9213505.2451 START

B07100-TMA-234

5/92

0045813

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

SEP 1992 RECEIVED OSM DMO

September 17, 1992

SENT BY FEDERAL EXPRESS

Ref. TMA/Norcal N2-07-063-7064

RECORD COPY

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 soil samples from 100-BC-5 Location, we received 17 July 1992. The QA/QC results are also given in the Summary Data Section.

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 through 6
Appendices

NOV 1996 RECEIVED EDMC

i 90 7-9-96

SDG 7064	Client Westinghouse Hanford
Contact Dinkar P. Kharkar	Contract MBH-SVV-069262

CASE NARRATIVE

1.0 GENERAL

Soil sample results from Location 100-BC-5 (TMA/Norcal Group 7064) are reported herein. TMA/Norcal Group 7064 is comprised of the two samples listed on the Chain-of-Custody documents and is identified as Samples 1 and 2.

1.1 CHAINS-OF-CUSTODY

This report includes data from the sample delivered under Chain-of-Custody documents Field Logbook N/A.

1.2 SAMPLE VOLUME

1000 mL bottles of the samples were received for the analyses.

1.3 MISSING SAMPLES

All samples were accounted for in an undamaged condition.

1.4 HOLDING TIMES

The collections were made on 7/07/92 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 7064-3,4, and 5.

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 ^{60}Co and ^{137}Cs were 105% and 95% and were within the 3 σ limits.

2.2 BLANKS

The blank results for the gamma scan nuclides were less than MDA.

2.3 REPLICATES

Results were satisfactory for the replicate analyses.

3.0 ANALYTICAL NOTES

3.1 Gamma Scan Analyses: Gamma scan analysis found positive concentration of ^{137}Cs in the samples.

TMA NORCAL

REPORTING GROUP 7064

DATA SHEET

N207063-01

B07100

SDG 7064
Contact Dinkar Kharkar
Client Westinghouse Hanford
Contract MBH-SVV-069262

Lab sample id N207063-01
Dept sample id 7064-001
Received 07/15/92
Client sample id B07100
Matrix SOIL
Collected 07/07/92
Chain of custody id NA

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	9.5	2.1				GAM
Iron 59		U		0.75		U	GAM
Chromium 51	14392-02-0	U		2.5		U	GAM
Cobalt 60	10198-40-0	U		0.17		U	GAM
Zinc 65	17982-39-3	U		0.28		U	GAM
Ruthenium 106	13967-48-1	U		1.1		U	GAM
Cesium 134	17967-70-9	U		0.18		U	GAM
Cesium 137	10045-97-3	0.84	0.17				GAM
Europium 152	14683-23-9	U		0.23		U	GAM
Europium 154	15585-10-1	U		0.15		U	GAM
Radium 226	13982-67-7	0.48	0.21				GAM
Thorium 228	14274-82-9	0.49	0.11				GAM
Thorium 232	7440-29-1	0.72	0.36				GAM

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-DS
Version 2.16
Report date 09/17/92

TMA NORCAL

REPORTING GROUP 7064

DATA SHEET

N207063-02

B07101

SDG 7064
Contact Dinkar Kharkar

Client Westinghouse Hanford
Contract MBH-SVV-069262

Lab sample id N207063-02
Dept sample id 7064-002
Received 07/15/92

Client sample id B07101
Matrix SOIL
Collected 07/07/92
Chain of custody id NA

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	7.8	1.5				GAM
Iron 59		U		0.44		U	GAM
Chromium 51	14392-02-0	U		1.9		U	GAM
Cobalt 60	10198-40-0	U		0.11		U	GAM
Zinc 65	17982-39-3	U		0.20		U	GAM
Ruthenium 106	13967-48-1	U		0.83		U	GAM
Cesium 134	17967-70-9	U		0.083		U	GAM
Cesium 137	10045-97-3	1.0	0.15				GAM
Europium 152	14683-23-9	U		0.18		U	GAM
Europium 154	15585-10-1	U		0.12		U	GAM
Radium 226	13982-67-7	0.38	0.12				GAM
Thorium 228	14274-82-9	0.39	0.12				GAM
Thorium 232	7440-29-1	U		0.48		U	GAM

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-DS
Version 2.16
Report date 09/17/92

N207063-05

TMA NORCAL

REPORTING GROUP 7064

REPLICATE

B07100

SDG 7064
Contact Dinkar Kharkar

Client Westinghouse Hanford
Contract MBH-SVV-069262

REPLICATE		ORIGINAL			
Lab sample id	N207063-05	Lab sample id	N207063-01	Client sample id	B07100
Dept sample id	7064-005	Dept sample id	7064-001	Matrix	SOIL
		Received	07/15/92	Collected	07/07/92
				Chain of custody id	NA

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	11	1.9				GAM	9.5	2.1			15	53	35
Iron 59	U		0.72		U	GAM	U		0.75	U	-		
Chromium 51	U		2.6		U	GAM	U		2.5	U	-		
Cobalt 60	U		0.15		U	GAM	U		0.17	U	-		
Zinc 65	U		0.39		U	GAM	U		0.28	U	-		
Ruthenium 106	U		1.3		U	GAM	U		1.1	U	-		
Cesium 134	U		0.15		U	GAM	U		0.18	U	-		
Cesium 137	0.90	0.20				GAM	0.84	0.17			7	55	35
Europium 152	U		0.19		U	GAM	U		0.23	U	-		
Europium 154	U		0.13		U	GAM	U		0.15	U	-		
Radium 226	0.55	0.39				GAM	0.48	0.21			14	133	35
Thorium 228	0.63	0.21				GAM	0.49	0.11			25	72	35
Thorium 232	0.91	0.49				GAM	0.72	0.36			23	117	35

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-REP
Version 2.16
Report date 09/17/92

Westinghouse Hanford Company 9213505.2456

CHAIN OF CUSTODY 000035

Custody Form Initiator CMChance

Company Contact CMChance Telephone 376-7619

Project Designation/Sampling Locations 100BC-5 Collection Date 7-7-92

Ice Chest No. FrY Field Logbook No. NA

Bill of Lading/Airbill No. Offsite Property No.

Method of Shipment Overnight Air

Shipped to TMA/NORCAL

Possible Sample Hazards/Remarks NA

Sample Identification

B07100 1-1000ml G (Gamma Spec.)

B07101 1-1000ml G (Gamma Spec.)

CC 7-7-92

CC 7-7-92

☐ Field Transfer of Custody

CHAIN OF POSSESSION (Sign and Print Names)

Relinquished by:	Received by:	Date/Time:
CMChance Cory Chance	Kermit Blum	7-15-92 1100
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Final Sample Disposition

Disposal Method:	Disposed by:	Date/Time:

Comments:

A-6000-407 (12/90

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector CM Chance Date Sampled 7-7-92 Time 1000 hours

Company Contact CM CHANCE Telephone (509) 376-2084

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
	1-120ml aG	Soil	CLP:ICP/AA Metals,Hg
	1-120ml aG	Soil	CLP:Cn
	1-120ml aG	Soil	CLP:VOA
	1-250ml aG	Soil	CLP:Semi-VOA,PCB/PEST
	1-120ml aG	Soil	300.0/353.2;Anions(F,SO4,NO3)
	1-950ml aG	Soil	Gross alpha/beta,Gamma Spec,Sr-90,C-14,
			U-235/238,Pu-239/240,Am-241
	1-120ml aG	Soil	CLP:ICP/AA Metals,Hg
	1-120ml aG	Soil	CLP:Cn
	1-120ml aG	Soil	CLP:VOA
	1-250ml aG	Soil	CLP:Semi-VOA,PCB/PEST
CG7-14-92	1-120ml aG	Soil	300.0/353.2:Anions(F,SO4,NO3)
	1-950ml aG	Soil	Gross alpha/beta,Gamma Spec,Sr-90,C-14
			U-235/238,Pu-239/240,Am-241
✓ B07100	1-1000ml G	Soil	Gamma Spec.
✓ B07101	1-1000ml G	Soil	Gamma Spec.

Field Information**

Special Handling and/or Storage Maintain at 4C

Possible Sample Hazards NA

PART II: LABORATORY SECTION

Received by Kermit Blum Title Sample Control Supervisor Date 7-15-92

Analysis Required

*Indicate whether sample is soil, sludge, water, etc.

9713505.2458

SAMPLE STATUS REPORT FOR E 3336. E-BLANK 607100 TIME: 7/ 8/92 8: 7
DISPATCHED: 6/30/92 9:27 SAMPLE HAS NOT BEEN SLURPED
RECEIVED: 7/ 7/92 11:34

EXT.	DETER.	RESULTS OR STATUS	OUT OF RANGE?	GOOD ANS?	CHARGE CODE
****	********	**********	***	***	******
4271	TOT-ACT	< 5.00000E 01 PICI/G	N	Y	P87AD

END OF REPORT

SAMPLE STATUS REPORT FOR E 3537. E-BLANK R07101 TIME: 7/ 8/92 8: 7
DISPATCHED: 6/30/92 9:29 SAMPLE HAS NOT BEEN SLURPED
RECEIVED: 7/ 7/92 11:34

EXT.	DETER.	RESULTS OR STATUS	OUT OF RANGE?	GOOD ANS?	CHARGE CODE
****	********	**********	***	***	******
4271	TOT-ACT	< 5.00000E 01 PICI/G	N	Y	P87AD

END OF REPORT

FORM OF PAYMENT

Check ☐ GBL ☐ FCCOD ☐

Bill to Shipper [X] Bill to Consignee ☐ Third Party Billing ☐

EMERY WORLDWIDE

A CF Company

SERVICES

UNITED STATES / CANADA: Same Day ☐ AM [X] PM ☐ Second Day ☐ Saturday Delivery ☐

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

Shipper's Account Number: E 850281585

Date: 07-14-92 | Origin: PSC | Shipment Number: 250986821 8

From:
WESTINGHOUSE SHIPPING DEPT (509) 376-6665
U.S. DEPARTMENT OF ENERGY C/O
WESTINGHOUSE HANFORD
BLDG 1163
2355 STEVENS DRIVE
RICHLAND WA
Canada ☐

To:
ROBERT FOX
TMA/NORCAL
2030 WRIGHT AVE
RICHMOND CA
Hold for Pick Up ☐
Canada ☐

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.

Customer's Reference Numbers: W12200 PB7AE W92-0-0436#24 29052

Consignee's Account Number: E 94804

Description	Pcs	L	W	H	Total Pieces	Total Weight (In Lbs)
1 RUBBERMAID FRY POLYCOOLER SOIL SAMPLES	1				1	66

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

Declared Value $

Remarks: OVERNIGHT DELIVERY

Shipper's Signature X

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 ☐

250986821 8

International Shipments: Free Domicile ☐ Commodity Code

Third Party Account Number mandatory for Third Party Billing. E

Third Party Account Number

International Customs Value

International Insurance

Base Charge

Total Transportation Charges

Other Charges/Advance at Origin ☐ OC/AO- $

1-OAK A

Terms and Conditions on Back

9713505.2459

9713505.2460

Overnight Delivery

Contractor	OFF-SITE PROPERTY CONTROL	CONTROL NUMBER (To be obtained from PROPERTY MANAGEMENT)
Westinghouse Hanford Company		W92-0-0436-004

PART I – TO BE COMPLETED BY ORIGINATOR

Department	Section	Unit
Env Eng & Geotech	EFSG	Env Charac & Sampling

The following items are to be shipped from ☒ Contractor ☐ Vendor

Routing Air ☒ Contractor ☐ Vendor

Shipped to
TMA/NORCAL
2030 WRIGHT AVE
RICHMOND CA 94804

Off-site Custodian: Robert Fox

Full Title: Project Coordinator

Quantity	Description (Include Serial and any Government Tag Numbers)	Original Cost
6 bottles	1 Rubbermaid Fr4 poly cooler. Contains soil samples that are double-bagged and packed in wet ice and vermiculite. Samples are nonhazardous. Sample #: B06M58 B06M35, B07100, B07101	N/A

☐ Classified ☒ Unclassified ☐ Shipped Under DOE Contract ☐ Shipped Under Contractor's Use Permit Contract

Necessity for the Off-Site Use of this Property

To support drilling and sampling at the 100 Areas

Bill of Lading: PSC 2501262212

CERTIFICATION OF THE RADIATION MONITORING RELEASE MUST BE SECURED THE SAME DAY THAT MATERIAL IS DELIVERED TO SHIPPING.

RM Clearance for Public Release	RM Survey No.	Date

Location of Property (Area & Bldg.)	Contact	Phone
100 Area 100KR-4	C. M. Chance	376-7619

Date Ready for Shipment	Cost Code to be Charged	Approximate Date This Property will be Returned
7-14-92	PB7AE 12200	N/A

Originated By	Relinquished by:	Date	Authorized By	Date
		7-14-92		7-14-92

Signature and Name of Property Control	Custodian Date	Property Management Approval	Date

PART II – TO BE COMPLETED BY SHIPPING

Signature of Recipient	Return Order No.	Date Issued	Purchase Order No.	Date Issued
Date 7-14-92				

DISTRIBUTION

By Originator	Shipping Operation – Sign all Copies and Forward to:	
White, Green, Yellow, Pink – Property Management Goldenrod – Retain	White – Property Management Yellow – Retain	Green – Property Control Custodian (Issuing Office) Pink – Originator

54-3000-479 (09/89)

 9713505-2461 TMA/Norcal CHAIN OF CUSTODY ORD # N2-07-063

RCVD: 07/17/92 DUE: 09/15/92 08/17/92 16:44:33 KEEP: 12/14/92 DISP: S

DASH	SAMPLE IDENTIFICATION	STORED	TESTS
01A	B07100	SCA2	GLY
02A	B07101	SCA2	GLY
03A	~~GC-LCS~~	n/a	GLY
04A	~~GC-blank~~	n/a	GLY
05A	~~G[illegible]-dup-of-01~~	n/a	GLY

RELEASED BY	DATE	TRANSFERRED TO	DATE	RECEIVED BY	DATE
		Low Level	08-18-92	[illegible]	08-18-92

7064

9713505.2462

VALIDATION SUMMARY

9713505.2463

000014

N207063-01

TMA NORCAL

REPORTING GROUP 7064

DATA SHEET

B07100

SDG	7064	Client	Westinghouse Hanford
Contact	Dinkar Kharkar	Contract	MBH-SVV-069262
Lab sample id	N207063-01	Client sample id	B07100
Dept sample id	7064-001	Matrix	SOIL
Received	07/15/92	Collected	07/07/92
		Chain of custody id	NA

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	9.5	2.1				GAM
Iron 59		U		0.75		U	GAM
Chromium 51	14392-02-0	U		2.5		U	GAM
Cobalt 60	10198-40-0	U		0.17		U	GAM
Zinc 65	17982-39-3	U		0.28		U	GAM
Ruthenium 106	13967-48-1	U		1.1		U	GAM
Cesium 134	17967-70-9	U		0.18		U	GAM
Cesium 137	10045-97-3	0.84	0.17				GAM
Europium 152	14683-23-9	U		0.23		U	GAM
Europium 154	15585-10-1	U		0.15		U	GAM
Radium 226	13982-67-7	0.48	0.21				GAM
Thorium 228	14274-82-9	0.49	0.11				GAM
Thorium 232	440-29-1	0.72	0.36				GAM

X01494
BC-S
GW-DR

AB
11-23-92

Lab id	TMAN
Protocol	WHC-HEIS
Version	Ver 1.0
Form	DVD-DS
Version	2.16
Report date	09/17/92

TMA NORCAL

REPORTING GROUP 7064

DATA SHEET

N207063-01

B07100

SDG 7064
Contact Dinkar Kharkar
Client Westinghouse Hanford
Contract MBH-SVV-069262

Lab sample id N207063-01
Dept sample id 7064-001
Received 07/15/92
Client sample id B07100
Matrix SOIL
Collected 07/07/92
Chain of custody id NA

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	9.5	2.1				GAM
Iron 59		U		0.75		U	GAM
Chromium 51	14392-02-0	U		2.5		U	GAM
Cobalt 60	10198-40-0	U		0.17		U	GAM
Zinc 65	17982-39-3	U		0.28		U	GAM
Ruthenium 106	13967-48-1	U		1.1		U	GAM
Cesium 134	17967-70-9	U		0.18		U	GAM
Cesium 137	10045-97-3	0.84	0.17				GAM
Europium 152	14683-23-9	U		0.23		U	GAM
Europium 154	15585-10-1	U		0.15		U	GAM
Radium 226	13982-67-7	0.48	0.21				GAM
Thorium 228	14274-82-9	0.49	0.11				GAM
Thorium 232	7440-29-1	0.72	0.36				GAM

RB
11-23-92

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-DS
Version 2.16
Report date 09/17/92

9213505.2465

000015

TMA NORCAL

REPORTING GROUP 7064

DATA SHEET

N207063-02

B07101

SDG 7064
Contact Dinkar Kharkar

Client Westinghouse Hanford
Contract MBH-SVV-069262

Lab sample id N207063-02
Dept sample id 7064-002
Received 07/15/92

Client sample id B07101
Matrix SOIL
Collected 07/07/92
Chain of custody id NA

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	7.8	1.5				GAM
Iron 59		U		0.44		U	GAM
Chromium 51	14392-02-0	U		1.9		U	GAM
Cobalt 60	10198-40-0	U		0.11		U	GAM
Zinc 65	17982-39-3	U		0.20		U	GAM
Ruthenium 106	13967-48-1	U		0.83		U	GAM
Cesium 134	17967-70-9	U		0.083		U	GAM
Cesium 137	10045-97-3	1.0	0.15				GAM
Europium 152	14683-23-9	U		0.18		U	GAM
Europium 154	15585-10-1	U		0.12		U	GAM
Radium 226	13982-67-7	0.38	0.12				GAM
Thorium 228	14274-82-9	0.39	0.12				GAM
Thorium 232	7440-29-1	U		0.48		U	GAM

AB
11-23-

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-DS
Version 2.16
Report date 09/17/92

9713505.2466

000015

TMA NORCAL

REPORTING GROUP 7064

DATA SHEET

N207063-02

B07101

SDG 7064
Contact Dinkar Kharkar

Client Westinghouse Hanford
Contract MBH-SVV-069262

Lab sample id N207063-02
Dept sample id 7064-002
Received 07/15/92

Client sample id B07101
Matrix SOIL
Collected 07/07/92
Chain of custody id NA

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	7.8	1.5				GAM
Iron 59		U		0.44		U	GAM
Chromium 51	14392-02-0	U		1.9		U	GAM
Cobalt 60	10198-40-0	U		0.11		U	GAM
Zinc 65	17982-39-3	U		0.20		U	GAM
Ruthenium 106.	13967-48-1	U		0.83		U	GAM
Cesium 134	17967-70-9	U		0.083		U	GAM
Cesium 137	10045-97-3	1.0	0.15				GAM
Europium 152	14683-23-9	U		0.18		U	GAM
Europium 154	15585-10-1	U		0.12		U	GAM
Radium 226	13982-67-7	0.38	0.12				GAM
Thorium 228	14274-82-9	0.39	0.12				GAM
Thorium 232	7440-29-1	U		0.48		U	GAM

BJB 11-23

Lab id TMAN
Protocol WHC-HEIS
Version Ver 1.0
Form DVD-DS
Version 2.16
Report date 09/17/92

9713505.2467

RADIOLOGICAL DATA VALIDATION CHECKLIST

PROJECT: Westinghouse	REVIEWER: PJB	DATE: 11-16-92
LABORATORY: TMA	CASE: N/A	SDG: B07100
SAMPLES/MATRIX: Soil		
2 samples -		
B07100		
B07101		

6.1 COMPLETENESS CHECKS

Begin by examining the data package for completeness. Use the checklists included in the Appendices, but also refer to the Statement of Work (SOW) for the analytical laboratory. Items specified in the SOW may supplement or take precedence over the list of items in the checklists.

Evaluation Criteria and Actions

Verify that the items listed in the SOW, if available, and the Method Specific Appendices are included in the data package. These items may be recorded in various ways, and the data package may be organized differently than this procedure, so some searching may be required. Information that pertains to a requirement that is associated with an **R** qualifier, e.g., initial calibration, is classed as major, and its lack would be a major deficiency. A minor deficiency would result from a lack of information associated with a **J** qualifier, e.g., duplicates. The validator may have to use professional judgement to classify some deficiencies.

If minor deficiencies are encountered and can not be rectified by the laboratory, then generally all affected (associated) data must be qualified as estimated (**J**). Major deficiencies that can not be rectified will require that all affected data be qualified as unusable (**R**). The validator may use other qualifiers, but their definition must be included in the data validation report. If the validator concludes that no qualification is necessary, the reason must be included in the data validation report.

9713505.2468

Indicate whether the following articles are present. Insert a "Y" if the corresponding item is in the data packet, an "N" if it is absent, or "N/A" if the item does not apply to the analysis:

Checklist:

✓ Case Narrative
✓ Chain of Custody

6.1.A COMPLETENESS CHECKLIST FOR ANALYSES USING GAS PROPORTIONAL COUNTERS

N.A.

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Counting Logs, Printouts, Notebook Pages)
_____ Calculation Sheets
_____ Sample Identifications
_____ Detector Identification
_____ Analysis Date and Initials of Analyst
_____ Amounts of Samples Prepared or Counted
_____ Weights of Solids Counted

Initial and Continuing Calibration

_____ Detector Identification
_____ Calibration Date(s) and Initials of Analyst
_____ Identification of Calibration and Check Standards including Radionuclide, Certification, Expiration Date, and Activity
_____ Amount of (Check) Standard Used
_____ Raw Data including Counts and Count Duration for Standards
_____ Weights of Preparations
_____ Efficiencies
_____ Weights of Carriers Added, If Applicable
_____ Results of Statistical Tests Used to Evaluate Instrument Reliability and Efficiency Checks
_____ Raw Data of Background Counts and Count Duration
_____ Results of Statistical Test Used to Evaluate Instrument Background
_____ Control Limits for Check Source and Background Counts

Blanks

_____ Detector Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used in Blank

NA.

Radiometric and Gravimetric Yields

_____ Amounts (Volumes, Concentrations, Activity) of Spikes, Tracers, or Carriers Used
_____ Weights of Precipitates or Solids Counted
_____ Calculated Recoveries

Duplicates

_____ Detector Identification
_____ Date of Analysis
_____ Aliquots of Samples
_____ Weights of Solids Counted
_____ Count Durations
_____ Sample Identifications
_____ Calculated Precision

Laboratory Control Samples

_____ Detector Identification
_____ Date of Analysis
_____ Calculation of Recoveries
_____ Results of Analyses

6.1.B COMPLETENESS CHECKLIST FOR ANALYSES USING ALPHA SPECTROSCOPY

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Spectra, Printouts, Notebook Pages)
_____ Calculation Sheets
_____ Sample Identifications
_____ Detector Identification
_____ Analysis Date and Initials of Analyst
_____ Amounts of Samples Counted (Precipitated or Deposited)

Initial and Continuing Calibration

_____ Detector Identification
_____ Calibration Date(s) and Initials of Analyst
_____ Identification of Calibration and Check Standards including Radionuclide, Certification, Expiration Date, and Activity
_____ Amount of (Check) Standard Used
_____ Raw Data including Spectra or Counts per Channel
_____ Kev/channel
_____ Count Duration for Standards
_____ Efficiencies
_____ Raw Data of Background Counts, Dates Counted, and Duration of Counts

Blanks

_____ Detector Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used in Blank

N/A

Duplicates

_____ Detector Identification
_____ Date of Analysis
_____ Amounts of Samples Counted
_____ Count Durations
_____ Sample Identifications
_____ Calculated Precision

Radiometric and Gravimetric Yields

_____ Amounts (Volumes, Concentrations, Activity) of Spikes, Tracers, or Carriers Used
_____ Weights of Precipitates or Solids Counted
_____ Calculated Recoveries

Laboratory Control Samples

_____ Detector Identification
_____ Date of Analysis
_____ Calculation of Recoveries
_____ Results of Analyses

6.1.C COMPLETENESS CHECKLIST FOR GAMMA SPECTROSCOPY

Analysis Results

- ✓ Results Report for Sample Analyses and Reanalyses
- ✓ Raw Data (Spectra, Printouts of Counts per Channel, Notebook Pages)
- ✓ Calculation Sheets
- ✓ Sample Identifications
- ✓ Detector Identification and Counting Position
- ✓ Analysis Date and Initials of Analyst
- ✓ Amounts of Samples Counted

Initial and Continuing Calibration

- ✓ Detector Identification
- ✓ Calibration Date(s) and Initials of Analyst
- ✓ Identification of Calibration and Check Standards including Radionuclides, Certification, Expiration Date, and Activity
- ✓ Amount of (Check) Standard Used
- ✓ Raw Data including Counts and Count Duration for Standards
- ✓ Efficiencies and/or Geometry and Matrix Factors
- ✓ Raw Data of Background Counts, Count Dates, and Duration of Counts
- ✓ Kev/Channel
- ✓ FWHM

Blanks

- ✓ Detector Identification
- ✓ Date of Analysis
- ✓ MDA of Method
- ✓ Amounts of Reagents Used in Blank
- ✓ Raw Data

Duplicates

- ✓ Detector Identification
- ✓ Date of Analysis
- ✓ Amounts of Samples
- ✓ Count Durations
- ✓ Sample Identifications
- ✓ Results of Analyses and Calculated Precision
- ✓ Raw Data

Radiometric and Gravimetric Yields

- N/A Amounts (Volumes, Concentrations, Activity) of Spikes, Tracers, or Carriers Used
- Weights of Precipitates or Solids Counted
- ✓ Calculated Recoveries

Laboratory Control Samples

- ✓ Detector Identification
- ✓ Date of Analysis
- ✓ Calculation of Recoveries
- ✓ Results of Analyses

6.1.D COMPLETENESS CHECKLIST - ALPHA-EMITTING RADIUM ISOTOPES USING SCINTILLATION COUNTING

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)
_____ Calculation Sheets
_____ Sample Identifications
_____ Detector Identification and Counting Position
_____ Analysis Date and Analyst Initials
_____ Sample Weight

Initial and Continuing Instrument Calibration

_____ Detector Identification
_____ Calibration Dates and Analyst Initials
_____ Identification of Calibration Standards including Radionuclides, Certification, Issue or Expiration Data and Activity
_____ Amount of Standard Used for Calibration
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)
_____ Routine Control Charts

Blanks

_____ Detector Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used
_____ Lot Numbers of Reagents Used
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)

Duplicates

_____ Detector Identification
_____ Date of Analysis
_____ Sample Weight
_____ Amount of Spike for Spiked Duplicates
_____ Raw Data (Gross Counts, Count Duration, Background Counts, and Background Count Duration)

Radiometric and Gravitimetric Yields

_____ Amount of Spike Used for Spiked Samples
_____ Amount of Radium Standard Used for Radiometric Yield Determination
_____ NIST Certification for Radium Standards
_____ Calculated Radiometric Yield
_____ Weight of Carrier Added for Gravitimetric Determination
_____ Weight of Carrier Recovered for Gravitimetric Determination
_____ Calculated Gravitimetric Yields

Laboratory Control Samples

_____ Sample Identification
_____ Detector Identification
_____ Date of Analysis
_____ Calculated Recoveries
_____ Results of Analyses
_____ Sample Weight

6.1.E COMPLETENESS CHECKLIST - RADIUM-226 USING SCINTILLATION (LUCAS) CELL COUNTING

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)
_____ Calculation Sheets
_____ Sample Identifications
_____ Scintillation (Lucas) Cell Identification
_____ Analysis Date and Analyst Initials
_____ Amounts of Samples Counted
_____ Sample Weight

Initial and Continuing Instrument Calibration

_____ Scintillation (Lucas) Cell Identification
_____ Calibration Dates and Analyst Initials
_____ Identification of Calibration Standards including Radionuclides, Certification, Issue or Expiration Date and Activity
_____ Amount of Standard Used for Calibration
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)
_____ Routine Control Charts

Blanks

_____ Scintillation (Lucas) Cell Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used
_____ Lot Numbers of Reagents Used
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)

N/A

Duplicates

_____ Scintillation (Lucas) Cell Identification
_____ Date of Analysis
_____ Sample Weight
_____ Amount of Spike for Spiked Duplicates
_____ Raw Data (Gross Counts, Count Duration, Background Counts, and Background Count Duration)

Radiometric and Gravitimetric Yields

_____ Amount of Spike Used for Spiked Samples
_____ Weight of Carrier Added for Gravitimetric Determination
_____ Weight of Carrier Recovered for Gravitimetric Determination
_____ Calculated Gravitimetric Yields

Laboratory Control Samples

_____ Sample Identification
_____ Scintillation (Lucas) Cell Identification
_____ Date of Analysis
_____ Calculated Recoveries
_____ Results of Analyses

6.1.F COMPLETENESS CHECKLIST - TRITIUM USING LIQUID SCINTILLATION COUNTING

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)
_____ Calculation Sheets
_____ Sample Identifications
_____ Instrument Identification
_____ Analysis Date and Analyst Initials
_____ Sample Weight

Initial and Continuing Instrument Calibration

_____ Instrument Identification
_____ Identification of Calibration Standards including Radionuclides, Certification, Issue or Expiration Date and Activity
_____ Amount of Standard Used for Calibration
_____ Raw Data (Gross Counts, Count Duration, Background Count, and Background Count Duration)
_____ Counting Efficiency Determination Method and Results
_____ Quench Correction Method

Blanks

_____ Instrument Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used
_____ Lot Numbers of Reagents Used
_____ Raw Data (Gross Counts, Count Duration, Background Count, Background Count Duration)
_____ Tritium Levels in Background Water

V-A-

Duplicates

_____ Instrument Identification
_____ Date of Analysis
_____ Amounts of Samples
_____ Amount of Spike for Spiked Duplicates
_____ Raw Data (Gross Counts, Count Duration, Background Counts, and Background Count Duration)

Radiometric Yields

_____ Amount of Tritium Standard Used for Radiometric Yield Determination
_____ Radiometric Yield Calculations and Results

Laboratory Control Samples

_____ Sample Identification
_____ Instrument Identification
_____ Date of Analysis
_____ Calculated Recoveries
_____ Results of Analyses

6.1.G COMPLETENESS CHECKLIST - FLUOROMETRIC ANALYSIS OF URANIUM

Analysis Results

_____ Results Report for Sample Analyses and Reanalyses
_____ Raw Data (Fluorometer Readings, Notebook Pages, etc.)
_____ Calculation Sheets
_____ Sample Identifications
_____ Instrument Identification
_____ Analysis Date and Analyst Initials
_____ Sample Weight

Initial and Continuing Instrument Calibration

_____ Instrument Identification
_____ Calibration Dates and Analyst Initials
_____ Identification of Calibration Standards including Certification, Expiration Date and Concentration Amount of Standards Used for Calibration
_____ Raw Data (Fluorometer Readings, Notebook Pages, etc.)

Blanks

_____ Instrument Identification
_____ Date of Analysis
_____ MDA of Method
_____ Amounts of Reagents Used
_____ Lot Numbers of Reagents Used
_____ Raw Data (Fluorometer Readings, Notebook Pages, etc.)

Duplicates

_____ Instrument Identification
_____ Date of Analysis
_____ Amounts of Samples
_____ Amount of Spike for Spiked Duplicates
_____ Raw Data (Fluorometer Readings, Notebook Pages, etc.)

N.A.

Gravitimetric Yields

_____ Weight of Carrier Added for Gravitimetric Determination
_____ Weight of Carrier Recovered for Gravitimetric Determination
_____ Calculated Gravitimetric Yields

Laboratory Control Samples

_____ Sample Identification
_____ Instrument Identification
_____ Date of Analysis
_____ Calculated Recoveries
_____ Results of Analyses

6.2 HOLDING TIMES

Answer each question with a "Y" for yes, "N" for no, or an "N/A" if the inquiry is not applicable.

Evaluation Criteria and Actions

Samples shall be analyzed within the period of 5 half-lives of the radionuclide of interest or six months, whichever comes first. Samples shall be properly contained and preserved (e.g., acidified) in accordance with laboratory standard procedures, to ensure that sample integrity is maintained.

Holding times for each radionuclide are established by comparing the sampling date on the Chain of Custody form with the dates of analysis found in the data package.

Analysis date - sample date = radionuclide holding time

Have the samples been analyzed within holding time? Yes No N/A

ACTION: If holding time or preservation requirements are not met, qualify all results > LLD as estimated detects (J) and results < LLD as estimated nondetects (UJ). Professional judgement must be used in the case of grossly exceeded holding times. One would expect smaller reported activities as the reviewer may determine that results < LLD are unusable (R).

Collection date: 7/7/92

analyzed: 9/9/92

6.3 CALIBRATION

Instruments must be calibrated in accordance with laboratory standard operating procedures and/or manufacturer's instructions initially and when a detector or other major system component is changed. Frequently thereafter, less extensive continuing calibration checks, which consist of background and check source counts, must be done.

Evaluation Criteria and Actions

a. Initial Calibration

Has the instrument been calibrated within the time period specified in the laboratory standard operating procedure or manufacturer's instructions, but not less than annually?

Yes No N/A

ACTION: If the instrument was not calibrated within the specified time period qualify the associated data as unusable (R). Associated data means, in this case, results for all the analyses for each run or day during the period for which no calibration is valid.

Compare the identifications of detectors calibrated against those used for all analyses to verify that each detector used was calibrated. Has each detector in multiple counting system been calibrated?

Yes No N/A

ACTION: If any detector was not calibrated qualify all associated data as unusable (R).

Review the certifications, including identification numbers, of the standard(s). Compare the identification numbers on the certificates with identification numbers on the instrument printouts. Have NIST, NIST traceable, or equivalent certified standards must be used for calibration?

Yes No N/A

ACTION: If the standards used for calibration are not certified or traceable, or cannot be positively identified, qualify all associated data as unusable (R).

Have the standards been used before their indicated expiration dates?

Yes No N/A

ACTION: If the standards were used past their expiration dates, or past five half-lives of the radionuclide of interest if no expiration date is provided, qualify all associated data as unusable (R).

6.3.A.1 Initial Calibration - Gas Proportional Counters

Evaluation Criteria and Actions

Depending upon the type of counter/system used review the results, as applicable, of the plateau determination, amount of alpha-beta crossover, random coincidence counts, and/or energy calibration. Review the efficiency determinations and self-absorption curves. Is the amount of sample counter within the range of the self-absorption curve?

Is a self-absorption curve present for each radionuclide of interest?

Yes No N/A

Are efficiencies $\geq$20%?

Yes No N/A

ACTION: If the field and QC sample preparations are outside the range of the self-absorption curves, qualify all associated data as estimated (J). If efficiencies are less than 20 %, qualify all associated data as unusable (R).

6.3.A.2 Continuing Calibration - Gas Proportional Counters

Evaluation Criteria and Actions

Have chi-square or other appropriate statistical tests been performed for the counters on a routine frequency at least weekly)?

Yes No N/A

ACTION: If a chi-square test was not performed, or results of the test show non-random behavior, then qualify all data as estimated (J).

Have stability verifications (e.g., plateau(s) or response(s) to the check sources) been made after each gas change? (Specific verifications may not be needed if check sources are used daily.)

Yes No N/A

ACTION: If stability verifications were not performed qualify all data as estimated (J).

6.3.B.1 Initial Calibration - Alpha Spectroscopy

Evaluation Criteria and Actions

Does calibration of the detector system cover the energy range of interest (i.e., are the radionuclides (peaks) used for calibration identical to and/or bound the energy range of the radionuclides of interest)?

Yes No N/A

ACTION: If the energy of the alpha particle(s) of the radionuclide(s) of interest falls outside the calibrated range of the detector, qualify all results as unusable (R).

Review the calibration spectrum or printout to verify that the resolution of the detector system provides accurate identification of each peak centroid. Do the peaks have sufficient counts?

Yes No N/A

Are the peaks separate and distinct from each other?

Yes No N/A

ACTION: If the centroids of the peaks used for calibration can not be determined from the spectrum or printout qualify all results as unusable (R).

Are FWHM values $\leq$20 KeV?

Yes No N/A

ACTION: If the resolution of the system is greater than 20 KeV (or corresponding number of number of channels) FWHM for any of the peaks used for calibration, qualify all results as estimated (J).

6.3.B.2 Continuing Calibration - Alpha Spectroscopy

Evaluation Criteria and Actions

Compare the efficiency obtained from the calibration to the efficiency obtained from the check source count(s) for the SDG. Are the efficiencies within 5%?

Yes No N/A

Compare the efficiency from the check source count for the SDG with the control charts. Are efficiencies within the control limits or 3 sigma?

Yes No N/A

Has the check source(s) been counted daily or as specified in the Appendices?

Yes No N/A

ACTION: If the daily check source is not performed qualify all associated results as unusable (R).

Review the result, including raw data, of all daily check source counts. Are the check source counts within the control limits provided by the laboratory, or within 3 standard deviations of the mean?

Yes No N/A

ACTION: If the check source counts are outside of the control limits, qualify all associated data as unusable (R). Associated data means here all the results for all the counts within the time period covered by the out of control counts. Use the raw data, or compare the raw data with the count log, to determine the affected time periods. Note any bias or trend in the data validation report.

Review the instrument printouts and counting logs to verify that the background counts were taken on the correct frequency. Have background counts been performed at least weekly and before and after all the field and QC samples in the SDG were taken?

Yes No N/A

ACTION: If the background counts were not performed qualify all associated results as unusable (R).

Are the background counts within control limits provided by the laboratory or within 3 standard deviations of the mean?

Yes No N/A

ACTION: If the background counts are outside of the control limits, qualify all associated data as unusable (R). Associated data means here all the results for all the field and QC samples counted within the time period during which the background counts were out of control. Use the raw data, or compare the raw data with the count log to determine the affected time periods. Note any bias or trend in the data validation report.

ACTION: If the check source efficiency is not within the limits, qualify all associated results as unusable (R).

6.3.C Calibration - Gamma Spectroscopy

Evaluation Criteria and Actions

Review the efficiency calibration curve and/or raw data.

ACTION: If the efficiency calibration does not approximate a smooth semi-log curve, then qualify all results as unusable (R).

Verify that geometry and matrix factors were accounted for in the analyses of all field and QC samples.

ACTION: If geometry and matrix factors are not used qualify all results as unusable (R).

The calibration of the detector system must cover the energy range of interest, but at least 0 to 2 MeV. Review the energy calibration and verify that the radionuclides (peaks) used for calibration are within and/or bound the energy range of the radionuclides of interest.

ACTION: If the energy of the radionuclides falls outside the calibrated range of the detector, qualify all results as unusable (R).

Review the calibration data to verify that the resolution of the detector system is sufficient for the radionuclides of interest, i.e., that accurate identification of peak centroid can be made, and the peaks are distinct and separate from each other. A nominal value of 5 channels FWHM is used to gauge resolution.

ACTION: If the resolution of the system is greater than 5 channels FWHM for any of the peaks used for calibration, qualify all results as estimated (J).

b. Continuing Calibration

Has the check source been identified by activity and radionuclide(s)?

Yes No N/A

ACTION: If the activity and identity of the radionuclide(s) used in the check source(s) are not provided qualify all associated data as estimated (J).

4.2 Calibration

In addition to the internal standard added to each sample, a calibration should be performed immediately prior to sample analysis to confirm the linear relationship between the fluorometer readings and uranium concentrations.

- If a calibration is not performed immediately prior to sample analysis to verify linear instrument response, qualify associated results estimated, (J).

4.3 References

1. U.S. Environmental Protection Agency, "Uranium in Drinking Water - Fluorometric Method," in Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, August 1980.

2. ASTM, "Standard Test Method for Microquantities of Uranium in Water by Fluorometry," in 1991 Annual Book of ASTM Standards, Volume 11.02, 1990.

3. U.S. Department of Energy Environmental Measurements Laboratory, "Fluorometric Determination of Uranium in Urine," in EML Procedures Manual, HASL-300-Ed.25, 1982.

6.4 BLANKS

Evaluation Criteria and Actions

A reagent (or method) blank of the same aliquot size as the samples must be processed like a sample and analyzed with each SDG on the same detectors or detector system, or a field blank must be analyzed with each SDG on the same detectors or detector system, or both. Has at least one blank been analyzed with the SDG?

Yes No N/A

ACTION: If no blanks were analyzed with the SDG, or if the blanks were not analyzed on the same detectors or detector system, qualify all the results > LLD as estimated (J).

The net blank value, i.e., the results from the analysis of the blank corrected for background, should be less than the minimum detectable activity (MDA), which is the minimum quantity of radioactive material that can be detected in the sample at the 95% confidence level. Have contaminants been detected in the blanks?

Yes No N/A

ACTION: If contaminants are detected in any blank, associated sample results that are reported as statistically greater than background but < the minimum detectable activity (MDA), are qualified as nondetects (U). Any other sample result is qualified as an estimated detect (J) unless the sample result is 10 times the contaminant in the blank. Generally, no action is taken for radionuclides detected in a blank but not in a sample, although the validator must be vigilant for situations when a radionuclide in a blank but not in a sample may cause interference with other radionuclides of interest in the sample. Verify calculation or method of calculating the net blank value. Any blank with a negative result whose absolute value is > LLD must be carefully evaluated to determine its effect on sample data. Review all the QC data specific to the method to evaluate the possibility of false negatives.

6.5 DETECTION LIMITS AND SAMPLE RESULTS

Verify calculation or method of calculating the Lower Limit of Detection and the Minimum Detectable Activity. Methods must be equivalent to the following:

$$LLD = (4.66)\ (\text{Background Counts})^{1/2}$$

$$MDA = \frac{(4.66)\ (\text{Background Counts})^{1/2}}{(\text{Efficiency})\ (\text{Volume})\ (\text{Yield})\ (\text{Conversion Factors})}$$

Verify that all positive results (detects or results not qualified with a U) reported meet the detection limits stated in the SOW and are above the MDA for the analysis or method.

Can the detection limits (LLD and MDA) be verified?

Yes No N/A

Verify the calculation of sample results by examining the raw data, i.e., spectra or printouts, for counts, counting time, efficiencies, and yields or recoveries, and data transcriptions, e.g., sample volumes.

ACTION: Correct any errors on the photocopied pages of the data package and include in the data validation report. Qualify all results for which the MDA and LLD calculations cannot be verified as estimated detects (J) or estimated nondetects (UJ).

6.6 RADIOMETRIC AND GRAVIMETRIC YIELDS

Evaluation Criteria and Actions

Has at least one spike, tracer, or chemical yield been analyzed in each SDG?

Yes No N/A

ACTION: If no or an inappropriate spike, tracer, or carrier was used qualify all associated results as unusable (R).

Samples identified as field blanks may not be used for spike, tracer, or chemical yield analysis. Look as chain-of-custody documents to find identifier. Has field blank been used for chemical yield analyses?

Yes No N/A

ACTION: If the field blank was used for spike, tracer, or chemical yield analysis, all other QC data must be carefully checked and professional judgement used when evaluating the data. Document if the field blank was used but don't qualify data on this alone.

Spike or tracer per cent recovery, or chemical yield must be within the control limits of 30-105 % for all radionuclides or as specified in the Appendices. If sample activity is > 4x the spike activity, recovery limits do not apply. Review the raw data for counts, activity, and aliquot of the tracer, spike, or carrier used. Have the per cent recoveries or yields been correctly calculated and reported?

Yes No N/A

Are percent recoveries within specified limits?

Yes No N/A

ACTION: Qualify associated sample results outside of the acceptable limits as estimated detects (J), estimated nondetects (UJ), or unusable (R) according to the following guidelines. Note any bias or trend in estimated results in the data validation report.

Yield (%R):	<30%	30-105%	>105%	>115%
Results < LLD:	R	acceptable	UJ	R
Results > LLD:	R	acceptable	J	R

6.6.A Radiometric Yields - Alpha Spectroscopy

Evaluation Criteria and Actions

Has tracer been used to spike each sample prior to analysis?

Yes No N/A

ACTION: If a sample did not have a tracer added, qualify the result as unusable (R).

The percent recovery of the tracer should be between 30 % and 105 %. Verify that the recovery is calculated from the applicable instrument efficiency. Check the calculation of recovery using the following formula:

% recovery = (net CPM tracer/DPM tracer added) (efficiency in DPM/CPM) (100)

Are percent recoveries within specification?

Yes No N/A

ACTION: Qualify results outside of the acceptable limits as estimated (J or UJ), or unusable (R) according to the following guidelines. Note any bias or trend in estimated results in the data validation report.

Yield (%R):	<30%	30-105%	>105%	>115%
Results < LLD:	R	acceptable	UJ	R
Results > LLD:	R	acceptable	J	R

6.7 DUPLICATE SAMPLES AND ANALYSES

Evaluation Criteria and Actions

Has at least one duplicate processing and analysis been performed for every ten samples in the SDG?

Yes No N/A

ACTION: If the number of duplicate analyses is not satisfactory then qualify all associated results as estimated (J).

Have samples identified as field blanks (look at chain-of-custody documents) been used for duplicate sample analysis?

Yes No N/A

ACTION: If the field blank was used for duplicate analysis, all other QC data must be carefully checked and professional judgement exercised when evaluating the data. Document if the field blank was used but don't qualify data on this alone.

Relative Percent Difference (RPD) between the sample and duplicate analysis of samples must be within the control limits of $\pm$ 35% for results > 5x the LLD). A control limit of $\pm$ 2x the LLD is applied if one or both of the sample values are < 5x the LLD. If both values are < LLD, no control limit is applicable. Review the data package and verify that results have been correctly calculated and reported and fall within the established control limits.

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100$$

S = first sample value (original)

D = second sample value (duplicate)

Are all RPD values within specification?

Yes No N/A

ACTION: If duplicate analysis results for a particular radionuclide are outside the specified control limits, qualify results < LLD as estimated nondetects (UJ), and results > LLD as estimated detects (J) for that radionuclide in all samples of the SDG.

6.8 LABORATORY CONTROL SAMPLE (LCS)

Laboratory Control Samples may be prepared by the same laboratory performing the analyses or by a reference laboratory or agency. Laboratory control samples are equivalent to internal or external control samples. Laboratory Control Samples, or their equivalents, may be identified as QC samples, as samples from a particular agency, or as LCS.

Evaluation Criteria and Actions

All LCS results must be within the control limits. If control limits are not provided by the laboratory then use the control limits of 80-120 %R.

$$\text{LCS \%R} = \frac{\text{LCS found}}{\text{LCS true}} \times 100$$

LCS found = concentration or activity for each radionuclide measured in the LCS

LCS true = concentration or activity of each radionuclide in the LCS

Have all LCS results been correctly calculated? Yes No N/A

Are all LCS results within established control limits? Yes No N/A

ACTION: Qualify affected sample results as estimated detects (J), estimated nondetects (UJ), or unusable (R) for radionuclides that are outside control limits according to the following guidelines. Affected sample results may be all results for the SDG or just the results following an out-of-control LCS.

Radionuclide %R	<50%	50-79%	>120%
Results < LLD:	R	UJ	R
Results > LLD:	R	J	R

Note any bias or trend in estimated results.

Has at least one LCS been analyzed with the SDG? Yes No N/A

6.9 SUMMARY

Has the laboratory conducted the analysis in accordance with the analytical SOW?

Yes No N/A

Were project-specific data quality objectives met for this analysis?

Yes No N/A

No problems.

APPENDIX 3
Requirements for Tritium Liquid Scintillation Analyses

Scope

This Appendix provides supplemental information used for validating analytical data from the determination of tritium in water using liquid scintillation counting.

Applicability

The validation criteria in this appendix are intended to be applied in addition to those found in the body of the procedure. In cases where discrepancies exist between the requirements of the procedure and the appendix, the criteria in the appendix shall apply.

3.1 Calibration

Liquid scintillation counting systems are calibrated using NIST traceable external or internal standards. The chemical and physical matrix of the standards should resemble the samples as closely as possible in order to match light emission (scintillation) and quenching properties.

- If the matrix of the standard is not representative of that for the samples, qualify all associated results as estimated, (J).

Most automated liquid scintillation systems are capable of processing many more samples than is normally contained in an SDG. As a minimum, one calibration standard should be included with every analytical run of samples. An analytical run can be comprised of more than one SDG.

- If sample data lacks calibration standards qualify all associated results as unusable. (R).

The efficiency for detecting the tritium beta particle must be established for each counting system. The counting system is comprised of the liquid scintillation counter, scintillation solution, and sample matrix. The laboratory should provide detailed explanation of the method and results for determining the counting system efficiency. For automated systems employing computerized algorithms, copies of applicable pages from the instrument manuals should be submitted with the analytical results.

- If the method and results for counting efficiency determination are not provided, qualify all associated results as unusable, (R).

3.2 Blanks

Tritium in chemical reagents or water used for background determinations will interfere with sample results and reduce the method sensitivity. Tritium levels in reagents and background water should be less than the desired MDA for the method.

- If the tritium levels in reagents or background water exceed the desired MDA, qualify associated results less than 10X the background tritium level as estimated, (J).

- If blank samples are not analyzed to check potential contamination in each lot of chemical reagents, qualify associated results estimated, (J).\

3.3 References

1. U.S. Environmental Protection Agency, "Tritium in Drinking Water," in Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, August 1980.

APPENDIX 1
General Requirements for the Analysis of Alpha Emitting Radium Isotopes Using Liquid Scintillation

Scope

This Appendix provides additional criteria for validating analytical results from the determination of total soluble alpha emitting radioisotopes of radium (radium-223, radium-224 and radium-226) in water. The radium is collected by coprecipitation with a carrier and counted with an alpha scintillation counter. This method tends to overestimate specific isotope results (i.e., radium-226) when other alpha emitting species are present. The method is useful as a screening technique for determining the need for isotopic analysis.

Applicability

The validation criteria in this appendix are intended to be applied in addition to those found in the body of the procedure. In cases where discrepancies exist between the procedure and the appendix, the criteria in the appendix shall apply.

1.1 Analytical Method

Specificity

The method is not specific for any given isotope of radium. Results will represent the activity of all soluble alpha-emitting radium isotopes present in the sample.

- Qualify all results attributed to a single radium isotope (specifically, Ra-223, Ra-224, or Ra-226) as estimated, (J), if the contribution to the total from individual isotopes is unknown.

Accuracy

Decay of Ra-226 present in samples will result in daughter products whose activity could lead to inaccurate results. The impact of the daughter ingrowth on the sample results is directly proportional to the elapsed time between the precipitation of the chemical carrier and counting the sample. The laboratory should provide evidence that: 1) Elapsed time from precipitation to counting is sufficiently short that daughter ingrowth effects are negligible, or 2) Sample results have been corrected for daughter ingrowth effects. Table 1-1 shows the factors to be divided into sample results to correct for Ra-226 daughter ingrowth.

Review the data package to insure that the times of sample precipitation and counting have been accurately recorded to allow determination of daughter ingrowth.

- If the time from sample precipitation to counting cannot be verified, qualify all associated results greater than the MDA as estimated, (J).

Interferences

Samples with greater than 0.2 mg barium content may cause a falsely high chemical yield, resulting in erroneously low sample results. If the potential exists for elevated barium levels in samples, actions must be identified that will either eliminate or correct erroneous sample results.

- If the laboratory has not taken steps to correct results for samples with potential elevated barium levels, qualify results as estimated, (J).

1.2 Counting Efficiency

The detector counting efficiency for Ra-226 in the sample matrix should be established with the analysis of each SDG. This can be accomplished by carrying two to three internal Ra-226 standards through the analysis procedure with each SDG.

- If the counting efficiency is not determined with each SDG, qualify all associated results unusable, (R).

1.3 Blanks

Most chemical reagents typically used in this procedure contain some levels of radium. It is prudent to analyze additional blank samples in the event that the batch or lot number of a reagent should change in the course of preparing a group of samples for analysis.

- If blank samples are not analyzed to check potential contamination in each lot number of chemical of reagents qualify associated results as estimated, (J).

1.4 Laboratory Control Samples

This method will not be able to achieve the criteria for accuracy specified in Section 6.8. Accuracy is determined by comparing the analytical results from laboratory control samples with the known concentration of radium isotopes. The

two values are used to compute a recovery factor (LCS %R presented in Section 6.8).

- Qualify associated sample results according to the following criteria:

Method Accuracy Criteria

LCS %R

	<50%	50-69%	70-130%	>130%
Results <MDA	R	UJ	Acceptable	R
Results >MDA	R	J	Acceptable	R

1.5 Holding Times

Samples are to be presented by adjusting the pH < 2 with Nitric Acid. The following holding time requirements apply according to the time of preservation:

a. If the sample is preserved at the time of collection, Section 6.9 requirements apply.

b. If the sample is not preserved at the time of collection, these requirements are substituted for those in Section 6.9:

- Time from sampling to receipt at laboratory cannot exceed 5 days.
- Laboratory must preserve the sample upon receipt and hold for at least 16 days prior to analysis.

- Qualify associated sample results estimated, (J), if holding time requirements are not met.

1.6 References

1. U.S. Environmental Protection Agency, "Alpha Emitting Radioisotopes," in Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, August 1980.

2. ASTM, "Standard Test Method for Radionuclides of Radium in Water," in 1991 Annual Book of ASTM Standards, Volume 11.02, 1990.

3. U.S. Department of Energy Environmental Measurements Laboratory, "Radiochemical Determination of Radium-226," in EML Procedures Manual, HASL-300-Ed.25, 1982.

Table 1-1: Correction Factors for Ra-226 Daughter Ingrowth

Time (From Precip. to Counting, Hrs.)	Ingrowth Correction Factor
0	1.00
1	1.02
2	1.04
3	1.06
4	1.08
5	1.10
6	1.12
24	1.49
48	1.91
72	2.25
96	2.54
120	2.78
144	2.99
192	3.29
240	3.51

APPENDIX 2
General Requirements for Lucas Cell Ra-226 Analyses

Scope

This Appendix provides supplemental information for validating analytical results from the determination of radium-226 in water. The radium-226 is separated from interfering species and concentrated by coprecipitation. After allowing for the ingrowth of radon-222, the radon is purged and counted in a scintillation (Lucas) cell.

Applicability

The validation criteria in this appendix are intended to be applied in addition to those found in the body of the procedure. In cases where discrepancies exist between the procedure and the appendix, the criteria in the appendix shall apply.

2.1 Calibration

A counting system consists of a scintillation cell and associated photomultiplier tube, electronics and scaler. Each counting system should be calibrated as a unit. Calibration consists of determining a calibration constant using a NIST traceable Ra-226 standard. The calibration constant includes the de-emanation efficiency of that system and the counting efficiency of the scintillation cell. The calibration constant should be established for a system at the beginning of each day that samples will be analyzed and each time the scintillation cell is replaced. The scintillation cell should be uniquely identified to allow its association with a specific counting system to be identified.

- If calibration data cannot be definitely associated with the specific counting system, qualify associated sample results unusable, (R).

- If the counting system is not calibrated each day that samples are analyzed, qualify associated results as estimated, (J).

- If the counting system is not calibrated upon replacing the scintillation cell, qualify associated results estimated, (J), if the cell has a previously determined calibration constant, or unusable, (R), if no constant is available for the replacement cell.

2.2 Blanks

Most chemical reagents typically used in this procedure contain some levels of radium. It is prudent to analyze additional blank samples in the event that the batch or lot number of a reagent should change in the course of preparing a group of samples for analysis.

- If blank samples are not analyzed to check potential contamination in each lot of chemical reagents qualify associated results estimated, (J).

2.3 Holding Times

Samples are to be preserved by adjusting the pH < 2 with Nitric Acid. The following holding time requirements apply according to the time of preservation:

a. If the sample is preserved at the time of collection, Section 6.9 requirements apply.

b. If the sample is <u>not</u> preserved at the time of collection, requirements are substituted for those in Section 6.9.

   - Time from sampling to receipt at laboratory should not exceed 5 days.
   - The laboratory <u>must</u> preserve the sample upon receipt and hold for at least 16 days prior to analysis.

- Qualify associated sample results estimated, (J), if holding time requirements are not met.

2.4 References

1. U.S. Environmental Protection Agency, "Radium-226 in Drinking Water, Radon Emanation Technique," in <u>Prescribed Procedures for Measurement of Radioactivity in Drinking Water</u>, EPA-600/4-80-032, August 1980.

2. ASTM, "Standard Test Method for Radium-226 in Water," in <u>1991 Annual Book of ASTM Standards</u>, Volume 11.02, 1990.

3. U.S. Department of Energy Environmental Measurements Laboratory, "Emanation Procedure for Radium-226," in <u>EML Procedures Manual</u>, HASL-300-Ed.25, 1982.

APPENDIX 4
Requirements for Fluorometric Analyses of Uranium

Scope

This Appendix provides supplemental information for validating analytical data from the determination of uranium by fluorometry. The uranium is separated from interferences and concentrated by coprecipitation and purified by solvent extraction. The sample is fused with flux and analyzed with a fluorometer.

Applicability

The validation criteria in this appendix are intended to be applied in addition to those found in the body of the procedure. In cases where discrepancies exist between the procedure and the appendix, the criteria in the appendix shall apply.

4.1 Analytical Method

Interferences

The fluorescence of uranium in the fluoride matrix can be either quenched or enhanced by the presence of cations or anions. When uranium is present in low concentrations, the interferences can be removed by various methods.

- The analytical laboratory should provide evidence that interference from cations or anions is negligible, or that steps have been taken to minimize their effects. If evidence is not provided, qualify associated results as estimated, (J).

Method Standardization

The fusion operation is the most critical step in the fluorometric procedure. Small variations in the duration of the fusion temperature of the fusion, and in the method of cooling the fused disk can cause large variations in the fluorescence yield. Each step of the fusion process should be standardized to obtain reproducible results.

- The analytical laboratory should provide a description of the method for fusion standardization. If the fusion process is not standardized, or information is not provided to allow the independent assessment of the standardization process, qualify associated results as estimated, (J).

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ACTION: If the required LCS are not analyzed, qualify all results as estimated (J).