.678	92	0.9486	2.303	10.NG	247.724	92	0.9273	2.961	11.
302.755	92	0.9620	3.233	14.NG	256.251	92	0.9850	4.793	15.
303.036	92	1.0485	3.558	14.	280.000	92	1.0064	1.922	22.
305.703	92	1.0410	3.007	10.	294.709	92	0.9629	4.149	14.
307.832	92	1.0296	3.695	10.	302.739	92	0.9701	2.117	20.
310.781	92	1.0489	2.886	10.	303.048	92	0.9965	1.124	11.
AVERAGE		1.0349	0.018		AVERAGE		0.9883	0.014	

CALIBRATION LINE FROM STANDARD FOR G- 1 OF 310.781 92
ENERGY= -9.293097 + 1.0037440*CH + 1.045168E-07*CH**2
FWHM =SQRT(9.6681 + 0.004018*ENERGY) (CO60= 3.876)

EFFICIENCIES FOR GEOMETRY JR1 CALIBRATED 33.000 1990

ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*	ENERGY	EFFC*
55.0	4.380*	110.0	4.150*	170.0	3.150*	400.0	1.330*	1200.0	0.432*
60.0	4.380*	120.0	3.970*	200.0	2.720*	500.0	1.060*	1500.0	0.343*
80.0	4.380*	130.0	3.820*	220.0	2.470*	600.0	0.880*	2000.0	0.255*
90.0	4.350*	140.0	3.650*	250.0	2.160*	800.0	0.650*	2500.0	0.202*
100.0	4.280*	150.0	3.450*	350.0	1.540*	1000.0	0.520*	3000.0	0.168*

ORIGINAL DATA

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7115    4            GLS                                        GSTOR 090
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     PK   ENERGY     CPM %ERR      COMMENT
      1    14.2    6.20  4.9 ..............................................
      2    27.5    1.16 22.1 ..............................................
      3    39.9    0.68 46.6 ........................................ Ru103
      4    76.1    1.25 39.7 ..............................................
b     5   239.0    1.04 27.1 ...................................... Th228s
      7   411.1    0.18 64.8 ..............................................
b     8   511.5    0.28 79.7 Th228 ......................... La140 Ru106 Na 22
b     9   609.1    0.66 39.3 ................................... Ru103 Ra226s
     10   780.9    0.19 49.6 Ac228 ........................................
b    11   968.9    0.14 65.0 Ac228 ............................ Sb124 Th232s
b    12  1461.0    0.86 12.1 ...................................... K  40s
b    13  1764.2    0.10 62.9 Ra226 ........................................
                     REJECTED PEAKS
      6   400.4    0.21 99.9 ..............................................
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9513354 1012

176 11-05-92

7115

"RUSH"

TMA #	Customer I.D.	T°	RECEIVED wt. G	T	N	Done By	Chkd By
7115-1	B01932	10-29-92	308.52 g	16.46	292.06	11-4-92	
-2	QC. LCS		NA	NA	NA		
	9702						
-3	QC. Blank						
	9703						
-4	QC. Dup #1	10-29-92					
	9704						
~~-5~~ 11-05-92							

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-JA 11-05-92

Done By	Checked By	DRIED WT G	→ N	Done By	Checked By	Aliquot GLS	Geom GLS	Done By	Checked By
-92		283.01	266.55 g	JA 11-05-92		131.50 g	JR	JA 11-05-92	
		NA	NA			1.05 smpl.	JR.		
						1.0 smpl.	JR.		
						135.05 g	JR		

9513354.1014

7115

LOG-IN VERIFICATION 7115
16:06:43 10-NOV-92
Cust. set 0 0
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TC
11/10/92

LOG-IN VERIFICATION
All samples
All planchets

N211024 WHC
Westinghouse Hanfor
2355 Stevens Drive

100 area & Riverland

Pr Mgr.... DPK Rcvd... 11/02/92
Charge.... 00-000 Due.... 11/02/92
Chemist... Value... 0.
Created... 04-NOV-92 Billed.. 0.
Billing status.. open
Calc. units..... PCI /Unit alq Min Pri
7

smp	alm	typ	mg rec	dpm rec Ash wgt	1st sep		2nd sep		aliquot		carr/ trac
1		GLS	0.00	0.0000	0.000	0	0.000	0	131.5	gram	# 0
2		GLS	0.00	0.0000	0.000	0	0.000	0	1.000	smpl	# 0
3		GLS	0.00	0.0000	0.000	0	0.000	0	1.000	smpl	# 0
4		GLS	0.00	0.0000	0.000	0	0.000	0	135.1	gram	# 0

Carriers/Tracers used -----