Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509)
376-5802

May 8, 1991

Mr. Jeff Lerch, T6-08
Westinghouse Hanford Company
P.O. Box 1970
Richland, Washington 99352

Dear Jeff:

TRANSMITTAL OF 200-BP-1 GROUNDWATER ANALYSIS PROJECT, TASK 7 DATA PACKAGE/REPORT NO. 1, REVISION 0, MAY 1, 1991 AND TASK 7 DATA PACKAGE/REPORT NO. 2 & 3, REVISION 0, MAY 8, 1991

Enclosed are three copies of the subject 200-BP-1 Task 7 Data Package/Report No. 2 & 3. This is also to document the transmittal of three copies of Task 7 Data Package/Report No. 1 on May 3, 1991. A cover letter was not furnished with the transmittal.

If you have any questions after reviewing the data, please give me a call on 376-5802.

Sincerely,

B. M. Gillespie

B. M. Gillespie
Analytical Laboratory Operations
200-BP-1 PNL Project Manager

Enclosures

cc: J.M. Latkovich

200-BP-1
GROUNDWATER ANALYSIS PROJECT

TASK 7

DATA PACKAGE/REPORT No. 1

Revision 0

May 1, 1991

Prepared by: B.M. Gillespie

Pacific Northwest Laboratory

(PNL Project #16772)

TABLE 1: 200-BP-1 Sample Numbers

WHC Sample Number	PNL ALO Sample Number
B00DK8	90-7067
B00DL1	90-7068
B00DM1	90-7069
B00DL8	90-7070
B00DM4	90-7071
B00DZ4	90-7072
B00F18	90-7073
B00F01	90-7074
B00F04	90-7075
B00DZ8	90-7076
B00F24	90-7077
B00DY8	90-7078
B00DZ1	90-7079

INTRODUCTION

This data package contains the results obtained by Pacific Northwest Laboratory (PNL) staff in the characterization of samples for the 200-BP-1 Groundwater Analysis Project. The samples were submitted for analysis by Westinghouse Hanford Company (WHC) under the Technical Project Plan (TPP) 16772 and the Quality Assurance Project Plan (QAPjP) ALO-001. The samples are all ground water collected in support of Task 7. The analytical procedures required for analysis were defined in the Test Instructions (TI) prepared by the PNL 200-BP-1 Project Management Office in accordance with the TPP and the QAPjP ALO-001.

The samples (Table 1) were submitted with the appropriate WHC Chain of Custody (COC) and Sample Analysis Request Forms. The samples were delivered at refrigerated temperature to the 300 Area, 325 Building and 314 Building 200-BP-1 Sample Custodians.

The requested analyses for these samples were cyanide, free cyanide and ferrocyanide. A complex cyanide result is determined by the difference of the total cyanide and the free cyanide results. A "ferrocyanide" result is not obtained nor calculated since the amount of the complex cyanide being ferrocyanide is indeterminant. Sample 90-7074 was submitted for Ru-106 analysis and the results will be reported in a separate data package for all Ru-106 sample data results for this task. The quality control (QC) requirements for each sample are defined in the test instructions for each sample. The QC requirements outlined in the procedures and requested in the WHC SOW were followed. Sample duplicates, methods blank, matrix spikes and laboratory control standards were analyzed. All QC data that exist are included in this Data Package/Report.

The data in this package are reported in separate tables (Tables 2 through 4) for each analyte or method. Three appendices are provided; one for Test Instruction, one for Chain of Custody, Sample Analysis Request Forms and Sample Receipt Forms and one that contains the primary inorganic analytical data.

CERTIFICATION STATEMENT

I certify that this data package is in compliance with the terms and conditions of the TPP 16772 and QAPjP ALO-001 for completeness. Release of the data contained in this hard copy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Project Manager or the Project Manager's designee, as verified by the following signature.

B. M. Gillespie

B. M. Gillespie
200-BP-1 Project Manager

5-1-91

Date

CYANIDE ANALYSIS RESULTS

Total cyanide analysis was performed in room 419 of building 325 in the 300 area. Results for Task 7 work package #1 are presented by colorimetric analysis set in Table 1.

Free cyanide analysis was only required on sample 90-7074. All other samples in this data package had total cyanide concentrations of less than 20 ug/L, except for sample 90-7067. The test instructions for sample 90-7067 did not require free cyanide analysis where the total cyanide was less than or equal to 2 ppm (TI-200-1-28). This limit was the limit for Task 6 cyanide analysis and was reevaluated for later Task 7 samples and found to be too high. The limit was reset at 20 ug/L. This sample has been submitted for Free CN results.

Sample results for sample and duplicate were below the CRDL of 10 ug/L except for samples 90-7067, 90-7071, 90-7079, 90-7074 and 90-7075. Duplicate precision was within the accepted limit for all samples except 90-7067 (defined in the CLP manual as one CRDL where the sample or duplicate value was below five times the CRDL). Results for this sample are suspect due to an inability to meet hold times because of a failure of laboratory support facilities. In this case we experienced a loss of the initial sample when a loss of house vacuum occurred during the distillation run. Vacuum line failure was traced to clogging of the line by Protactinium sludge, described in LRB 54026 pages 24-26. The reported 90-7067 and 90-7068 results are from a split of the sample obtained from Karl Pool and ran on 3/25/91. While sample values, not sample duplicate values should be taken for calculation of total cyanide, for the case of 90-7067 the duplicate may be better. This suggestion is based on obtaining a 98% spike recovery for sample + spike if the duplicate sample is used for %recovery calculations.

The 12 day hold time specified for cyanide analysis under the CLP protocol was met except for samples 90-7067, 90-7068, 90-7069, 90-7070 and 90-7071. The hold time was missed by one day for samples 90-7069, 90-7070 and 90-7071. Justification for missing hold times for samples 90-7067 and 90-7068 are described in the previous paragraph.

Sample 90-7079 distillation and analysis was repeated on March 8, 1991 due to poor initial calibration verification (ICV) and spike recovery on March 6, 1991. This latter analysis had a spike recovery of 105.7% and ICV recovery of 121%.

We changed our sample analysis group size from 6 sample/run to 2 sample/run during this initial data package #1 of Task 7 cyanide analysis program. The only samples to be reported in a group of 6/run are 90-7079, 90-7075, 90-7076, 90-7077 and 90-7078. As the latter four samples had an acceptable distillation ICV recovery of 99.7% these samples were not rerun like sample 90-7079.

Average spiked sample cyanide recovery was 96% $\pm$ 29%. This average recovery is 90% $\pm$ 9% if the duplicate results is used for sample 90-7067 to determine the sample + spike recovery (see above). Recovery of cyanide for laboratory control samples was 103.4% for liquid standard ICV-6. Recovery value for ICV-6 is based on the spiking of 1 mL of stock standard ICV-6 to 500mL of deionized water and recovery back calculated to the original ICV-6 cyanide concentration. Cyanide found in blank was below stated IDL.

TABLE 2: TOTAL CYANIDE ANALYSIS DATA

Sample ID#	PNL Log#	G1 Sample (ug/L)	C	G2 Sample dup. (ug/L)	C	%RPD	G5 Blank (ug/L)	C	G3 Sample+ spike (ug/L)	G4 - ICV (mg/L)	G3 Sample+ spike recovery (%)	G4 - ICV sample recovery (%)	Flags Q	Footnote#
														1,2,3, 10
B00DK8	90-7067	30.5		67		74.9	5.9	U	155.9	9.03	138.5	113.3	N, *	4,5
B00DL1	90-7068	5.9	U										N, *	4
B00DM1	90-7069	5.9	U	5.9	U	N/A	5.9	U	95.6	10.4	102.3	110.6		
B00DL8	90-7070	5.9	U											
B00DM4	90-7071	12.4		5.9	U	N/A	5.9	U	100.9	10.4	97.8	110.6		8
B00DZ4	90-7072	5.9	U											
B00F18	90-7073	5.9	U	5.9	U	N/A	5.9	U	84.1	9.42	93.3	100.2		
B00F01	90-7074	385.2												
B00DZ1	90-7079	5.9	U	17.7		N/A	5.9	U	42.3	6.43	41	68.4	N	6,8
B00F04	90-7075	13.9					5.9	U		9.37		99.7	N	
B00DZ8	90-7076	5.9	U										N	
B00F24	90-7077	5.9	U										N	
B00DY8	90-7078	5.9	U										N	
B00F11	90-7082	17.8		17.1		4	5.9	U	113.6	11.4	105.7	121.2		7
B00DZ1	90-7079	20.7												9
											---	---		
										Mean	96.4	103.4		
										Std. Dev.	28.8	15.9		

1. Concentration of stock ICV-6 = 9.4 mg/L (In actual practice 9.4 g of cyanide is added to each distillation flask and recovered in 250 mL of NaOH).
2. Concentration of spike added = 90.6 ug/L.
3. Contract required detection limit for water = 10 ug/L.
4. Exceeded contract required hold time due to an "act of god" (see LRD 54026, pages 24-26.)
5. If the duplicate sample CN value is used a 98% spike recovery is obtained.
6. Analysis unacceptable due to poor ICV recovery (analysis repeated below).
7. Sample 90-7082 not part of data set #1 of task 7.
8. Duplicate precision under the CLP protocol must be within one CRDL when either sample or duplicate are below 5X CRDL.
9. Repeat of sample 90-7079 to correct for very low ICV recovery associated with the initial distillation batch.
10. Used 250 mL of sample per distillation due to limited sample size of 1.5L of total sample.

CLP Flags

U = Analyzed but not detected (IDL or less than IDL)
N = Spiked sample recovery not within control limits
* = Duplicate analysis not within control limits

FREE CYANIDE ANALYSIS RESULTS

The sample solutions were analyzed by direct injection into an ion chromatograph/amperometric detector instrument system according to procedure PNL-ALO-271, "Procedure for Analysis of Free Cyanide in Water and Solid Sample Leachates" in the 314 building in the 300 area.

The analysis of free cyanide in water samples was to be performed on samples whose total cyanide content was found to be greater than 20 g CN^-/L. Free cyanide analysis was done for a few samples that were nearing hold time requirements even though Total Cyanide results were not available and subsequently found to be below 20 g CN^-/L.

Chromatograms for samples found to have near zero Free Cyanide content, revealed a disturbing "negative peak" interference in the cyanide region. The analyst believes this interference can be eliminated or at least greatly reduced by a relatively minor adjustment of the chromatographic eluent composition. Such adjustment has not been tried to date but will be as time and resources become available. One of the samples with essentially zero free cyanide content (90-7073) which displayed the largest "negative peak" interference of all the samples in this set, was used to evaluate spike recovery. When spiked at nominal 10 ppb CN^- level, the spike recovery was found to be only 71% (flagged with "N"). Duplicate spikes at nominal 20 ppb CN^-, revealed 86 and 83% recoveries.

Upon review of this data set, the average spike recovery was 80% with a standard deviation of 8% and the average recovery of the standards was 98.5% with a standard deviation of 1.4%. Thus, the method precision and bias observed for free cyanide analysis during the analytical session involving these samples meets the client requirements.

The CLP defined hold times of 12 days from receipt was met for all samples reported to date.

TABLE 3: FREE CYANIDE ANALYSIS

WHC Sample ID#	PNL Sample ID#	J1 Sample ug/L	Flags	J2 Sample Duplicate ug/L	%RPD	J5 Matrix Blank ug/L	J3 Sample+ Spike ug/L	J3 Spike Added ug/L	J4 Control Std. ppb	J4 Standard Added ppb	J6 Dup. + Spike ug/L	J6 Spike Added ug/L	%recovery J3 Spike Rec.	%recovery J6 Dup. + Spike Rec.	%recovery J4 Control Std. Rec.	Flags
B00DZ4	90-7072	3	U			0			19.26	19.36					99.5	
B00F18	90-7073	3	U				6.84	9.68			16.1	19.36	71	83		N
							16.58	19.36					86			
B00F01	90-7074	298														
B00DZ4	90-7075	22.5		23.0	2.17											
B00DZ8	90-7076	3	U			0			9.44	9.68					97.5	
B00F24	90-7077	3	U													
B00DY8	90-7078	3	U													
B00DZ1	90-7079	3	U													

J1 = SAMPLE
J2 = DUPLICATE SAMPLE
J3 = SPIKE SAMPLE
J4 = STANDARD
J5 = METHODS BLANK
J6 = SPIKE DUPLICATE

CLP Flags

U = Analyzed but not detected (IDL or less than IDL)
N = Spiked sample recovery not within control limits

COMPLEX CYANIDE RESULTS

The complex cyanide results are calculated from the difference in the total cyanide results and the free cyanide results. A "ferrocyanide" result is not obtained nor calculated since the amount of the complex cyanide being ferrocyanide is indeterminant.

Samples are analyzed for free cyanide based on first determining that the total cyanide results is greater than 20 ug/L. Samples below 20 ug/L total cyanide are typically not analyzed for free cyanide to save on analysis cost. Attempting to perform free cyanide analysis near the Contract Required Detection Limit of total cyanide is not meaningful.

In this data set, there were only two samples (90-7067 & 90-7074) requiring free cyanide determination. One of the samples has not been analyzed for free cyanide content yet. Initial determination of total cyanide for this sample, 90-7067, was assumed to be <20ug/L which later was found to be a poor analysis set. This sample, along with 90-7068, were reanalyzed at a later date due to building vacuum malfunction. The sample has been submitted for free cyanide analysis. The results will be submitted at a later date for incorporation into this data report. The other samples analyzed for free cyanides were analyzed because they were nearing the hold time limit.

TABLE 4: COMPLEX CYANIDE DETERMINATION

Sample ID#	Total CN Sample ug/L	Free CN Sample ug/L	Complex CN Sample ug/L (1)
90-7067	30.5	(2)	
90-7074	385.2	298	87.0
90-7075	13.9	22.5	0 (3)

(1) Results calculated by subtracting the Free cyanide results from the Total cyanide results.
(2) Sample results not obtained to date. Will be submitted at a later date.
(3) The results is 0 as the total cyanide and free cyanide results are near the CRDL of both analytes.

9613477.3356

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/12/91	Time	1330
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-446 1 / Pg.3		
Remarks					
Bill of Lading No.		Offsite Property No.			
Method of Shipment					
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 DL1
3, 1L, P, WATER, TOTAL CYANIDE, FREE CYANIDE

Recieved 1 ea 1 liter bottle - KHP
Received 2ea 1L bottles - JmR

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: Parley H Butcher	Date/Time: 2/12/91 1725
Relinquished by: Parley H Butcher	Received by: Earl Pool	Date/Time: 2-13-91 1500
Relinquished by: Parley H. Butcher	Received by: James Ribbon	Date/Time: 2-13-91 1530
Relinquished by:	Received by:	Date/Time:

9619177.2367

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00D41	~~1, 4L, P~~	~~W~~	~~Ru-106~~
	2, 1L, P	W	Total Cyanide, ~~Free Cyanide~~

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by James Robbins Title Sr. Research Scientist Date 2/13/91

Analysis Required TOTAL CYANIDE

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

B01-003

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00DL1	~~1, 4L, P~~	~~W~~	~~Ru-106~~
	~~1~~X, 1L, P	W	~~Total Cyanide,~~ Free Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 2-13-91

Analysis Required Free CN-

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

9615172659

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/12/91	Time	1500
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-4461 / Pg. 3		
Remarks					
Bill of Lading No.		Offsite Property No.			
Method of Shipment					
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00DK8

~~1, 4L, P, WATER, Ru-106~~ WHC 2-13-91

3, 1L, P, WATER, TOTAL CYANIDE, FREE CYANIDE

Recieved 1 ea 1L bottle - ICP

Received 2 ea 1L bottle - JMR

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: MH Edrington M H Edrington	Date/Time: 2/12/91 1720
Relinquished by: MH Edrington M H Edrington	Received by: Jarl Pool	Date/Time: 2/13/91 1500
Relinquished by: Farley H Butcher Farley H Butcher	Received by: James Robbins	Date/Time: 2-13-91 1530
Relinquished by:	Received by:	Date/Time:

9613427.2618

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 1N28	~~1, 4L, P~~	~~W~~	~~Ru-106~~
	2, 1L, P	W	Total Cyanide, ~~Free Cyanide~~

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by James Robbins Title Sr Research Scientist Date 2/13/91

Analysis Required TOTAL CYANIDE

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

B01-006

9613427.2611

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00DKX	~~1, 4L, P~~	~~W~~	~~Ru-106~~
	~~1~~X, 1L, P	W	~~Total Cyanide~~, Free Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 2-13-91

Analysis Required Free - CN-

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 2/13/91 1500

Received by: Karl H. Pool

Customer Sample Number(s): B00DK8, B00DL1

ALO Sample Number(s): 90-7067 90-7068

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial. NA

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Shipping containers (1 Liter poly bottles) are intact, sealed, unbreached in sealed plastic bags. Temp. not recorded upon receipt but obviously were very cold & right out of ice-chest.

6. Condition of Sample Vials. NA

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. Looks OK to me. K.H. Pool

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: P. BATCHER Date/Time: 2/13/91, 1530

Received by: J. ROBBINS

Customer Sample Number(s): B00DL1, B00DK8

ALO Sample Number(s): 90-7068 90-7067

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   SAMPLE ANALYSIS REQUEST

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature). OK

6. Condition of Sample Vials. OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. OK

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

9615172.2649

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/13/91	Time	1515
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-4461 / pg. 4		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00DL5
3, 1L, P, WATER, TOTAL CYANIDE, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: PH Butcher P H Butcher	Date/Time: 2/13/91 1715
Relinquished by: PH Butcher P H Butcher	Received by: James Robbins	Date/Time: 2/14/91 1430
Relinquished by: PH Butcher P H Butcher	Received by: Karl Pool	Date/Time: 2/14/91 1520
Relinquished by:	Received by:	Date/Time:

Comments: accepted 2 each of 1 liter water for total cyanide. JMR 2/14/91 14:30
Accepted 1 each of 1 liter water sample 1CHP 2/14/91 1520

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 D48	~~1, 4L, P~~ PHS 2/14/91	W	~~Ru-106~~ PHS 2/14/91
	3, 1L, P	W	Total Cyanide, ~~Free Cyanide~~ PHS 2/14/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by James Kubsch Title Sr. Research Scientist Date 2/14/91

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90

B01-011

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 DL 8	~~1, 4L, P~~ pad 2/14/91	W	~~Ru-106~~ pad 2/14/91
	18, 1L, P 2/14/91	W	pad 2/14/91 ~~Total Cyanide~~, Free Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 2/14/91

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

B01-012

9213477.2347

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/13/91	Time	1300
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-446 1/pg. 4		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 Dm1

~~1, 4L, P, WATER, Ru-106~~ 2/14/91 PHB

3, 1L, P, WATER, TOTAL CYANIDE, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: PH Butcher PH Butcher	Date/Time: 2/13/91 1720
Relinquished by: PH Butcher PH Butcher	Received by: James Robbins	Date/Time: 2/14/91 1430
Relinquished by: PH Butcher PH Butcher	Received by: Karl Pool	Date/Time: 2/14/91 1520
Relinquished by:	Received by:	Date/Time:

Comments: Accepted 2 each of 1 liter water for ~~Total~~ Cyanide, JMR 2/14/91 14:30

Accepted 1 each of 1 liter water for free CN- analysis.

KHP 2/14/91

B01-013

9615177.2319

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00DM1	~~1, 4L, P~~ PHO 2/14/91	W	~~Ru-106~~
	2, 1L, P	W	Total Cyanide, ~~Free Cyanide~~ PHO 2/14/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by James Robinson Title Sr. Research Scientist Date 2/14/91

Analysis Required F

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

B01-014

96-5927.2-19

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 DM1	~~1, 4L, P~~ PAD 2/14/91	W	~~Ru-106~~ PAD 2/14/91
	1 PAD 2/14/91 4L, P	W	PAD 2/14/91 ~~Total Cyanide~~, Free Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by J Carl Pool Title Senior Research Scientist Date 2/14/91

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 2-14-91 3:20 pm

Received by: Karl H. Pool

Customer Sample Number(s): B00DC8, B00DM1,

ALO Sample Number(s): 90-7070 90-7069

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: NA

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Good. 2.5°C

6. Condition of Sample Vials. NA

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. OK

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

6-9782

SAMPLE RECEIPT FORM

Delivered by: P. H. BUTCHER Date/Time: 2/14/91 1430

Received by: J. ROBBINS

Customer Sample Number(s): B00DM1, B00DL8

ALO Sample Number(s): 90-7069, 90-7070

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   Sample analysis request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   @ 10°C

6. Condition of Sample Vials.
   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.
   OK

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

9613177.2652

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/14/91	Time	1600
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-446 1 / pg. 5		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

800 DM4
~~1, 4L, P, WATER, Ru-106~~
* 3, 1L, P, WATER, TOTAL CYANIDE, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: Parley H Butcher Parley H Butcher	Date/Time: 2/14/91 1800
Relinquished by: PH Butcher PH Butcher	Received by: James Robbins	Date/Time: 2/15/91 1148
Relinquished by: PH Butcher PH Butcher	Received by: Karl Pool	Date/Time: 2/15/91 1246
Relinquished by:	Received by:	Date/Time:

* Comments:
1. Received 1 sample of 2 bottles (1 L, each) for total cyanide
2. Received 1 sample of 1 bottle (1 liter) for free cyanide

KH Pool

B01-018

9618172669

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector LD WALKER Date Sampled 2/14/91 Time _____ hours

Company Contact BH FORD Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00Dm4	1, 1L, P	W	FREE CYANIDE
B00	1, 1L, P	W	FREE CYANIDE

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

:eived by Karl Pool Title Senior Research Scientist Date 2/15/91

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

B01-019

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 2/15/91 1246

Received by: Carl H. Pool

Customer Sample Number(s): B00DM4

ALO Sample Number(s): 90-7071

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact - good.

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Sample container in good condition
   Temp = 2.3°C

6. Condition of Sample Vials. N/A

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: P. BUTCHER Date/Time: 2/15/91 1148

Received by: J. ROBBINS

Customer Sample Number(s): B00 DM4

ALO Sample Number(s): 90-7071

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   Sample analysis request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   OK

6. Condition of Sample Vials.
   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.
   OK

8. Resolution of Problems or Discrepancies.
   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/19/91	Time	2:50
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.			
Remarks					
Bill of Lading No.		Offsite Property No.			
Method of Shipment					
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00F1S
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: B.H. Ford P.H. Butcher	Received by: P.H. Butcher P.H. Butcher	Date/Time: 20 Feb 91 / 0852
Relinquished by: P.H. Butcher	Received by: James Robbins	Date/Time: 2-20-91 0952
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/14/91	Time	2:50
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.			
Remarks					
Bill of Lading No.		Offsite Property No.			
Method of Shipment					
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B001-16
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: BH Ford	Received by: P H Butcher	Date/Time: 20 Feb 91/0852
Relinquished by: P H Butcher	Received by: Karl Pool	Date/Time: 2/20/91 0918
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613072.2658

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/19/91	Time	11:40
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.			
Remarks					
Bill of Lading No.		Offsite Property No.			
Method of Shipment					
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00DZ4

2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by:	Received by:	Date/Time:
BH FORD	P H Butcher	20 Feb 91 / 0852
Relinquished by: P H Butcher	Received by:	Date/Time: 2/20/91 0951
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

B01-024

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/19/91	Time	11:40
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.			
Remarks					
Bill of Lading No.		Offsite Property No.			
Method of Shipment					
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 D24

1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: BH Ford BH Ford PH Batcher	Received by: PH Batcher	Date/Time: 20Feb91 / 0852
Relinquished by: PH Batcher	Received by: Karl Pool	Date/Time: 2/20/91 0917
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613177.2649

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector _____ Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00D24	2, 1L, P	W	Total Cyanide
B00F18	2, 1L, P	W	Total Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by C. Robbins Title Sr Res Scientist Date 2/20/91

Analysis Required Total Cyanide

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

**Use back of page for additional information relative to sample location.

B01-026

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector _____ Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00DZ4	1, 1L, P	W	Free Cyanide
B00F18	1, 1L, P	W	Free Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Requested by Karl Pool Title Senior Research Scientist Date 2/20/91

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

B01-027

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 2/20/91 0915

Received by: K. H. Pool

Customer Sample Number(s): B00DZ4 B00F18

ALO Sample Number(s): 90-7072 90-7073

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact - good.

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Good condition - no problem
   T = 3.0°C

6. Condition of Sample Vials.
   N/A

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: P. Butcher Date/Time: 2/20/90 0952

Received by: J. ROBBINS

Customer Sample Number(s): B00F18 & B00D74

ALO Sample Number(s): 90-7073 90-7072

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   SAMPLE ANALYSIS REQUEST

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   OK 5°C

6. Condition of Sample Vials.
   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.
   OK

8. Resolution of Problems or Discrepancies.
   N/A

RETURN COMPLETED FORM TO PROJECT MANAGER

9614477.2654

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/20/91	Time	11:00
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-370		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand delivery				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F01

2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: B.H. Ford	Received by: P.K. Butcher	Date/Time: 21 Feb 91 / 0830
Relinquished by: P.K. Butcher	Received by: M.W. Ulm	Date/Time: 2/21/91/13:05
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9619177.2665

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/20/91	Time	11:00
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-370		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F01

1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: B H Ford	Received by: P H Butcher	Date/Time: 21 Feb 91 / 0830
Relinquished by: P H Butcher	Received by: Earl Pool	Date/Time: 2/21/91 1147
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613917.2316

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/20/91	Time	11:00
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-370		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 329 Laboratory				

SAMPLE IDENTIFICATION

B00 F01
1, 4L, P, WATER, Ru-106

CHAIN OF POSSESSION

Relinquished by: BH Ford	Received by: PH Butcher	Date/Time: 21Feb91/0830
Relinquished by: PH Butcher	Received by: SA Lapel	Date/Time: 2/21/91 1240
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9615477.2667

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/20/91	Time	1:25
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-370		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 FP4
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: B H Ford / P H Butcher	Received by: P H Butcher	Date/Time: 21Feb91/0830
Relinquished by: P H Butcher	Received by: M W Ulm	Date/Time: 2/21/91/13:05
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2669

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/20/91	Time	1:25
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-370		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F04
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: B.H. FORD	Received by: P.H. Butcher	Date/Time: 2/20/91 / 0830
Relinquished by: P.H. Butcher	Received by: Carl Pool	Date/Time: 2/21/91 1147
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector _____ Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 F01	2, 1L, P	W	Total Cyanide
B00 F04	2, 1L, P	W	Total Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by M W Thee Title Group Leader Date 2/26/91

Analysis Required _____

B01-035

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector _____ Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 F01	1, 1L, P	W	Free Cyanide
B00 F04	1, 1L, P	W	Free Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 2/21/91

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

B01-036

9618127.2671

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00F01	1, 4L, P	W	Ru-106
	~~3, 1L, P~~	~~W~~	~~Total Cyanide, Free Cyanide~~ PHB-11689

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by S A Logel Title Rad Tech. Specialist Date 2/21/91

Analysis Required Ru-106

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

B01-037

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: _____

Received by: K. H. Pool

Customer Sample Number(s): B00F01 B00F04

ALO Sample Number(s): 90-7074 90-7075

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact - wonderful!

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Good condition. T = 3.0°C

6. Condition of Sample Vials.

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: Butcher Date/Time: 2/21/91 13:05

Received by: Ulrie

Customer Sample Number(s): BØØFØ1 BØØFØ4

ALO Sample Number(s): 90-7074 90-7075

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   SAMPLE ANALYSIS REQUEST

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: _____

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: N/A

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   ICED TEMP = 3°C

6. Condition of Sample Vials.
   GOOD

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.
   Agreement

8. Resolution of Problems or Discrepancies.
   N/A

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: P. H. Butcher Date/Time: 2/21/91 12:30

Received by: EA Lepel

Customer Sample Number(s): B00F01

ALO Sample Number(s): 90-7074

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   Sample Analysis Request - Westinghouse

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   No Shipping container. 1 Gallon bottle.

6. Condition of Sample Vials. OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. Yes. Agrees.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

9613477.2675

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/21/91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	~~bbb~~ LW 2/21/91 WHC-N-4461 /Pg.6		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00DZ8

2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 1610 2/21/91
Relinquished by: P.H. Butcher P.H. Butcher	Received by: B.M. Gillespie B.M. Gillespie	Date/Time: 13:53 2-25-91
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/21/91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 /Pg. 6		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 314 Laboratory				

SAMPLE IDENTIFICATION

B00 DZ6

1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: LP Walker L.D. Walker	Received by: PH Butcher P H Butcher	Date/Time: 2/21/91 1610
Relinquished by: PH Butcher P H Butcher	Received by: Karl Pool	Date/Time: 2/25/91 1330
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9615927.2677

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/21/91	Time	1200
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / Pg. 6		
Remarks	N/A				
Bill of Lading No.		Offsite Property No.	~~#0~~ N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00F24
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.P. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 1615 2/21/91
Relinquished by: P.H. Butcher P.H. Butcher	Received by: B.M. Gillespie B.M. Gillespie	Date/Time: 13:52 2/25/91
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/21/91	Time	1200
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461/Pg-6		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 314 Laboratory				

SAMPLE IDENTIFICATION

B00F24
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: PH Butcher PH Butcher	Date/Time: 1615 2/21/91
Relinquished by: PH Butcher PH Butcher	Received by: Karl Pool	Date/Time: 2/25/91 1330
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. Walker Date Sampled 2/21/91 Time*** hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00DZ8	2, 1L, P	W	Total Cyanide
B00F24	2, 1L, P	W	Total Cyanide

Field Information** N/A

Special Handling and/or Storage

Possible Sample Hazards

PART II: LABORATORY SECTION

Received by B M Gillespie Title Project Manager Date 2-25-91

Analysis Required

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

**Use back of page for additional information relative to sample location.

B01-045

A-6000-406 (05/90)

*** B00DZ8 Sampled at 1400

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L Walker Date Sampled 2/21/91 Time *** hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 DZ8	1, 1L, P	W	Free Cyanide
B00 F24	1, 1L, P	W	Free Cyanide

Field Information** N/A

Special Handling and/or Storage

Possible Sample Hazards

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 2/25/91

Analysis Required

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

**Use back of page for additional information relative to sample location.

*** B00DZ8 sampled at 1400, B00F24 sampled at 1800

B01-046

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 2/25/91 1330

Received by: K.H. Pool

Customer Sample Number(s): B00D278 B00F241

ALO Sample Number(s): 90-7076 90-7077

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact - good

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) T = 3.5°C Shipping container in good shape!

6. Condition of Sample Vials. N/A

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 2-25-91 / 1:53

Received by: Barb Gillespie

Customer Sample Number(s): B00D78, B00F24

ALO Sample Number(s): 90-7076, 90-7077

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):
   Sample Analysis Request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.
   Present X Absent _____
   If Present, Condition: intact

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.
   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   4°C

6. Condition of Sample Vials.
   Good / OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

9615477.2693

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/25/91	Time	1300
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 8		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 Y8
3, 1L, P, WATER, TOTAL CYANIDE, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: PH Butcher	Date/Time: 2/25/91 1650
Relinquished by: PH Butcher	Received by: Karl Pool	Date/Time: 2/26/91 1123
Relinquished by: PH Butcher	Received by: Simon Barrow	Date/Time: 02/26/91 11:48
Relinquished by:	Received by:	Date/Time:

Comments:

1) Received 1 ea 1.0liter bottle for free cyanide analysis. KHP 2/26/91

2) Received 2 one liter BOTTLE for each SAMPLE SIB 02/26/91

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/25/91	Time	1130
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 /pg. 7		
Remarks	n/A				
Bill of Lading No.	n/A	Offsite Property No.	n/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 DZ1
3, 1L, P, WATER, TOTAL CYANIDE, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P H Butcher	Date/Time: 2/25/91 1655
Relinquished by: P H Butcher	Received by: Karl Pool	Date/Time: 2/26/91 1123
Relinquished by: P H Butcher	Received by: Simon Burrow	Date/Time: 02/26/91 11:48
Relinquished by:	Received by:	Date/Time:

Comments:
1) Received 1 ea 1.0 Liter bottle for free cyanide analysis. KHP 2/26/91
2) Received 2 one liter bottles for each sample SEB 02/26/91

9613477.2685

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector _____ Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00DY8	2, 1L, P	W	Total Cyanide
B00DZ1	2, 1L, P	W	Total Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Simon Robinson Title Service Tech 5 Pcs Date 02/26/91

Analysis Required TOTAL CYANIDES

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

**Use back of page for additional information relative to sample location.

B01-051

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 02/26/91 11:48

Received by: SIMON BARSOUM

Customer Sample Number(s): B00DY8 & B00DZ1

ALO Sample Number(s): ~~91-1644~~ SIB 90-7078 ~~91-1645~~ SIB 90-7079

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: GOOD

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature). GOOD T = 3.0 C°

6. Condition of Sample Vials.

   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

   OK

8. Resolution of Problems or Discrepancies.

   N/A

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: _____

Received by: K. H. Pool

Customer Sample Number(s): B00DY8 B00DZ1

ALO Sample Number(s): 90-7078 90-7079

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Good condition, T= 2.0°C

6. Condition of Sample Vials.

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

Chain of Custody Number 200BP1-91

ALO CHAIN OF CUSTODY

90-7067	Total Cyanide	B00DK8
ALO SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION

SENDER Karl Pool — 3/4/91 DATE

RECEIVER P H Butcher — 3/4/91 DATE

90-7068	Total Cyanide	B00DL1
ALO SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION

SENDER Karl Pool — 3/4/91 DATE

RECEIVER P H Butcher — 3/4/91 DATE

90-7067	TOTAL CN	B00DK8
ALO SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION

SENDER P H Butcher ~~Karl Pool~~ — 3/4/91 ~~3/4/~~ DATE

RECEIVER J. Robbins — 3/4/91 DATE

90-7068	TOTAL CN	B00DL1
ALO SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION

SENDER P H Butcher ~~Karl Pool~~ — 3/4/91 DATE

RECEIVER J. Robbins — 3/4/91 DATE

Original - Project Management Office
Copy - Sender
Copy - Receiver

Applicable Test Instruction

TI-200BP-1-28

Chain of Custody Number 200BP1-92

ALO CHAIN OF CUSTODY

90-7067	Free Cyanide	B00DK8
ALO SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION

SENDER G. Robbins — 4/24/91 DATE

RECEIVER Karl Pool — 4/24/91 DATE

ALO SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION

SENDER _____ _____ DATE

RECEIVER _____ _____ DATE

ALO SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION

SENDER _____ _____ DATE

RECEIVER _____ _____ DATE

ALO SAMPLE NUMBER	ANALYSIS REQUESTED	SAMPLE DESCRIPTION

SENDER _____ _____ DATE

RECEIVER _____ _____ DATE

Original - Project Management Office
Copy - Sender
Copy - Receiver

Applicable Test Instruction

TI-200BP-1-28

Samples were delivered directly to the Analysts. Therefore, no other PNL Chain of Custody forms were needed.

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509) 376-5802

November 18, 1991

Mr. Jeff Lerch, T6-08
Westinghouse Hanford Company
P.O. Box 1970
Richland, Washington 99352

Dear Jeff:

TRANSMITTAL OF 200-BP-1 GROUNDWATER ANALYSIS PROJECT, TASK 7, Ru-106, DATA PACKAGE/REPORT, REVISION 0, NOVEMBER 12, 1991

Enclosed are three copies of the subject 200-BP-1 Task 7, Ru-106, Data Package/Report, Revision 0. Please discard the data packages sent under the November 12, 1991 cover letter. The appendices were not paginated.

If you have any questions after reviewing the data, please give me a call on 376-5802.

Sincerely,

B. M. Gillespie

B. M. Gillespie
200-BP-1 PNL Project Manager
Analytical Laboratory Operations

BMG:pl

Enclosures

Resubmittal of original data.

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509) 376-5802

November 12, 1991

Mr. Jeff Lerch, T6-08
Westinghouse Hanford Company
P.O. Box 1970
Richland, Washington 99352

Dear Jeff:

TRANSMITTAL OF 200-BP-1 GROUNDWATER ANALYSIS PROJECT, TASK 7, Ru-106, DATA PACKAGE/REPORT, REVISION 0, NOVEMBER 12, 1991

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If you have any questions after reviewing the data, please give me a call on 376-5802.

Sincerely,

B. M. Gillespie

B. M. Gillespie
200-BP-1 PNL Project Manager
Analytical Laboratory Operations

BMG:pl

Enclosures

INTRODUCTION

This data package contains the results obtained by Pacific Northwest Laboratory (PNL) staff in the characterization of samples for the 200-BP-1 Groundwater Analysis Project. The samples were submitted for analysis by Westinghouse Hanford Company (WHC) under the Technical Project Plan (TPP) 16772 and the Quality Assurance Project Plan (QAPjP) ALO-001. The samples are all ground water collected in support of Task 7. The analytical procedures required for analysis were defined in the Test Instructions (TI) prepared by the PNL 200-BP-1 Project Management Office in accordance with the TPP and the QAPjP ALO-001.

The samples (Table 1) were submitted with the appropriate WHC Chain of Custody (COC) and Sample Analysis Request Forms. The samples were delivered to the 300 Area, 329 Building 200-BP-1 Sample Custodian.

The requested analysis for these samples was for Ru-106. The quality control (QC) requirements for each sample are defined in the test instructions for each sample. The QC requirements outlined in the procedures and requested in the WHC SOW were followed. A methods blank, methods spike and methods spike duplicate were analyzed. All QC data that exist are included in this Data Package/Report.

Three appendices are provided; one for Test Instruction, one for Chain of Custody, Sample Analysis Request Forms and Sample Receipt Forms and one that contains the primary radiochemistry analytical data.

CERTIFICATION STATEMENT

I certify that this data package is in compliance with the terms and conditions of the TPP 16772 and QAPjP ALO-001 for completeness. Release of the data contained in this hard copy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Project Manager or the Project Manager's designee, as verified by the following signature.

B. M. Gillespie

B. M. Gillespie
200-BP-1 Project Manager

1-8-91

Date

TABLE 1: 200-BP-1 Sample Numbers

WHC Sample Number	PNL ALO Sample Number
B00F01	90-7074
B00F11	90-7082
B00FF7	91-1825
B00FB3	91-2707
B00F93	91-2708
B00FB0	91-2709
B00F54	91-2710
B00FD0	91-2711
B00F90	91-2781
B00FB6	91-2859
B00FC4	91-2860
B00FG4	91-2962

Ru-106 Analysis in Groundwaters for Task 7 of the 200 BP-1 Site Investigation

Discussion of Procedure and Results

Twelve groundwater samples were received for analysis of Ru-106 under Task 7. These samples were analyzed according to PNL-ALO-471, "Determination of Low Concentration of Ru-106 in Groundwater by Direct Counting on Dual Large Sodium Iodide Detectors with Coincidence/Anticoincidence Multidimensional Analysis." A Methods blank was added to the sample set consisting of 3.5 L of ultrapure water sealed in the sample geometry of a large Tupperware pie container. In all cases, the samples were counted in new Tupperware Pie containers. Because of the large volume of sample analyzed (3.5 L), there was not enough liquid left to perform sample duplicate analysis. The Test Instruction indicates that field duplicates would be required if duplicate samples analysis were required. No field duplicates were received. A Methods spike and Methods spike duplicate were analyzed consisting of an aliquot of Ru-106 in 3.5 L of ultrapure water in a Tupperware pie container. All work was performed according to the Test Instruction received that covers these samples.

The samples were prepared for counting by taring a "NEW" Tupperware pie container and then adding exactly 3.500 Kg of sample (or ultrapure water). The container was then sealed with tape to help prevent leakage and then sealed in a heavy polyethylene bag. This bag was then put inside another plastic bag until the sample was counted. This work followed PNL-ALO-471. A Methods blank, Methods blank spike, and Methods blank spike duplicate were also prepared in a similar manner.

The samples were then analyzed by direct counting of the samples between two large sodium iodide detectors using coincidence/anticoincidence multidimensional analysis. Spectral data was acquired directly into a PC and the data was stored on a floppy. The data was analyzed according to the procedure described in PNL-ALO-471. The activity observed for Ru-106 in the samples is listed in Table 2. Five samples were counted twice as a check on sample reproducability. No detectable activity of Ru-106 was observed in the

samples or blank that were counted, therefore, a lower limit of detection (LLD) value was reported. Sample 90-7074-L-1 presented the greatest analytical problem because of the presence of 374 pCi of ^{60}Co. The compton from the full energy peaks of ^{60}Co present an interference that must be corrected for.

Instrument check sources (controls) were counted intermittently over the period of time the samples were counted. The Control Procedure, PNL-ALO-470, was followed.

A Methods blank, 90-7074-L-5, was used to calculate the detection limit for Ru-106 which was determined to be <1.1 pCi/L. This lower limit of detection (LLD) was determined using the method described in HASL-300 to calculate a LLD with 95% confidence. The Target Detection Limit given in QAPjP ALO-001, Rev 1, is 3 pCi/L with 95% confidence.

A Methods spike (90-7074-L-3) and Methods spike duplicate (90-7074-L-6) were also counted. The known value of Ru-106 in both samples is 5890 ± 200 pCi and the determined values were 5890 ± 60 and 5890 ± 40 pCi, respectively. The errors reported are 2 sigma counting errors. The Target accuracy and precision is ± 25%. This data is well within the required range for accuracy and precision.

Table 2: Ru-106 Activity in Groundwater Samples for Task 7

Sample Set 1

MDA Detector 9

(Radionuclide activity in pCi/L)

Sample ID	LRB #	Collection Time	Count Time	Volume[a] (L)	Ru-106 Activity
90-7074-L-1	54100-008	2/20/91 11:30	3/18/91 19:36	3.500	<4.4
			5/10/91 18:02	3.500	<4.6
90-7074-L-5	54100-007	3/29/91 12:00	3/29/91 12:52	3.500	<1.1
			4/18/91 16:16	3.500	<2.1
90-7082-L-1	54100-017	2/27/91 15:19	3/22/91 16:19	3.500	<1.3
91-1825-L-1	54100-018	3/6/91 16:06	4/1/91 13:52	3.500	<2.1
91-2707-L-1	54100-020	3/27/91 11:16	4/2/91 14:54	3.500	<3.1
91-2708-L-1	54100-021	3/25/91 11:04	4/3/91 15:23	3.500	<3.0
91-2709-L-1	54100-022	3/25/91 14:04	4/4/91 14:00	3.500	<2.8
			5/17/91 15:29	3.500	<1.2
91-2710-L-1	54100-023	3/25/91 11:16	4/9/91 14:32	3.500	<2.3
91-2711-L-1	54100-024	3/27/91 13:23	4/5/91 15:39	3.500	<2.2
			5/15/91 13:23	3.500	<2.1
91-2781-L-1	54100-025	4/1/91 12:58	4/10/91 14:07	3.500	<3.0
91-2859-L-1	54100-026	4/3/91 13:54	4/11/91 16:32	3.500	<3.5
91-2860-L-1	54100-027	4/4/91 13:24	4/12/91 15:18	3.500	<1.6
91-2962-L-1	54100-028	4/4/91 13:23	4/16/91 15:38	3.500	<2.4
			5/10/91 11:30	3.500	<4.6
90-7074-L-3	54124-2-1	3/18/91 12:00	3/21/91 18:09	3.500	5890 ± 60 pCi
90-7074-L-6	54124-2-2	3/18/91 12:00	3/27/91 15:10	3.500	5890 ± 40 pCi

[a]It is assumed the density of water is 1.00 kg/L.

The less than values presented above are Lower Limits of Detection (LLD) values calculated for a 95% confidence interval as described in HASL-300. The reported errors were 2 sigma counting errors.

9613477.2699

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/20/91	Time	11:00
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-370		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 329 Laboratory				

SAMPLE IDENTIFICATION

B00 F01
1, 4L, P, WATER, Ru-106

CHAIN OF POSSESSION

Relinquished by: BH Ford / PH Butcher	Received by: PH Butcher	Date/Time: 11Feb91/0830
Relinquished by: PH Butcher	Received by: SA Lapel	Date/Time: 2/21/91 1240
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00F01	1, 4L, P	W	Ru-106
	~~3, 1L, P~~	~~W~~	~~Total Cyanide, Free Cyanide~~ PHB 2/1/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by S A Lopez Title Res Tech. Specialist Date 2/21/91

Analysis Required Ru-106

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

**Use back of page for additional information relative to sample location

B01-003

A-6000-406 (05/

SAMPLE RECEIPT FORM

Delivered by: P. H. Butcher Date/Time: 2/21/91 12:30

Received by: EA Lepel

Customer Sample Number(s): B00F01

ALO Sample Number(s): 90-7074

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   Sample Analysis Request - Westinghouse

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   No Shipping container. 1 Gallon bottle.

6. Condition of Sample Vials. Ok

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. Yes. Agrees.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

9615477.2132

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/27/91	Time	1500
Sample Locations	200-BP-1				
Ice Chest No.	West 2	Field Logbook and Page No.	WHC-N-4461 / pg. 11		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F11
2, 1L, P, WATER, TOTAL CYANIDE
pres 3/1/91
1, 4L, P, Water, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 2/27/91 1745
Relinquished by: P.H. Butcher P.H. Butcher	Received by: E.A. Lopez E.A. Lopez	Date/Time: 3/4/91 1055
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/4/91 1135
Relinquished by:	Received by:	Date/Time:

Comments: 1) Received 1 - 1 gallon bottle for Ru-106 Analysis E.A. Lopez
2) Received 2 1L bottle for total cyanid

9613477.2215

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled 2/27/91 Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00F11	1, 4L, P	W	Ru-106
~~———~~	~~3, 1L, P~~	~~W~~	~~Total Cyanide, Free Cyanide~~ PNB 3/4/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by _____ Title _____ Date _____

Analysis Required _____

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

**Use back of page for additional information relative to sample location

B01-006

6000-405 (05/9

SAMPLE RECEIPT FORM

Delivered by: P H Butcher Date/Time: 3/4/91 10:55

Received by: E A Lepel

Customer Sample Number(s): B00F11 (B)

ALO Sample Number(s): 90 - 7082

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   Sample Analysis Request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: ✓

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   NA

6. Condition of Sample Vials. 1 gallon bottle – OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. OK

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

9615977.2305

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/6/91	Time	1000
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 15		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand delivered				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00FF7

2, 1L, P, WATER, TOTAL CYANIDE
1, 4L, P, Water, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.H. Butcher	Date/Time: 3/6/91 1800
Relinquished by: P.H. Butcher	Received by: R.A. Lagel (1)	Date/Time: 1432 3/7/91
Relinquished by: P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/7/91 3:20
Relinquished by:	Received by:	Date/Time:

Comments: (1) 1 - 4L poly bottle for Ru106
2) 2 - 1L " for total CN

B01-008

9615177.3206

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled 3/6/91 Time 1000 hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 FF7	1, 4L, P	W	Ru-106
	~~3, 1L, P~~	~~W~~	~~Total Cyanide, Free Cyanide~~ PBS 3-7-91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Elwood Kopel Title Sr. Tech Spec. Date 3/7/91

Analysis Required Ru-106

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

**Use back of page for additional information relative to sample

B01-009

9613977.0707

PNL-ALO-051, Rev. 0
Exhibit 1
Page 1 of 1

SAMPLE RECEIPT FORM

Delivered by: PH Butcher Date/Time: 3/7/91 1432

Received by: E A Lepel

Customer Sample Number(s): B00FF7

ALO Sample Number(s): 91-1825

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list): WHC Sample Analysis Request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: NA

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   NA

6. Condition of Sample Vials. NA

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. Note: Sample collection for Ru 106 3/6/91 @ 1606

8. Resolution of Problems or Discrepancies.

   NA

RETURN COMPLETED FORM TO PROJECT MANAGER

9143472.2398

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-27-91	Time	1115
Sample Locations	200-BP-1				
Ice Chest No.	N/A	Field Logbook and Page No.	WHC-N-4461 / Pg. 24		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 329 Laboratory				

SAMPLE IDENTIFICATION

B00 FB3
1, 4L, P, WATER, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / L.D. Walker	Received by: P.H. Butcher / P.H. Butcher	Date/Time: 3-27-91 1620
Relinquished by: P.H. Butcher / P.H. Butcher	Received by: W.H. Edrington	Date/Time: 3-29-91 10:30
Relinquished by: W.H. Edrington	Received by: S.A. Lepel	Date/Time: 3/29/91 1051
Relinquished by:	Received by:	Date/Time:

9613627.2209

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-25-91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.	N/A	Field Logbook and Page No.	WHC-N-4461 / pg. 22		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 329 Laboratory				

SAMPLE IDENTIFICATION

B00 F93
1, 4L, P, WATER, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Barker P.H. Barker	Date/Time: 3-25-91 1740
Relinquished by: P.H. Barker P.H. Barker	Received by: T.A. Edrington T.A. Edrington	Date/Time: 3-29-91 10:30
Relinquished by: T.A. Edrington	Received by: L.A. Lopel	Date/Time: 3/29/91 1851
Relinquished by:	Received by:	Date/Time:

9613977.2210

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-25-91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	N/A	Field Logbook and Page No.	WHC-N-4461 / pg. 22		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	~~N/A~~ PHB 3/28/91	Hand Delivered			
Shipped to	Battelle Northwest/ PNL 329 Laboratory				

SAMPLE IDENTIFICATION

B00 FBO
1, 4L, P, WATER, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher	Date/Time: 3-25-91 1730
Relinquished by: P.H. Butcher	Received by: R.H. Eschinger	Date/Time: 3-29-91 1030
Relinquished by: R.H. Eschinger	Received by: S.A. Lopel	Date/Time: 3/29/91 0951
Relinquished by:	Received by:	Date/Time:

9615477.3711

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-25-91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.	~~N/A~~ PNB 3/26/91 N/A	Field Logbook and Page No.	WHC-N-4461 / Pg. 22		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 329 Laboratory				

SAMPLE IDENTIFICATION

B00 F54
1, 4L, P, WATER, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher	Date/Time: 3-25-91 1725
Relinquished by: P.H. Butcher	Received by: E.A. Edington	Date/Time: 3-29-91 1030
Relinquished by: E.A. Edington	Received by: S.A. Lopel	Date/Time: 3/29/91 1052
Relinquished by:	Received by:	Date/Time:

9613477.2712

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-27-91	Time	1320
Sample Locations	200-BP-1				
Ice Chest No.	N/A	Field Logbook and Page No.	WHC-N-4461 / pg. 24		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Delivery				
Shipped to	Battelle Northwest/ PNL 329 Laboratory				

SAMPLE IDENTIFICATION

B00 F D O
1, 4L, P, WATER, Ru-106

CHAIN OF POSSESSION

Relinquished by: L. D. Walker / L D Walker	Received by: P H Butcher / P H Butcher	Date/Time: 3-27-91 1610
Relinquished by: P H Butcher / P H Butcher	Received by:	Date/Time: 3-29-91 1030
Relinquished by:	Received by: E A Lopez	Date/Time: 3/29/91 1052
Relinquished by:	Received by:	Date/Time:

9615072215

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled ★★★ Time ★★★ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested ★★★		
B00FB3	1, 4L, P	W	Ru-106	3/27/91	1115
	~~3, 1L, P~~	~~W~~	~~Total Cyanide, Free Cyanide~~	PHC 3/28/91	
B00F93	1, 4L, P	✓	Ru-106	3/25/91	1100
B00FB0	1, 4L, P	✓	Ru-106	3/25/91	1400
B00F54	1, 4L, P	✓	Ru-106	3/25/91	1100
B00FD0	1, 4L, P	W	Ru-106	3/27/91	1320

Field Information**

Special Handling and/or Storage

Possible Sample Hazards

PART II: LABORATORY SECTION

Received by Elwood Lopel Title Sr. Tech. Spec. Date 3/29/91

Analysis Required Ru-106

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

**Use back of page for additional information relati...

B01-016

9618077.2214

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	~~4-1-91~~ 4-1-91 LW 4-1-91	Time	1300
Sample Locations	200-BP-1				
Ice Chest No.	N/A	Field Logbook and Page No.	WHC-N-4461 / Pg. 26		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 329 Laboratory				

SAMPLE IDENTIFICATION

B00F90
1, 4L, P, WATER, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 4-1-91 1635
Relinquished by: P.H. Butcher P.H. Butcher	Received by: S.H. Lepel	Date/Time: 4/3/91 1002
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613472.2215

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled ★★★ Time ★★★ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested ★★★
B00 F90	1, 4L, P	W	Ru-106 4-1-91 / 130
	~~3, 1L, P~~	~~W~~	~~Total Cyanide, Free Cyanide~~ PHS 4/3/91
~~B00F88~~			~~Ru-106~~ 4-1-91 / 130
	Sampled was not delivered, spilled in transit PHS 4/3/91		
→ Sample spilled. Not received by SK L			4/3/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by SK Lapel Title Sr. Technical Spec. Date 4/3/91

Analysis Required Ru-106

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

**Use back of page for additional information relative to sample location

B01-019

SAMPLE RECEIPT FORM

Delivered by: P H Butcher Date/Time: 1002

Received by: E A Lepel

Customer Sample Number(s): B00F90,

ALO Sample Number(s): 91-2781

1. Customer Chain-of-Custody Form: Present ✓ Absent _____
2. Additional Shipping Forms (list): WHC Sample Analysis Request
3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present Yes Absent _____

   If Present, Condition: OK
4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: NA
5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   NA
6. Condition of Sample ~~Vials~~. Container - Outside damp from spilled sample
7. Verification of Agreement or Nonagreement of Information on Receiving Documents. Sample B00FB8 spilled in transit. Not enough sample for analysis (See WHC Sample Analysis Request).
8. Resolution of Problems or Discrepancies.

   One sample delivered only. Other sample lost in transit. 4/3/91 EAlepel

RETURN COMPLETED FORM TO PROJECT MANAGER

9613477.2717

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-3-91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	N/A	Field Logbook and Page No.	WHC-N-4461 / pg. 27		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 329 Laboratory				

SAMPLE IDENTIFICATION

B00 FB 6
1, 4L, P, WATER, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: H.E. Walker P.H. Butcher	Date/Time: 4-3-91 1710
Relinquished by: P.H. Butcher P.H. Butcher	Received by: G.A. Lepel	Date/Time: 4/5/91 1122
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-4-91	Time	1330
Sample Locations	200-BP-1				
Ice Chest No.	N/A	Field Logbook and Page No.	WHC-N-4461 / pg. 28		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Delivered				
Shipped to	Battelle Northwest/ PNL 329 Laboratory				

SAMPLE IDENTIFICATION

B00 FC4 ✓
1, 4L, P, WATER, Ru-106

~~B00FG4~~ LW 4-4-91
B00FG4 ✓
1, 4L, P, Water, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.A. Butcher	Date/Time: 4-4-91 1640
Relinquished by: P.A. Butcher	Received by: P.A. Lopez	Date/Time: 4/5/91 1122
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2719

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested		
B00FB6	1, 4L, P	W	Ru-106	4/3/91	140
	~~3, 1L, P~~	~~W~~	~~Total Cyanide, Free Cyanide~~	PRG 4/5/91	
B00FC4	1, 4L, P	W	Ru-106	4/4/91	133
B00FG4	1, 4L, P	W	Ru-106	4/4/91	133

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by E A Lopel Title Sr Technical Spec Date 4/5/91

Analysis Required Ru-106

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

**Use back of page for additional information relating to sample.

R01-023

SAMPLE RECEIPT FORM

Delivered by: P H. Butcher Date/Time: 4/5/91 1124

Received by: E A Lepel

Customer Sample Number(s): B00FB6, B00FC4, B00FG4

ALO Sample Number(s): 91-2859 91-2860 91-2962

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):
   White Sample Analysis Request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.
   Present X Absent _____
   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.
   Notes: NA

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   NA

6. Condition of Sample Vials. OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. OK

8. Resolution of Problems or Discrepancies. NA

RETURN COMPLETED FORM TO PROJECT MANAGER

Samples were delivered directly to the Analysts. Therefore, no PNL Chain of Custody forms were needed.

200-BP-1
GROUNDWATER ANALYSIS PROJECT

TASK 7

DATA PACKAGE/REPORT No. 4 & 5

Revision 0

June 3, 1991

Prepared by: B.M. Gillespie

Pacific Northwest Laboratory

(PNL Project #16772)

INTRODUCTION

This data package contains the results obtained by Pacific Northwest Laboratory (PNL) staff in the characterization of samples for the 200-BP-1 Groundwater Analysis Project. The samples were submitted for analysis by Westinghouse Hanford Company (WHC) under the Technical Project Plan (TPP) 16772 and the Quality Assurance Project Plan (QAPjP) ALO-001. The samples are all ground water collected in support of Task 7. The analytical procedures required for analysis were defined in the Test Instructions (TI) prepared by the PNL 200-BP-1 Project Management Office in accordance with the TPP and the QAPjP ALO-001.

The samples (Table 1) were submitted with the appropriate WHC Chain of Custody (COC) and Sample Analysis Request Forms. The samples were delivered at refrigerated temperature to the 300 Area, 325 Building and 314 Building 200-BP-1 Sample Custodians.

The requested analyses for these samples were cyanide, free cyanide and ferrocyanide. A complex cyanide result is determined by the difference of the total cyanide and the free cyanide results. A "ferrocyanide" result is not obtained nor calculated since the amount of the complex cyanide being ferrocyanide is indeterminant. Samples 91-2707, 91-2708, 91-2709, 91-2710, 91-2711, 91-2780, 91-2781, 91-2859, 91-2860, and 91-2962 were submitted for Ru-106 analysis and the results will be reported in a separate data package for all Ru-106 sample data for this task. The quality control (QC) requirements for each sample are defined in the test instructions for each sample. The QC requirements outlined in the procedures and requested in the WHC SOW were followed. Sample duplicates, methods blank, matrix spikes and laboratory control standards were analyzed. All QC data that exist are included in this Data Package/Report.

The data in this package are reported in separate tables (Tables 2 through 4) for each analyte or method. Three appendices are provided; one for Test Instruction, one for Chain of Custody, Sample Analysis Request Forms and Sample Receipt Forms and one that contains the primary inorganic analytical data.

CERTIFICATION STATEMENT

I certify that this data package is in compliance with the terms and conditions of the TPP 16772 and QAPjP ALO-001 for completeness. Release of the data contained in this hard copy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Project Manager or the Project Manager's designee, as verified by the following signature.

_____ _____

B. M. Gillespie
200-BP-1 Project Manager

Date

TABLE 1: 200-BP-1 Sample Numbers

SAMPLE DELIVERY GROUP #4

WHC Sample Number	PNL ALO Sample Number
B00FB3	91-2707
B00F93	91-2708
B00FB0	91-2709
B00F54	91-2710
B00FD0	91-2711
B00FB8	91-2780
B00F90	91-2781
B00FB6	91-2859
B00FC4	91-2860
B00FG4 (Ru-106 only)	91-2962

SAMPLE DELIVERY GROUP #5

WHC Sample Number	PNL ALO Sample Number
B00F68	91-2979
B00F75	91-2980
B00F78	91-2981
B00FH2	91-2990
B00F84	91-3133

CYANIDE ANALYSIS RESULTS FOR SAMPLE DELIVERY GROUP #4

Cyanide analysis was performed in room 419 of building 325 in the Hanford Site 300 area. The analytical method used to aquire data for this data package was PNL-ALO-270; a distillation/colorimetric analysis referenced to a plot of cyanide standard concentration vs absorbance. Data package total cyanide results are summarized in Table 2.

Sample results for sample and duplicate were below the instrument detection limit (IDL) of 5.9 μg/L except for samples 91-2707, 91-2711, 91-2780, 91-2781 and 91-2859. Duplicate precision was within the accepted limit for all samples. Cyanide concentrations were above the IDL and below the CRDL (10 μg/L) for samples 91-2707 and 91-2711, which had CN concentrations of 9.2 and 7.4 μg/L, respectively. Samples 91-2780, 91-2781 and 91-2859 had cyanide concentrations of 12.3, 11.6 and 14.7 μg/L, respectively. Free cyanide analysis was not done as samples must have a total cyanide concentrations of greater than 20 μg/L before free cyanide analysis is required.

The 12 day hold time specified for cyanide analysis under the CLP protocol was met for all samples in this work package.

Average spiked sample cyanide recovery was 102.1% with a standard deviation of 2.1%. We chose to calculate the spike recovery for Task 7 by subtracting the sample cyanide concentration from the sample + spike concentration. This is a deviation from the CLP protocol which calls for correcting the sample + spike concentration for just those samples where the sample concentration was above the IDL. This deviation was implemented to avoid biasing the cyanide recovery by the high IDL values we obtained in our quarterly IDL study. We thus prevented the reporting of high spike recovery values obtained where cyanide concentrations were detectable in the sample but were below the arbitrary IDL.

Recovery of cyanide for initial calibration verification sample [ICV-6 (0789), ICF Technology Inc., Consensus value 9.4 mg/L] was 109.3% with a standard deviation of 4.5%. Recovery value for ICV-6 is based on the spiking of 1 mL of stock standard ICV-6 to 500 mL of deionized water and recovery back

calculated to the original ICV-6 cyanide concentration. Cyanide found in blanks analyzed in the work package were below the stated IDL.

TABLE 2: TOTAL CYANIDE ANALYSIS DATA
SDG #4

Sample ID#	PNL Log#	G1 Sample (ug/L)	C	G2 Sample dup. (ug/L)	C	%RPD	G5 Blank (ug/L)	C	G3 Sample+ spike (ug/L)	G4 - ICV (mg/L)	G3 Sample+ spike recovery (%)	G4 - ICV sample recovery (%)	Flags Q	Footnote#
														1,2,3, 4, 5 (ALL)
B00FB3	91-2707	9.2	B	8.8	B	3.86	5.9	U	99.6	10.82	100.1	115.1		
B00F54	91-2710	5.9	U											
B00F93	91-2808	5.9	U	5.9	U	N/A	5.9	U	94.1	10.65	102.4	113.3		
B00FB0	91-2809	5.9	U											
B00FD0	91-2711	7.4	B	7.0	B	4.82	5.9	U	98.3	10.14	99.7	107.8		
B00FB8	91-2780	12.3		11.6		5.84	5.9	U	97.9	10.14	105.7	107.8		
B00F90	91-2781	11.6												
B00FB6	91-2859	14.7		14.3		2.6	5.9	U	103	9.62	102.6	102.3		
B00FC4	91-2860	5.9	U											
											---	---		
										Mean	102.1	109.3		
										Std. Dev.	2.1	4.5		

1. Concentration of stock ICV-6 = 9.4 mg/L(9.4 ug of cyanide is added to each distillation flask and recovered in 250 mL of NaOH).
2. Concentration of spike added = 90.6 ug/L.
3. Contract required detection limit for water = 10 ug/L.
4. Used 250 mL of sample per distillation for sample G1, G2 and G3 due to limited sample size of 1.5L of total sample.
5. Duplicate precision under the CLP protocol must be within one CRDL when either sample or duplicate are below 5X CRDL.

CLP "C" FLAGS

U = Analyzed but not detected (IDL or less than IDL)
B = Less than CRDL but greater than or equal to IDL.

CLP "Q" FLAGS

N = Spiked sampe recovery not within control limits
* = duplicate analysis not within control limits

CYANIDE ANALYSIS RESULTS FOR SAMPLE DELIVERY GROUP #5

Cyanide analysis was performed in room 419 of building 325 in the Hanford Site 300 area. The analytical method used to aquire the data for this data package was PNL-ALO-270; a distillation/colorimetric analysis referenced to a plot of cyanide standard concentration vs absorbance. Data package total cyanide results are summarized in Table 3.

Sample results for sample and duplicate were below the instrument detection limit (IDL) of 5.9 μg/L for all samples. Free cyanide analysis was not done as samples must have a total cyanide concentrations of greater than 20 μg/L before free cyanide analysis is required.

The 12 day hold time specified for cyanide analysis under the CLP protocol was met for all samples in this work package.

Average spiked sample cyanide recovery was 98.1% with a standard deviation of 3.2%. We chose to calculate the spike recovery for Task 7 by subtracting the sample cyanide concentration from the sample + spike concentration. This is a deviation from the CLP protocol which calls for correcting the sample + spike concentration for just those samples where the sample concentration was above the IDL. This deviation was implemented to avoid biasing the cyanide recovery by the high IDL values we obtained in our quarterly IDL study. We thus prevented the reporting of high spike recovery values obtained where cyanide concentrations were detectable in the sample but were below the arbitrary IDL.

Recovery of cyanide for initial calibration verification sample [ICV-6 (0789), ICF Technology Inc., Consensus value 9.4 mg/L] was 107.2% with a standard deviation of 4.0%. Recovery value for ICV-6 is based on the spiking of 1 mL of stock standard ICV-6 to 500 mL of deionized water and recovery back calculated to the original ICV-6 cyanide concentration. Cyanide found in blanks analyzed in the work package were below the stated IDL.

TABLE 3: TOTAL CYANIDE ANALYSIS DATA
SDG #5

Sample ID#	PNL Log#	G1 Sample (ug/L)	C	G2 Sample dup. (ug/L)	C	%RPD	G5 Blank (ug/L)	C	G3 Sample+ spike (ug/L)	G4 - ICV (mg/L)	G3 Sample+ spike recovery (%)	G4 - ICV sample recovery (%)	Flags Q	Footnote#
														1,2,3, 4, 5 (ALL)
B00F68	91-2979	5.9	U	5.9	U	N/A	5.9	U	85.4	9.93	102.6	105.7		
B00F75	91-2980	5.9	U											
B00F78	91-2981	5.9	U	5.9	U	N/A	5.9	U	105.9	9.7	95.9	103.2		
B00FH2	91-2990	5.9	U											
B00F84	91-3133	5.9	U	5.9	U	N/A	5.9	U	90.0	10.58	95.9	112.6		
											---	---		
										Mean	98.1	107.2		
										Std. Dev.	3.2	4.0		

1. Concentration of stock ICV-6=9.4 mg/L (9.4 ug of cyanide is added to each distillation flask and recovered in 250 mL of NaOH).
2. Concentration of spike added = 90.6 ug/L.
3. Contract required detection limit for water = 10 ug/L.
4. Used 250 mL of sample per distillation for samples G1, G2 and G3 due to limited sample size of 1.5L of total sample.
5. Duplicate precision under the CLP protocol must be within one CRDL when either sample or duplicate are below 5X CRDL.

CLP "C" FLAGS

U = Analyzed but not detected (IDL or less than IDL)
B = less that CRDL but greater than or equal to IDL

CLP "Q" FLAGS

N = Spiked sample recovery not within control limits
* = Duplicate analysis not within control limits

FREE CYANIDE ANALYSIS RESULTS

Free cyanide analysis was not performed as samples must have a total cyanide concentration of greater than 20 µg/L before free cyanide analysis is required.

Table 4: Free Cyanide Analysis Data

NO DATA REQUIRED

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 3/28/91 2:25 pm

Received by: JIM ROBBINS

Customer Sample Number(s): B00FB3, B00F93, B00FB0, B00F54, B00FD0

ALO Sample Number(s): 91-2707, 91-2708, 91-2709, 91-2710, 91-2711

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   Sample receipt form WHC

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: INTACT

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   ✓ OK 4°C

6. Condition of Sample Vials.
   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.
   OK

8. Resolution of Problems or Discrepancies.
   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

9613477.2734

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D Walker Date Sampled *** Time *** hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested ***
B00 FB3	2, 1L, P	W	Total Cyanide 3/27/91 - 1115
B00 F93	2, 1L, P	W	Total Cyanide 3/25/91 - 1100
B00 FB0	2, 1L, P	W	Total Cyanide 3/25/91 - 1400
B00 F54	2, 1L, P	W	Total Cyanide 3/25/91 - 1100
B00 F00	2, 1L, P	W	Total Cyanide 3/27/91 - 1320

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by J. Robbins Title Sr. Research Scientist Date 3/29/91

Analysis Required TOTAL CN

B01-003

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

**Use back of page for additional information relative to sample location.

A-6000-106 (05/90)

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-27-91	Time	1115
Sample Locations	200-BP-1				
Ice Chest No.	U-01	Field Logbook and Page No.	WHC-N-4461 / Pg. 24		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Delivered				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F83
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: K.D. Walker L.D. Walker	Received by: P Fletcher P H Butcher	Date/Time: 3-27-91 1615
Relinquished by: M Barker P H Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/28/91 1430
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-25-91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.	CC-01	Field Logbook and Page No.	WHC-N-4461 / pg. 22		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F93
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: P H Butcher P H Butcher	Date/Time: 3-25-91 1740
Relinquished by: P H Butcher P H Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/28/91 1430
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9616477.2737

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/25/91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	U-01	Field Logbook and Page No.	WHC-N-4461 / pg. 22		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

800 FBO
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker P.H. Barker P.H. Barker	Received by: P.H. Barker P.H. Barker	Date/Time: 3-25-91 1730
Relinquished by: P.H. Barker P.H. Barker	Received by: J. ROBBINS J. Robbins	Date/Time: 3/28/91 1430
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

96-WHC-7230

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-25-91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.	4-01	Field Logbook and Page No.	WHC-N-4461 / pg. 22		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

800 F54
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3-25-91 1720
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/28/91 1430
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2299

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/27/91	Time	1320
Sample Locations	200-BP-1				
Ice Chest No.	LL-01	Field Logbook and Page No.	WHC-N-4461 / pg.24		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00FD0
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by:	Date/Time: 3-27-91 1610
Relinquished by:	Received by: J. ROBBINS	Date/Time: 3/28/91 1430
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

SAMPLE RECEIPT FORM

Delivered by: R.H. Butcher Date/Time: 3/28/91 1400

Received by: K.H. Pool

Customer Sample Number(s): B00FB3, B00F93, B00FB0, B00F54, B00FD0

ALO Sample Number(s): 91-2707, 91-2708, 91-2709, 91-2710, 91-2711

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Excellent

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Everything just fine. T = +0.5°C

6. Condition of Sample Vials.

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

9613477.2741

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L D Walker Date Sampled *** Time *** hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 FB3	1, 1L, P	W	Free Cyanide 3/27/91 - 1115
B00 F93	1, 1L, P	W	Free Cyanide 3/25/91 - 1100
B00 FB0	1, 1L, P	W	Free Cyanide 3/25/91 - 1400
B00 F54	1, 1L, P	W	Free Cyanide 3/25/91 - 1100
B00 FD0	1, 1L, P	W	Free Cyanide 3/27/91 - 1320

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 3/28/91

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

B01-010

A-6000-406 (05/90)

9615477.2242

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/25/91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.	U-01	Field Logbook and Page No.	WHC-N-4461 / pg. 22		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F93
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / L.D. Walker	Received by: P.H. Butcher / P.H. Butcher	Date/Time: 3-25-91 1740
Relinquished by: P.H. Butcher / P.H. Butcher	Received by: Karl Pool	Date/Time: 3-28-91 1400
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2245

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-27-91	Time	1115
Sample Locations	200-BP-1				
Ice Chest No.	44-01	Field Logbook and Page No.	WHC-N-4461/pg.24		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 FB3
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: Patricia A Butcher Patricia A Butcher	Date/Time: 3-27-91 1615
Relinquished by: P.H. Butcher P.H. Butcher	Received by: Karl Pool	Date/Time: 3-28-91 1400
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2744

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-25-91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	U-01	Field Logbook and Page No.	WHC-N-4461 / pg. 22		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Delivery				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 FB0
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: Pr Butcher P.R. Butcher	Date/Time: 3-25-91 1730
Relinquished by: Pr Butcher P.R. Butcher	Received by: Karl Pool	Date/Time: 3-28-91 1400
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2745

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/25/91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.	C-01	Field Logbook and Page No.	WHC-N-4461 / pg. 22		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F54
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P. Hutchison	Date/Time: 3-25-91 1720
Relinquished by: P. Hutchison	Received by: Karl Pool	Date/Time: 3-28-91 1400
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

B01-014

9613477.2246

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-27-91	Time	1320
Sample Locations	200-BP-1				
Ice Chest No.	U-01	Field Logbook and Page No.	WHC-IV-4461/Pg. 24		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 FDO
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: A H Hatcher A H Hatcher	Date/Time: 3-27-91 1605
Relinquished by: A H Hatcher A H Hatcher	Received by: Karl Pool	Date/Time: 3-28-91 1400
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

SAMPLE RECEIPT FORM

Delivered by: PH Butcher Date/Time: 4/3/91 10:30

Received by: K. H Pool

Customer Sample Number(s): B00FB8 B00F90

ALO Sample Number(s): 91-2780 91-2781

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Good.

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Everything fine ! T= 0.6°C

6. Condition of Sample Vials.

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

9613477.2748

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4/1/91	Time	1300
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 26		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 FB8
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / L.D. Walker / P.H. Butcher	Received by: P.H. Butcher / P.H. Butcher	Date/Time: 4/1/91 1630
Relinquished by: P.H. Butcher	Received by: Karl Pool	Date/Time: 4/3/91 1030
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

B01-017

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-1-91	Time	1300
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / Pg. 26		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F90
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.B. Walker L.D. Walker	Received by: P.H. Fletcher	Date/Time: 4-1-91 1635
Relinquished by: P.H. Fletcher	Received by: Karl Pool	Date/Time: 4-3-91 1030
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2250

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector J Walker Date Sampled *** Time *** hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested **
B00 F90	1, 1L, P	W	Free Cyanide 4-1-91 / 1300
B00 F88	1, 1L, P	W	Free Cyanide 4-1-91 / 1300

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 4/3/91

Analysis Required _____

B01-019

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 4/3/91 10:55

Received by: J. ROBBINS

Customer Sample Number(s): BØØFB8 , BØØF90

ALO Sample Number(s): 91-2780 91-2781

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: INTACT

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   OK

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   OK 4°C

6. Condition of Sample Vials.

   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

   OK

8. Resolution of Problems or Discrepancies.

   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

9513177.2752

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-1-91	Time	1300
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 26		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00F90
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 4-1-91 1630
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 4/3/91 10:52
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-1/91	Time	~~0600~~ 1300
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 26		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

LW 4-1-91

SAMPLE IDENTIFICATION

B00 F B8
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L. P. Walker L.D. Walker	Received by: P. Hartcher	Date/Time: 4-1-91 1630
Relinquished by: P. Hartcher	Received by: J. ROBBINS	Date/Time: 4/3/91 10:52
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L Walker Date Sampled *** Time *** hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested ***	***
B00F90	2, 1L, P	W	Total Cyanide	4/1/91 1300
B00F88	2, 1L, P	W	Total Cyanide	4/1/91 1300

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by D. Robbins Title Sr. Res Scientist Date 4/3/91

Analysis Required TOTAL CN

B01-023

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: P. H. Butcher Date/Time: 4/5/91 1140

Received by: K. H. Pool 1SHP 4/5/91

Customer Sample Number(s): B00 FB6 B00 F8C4

ALO Sample Number(s): 91-2859 91-2860

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Good.

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) All in good condition. T = 0.6°C

6. Condition of Sample Vials.

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector LD Walker Date Sampled _____ Time _____ hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00F86	1, 1L, P	W	Free Cyanide 4/3/91 – 1400
B00	1, 1L, P	W	Free Cyanide 4/4/91 – 1330

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 4/5/91

Analysis Required _____

B01-025

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-4-91	Time	1330
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-IN-4461 / pg. 28		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F C4
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / L.D. Walker / P.H. Butcher	Received by: P.H. Butcher / P.H. Butcher	Date/Time: 4-4-91 1635
Relinquished by: P.H. Butcher / P.H. Butcher	Received by: Karl Pool	Date/Time: 4-5-91 1140
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

B01-026

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-3-91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / Pg-27		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 FB6
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Erickson P.H. Erickson	Date/Time: 4-3-91 1710
Relinquished by: P.H. Erickson P.H. Erickson	Received by: Carl Pool	Date/Time: 4-5-91 1140
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 4/5/91 11:50am

Received by: J. ROBBINS

Customer Sample Number(s): B00FB6 B00FC4

ALO Sample Number(s): 91-2859 91-2860

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   Sample analysis request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: INTACT

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   OK 3°C

6. Condition of Sample Vials.
   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.
   OK

8. Resolution of Problems or Discrepancies.
   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

9615177.0760

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L D Walker Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00F86	2, 1L, P	W	Total Cyanide 4/3/91 — 1400
B00FC4	2, 1L, P	W	Total Cyanide 4/4/91 — 1330

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by J. Robbins Title Sr. Res. Scientist Date 4/5/91

Analysis Required TOTAL CYANIDE

B01-029

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-3-91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / Pg. 27		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F B6
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L. D. Walker L.D. Walker	Received by: P.F. Butcher P.F. Butcher	Date/Time: 4-3-91 1710
Relinquished by: P.F. Butcher P.F. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 11:50 4/5/91
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-4-91	Time	1330
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 28		
Remarks	n/a				
Bill of Lading No.	N/A	Offsite Property No.	n/a		
Method of Shipment	Hand Delivery				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 FC4
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Rutcher P.H. Rutcher	Date/Time: 4-4-91 1635
Relinquished by: P.H. Rutcher P.H. Rutcher	Received by: J. ROBBINS J. Robbins	Date/Time: 11:50 4/5/91
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

B01-031

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 4/11/91 1330

Received by: J. ROBBINS

Customer Sample Number(s): BØØF68, BØØF75, BØØF78

ALO Sample Number(s): 91-2979, 91-2980, 91-2981

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   sample analysis request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: _____

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: OK

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   OK 4°C

6. Condition of Sample Vials.
   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.
   OK

8. Resolution of Problems or Discrepancies.
   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L D Walker Date Sampled *** Time *** hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested ***
B00 F68	2, 1L, P	W	Total Cyanide 8 Apr 91 / 1400
B00 F75	2, 1L, P	W	Total Cyanide 10 Apr 91 / 1100
B00 F78	2, 1L, P	W	Total Cyanide 9 Apr 91 / 1400

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by J. Robbins Title Sr. Research Scientist Date 4/11/91

Analysis Required TOTAL CYANIDE

B01-033

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

**Use back of page for additional information relative to sample location.

A-6000-400 (05/90)

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-8-91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461/pg. 29		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F68
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: P.H. Butcher	Date/Time: 4-8-91 1700
Relinquished by: P.H. Butcher	Received by: ~~[illegible]~~ J. ROBBINS	Date/Time: 1330 4/11/91
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2265

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-9-91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 30		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Delivery				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F78
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.H. Butcher	Date/Time: 4-9-91 1615
Relinquished by: P.H. Butcher	Received by: V. ROBBINS	Date/Time: 4/11/91 1330
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

B01-035

9615477.2367

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-10-91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-4461 / pg. 31		
Remarks					
Bill of Lading No.		Offsite Property No.			
Method of Shipment					
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F75
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.P. Walker L.P. Walker	Received by: P.H. Ford	Date/Time: 4-10-91 1400
Relinquished by: P.H. Ford	Received by: J. ROBBINS J. Robbins	Date/Time: 4/11/91 1330
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

B01-036

SAMPLE RECEIPT FORM

Delivered by: P. H. Butcher Date/Time: 4/11/91 1253

Received by: K. H. Pool

Customer Sample Number(s): B00F68, B00F75, B00F78

ALO Sample Number(s): 91-2979 91-2980 91-2981

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Good.

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Intact, T = 3.7°C

6. Condition of Sample Vials.

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L D Walker Date Sampled *** Time *** hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested ***
B00F68	1, 1L, P	W	Free Cyanide 8Apr91 / 1400
B00F75	1, 1L, P	W	Free Cyanide 10Apr91 / 1100
B00F78	1, 1L, P	W	Free Cyanide 9Apr91 / 1400

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 4/11/91

Analysis Required _____

B01-038

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-8-91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / Pg. 29		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F68
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 4-8-91 1700
Relinquished by: P.H. Butcher P.H. Butcher	Received by: Karl Pool	Date/Time: 4-11-91 1253
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613972.271

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-9-91	Time	1400
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 30		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F78
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.H. Butcher	Date/Time: 4-9-91 1615
Relinquished by: P.H. Butcher	Received by: Carl Pool	Date/Time: 4-11-91 1253
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9513972.2172

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-10-91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.		Field Logbook and Page No.	WHC-N-4461 / pg. 31		
Remarks					
Bill of Lading No.		Offsite Property No.			
Method of Shipment					
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F75
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Gutcher P.H. Gutcher	Date/Time: 4-10-91 1400
Relinquished by: P.H. Gutcher P.H. Gutcher	Received by: Karl Pool	Date/Time: 4-11-91 1253
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

SAMPLE RECEIPT FORM

Delivered by: P. H Butcher Date/Time: 4-12-91 1013

Received by: L.O. Slate mail

Customer Sample Number(s): B00 FH ~~1~~ 2

ALO Sample Number(s): 91-2990

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list): Sample Analysis Request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: N/A

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) 3.2°C

6. Condition of Sample Vials. Good

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L D Walker Date Sampled 11 Apr 91 Time 1300 hours

Company Contact R H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00FHZ	1, 1L, P	W	Free Cyanide
B00	1, 1L, P	W	Free Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Sally O. Slater Title Tech Specialist III Date 4-12-91

Analysis Required Free Cyanide

B01-043

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

9615077.2275

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-11-91	Time	1300
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 32		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 FH2
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / L.D. Walker	Received by: P.H. Butcher / P.H. Butcher	Date/Time: 4-11-91 1500
Relinquished by: P.H. Butcher / P.H. Butcher	Received by: SALLY O. SLATE / Sally O. Slate	Date/Time: 4-12-91 1013
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

SAMPLE RECEIPT FORM

Delivered by: Butcher Date/Time: 4/12/91 10:50

Received by: Uric

Customer Sample Number(s): B00FH ~~#2~~ ~~B00~~

ALO Sample Number(s): 91-2990

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   Sample analysis request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.
   Present ✓ Absent _____
   If Present, Condition: OKay

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.
   Notes: N/A

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   3.5°C

6. Condition of Sample Vials.
   Good

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.
   Agree

8. Resolution of Problems or Discrepancies.
   N/A

RETURN COMPLETED FORM TO PROJECT MANAGER

9615477.2279

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-11-91	Time	1300
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / Pg. 32		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00FH2
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.H. Butcher	Date/Time: 4-11-91 1500
Relinquished by: P.H. Butcher	Received by:	Date/Time: 4/12/91 10:50
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613072.2278

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L D Walker Date Sampled 11 Apr 91 Time 1300 hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00FHZ	2, 1L, P	W	Total Cyanide
~~B00~~	~~2, 1L, P~~	~~W~~	~~Total Cyanide~~

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

eived by _____ Title Group Leader Date 4/12/91

Analysis Required _____

B01-047

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 4/19/91 11:30

Received by: J. ROBBINS

Customer Sample Number(s): B00 F84

ALO Sample Number(s): 91-3133

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: INTACT

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: N/A

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   OK 2°C

6. Condition of Sample Vials.

   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

   OK

8. Resolution of Problems or Discrepancies.

   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

9613072.2230

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-17-91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 33		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F84
2, 1L, P, WATER, TOTAL CYANIDE

91-3133

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / P.H. Butcher	Received by: P.H. Butcher	Date/Time: 4/17/91 1220
Relinquished by: P.H. Butcher	Received by: J. ROBBINS	Date/Time: 4/19/91 11:30
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9615477.2281

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L D Walker Date Sampled 17Apr91 Time 1100 hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00	2, 1L, P	W	Total Cyanide
B00	2, 1L, P	W	Total Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by J. Robbins Title Sr. Research Sci Date 4/19/91

Analysis Required TOTAL CN

B01-050

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 4-19-91 @ 11:00 am

Received by: Sally O-Slat

Customer Sample Number(s): B00 F84

ALO Sample Number(s): 91-3133

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list): NLO

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: good

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: NA

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.)

   2°C

6. Condition of Sample Vials.

   N/A

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	4-17-91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 33		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F84
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 4-17-91 1220
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J.D. Slate	Date/Time: 4-19-91 1100a
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9619127.2284

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L D Walker Date Sampled 17 Apr 91 Time 1100 hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00	1, 1L, P	W	Free Cyanide
B00	1, 1L, P	W	Free Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by A. J. Stat Title Lab Specialist II Date 4-19-91

Analysis Required Free Cyan.

B01-053

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

Samples were delivered directly to the Analysts. Therefore, no PNL Chain of Custody forms were needed.

200-BP-1
GROUNDWATER ANALYSIS PROJECT

TASK 7

DATA PACKAGE/REPORT No. 2 & 3

Revision 0

May 8, 1991

Prepared by: B.M. Gillespie

Pacific Northwest Laboratory

(PNL Project #16772)

 KDD 5/28/96

INTRODUCTION

This data package contains the results obtained by Pacific Northwest Laboratory (PNL) staff in the characterization of samples for the 200-BP-1 Groundwater Analysis Project. The samples were submitted for analysis by Westinghouse Hanford Company (WHC) under the Technical Project Plan (TPP) 16772 and the Quality Assurance Project Plan (QAPjP) ALO-001. The samples are all ground water collected in support of Task 7. The twenty one samples from sample delivery group number two and the two samples from sample delivery group number three are reported together in this one data report/package to save on preparation costs of a separate package for set three. The analytical procedures required for analysis were defined in the Test Instructions (TI) prepared by the PNL 200-BP-1 Project Management Office in accordance with the TPP and the QAPjP ALO-001.

The samples (Table 1) were submitted with the appropriate WHC Chain of Custody (COC) and Sample Analysis Request Forms. The samples were delivered at refrigerated temperature to the 300 Area, 325 Building and 314 Building 200-BP-1 Sample Custodians.

The requested analyses for these samples were cyanide, free cyanide and ferrocyanide. A complex cyanide result is determined by the difference of the total cyanide and the free cyanide results. A "ferrocyanide" result is not obtained nor calculated since the amount of the complex cyanide being ferrocyanide is indeterminant. Samples 90-7082 and 91-1825 were submitted for Ru-106 anaysis and the results will be reported in a separate data package for all Ru-106 sample data results for this task. The quality control (QC) requirements for each sample are defined in the test instructions for each sample. The QC requirements outlined in the procedures and requested in the WHC SOW were followed. Sample duplicates, methods blank, matrix spikes and laboratory control standards were analyzed. All QC data that exist are included in this Data Package/Report.

The data in this package are reported in separate tables (Tables 2 through 4) for each analyte or method. Three appendices are provided; one for Test Instruction, one for Chain of Custody, Sample Analysis Request Forms and

Sample Receipt Forms and one that contains the primary inorganic analytical data.

CERTIFICATION STATEMENT

I certify that this data package is in compliance with the terms and conditions of the TPP 16772 and QAPjP ALO-001 for completeness. Release of the data contained in this hard copy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Project Manager or the Project Manager's designee, as verified by the following signature.

B.M Gillespie

B. M. Gillespie
200-BP-1 Project Manager

5-8-91

Date

TABLE 1: 200-BP-1 Sample Numbers

SAMPLE DELIVERY GROUP #2

WHC Sample Number	PNL ALO Sample Number
B00DL4	90-7080
B00F08	90-7081
B00F11	90-7082
B00F14	90-7083
B00F21	90-7084
B00F30	91-1691
B00F33	91-1692
B00F36	91-1693
B00F46	91-1787
B00F49	91-1788
B00F43	91-1803
B00F58	91-1804
B00FF4	91-1805
B00F52	91-1822
B00F62	91-1823
B00F65	91-1824
B00FF7	91-1825
B00FG0	91-2396
B00F71	91-2397
B00F81	91-2398
B00FG3	91-2399

SAMPLE DELIVERY GROUP #3

WHC Sample Number	PNL ALO Sample Number
B00FC7	91-2456
B00F87	91-2457

CYANIDE ANALYSIS RESULTS

Cyanide analysis was performed in room 419 of building 325 in the Hanford Site 300 area. Results for Task 7 data packages #2 and #3 are presented by colorimetric analysis run accompanied by a plot of cyanide standard concentration vs absorbance for that analysis run. Data package #2 and #3 results are summarized in Table 2.

Sample results for sample and duplicate were below the instrument detection limit (IDL) of 5.9 μg/L except for samples 91-2399 and 90-7082. Duplicate precision was within the accepted limit for all samples. Sample 91-2399 had a cyanide concentration of 6.3 μg/L and sample 90-7082 had a value of 17.8 μg/L. Free cyanide analysis was not done as samples must have a total cyanide concentration of greater than 20 μg/L before free cyanide analysis is required.

The 12 day hold time specified for cyanide analysis under the CLP protocol was met for all samples in this work package.

Average spiked sample cyanide recovery was 99.6% with a standard deviation of 3.8%. We chose to calculate the spike recovery for task 7 by subtracting the sample cyanide concentration from the sample + spike concentration. This is a deviation from the CLP protocol which calls for correcting the sample + spike concentration for just those samples where the sample concentration was above the IDL. This deviation was implemented to avoid biasing the cyanide recovery by the high IDL values we obtained in our quarterly IDL study. We thus prevented the reporting of high spike recovery values obtained where cyanide concentrations were detectable in the sample but were below the arbitrary IDL.

Recovery of cyanide for initial calibration verification sample (ICV-6) was 105.9% with a standard deviation of 5.6%. Recovery value for ICV-6 is based on the spiking of 1 mL of stock standard ICV-6 to 500 mL of deionized water and recovery back calculated to the original ICV-6 cyanide concentration. Cyanide found in blanks analyzed in the work package were below the stated IDL.

TABLE 2: TOTAL CYANIDE ANALYSIS DATA (WATER SAMPLES)

Sample ID#	PNL Log#	G1 Sample (ug/L)	C	G2 Sample dup. (ug/L)	C	%RPD	G5 Blank (ug/L)	C	G3 Sample+ spike (ug/L)	G4 - ICV (mg/L)	G3 Sample+ spike recovery (%)	G4 - ICV sample recovery (%)	Flags Q	Footnote#
B000L4	90-7080	5.9	U	5.9	U	N/A	5.9	U	89.9	9.98	98.7	106.2		1,2,3,4,5 (All)
B00F08	90-7081	5.9	U											
B00F11	90-7082	17.8		17.1		4	5.9	U	113.6	11.39	105.7	121.2		6
B000Z1	90-7079	25.8												
B00F14	90-7083	5.9	U	5.9	U	N/A	5.9	U	91.3	10.63	101	113.1		
B00F21	90-7084	5.9	U											
B00F30	91-1691	5.9	U	5.9	U	N/A	5.9	U	92.1	9.72	101	103.4		
B00F33	91-1692	5.9	U											
B00F36	91-1693	5.9	U	5.9	U	N/A	5.9	U	90	9.65	101.3	102.7		
B00F43	91-1803	5.9	U											
B000K8	90-7067	5.9	U	5.9	U	N/A	5.9	U	91.6	9.97	99.8	106.1		6
B00F46	91-1787	5.9	U											
B00F49	91-1788	5.9	U	5.9	U	N/A	5.9	U	91.1	9.81	99.9	104.4		
B00F81	91-2398	5.9	U											
B00F58	91-1804	5.9	U	5.9	U	N/A	5.9	U	97.4	9.83	103.3	104.6		
B00FF4	91-1805	5.9	U											
B00F52	91-1822	5.9	U	5.9	U	N/A	5.9	U	83.2	9.79	91.3	104.2		
B00F62	91-1823	5.9	U											
B00F65	91-1824	5.9	U	5.9	U	N/A	5.9	U	87.9	10.03	96.1	106.7		
B00FF7	91-1825	5.9	U											
B00FG0	91-2396	5.9	U	5.9	U	N/A	5.9	U	85.4	9.81	93.5	104.4		
B00F71	91-2397	5.9	U											
B00FG3	91-2399	6.3	B	5.9	U	N/A	5.9	U	97.6	9.64	100.9	102.5		
B00FC7	91-2456	5.9	U	5.9	U	N/A	5.9	U	94.1	9.11	102.8	96.9		
B00F87	91-2457	5.9	U											
										Mean	99.6	105.9		

1. Concentration of stock ICV-6 = 9.4 mg/L (In actual practice 9.4 ug of cyanide is added to each distillation flask and recovered in 250 mL of NaOH).
2. Concentration of spike added = 90.6 ug/L.
3. Contract required detection limit for water = 10 ug/L.
4. Used 250 mL of sample per distillation due to limited sample size of 1.5L of total sample.
5. Duplicate precision under the CLP protocol must be within one CRDL when either sample or duplicate are below 5X CRDL.
6. Sample 90-7067 and 90-7079 not part of data set #2 of task 7.

CLP Flags

U = Analyzed but not detected (ICL or less than IDL)
N = Spiked sample recovery not within control limits
* = Duplicate analysis not within control limits

FREE CYANIDE ANALYSIS RESULTS

Free cyanide analysis was not done as samples must have a total cyanide concentrations of greater than 20 µg/L before free cyanide analysis is required.

Table 3: Free Cyanide Analysis Data

NO DATA REQUIRED

COMPLEX CYANIDE RESULTS

Complex cyanide can not be determined from the existing total cyanide data as no free cyanide results were required.

Table 4: Complex Cyanide Determination

NO DATA REQUIRED

9613477.2797

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-11-91	Time	1115
Sample Locations	200-BP-1				
Ice Chest No.	Crosby	Field Logbook and Page No.	WHC-N-4461/pg. 18		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F G0

1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3-11-91 1655
Relinquished by: P.H. Butcher P.H. Butcher	Received by: Karl Pool	Date/Time: 3-13-91 1405
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-11-91	Time	1130
Sample Locations	200-BP-1				
Ice Chest No.	Crosby	Field Logbook and Page No.	WHC-N-4461 / pg. 18		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand delivered				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00F71
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D Walker	Received by: P H Hutchor P H Butcher	Date/Time: 3-11-91 1650
Relinquished by: P H Butcher P H Butcher	Received by: Karl Pool	Date/Time: 3/13/91 1405
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2799

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-11-91	Time	0800
Sample Locations	200-BP-1				
Ice Chest No.	Cross 1	Field Logbook and Page No.	WHC-N-4461 / Pg. 18		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F81
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / L.D. Walker	Received by: P.H. Butcher / P.H. Butcher	Date/Time: 3/11/91 1645
Relinquished by: P.H. Butcher / P.H. Butcher	Received by: Karl Pool	Date/Time: 3/13/91 1405
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9615472.2500

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-11-91	Time	1415
Sample Locations	200-BP-1				
Ice Chest No.	Crosby	Field Logbook and Page No.	WHC-N-4461 / pg. 18		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand delivery				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F63

1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3-11-91 1700
Relinquished by: P.H. Butcher P.H. Butcher	Received by: Karl Pool	Date/Time: 3-13-91 1405
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

B01-005

9613427.2001

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-11-91	Time	1115
Sample Locations	200-BP-1				
Ice Chest No.	Crosby	Field Logbook and Page No.	WHC-N-4461 / pg. 18		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00FG0

2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3-11-91 1655
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/13/91 2:39
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9215477.2902

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-11-91	Time	1130
Sample Locations	200-BP-1				
Ice Chest No.	Crosby	Field Logbook and Page No.	WHC-N-4461 / Pg. 18		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand delivery				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.H. Butcher	Date/Time: 3-11-91 1650
Relinquished by: P.H. Butcher	Received by: J. ROBBINS	Date/Time: 3/13/91 2:40
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.3813

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-11-91	Time	0800
Sample Locations	200-BP-1				
Ice Chest No.	Crosby	Field Logbook and Page No.	WHC-N-4461 / pg. 18		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F81
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D Walker	Received by: P.H. Butcher P.H Butcher	Date/Time: 3/11/91 1645
Relinquished by: P.H. Butcher P.H Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/13/91 3:40
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2804

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-11-91	Time	1415
Sample Locations	200-BP-1				
Ice Chest No.	Cooler	Field Logbook and Page No.	WHC-N-4461 / pg. 18		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Delivered				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00FG3

2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3-11-91 1700
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/13/91 3:40
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9213477.2305

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

lector J D Walker Date Sampled *** Time ____ hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested	***
B00 FG0	1, 1L, P	W	Free Cyanide	3/11/91
B00 F71	1, 1L, P	W	Free Cyanide	3/11/91
B00 F81	1, 1L, P	W	Free Cyanide	3/11/91
B00 FG3	1, 1L, P	W	Free Cyanide	3/11/91

Field Information** ____

Special Handling and/or Storage ____

Possible Sample Hazards ____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 3/13/91

A ysis Required ____

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

B01-010

9813477.2006

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

ector L D Walker Date Sampled 3/11/91 Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 F60	2, 1L, P	W	Total Cyanide
B00 F71	2, 1L, P	W	Total Cyanide
B00 F81	2, 1L, P	W	Total Cyanide
B00 F63	2. 1L, P	W	Total Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by J. ROBBINS Title Sr. RESEARCH SCIENTIST Date 3/13/91

Analysis Required TOTAL CYANIDE

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

**Use back of page for additional information relative to sample location.

B01-011

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 3/13/91 1405

Received by: K. H. Pool

Customer Sample Number(s): B00FG0, B00F71, B00F81, B00FG3

ALO Sample Number(s): 91-2396 91-2397 91-2398 91-2399

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Good condition, T = 2.5°C

6. Condition of Sample Vials.

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 3/13/91 2:40

Received by: J. ROBBINS

Customer Sample Number(s): B00FG3, B00F81, B00F71, B00FG0

ALO Sample Number(s): 91-2396, 91-2397, 91-2398, 91-2399

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   Sample analysis request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: INTACT

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).
   5°C

6. Condition of Sample Vials.
   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.
   OK

8. Resolution of Problems or Discrepancies.
   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/6/91	Time	1000
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 15		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand delivered				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00FF7

2, 1L, P, WATER, TOTAL CYANIDE
1, 4L, P, Water, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / P.H. Butcher	Received by: P.H. Butcher	Date/Time: 3/6/91 1800
Relinquished by: P.H. Butcher	Received by: P.A. Kagel (1)	Date/Time: 1432 3/7/91
Relinquished by: P.H. Butcher	Received by: J. ROBBINS / J. Robbins	Date/Time: 3/7/91 3:20
Relinquished by:	Received by:	Date/Time:

Comments: (1) 1 - 4L poly bottle for Ru106
2) 2 - 1L " for Total CN

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/5/91	Time	~~10~~ 1020
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461/pg.14		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

LW 3/5/91

SAMPLE IDENTIFICATION

B00 F52

2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3/5/91 1715
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/7/91 3:20
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/6/91	Time	1215
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461/pg.15		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00F62
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3-6-91 1755
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/7/91 3:20
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/6/91	Time	1445
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 15		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F65
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3-6-91 1755
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/7/91 3:20
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/6/91	Time	1000
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 15		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand delivered				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00FF7

2, 1L, P, WATER, TOTAL CYANIDE
1, 4L, P, Water, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / L.D. Walker	Received by: P.H. Butcher / P.H. Butcher	Date/Time: 3/6/91 1800
Relinquished by: P.H. Butcher / P.H. Butcher	Received by: R.A. Kogel (1)	Date/Time: 1432 3/7/91
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Comments: (1) 1 - 4L poly bottle for Ru106
2)

9613477.2814

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/6/91	Time	1000
Sample Locations	200-BP-1				
Ice Chest No.	Simms	Field Logbook and Page No.	WHC-N-4461 / pg. 15		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand delivered				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 FF7

1, 1L, P, WATER, FREE CYANIDE

~~1, 4L, P, water, Ru-106~~ PNL 3/7/91

CHAIN OF POSSESSION

Relinquished by: LD Walker LD Walker	Received by: PH Butcher PH Butcher	Date/Time: 3-6-91 1800
Relinquished by: PH Butcher PH Butcher	Received by: Karl Pool	Date/Time: 3-7-91 1500
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/6/91	Time	1445
Sample Locations	200-BP-1				
Ice Chest No.	Simson	Field Logbook and Page No.	WHC-N-4461 / pg. 15		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand delivered				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00F65
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P H Butcher	Date/Time: 3-6-91 1755
Relinquished by: P.H. Butcher P H Butcher	Received by: Karl Pool	Date/Time: 3-7-91 1500
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2816

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/6/91	Time	1215
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 15		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00F62
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: P H Butcher P H Butcher	Date/Time: 3-6-91 1755
Relinquished by: P H Butcher P H Butcher	Received by: Karl Pool	Date/Time: 3-7-91 1500
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2817

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-5-91	Time	1020
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / Pg. 14		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F52

1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P H Butcher P H Butcher	Date/Time: 3-5-91 1715
Relinquished by: P H Butcher P H Butcher	Received by: Karl Pool	Date/Time: 3-7-91 1500
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

B01-022

9615977.2818

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

ector L Walker Date Sampled *** Time _____ hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested	***
B00 F52	1, 1L, P	W	Free Cyanide	3/5/91
B00 F62	1, 1L, P	W	Free Cyanide	3/6/91
B00F65	1, 1L, P	W	Free Cyanide	3/6/91
B00FF7	1, 1L, P	W	Free Cyanide	3/6/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 3/7/91

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

9613477.2819

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

ector _____ Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 F52	2, 1L, P	W	Total Cyanide
B00 F62	2, 1L, P	W	Total Cyanide
B00 F65	2, 1L, P	W	Total Cyanide
B00 FF7	2, 1L, P	W	Total Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by J. Robbins Title Sr. RES SCIENTIST Date 3/7/91

Analysis Required TOTAL CN

*Indicate whether sample is soil, sludge, water, etc. B01-024

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

9613127 2920

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled 3/6/91 Time 1000 hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 FF7	1, 4L, P	W	Ru-106
	~~3, 1L, P~~	~~W~~	~~Total Cyanide, Free Cyanide~~ PRS 3/7/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Elwood Kopel Title Sr. Tech Spec. Date 3/7/91

Analysis Required Ru-106

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

B01-025

SAMPLE RECEIPT FORM

Delivered by: PH Butcher Date/Time: 3/7/91 1432

Received by: E A Lepel

Customer Sample Number(s): B00FF7

ALO Sample Number(s): _____

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list): WHC Sample Analysis Request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: NA

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   NA

6. Condition of Sample Vials. NA

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. Note: Sample collection for Ru 106 3/6/91 @ 1606

8. Resolution of Problems or Discrepancies.

   NA

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 3/7/91 1500

Received by: Karl H. Pool

Customer Sample Number(s): B00F52, B00F62, B00F65, B00FF7

ALO Sample Number(s): _____

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact.

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Good condition T=1.5°C

6. Condition of Sample Vials.

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 3/7/91 1520

Received by: J. ROBBINS

Customer Sample Number(s): B00F52, B00F62, B00F65, B00FF7

ALO Sample Number(s): 91-1822, 91-1823, 91-1824, 91-1825

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: INTACT

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   OK 3°C

6. Condition of Sample Vials.

   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. OK

8. Resolution of Problems or Discrepancies.

   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-5-91	Time	1315
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 14		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F58
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.H. Butcher	Date/Time: 3-5-91 1715
Relinquished by: P.H. Butcher	Received by: 3/6/91 J. ROBBINS	Date/Time: 3/6/91 1:30
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/5/91	Time	15/15
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 14		
Remarks	n/a				
Bill of Lading No.	n/a	Offsite Property No.	n/a		
Method of Shipment	Hand deliver				
Shipped to	BATTELLE				

SAMPLE IDENTIFICATION

B00FF3
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3-5-91 1710
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/6/91 1:30
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Westinhouse Hanford Company

CHAI JF CUSTODY

Company Contact B. H. Ford Telephone 509-376-6465

ple Collected by L.D. Walker Date 3/4/91 Time 1100

S. le Locations

Ice Chest No. Simon Field Logbook and Page No. WHC-N-4461 / pg. 13

Remarks N/A

Bill of Lading No. N/A Offsite Property No. N/A

Method of Shipment Hand deliver

Shipped to PNL / 325 bldg

Sample Identification

B00F43

2, 1L, P, Water, Total Cyanide

N A

N A

Chain of Possession

Relinquised by: L. D. Walker L.D. Walker	Received by: P H Butcher P H Butcher	Date/Time: 3-4-91 1710
Relinquised by: P H Butcher P H Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/6/91 1:30
Relinquised by:	Received by:	Date/Time:
Rel ilised by:	Received by:	Date/Time:

A-6000-407 (07/89)

B01-031

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3-5-91	Time	1315
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 14		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F58
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / L.D. Walker	Received by: P.K. Butcher / P.K. Butcher	Date/Time: 3-5-91 1715
Relinquished by: P.K. Butcher / P.K. Butcher	Received by: Karl Pool	Date/Time: 3/6/91 1315
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/5/91	Time	1515
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / Pg. 14		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	BATTELLE				

SAMPLE IDENTIFICATION

LW 3-5-91

B00FF3 4
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3/5/91 1710
Relinquished by: P.H. Butcher P.H. Butcher	Received by: Karl Pool	Date/Time: 3/6/91 1315
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Westinghouse Hanford Company

CHAIN OF CUSTODY

Company Contact ~~L Walker~~ B H Ford Telephone 6-6465

Sample Collected by L Walker Date 3/4/91 Time 1100

Sample Locations

Ice Chest No. Simon Field Logbook and Page No. WHC-N-4461 pg 13

Remarks N/A

Bill of Lading No. N/A Offsite Property No. N/A

Method of Shipment Hand deliver

Shipped to PNL / 314 bldg

Sample Identification

B00F43

1, 1L, P, Free Cyanide

N/A

N/A

Chain of Possession

Relinquished by:	Received by:	Date/Time:
L.D. Walker	P H Butcher	3-4-91 1710
P H Butcher	Karl Pool	3/6/91 1315

A-6000-107 (07/89)

B01-034

9615477.2030

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. Walker Date Sampled *** Time _____ hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested	***
B00 F58	1, 1L, P	W	Free Cyanide	3/5/91
B00 FF4	1, 1L, P	W	Free Cyanide	3/5/91
~~B00F43~~				
B00F43	1, 1L, P	W	Free Cyanide	3/4/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Carl Pool Title Senior Research Scientist Date 3/6/91

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

B01-035

A-6000-406 (05/90)

9613477.2831

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

ector L Walker Date Sampled *** Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested ***
B00 F58	2, 1L, P	W	Total Cyanide 3/5/91
B00 FF3	2, 1L, P	W	Total Cyanide 3/5/91
B00 F43	2, 1L, P	W	Total Cyanide 3/4/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

eived by J. Robbins Title Sr. Res Scientist Date 3/6/91

Analysis Required TOTAL CYANIDE

*Indicate whether sample is soil, sludge, water, etc. B01-036

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 3/6/91 1315

Received by: K. H. Pool

Customer Sample Number(s): B00F43 B00F58 B00FF4

ALO Sample Number(s): ~~91-108~~ 1803 91-1804 91-1805
KP 3/6/91

1. Customer Chain-of-Custody Form: Present X Absent_____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent_____

   If Present, Condition: Intact

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) A. O. K. Temp = 4.0°C

6. Condition of Sample Vials.

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 3/6/91 1:30

Received by: J. ROBBINS

Customer Sample Number(s): BØØF43, BØØF58, BØØFF4

ALO Sample Number(s): 91-1803, 91-1804, 91-1805

1. Customer Chain-of-Custody Form: Present ✓ Absent_____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent_____

   If Present, Condition: INTACT

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   OK 1°C

6. Condition of Sample Vials.

   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

   OK

8. Resolution of Problems or Discrepancies.

   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

9613477.2834

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/4/91	Time	1300
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 13		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F46
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.A. Butcher P.A. Butcher	Date/Time: 3/4/91 1715
Relinquished by: P.A. Butcher P.A. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/5/91 1420
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/4/91	Time	1500
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 13		
Remarks	n/A				
Bill of Lading No.	n/A	Offsite Property No.	n/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00F49

2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: LD Walker LD Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 3-4-91 1715
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/5/91 1420
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector _____ Date Sampled _____ Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00F46	2, 1L, P	W	Total Cyanide
B00F49	2, 1L, P	W	Total Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

ived by J. Robbins Title Sr. Research Scientist Date 3/5/91

Analysis Required TOTAL CN

*Indicate whether sample is soil, sludge, water, etc. B01-041

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/4/91	Time	1300
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 13		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F46
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: A D Walker L.D. Walker	Received by: P.H. Butcher P H Butcher	Date/Time: 3/4/91 1715
Relinquished by: P.H. Butcher P H Butcher	Received by: Karl Prok	Date/Time: 3/5/91 1405
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2960

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	3/4/91	Time	1500
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 13		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F49

1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.H. Butcher	Date/Time: 3/4/91 1720
Relinquished by: P.H. Butcher	Received by: Karl Pool	Date/Time: 3/5/91 1405
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9618427.2059

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

ector _____ Date Sampled _____ Time _____ hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00 F46	1, 1L, P	W	Free Cyanide
B00 F49	1, 1L, P	W	Free Cyanide

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date 3/5/91

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

B01-044

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: _____

Received by: Karl H. Pool

Customer Sample Number(s): B00F46 B00F49

ALO Sample Number(s): 91-1787 91-1788

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Good condition T= 4.0°C

6. Condition of Sample Vials.

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 3/5/91 1420

Received by: J. ROBBINS

Customer Sample Number(s): B00F46 B00F49

ALO Sample Number(s): 91-1787 91-1788

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: _____

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   GOOD 10°C

6. Condition of Sample Vials.

   OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

   OK

8. Resolution of Problems or Discrepancies.

   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

9615127.2842

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/27/91	Time	1500
Sample Locations	200-BP-1				
Ice Chest No.	West 2	Field Logbook and Page No.	WHC-N-4461 / Pg. 11		
Remarks	N/A.				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F11
2, 1L, P, WATER, TOTAL CYANIDE
pmd 3/1/91
1, 4L, P, Water, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.K. Butcher P.K. Butcher	Date/Time: 2/27/91 1745
Relinquished by: P.K. Butcher P.K. Butcher	Received by: E.A. Lopez	Date/Time: 3/4/91 1055
Relinquished by: P.K. Butcher P.K. Butcher	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

Comments: 1) Received 1 - 1 Gallon bottle for Ru-106 Analysis E.A. Lopez

2)

B01-047

9613477.2843

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/26/91	Time	1130
Sample Locations	200-BP-1				
Ice Chest No.	West 2	Field Logbook and Page No.	WHC-N-4461 / pg.9		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

800 DL4
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker	Received by: P H Luther P H Luther	Date/Time: 2/26/91 1645
Relinquished by: P H Luther P H Luther	Received by: J. ROBBINS J. Robbins	Date/Time: 3/4/91 1135
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2844

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/26/91	Time	1430
Sample Locations	200-BP-1				
Ice Chest No.	West 2	Field Logbook and Page No.	WHC-N-4461 / Pg. 9		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00F08
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.H. Butcher	Date/Time: 2/26/91 1640
Relinquished by: P.H. Butcher	Received by: J. ROBBINS	Date/Time: 3/4/91 1135
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2845

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/27/91	Time	1500
Sample Locations	200-BP-1				
Ice Chest No.	West 2	Field Logbook and Page No.	WHC-N-4461 / pg. 11		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00 F11
2, 1L, P, WATER, TOTAL CYANIDE
and 3/4/91
1, 4L, P, Water, Ru-106

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 2/27/91 1745
Relinquished by: P.H. Butcher P.H. Butcher	Received by: E.A. Lopez E.A. Lopez	Date/Time: 3/4/91 1055
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/4/91 1135
Relinquished by:	Received by:	Date/Time:

Comments: 1) Received 1 - 1 Gallon bottle for Ru-106 Analysis E.A. Lopez
2) Received 2, 1L bottle for total cyanide

9613477.2846

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/27/91	Time	1445
Sample Locations	200-BP-1				
Ice Chest No.	West 2	Field Logbook and Page No.	WHC-N-4461 / P.9.11		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00F14
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 2/27/91 1735
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/4/91 1135
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2847

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/27/91	Time	1230
Sample Locations	200-BP-1				
Ice Chest No.	West 2	Field Logbook and Page No.	WHC-N-4461 / Pg. 11		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

800 F21
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 2/27/91 1730
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/4/91 1135
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2648

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/28/90	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.	West 2	Field Logbook and Page No.	WHC-N-4461 / pg. 12		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00F30
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 2/28/91 1630
Relinquished by: P.H. Butcher P.H. Butcher	Received by: J. ROBBINS J. Robbins	Date/Time: 3/4/91 1135
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/28/91	Time	1230
Sample Locations	200-BP-1				
Ice Chest No.	West 2	Field Logbook and Page No.	WHC-N-4461 /pg.12		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

B00F33
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.H. Butcher	Date/Time: 2/28/91 1635
Relinquished by: P.H. Butcher	Received by: J. ROBBINS	Date/Time: 3/4/91 1135
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2850

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/28/91	Time	1430
Sample Locations	200-BP-1				
Ice Chest No.	West 2	Field Logbook and Page No.	WHC-N-4461 / pg. 12		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand Deliver				
Shipped to	Battelle Northwest/ PNL 325 Laboratory				

SAMPLE IDENTIFICATION

800 F36
2, 1L, P, WATER, TOTAL CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: P.H. Butcher	Date/Time: 2/28/91 1630
Relinquished by: P.H. Butcher	Received by: V. ROBBINS	Date/Time: 3/4/91 1135
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2851

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/28/91	Time	1430
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / Pg. 12		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00 F36
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P H Butcher P H Butcher	Date/Time: 2-28-91 1630
Relinquished by: P H Butcher P H Butcher	Received by: Carl Pool	Date/Time: 3/4/91 1110
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2852

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/28/91	Time	1230
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 12		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL 314 Laboratory				

SAMPLE IDENTIFICATION

B00F33
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 2/28/91 1635
Relinquished by: P.H. Butcher P.H. Butcher	Received by: Karl Pool	Date/Time: 3/4/91 1110
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2853

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/28/91	Time	1100
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 12		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 314 PTB 3/4/91 Laboratory				

SAMPLE IDENTIFICATION

B00F30
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L D Walker L.D. Walker PH Butcher	Received by: PH Butcher P H Butcher	Date/Time: 2/28/91 1630
Relinquished by: P H Butcher	Received by: J Carl Pool	Date/Time: 3/4/91 1110
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2854

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/27/91	Time	1230
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 11		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand delivered				
Shipped to	Battelle Northwest/ PNL ~~325~~ 314 PH 3/4/91 Laboratory				

SAMPLE IDENTIFICATION

B00 F21
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker	Received by: PH Butcher	Date/Time: 2/27/91 1730
Relinquished by: PH Butcher	Received by: Karl Pool	Date/Time: 3/4/91 1110
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

B01-059

9613472.2855

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/27/91	Time	1445
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 11		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 319 PHB 3/4/91 Laboratory				

SAMPLE IDENTIFICATION

B00 F14
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: P.H. Butcher P.H. Butcher	Date/Time: 2/27/91 1735
Relinquished by: P.H. Butcher P.H. Butcher	Received by: Karl Pool	Date/Time: 3/4/91 1110
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2856

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/27/91	Time	1500
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 11		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 314 MAB 3/4/91 Laboratory				

SAMPLE IDENTIFICATION

B00 F11
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / L.D. Walker	Received by: P.H. Butcher / P.H. Butcher	Date/Time: 2/27/91 1750
Relinquished by: P.H. Butcher / P.H. Butcher	Received by: Karl Pool	Date/Time: 3/4/91 1110
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2/26/91	Time	1430
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461/p99		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 317 PTHB 3/4/91 Laboratory				

SAMPLE IDENTIFICATION

B00F08
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker L.D. Walker	Received by: PHButcher PHButcher	Date/Time: 2/26/91 1640
Relinquished by: PHButcher PHButcher	Received by: Karl Pool	Date/Time: 3/4/91 1110
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2858

CHAIN OF CUSTODY

Company Contact	B.H. FORD	Telephone	509-376-6465		
Sample Collected by	L. WALKER	Date	2-26-91	Time	1130
Sample Locations	200-BP-1				
Ice Chest No.	Simon	Field Logbook and Page No.	WHC-N-4461 / pg. 9		
Remarks	N/A				
Bill of Lading No.	N/A	Offsite Property No.	N/A		
Method of Shipment	Hand deliver				
Shipped to	Battelle Northwest/ PNL ~~325~~ 3L4 and 314/91 Laboratory				

SAMPLE IDENTIFICATION

B00 D24
1, 1L, P, WATER, FREE CYANIDE

CHAIN OF POSSESSION

Relinquished by: L.D. Walker / L.D. Walker	Received by: P.H. Butcher / P.H. Butcher	Date/Time: 2/26/91 1650
Relinquished by: P.H. Butcher / P.H. Butcher	Received by: Karl Pool	Date/Time: 3/4/91 1110
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:

9613477.2059

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L Walker Date Sampled *** Time _____ hours

Company Contact B H Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested	***
B00D24	1, 1L, P	W	Free Cyanide	2/26/91
B00F08	1, 1L, P	W	Free Cyanide	2/26/91
B00F11	1, 1L, P	W	Free Cyanide	2/27/91
B00F14	1, 1L, P	W	Free Cyanide	2/27/91
B00F31	1, 1L, P	W	Free Cyanide	2/27/91
B00F30	1, 1L, P	W	Free Cyanide	2/28/91
B00F33	1, 1L, P	W	Free Cyanide	2/28/91
B00F36	1, 1L, P	W	Free Cyanide	2/28/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by Karl Pool Title Senior Research Scientist Date March 4, 1991

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

A-6000-406 (05/90)

9615477.2860

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L. D. Walker Date Sampled 2/27/91 Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested
B00F11	1, 4L, P	W	Ru-106
~~_____~~	~~3, 1L, P~~	~~W~~	~~Total Cyanide, Free Cyanide~~ PNL 3/4/91

Field Information** _____

_____

_____

Special Handling and/or Storage _____

_____

Possible Sample Hazards _____

_____

PART II: LABORATORY SECTION

Received by _____ Title _____ Date _____

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

B01-065

A-6000-406 (05/90)

9613477.2861

Westinghouse Hanford Company

SAMPLE ANALYSIS REQUEST

PART I: FIELD SECTION

Collector L Walker Date Sampled *** Time _____ hours

Company Contact B. H. Ford Telephone (509) 376-6465

Sample Number	Number and Type of Sample Containers	Type of Sample*	Analysis Requested	***
B00D24	2, 1L, P	W	Total Cyanide	2/26/91
B00F08	2, 1L, P	W	Total Cyanide	2/26/91
B00F11	2, 1L, P	W	Total Cyanide	2/27/91
B00F14	2, 1L, P	W	Total Cyanide	2/27/91
B00F21	2, 1L, P	W	Total Cyanide	2/27/91
B00F30	2, 1L, P	W	Total Cyanide	2/28/91
B00F33	2, 1L, P	W	Total Cyanide	2/28/91
B00F36	2, 1L, P	W	Total Cyanide	2/28/91

Field Information** _____

Special Handling and/or Storage _____

Possible Sample Hazards _____

PART II: LABORATORY SECTION

Received by _____ Title _____ Date _____

Analysis Required _____

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

**Use back of page for additional information relative to sample location.

B01-066

A-6000-406 (05/90)

SAMPLE RECEIPT FORM

Delivered by: P H Butcher Date/Time: 3/4/91 10:55

Received by: E A Lepel

Customer Sample Number(s): B00F11 (B)

ALO Sample Number(s): _____

1. Customer Chain-of-Custody Form: Present ✓ Absent _____

2. Additional Shipping Forms (list):
   Sample Analysis Request

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present ✓ Absent _____

   If Present, Condition: OK

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes: ✓

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   NA

6. Condition of Sample Vials. 1 gallon bottle – OK

7. Verification of Agreement or Nonagreement of Information on Receiving Documents. OK

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: Dusty Butcher Date/Time: 3/4/91 1110

Received by: K. H. Pool

Customer Sample Number(s): B00DL4 (90-7080); B00F08 (90-7081),

~~ALO Sample Number(s)~~: B00F11 (90-7082), B00F14 (90-7083) B00F21 (90-7084
B00F30 (91-1691); B00F33 (91-1692), B00F36 (91-1693)

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: Intact

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (i,e., broken container, dented, breached plastic bag, temperature of sample container as defined in Section 3.0 in PNL-ALO-051, etc.) Good condition, T = 1.7°C

6. Condition of Sample Vials. N/A

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

8. Resolution of Problems or Discrepancies.

RETURN COMPLETED FORM TO PROJECT MANAGER

SAMPLE RECEIPT FORM

Delivered by: DUSTY BUTCHER Date/Time: 3/4/91 11:35

Received by: JAMES ROBBINS

Customer Sample Number(s): B0D1-11 (90-7082) B00F14 (90-7083)

ALO Sample Number(s): B00F21 (90-7084), B00F30 (91-1691), B00F33 (91-1692), B00F36 (91-1693), B00DL4 (90-7080), B00F08 (90-7081)

1. Customer Chain-of-Custody Form: Present X Absent _____

2. Additional Shipping Forms (list):

3. Custody Seals on Shipping and/or Sample Containers and their Conditions.

   Present X Absent _____

   If Present, Condition: INTACT

4. Sample Tag(s) ID Numbers if not Recorded on the Chain-of-Custody Record or on Sample Vial.

   Notes:

5. Condition of Shipping Container (Verify that ice still exists such that samples are at refrigerated temperature).

   OK 2°C

6. Condition of Sample Vials.

   N/A

7. Verification of Agreement or Nonagreement of Information on Receiving Documents.

   OK

8. Resolution of Problems or Discrepancies.

   OK

RETURN COMPLETED FORM TO PROJECT MANAGER

Samples were delivered directly to the Analysts. Therefore, no PNL Chain of Custody forms were needed.

Science Applications International Corporation
An Employee-Owned Company

1144-PKB.92
October 12, 1992

Mr. Mark A. Buckmaster
Westinghouse Hanford Company
P.O. Box 1970, MSIN H4-55
Richland, WA 99352

Subject: Deliverable for 200-BP-1 Data Validation, Task Order S-92-19 Rev. D, WHC Contract No. MLW-SVV-073750

Dear Mr. Buckmaster:

Enclosed is the subject deliverable required by the referenced SAIC Task Order and WHC contract. Included in this deliverable, please find a copy of the Data Validation Summary Report for Data Package B00JF01-PNL-033. This deliverable was prepared by Golder Associates with support from Tom Clark of SAIC under the direction of Kent M. Angelos.

Should you have any questions, please do not hesitate to contact the following: Mr. Kent Angelos of Golder Associates at (206) 883-0777, Michael Hoxie or myself at (509) 943-3133.

Sincerely yours,

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

for

P. K. Brockman
Program Manager

PKB/mkc

Enclosures

cc w/encl:
B. Bechtold, WHC
LB/Task S-92-19 Deliv File

cc w/o encl:
R. Henckel, WHC
D. Martin, Albq
D. Wilson, WHC

cc: w/encl (including original data package):
D. Leech, WHC

5-28-96
MC

Report To

Westinghouse Hanford Company
Richland, Washington

Radiochemistry
Data Limitations and Validation Report 3
200-BP-1 RI/FS

Laboratory: Battelle-Pacific Northwest Laboratory
Data Package: B00F01-PNL-033
HEIS Sample Numbers: B00F01, B00F11, B00FF7
B00FB3, B00F93, B00FB0, B00F54, B00FD0,
B00F90, B00FB6, B00FC4, B00FG4

Prepared By

Golder Associates Inc.
Redmond, Washington

October 6, 1992

913-1719

TABLE OF CONTENTS

LIST OF APPENDICES

1. INTRODUCTION

This report presents the results of data validation on data package B00F01-PNL-033. The samples contained in this data package were analyzed for ruthenium-106 (Ru-106) by the Battelle-Pacific Northwest Laboratories of Richland, Washington.

The table presented below provides a cross reference list of sample delivery group (SDG) numbers, HEIS numbers and laboratory sample identification numbers.

SDG	HEIS No.	LAB No.
B00F01-PNL-033	B00F01	90-7074
	B00F11	90-7082
	B00FF7	91-1825
	B00FB3	91-2707
	B00F93	91-2708
	B00FB0	91-2709
	B00F54	91-2710
	B00FD0	91-2711
	B00F90	91-2781
	B00FB6	91-2859
	B00FC4	91-2860
	B00FG4	91-2862

Data validation was conducted in accordance with the Westinghouse Hanford Company statement of work (WHC 1991), validation procedures (WHC 1992) and the laboratory technical procedure, PNL-ALO-471 (PNL 1991). Data verification was conducted by comparison of the reported results against the raw data and laboratory worksheets provided in the data packages, discrepancies noted were corrected on the laboratory report forms provided in Appendix A. Sample results and lower limit of detection (LLD) values were calculated using computer spreadsheet models based on the formulae provided in the laboratory procedure. Printouts of the spreadsheet data are provided in Appendix B along with a description of the formulae used for recalculation. Data validation was documented using a checklist prepared according to the requirements listed in the validation procedures (WHC 1992). Copies of the checklists are provided in Appendix C.

Qualifiers assigned to the sample data as a result of the validation are explained below:

U The constituent was analyzed for, but was not detected above the Lower Limit of Detection (LLD).

UJ The constituent was analyzed for, but it's absence (non-detection) is estimated and may be inaccurate or imprecise.

UR The constituent was analyzed for but was not detected above the Lower Limit of Detection. The associated result is conditionally rejected pending submittal of

additional information.

J The associated value is an estimated quantity and may not represent the amount actually present in the sample.

R The associated value is unusable due to a major deficiency identified during validation.

R* The constituent was analyzed for and detected. The associated result is conditionally rejected pending submittal of additional information.

Abbreviations used in the laboratory data summary tables and calculation spreadsheets are summarized below.

NR Not reported by the laboratory.
NA Not applicable.

2. DATA QUALITY OBJECTIVES

This section provides a summary of data quality indicators as compared to the work plan data quality objectives.

2.1 Detection Limits

Work plan detection limit goals were met for all samples and analytical parameters with the exception of the results listed in the table below.

ANALYSIS	SAMPLES	DETECTION LIMIT GOAL	CALCULATED LLD
Ruthenium-106	B00F01 B00FB3 B00FB6	3 pCi/L	4.6 3.1 3.5

2.2 Accuracy

Two replicate blank spike samples were analyzed as part of this data package and were used as detector control samples (PNL Nos. 90-7074-L-3 and 90-7074-L-6). The percent recoveries for both samples was 100%. No other spike samples were analyzed as part of this data set, therefore the spike recoveries may not represent recovery of Ru-106 from the sample matrix.

2.3 Precision

Two blank spike samples and one set of field duplicate samples (HEIS Nos. B00FC4 and B00FG4) were analyzed as part of this data set. Precision of the blank spike samples as relative percent difference (RPD) was 0. Ru-106 was not detected in the field duplicate

samples therefore no RPD value could be determined.

2.4 Field Blanks

No field blanks were analyzed for this sample set for evaluation.

3. COMPLETENESS

The data package was complete for all necessary items required for validation with the exception of the items outlined in the sections below.

4. CALIBRATION

Calibration data was reported for the detector control samples only (blank spikes), as discussed in section 2.2. In addition, a series of check source analyses were reported for cesium-137 and cobalt-60 analyses only. No other check source analyses were conducted for ruthenium-106. Since all reported calibration analyses were within the laboratory control limits and the detector calibration requirements specified in the technical procedure were followed, no qualification is necessary.

5. BLANKS

Method blanks were not analyzed as part of this sample set, however no qualification of data was necessary since Ru-106 was not detected in any of the samples.

6. DETECTION LIMITS AND SAMPLE RESULTS

All sample and LLD result calculations were verified using the formulae provided in the laboratory technical procedure and no discrepancies were identified with the exception of one non-detect result reported for sample B00FG4. The result has been corrected on the laboratory report form provided in Appendix A.

7. RADIOMETRIC AND GRAVIMETRIC YIELDS

Two blank spike samples were analyzed as part of this group of samples and the results were acceptable, however, since actual project samples were not spiked, the results may not be representative of the sample matrices.

8. DUPLICATE ANALYSES

Field duplicate samples were analyzed as part of this group and ruthenium-106 was not detected in either sample.

9. LABORATORY CONTROL SAMPLES

Laboratory control samples were not analyzed as part of this sample group, however no qualification is necessary since Ru-106 was not detected in any of the samples.

10. HOLDING TIMES

All samples were analyzed within 180 days of collection as required by the data validation procedures.

11. CONCLUSIONS

Sections 1 through 10 present a summary of the data quality for the subject data packages. The results contained in this report are acceptable for use. The appendices provide the laboratory result reports and supporting documentation. The original, as-received data package is being transmitted for submittal to the project QA record.

12. REFERENCES

WHC, 1991, Westinghouse Hanford Company, Validation of 200-BP-1 Data, Statement of Work, Revision A, November 1991. Westinghouse Hanford Company, Richland, Washington.

WHC, 1992, Westinghouse Hanford Company, Data Validation Procedures for Radiochemical Analyses, WHC-SD-EN-SPP-001, Rev. 1, 1992. Westinghouse Hanford Company, Richland, Washington.

PNL, 1991, Battelle-Pacific Northwest Laboratory Technical Procedure: PNL-ALO-471, Determination of ^{106}Ru in Groundwater by Direct Counting on Dual Large Sodium Iodide Detectors with Coincidence/Anticoincidence Multidimensional Analysis.

APPENDIX A

AS QUALIFIED LABORATORY RESULT REPORTS

Table 2: Ru-^{106} Activity in Groundwater Samples for Task 7

Sample Set 1

MDA Detector 9

(Radionuclide activity in pCi/L)

Sample ID	LRB #	Collection Time	Count Time	Volume[a] (L)	^{106}Ru Activity
B00F01 90-7074-L-1	54100-008	2/20/91 11:30	3/18/91 19:36	3.500	<4.4
			5/10/91 18:02	3.500	<4.6
B00F01 90-7074-L-5	54100-007	3/29/91 12:00	3/31/91 23:23 ~~3/29/91 12:52~~	3.500	<1.1
			4/18/91 16:16	3.500	<2.1
B00F11 90-7082-L-1	54100-017	2/27/91 15:19	3/22/91 16:19	3.500	<1.3
B00FF7 91-1825-L-1	54100-018	3/6/91 16:06	4/1/91 13:52	3.500	<2.1
B00FB3 91-2707-L-1	54100-020	3/27/91 11:16	4/2/91 14:54	3.500	<3.1
B00F93 91-2708-L-1	54100-021	3/25/91 11:04	4/3/91 15:23	3.500	<3.0
B00FB0 91-2709-L-1	54100-022	3/25/91 14:04	4/4/91 14:00	3.500	<2.8
			5/17/91 15:29	3.500	<1.2
B00F54 91-2710-L-1	54100-023	3/25/91 11:16	4/9/91 14:32	3.500	<2.3
B00FD0 91-2711-L-1	54100-024	3/27/91 13:23	4/5/91 15:38:36 ~~15:39~~	3.500	<2.2
			5/15/91 16:31:44 ~~13:23~~	3.500	<2.1
B00F90 91-2781-L-1	54100-025	4/1/91 12:58	4/10/91 14:07	3.500	<3.0
B00FB6 91-2859-L-1	54100-026	4/3/91 13:54	4/11/91 16:31:53 ~~16:32~~	3.500	<3.5
B00FC4 91-2860-L-1	54100-027	4/4/91 13:24	4/12/91 15:18	3.500	<1.6
B00FG4 91-2962-L-1	54100-028	4/4/91 13:23	4/16/91 15:38	3.500	<2.4
			5/14/91 15:18 ~~5/10/91 11:30~~	3.500	~~<4.6~~ <1.9
90-7074-L-3	54124-2-1	3/18/91 12:00	3/21/91 18:09	3.500	5890 ± 60 pCi
90-7074-L-6	54124-2-2	3/18/91 12:00	3/27/91 15:10	3.500	5890 ± 40 pCi

[a]It is assumed the density of water is 1.00 kg/L.

The less than values presented above are Lower Limits of Detection (LLD) values calculated for a 95% confidence interval as described in HASL-300. The reported errors were 2 sigma counting errors.

10/6/92

TABLE 1: 200-BP-1 Sample Numbers

WHC Sample Number	PNL ALO Sample Number
B00F01	90-7074
B00F11	90-7082
B00FF7	91-1825
B00FB3	91-2707
B00F93	91-2708
B00FB0	91-2709
B00F54	91-2710
B00FD0	91-2711
B00F90	91-2781
B00FB6	91-2859
B00FC4	91-2860
B00FG4	91-2962

APPENDIX B

SAMPLE RESULT VERIFICATION SPREADSHEETS

This appendix contains constituent result verification and recalculation spreadsheet printouts conducted using Lotus 1-2-3. The accuracy of the formulae used in the calculations have been verified using hand calculation methods and no discrepancies were noted. The formulae used for recalculation are provided in the attached PNL technical procedure, PNL-ALO-471.

Date 10/4/92

HEIS NO: B00F01
PNL SAMPLE: 90-7074-L-1
TIME, ZERO: 2/20/91 11:30
TIME, COUNTED: 3/18/91 19:36
DECAY TIME: 37926
WT: 3.5
LT: 2997.74
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	6769	NET:	6233
BKGD:	536		
CO60, GROSS COUNTS:	224384	NET:	224288
BKGD:	96		
BI-214, GROSS COUNTS:	55340	NET:	54163
BKGD:	1177		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	54163	-	251.5015	-	53402.97	=	508.5256
TEMP. NET CO-60 =	224288	-	5.385286	-	14.21124	=	224268.4
TEMP. NET RU-106 =	6233	-	107.7362	-	6198.778	=	-73.5149

2ND ITERATION

TEMP. NET BI-214 =	54163	-	-2.96632	-	53398.30	=	767.6594
TEMP. NET CO-60 =	224288	-	8.129513	-	-0.16761	=	224280.0
TEMP. NET RU-106 =	6233	-	162.6363	-	6199.100	=	-128.736

3RD ITERATION

TEMP. NET BI-214 =	54163	-	-5.19452	-	53401.07	=	767.1174
TEMP. NET CO-60 =	224288	-	8.123773	-	-0.29351	=	224280.1
TEMP. NET RU-106 =	6233	-	162.5215	-	6199.103	=	-128.625

4TH ITERATION

TEMP. NET BI-214 =	54163	-	-5.19003	-	53401.10	=	767.0816
TEMP. NET CO-60 =	224288	-	8.123394	-	-0.29326	=	224280.1
TEMP. NET RU-106 =	6233	-	162.5139	-	6199.103	=	-128.617

FINAL ITERATION

BI-214 COMPTON FACTOR =	162.513911
CO-60 COMPTON FACTOR =	6199.10389
	==========
TOTAL COMPTON INTERF.	6361.6

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	6769
SYSTEM BKGR:	536
COMPTON INTERF.:	6361.61780
NET COUNTS:	-128.61780
D/C FACTOR:	259.97
LIVE TIME, MIN.:	2997.74
VOLUME:	3.5
DECAY TIME:	37926
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.050216

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY = -1.30E+0
RPTD ACTIVITY = -1.5
CALC. LLD = 4.53E+19 (4.66*9)/(CONVERSION FACTORS)
RPTD. LLD = 4 4

HEIS NO: B00F01
PNL SAMPLE: 90-7074-L-1
TIME, ZERO: 2/20/91 11:30
TIME, COUNTED: 5/10/91 18:02:28
DECAY TIME: 114152.4
WT: 3.5
LT: 3597.51
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	8315	NET:	7672
BKGD:	643		
CO60, GROSS COUNTS:	272232	NET:	272117
BKGD:	115		
BI-214, GROSS COUNTS:	67956	NET:	66543
BKGD:	1413		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	66543	-	309.5652	-	64791.05	=	1442.377
TEMP. NET CO-60 =	272117	-	15.27477	-	17.49216	=	272084.2
TEMP. NET RU-106 =	7672	-	305.5820	-	7520.408	=	-153.990

2ND ITERATION

TEMP. NET BI-214 =	66543	-	-6.21350	-	64783.25	=	1765.957
TEMP. NET CO-60 =	272117	-	18.70149	-	-0.35109	=	272098.6
TEMP. NET RU-106 =	7672	-	374.1357	-	7520.806	=	-222.942

3RD ITERATION

TEMP. NET BI-214 =	66543	-	-8.99572	-	64786.68	=	1765.307
TEMP. NET CO-60 =	272117	-	18.69460	-	-0.50830	=	272098.8
TEMP. NET RU-106 =	7672	-	373.9979	-	7520.811	=	-222.809

4TH ITERATION

TEMP. NET BI-214 =	66543	-	-8.99035	-	64786.72	=	1765.262
TEMP. NET CO-60 =	272117	-	18.69413	-	-0.50800	=	272098.8
TEMP. NET RU-106 =	7672	-	373.9885	-	7520.811	=	-222.799

FINAL ITERATION

BI-214 COMPTON FACTOR =	373.988578
CO-60 COMPTON FACTOR =	7520.81121
	==========
TOTAL COMPTON INTERF.	7894.8

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	8315
SYSTEM BKGR:	643
COMPTON INTERF.:	7894.79979
NET COUNTS:	-222.79979
D/C FACTOR:	259.97
LIVE TIME, MIN.:	3597.51
VOLUME:	3.5
DECAY TIME:	114152.466
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.158902

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY = -3.40138
PF'D ACTIVITY = -2.7
CALC. LLD = 4.640941 (4.66*S)/(CONVERSION FACTORS)
SPEC. LLD = 4.6

HEIS NO: B00F01
PNL SAMPLE: 90-7074-L-5
TIME, ZERO: 3/29/91 13:00
TIME, COUNTED: 3/31/91 23:23:26
DECAY TIME: 3503.433
WT: 3.5
LT: 3600.89
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	644	NET:	0
BKGD:	644		
CO60, GROSS COUNTS:	115	NET:	0
BKGD:	115		
BI-214, GROSS COUNTS:	1452	NET:	38
BKGD:	1414		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2351
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	38	-	0	-	0	=	38
TEMP. NET CO-60 =	0	-	0.40242	-	0	=	-0.40242
TEMP. NET RU-106 =	0	-	8.05068	-	-0.01112	=	-8.03955

2ND ITERATION

TEMP. NET BI-214 =	38	-	-0.32439	-	-0.09581	=	38.42021
TEMP. NET CO-60 =	0	-	0.406870	-	-0.01833	=	-0.38853
TEMP. NET RU-106 =	0	-	8.139706	-	-0.01073	=	-8.12896

3RD ITERATION

TEMP. NET BI-214 =	38	-	-0.32800	-	-0.09251	=	38.42051
TEMP. NET CO-60 =	0	-	0.406873	-	-0.01853	=	-0.38833
TEMP. NET RU-106 =	0	-	8.139770	-	-0.01073	=	-8.12903

4TH ITERATION

TEMP. NET BI-214 =	38	-	-0.32800	-	-0.09246	=	38.42047
TEMP. NET CO-60 =	0	-	0.406872	-	-0.01853	=	-0.38833
TEMP. NET RU-106 =	0	-	8.139760	-	-0.01073	=	-8.12902

FINAL ITERATION

BI-214 COMPTON FACTOR =	8.13976081
CO-60 COMPTON FACTOR =	-0.0107336
	==========
TOTAL COMPTON INTERF.	8.1

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	644
SYSTEM BKGR:	644
COMPTON INTERF.:	8.12902713
NET COUNTS:	-8.1290271
D/C FACTOR:	259.97
LIVE TIME, MIN.:	3600.89
VOLUME:	3.5
DECAY TIME:	3503.43333
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.004536

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY =	-0.07587
REPT ACTIVITY =	-0.077
CALC. LLD =	1.110735 (4.66*3)/(CONVERSION FACTORS)
REPT. LLD =	1.1

HEIS NO: B00F01
PNL SAMPLE: 90-7074-L-5
TIME, ZERO: 3/1/91 12:00
TIME, COUNTED: 4/16/91 16:16
DECAY TIME: 69376
WT: 3.5
LT: 1200.25
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	238	NET:	23
BKGD:	215		
CO60, GROSS COUNTS:	30	NET:	-8
BKGD:	38		
BI-214, GROSS COUNTS:	517	NET:	46
BKGD:	471		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	46	-	0.92805	-	-1.9048	=	46.97675
TEMP. NET CO-60 =	-8	-	0.497483	-	0.05244	=	-8.54992
TEMP. NET RU-106 =	23	-	9.952494	-	-0.23631	=	13.28382

2ND ITERATION

TEMP. NET BI-214 =	46	-	0.536002	-	-2.03573	=	47.49973
TEMP. NET CO-60 =	-8	-	0.503022	-	0.030287	=	-8.53330
TEMP. NET RU-106 =	23	-	10.06329	-	-0.23586	=	13.17256

3RD ITERATION

TEMP. NET BI-214 =	46	-	0.531513	-	-2.03178	=	47.50026
TEMP. NET CO-60 =	-8	-	0.503027	-	0.030033	=	-8.53306
TEMP. NET RU-106 =	23	-	10.06340	-	-0.23585	=	13.17244

4TH ITERATION

TEMP. NET BI-214 =	46	-	0.531508	-	-2.03172	=	47.50021
TEMP. NET CO-60 =	-8	-	0.503027	-	0.030033	=	-8.53306
TEMP. NET RU-106 =	23	-	10.06339	-	-0.23585	=	13.17245

FINAL ITERATION

BI-214 COMPTON FACTOR =	10.0633952
CO-60 COMPTON FACTOR =	-0.2352637
	==========
TOTAL COMPTON INTERF.	9.8

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	236
SYSTEM BKGR:	215
COMPTON INTERF.:	9.82754147
NET COUNTS:	13.1724585
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1200.25
VOLUME:	3.5
DECAY TIME:	69376
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.093766

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY = 14.1625
RPTD ACTIVITY = 0.396
CALC. LLD = 2.130421 (4.66*SQRT(CONVERSION FACTORS))
RPTD. LLD = 2.1

HEIS NO: B00F11
PNL SAMPLE: 90-7082-L-1
TIME, ZERO: 2/27/91 15:19
TIME, COUNTED: 3/22/91 16:18:52
DECAY TIME: 33179.86
WT: 3.5
LT: 3600.44
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	859	NET:	215
BKGD:	644		
CO60, GROSS COUNTS:	11442	NET:	11327
BKGD:	115		
BI-214, GROSS COUNTS:	3763	NET:	2349
BKGD:	1414		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.2118

1ST ITERATION

TEMP. NET BI-214 =	2349	-	8.67525	-	2696.958	=	-356.633
TEMP. NET CO-60 =	11327	-	-3.77675	-	0.4902	=	11330.28
TEMP. NET RU-106 =	215	-	-75.5564	-	313.1691	=	-22.6126

2ND ITERATION

TEMP. NET BI-214 =	2349	-	-0.91242	-	2697.741	=	-347.828
TEMP. NET CO-60 =	11327	-	-3.68350	-	-0.05155	=	11330.73
TEMP. NET RU-106 =	215	-	-73.6910	-	313.1815	=	-24.4905

3RD ITERATION

TEMP. NET BI-214 =	2349	-	-0.98819	-	2697.848	=	-347.859
TEMP. NET CO-60 =	11327	-	-3.68383	-	-0.05583	=	11330.73
TEMP. NET RU-106 =	215	-	-73.6975	-	313.1816	=	-24.4840

4TH ITERATION

TEMP. NET BI-214 =	2349	-	-0.98793	-	2697.849	=	-347.861
TEMP. NET CO-60 =	11327	-	-3.68384	-	-0.05582	=	11330.73
TEMP. NET RU-106 =	215	-	-73.6978	-	313.1816	=	-24.4837

FINAL ITERATION

BI-214 COMPTON FACTOR =	-73.697870
CO-60 COMPTON FACTOR =	313.181644
	==========
TOTAL COMPTON INTERF.	239.5

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	859
SYSTEM BKGR:	644
COMPTON INTERF.:	239.483774
NET COUNTS:	-24.483774
D/C FACTOR:	259.97
LIVE TIME, MIN.:	3600.44
VOLUME:	3.5
DECAY TIME:	33179.8666
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.043797

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY = -0.23748
RPTD ACTIVITY = -0.24
CALC. LLD = 1.343531 (4.66*S)/(CONVERSION FACTORS)
RPTD. LLD = 1.3

HEIS NO: B00FF7
PNL SAMPLE: 91-1825-L-1
TIME, ZERO: 3/6/91 16:06
TIME, COUNTED: 4/1/91 13:52
DECAY TIME: 37306
WT: 3.5
LT: 1200.28
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	237	NET:	22
BKGD:	215		
CO60, GROSS COUNTS:	1623	NET:	1585
BKGD:	38		
BI-214, GROSS COUNTS:	738	NET:	267
BKGD:	471		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00225
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	9.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	267	-	0.8877	-	377.3885	=	-111.276
TEMP. NET CO-60 =	1585	-	-1.17841	-	0.05016	=	1586.128
TEMP. NET RU-106 =	22	-	-23.5749	-	43.84058	=	1.734390

2ND ITERATION

TEMP. NET BI-214 =	267	-	0.069982	-	377.6571	=	-110.727
TEMP. NET CO-60 =	1585	-	-1.17260	-	0.003954	=	1586.168
TEMP. NET RU-106 =	22	-	-23.4586	-	43.84170	=	1.616946

3RD ITERATION

TEMP. NET BI-214 =	267	-	0.065243	-	377.6667	=	-110.731
TEMP. NET CO-60 =	1585	-	-1.17265	-	0.003686	=	1586.168
TEMP. NET RU-106 =	22	-	-23.4596	-	43.84171	=	1.617970

4TH ITERATION

TEMP. NET BI-214 =	267	-	0.065285	-	377.6668	=	-110.732
TEMP. NET CO-60 =	1585	-	-1.17265	-	0.003688	=	1586.168
TEMP. NET RU-106 =	22	-	-23.4597	-	43.84171	=	1.617995

FINAL ITERATION

BI-214 COMPTON FACTOR =	-23.459706
CO-60 COMPTON FACTOR =	43.8417101
	==========
TOTAL COMPTON INTERF.	20.4

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	237
SYSTEM BKGR:	215
COMPTON INTERF.:	20.3820041
NET COUNTS:	1.61799587
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1200.28
VOLUME:	3.5
DECAY TIME:	37306
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.049375

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY =	0.047329
REPT'D ACTIVITY =	0.063
CALC. LLD =	2.0°1333 (4.66*S)/(CONVERSION FACTORS)
REPT. LLD =	2.1

HEIS NO: B00FB3
PNL SAMPLE: 91-2707-L-1
TIME, ZERO: 3/27/91 11:16
TIME, COUNTED: 4/2/91 14:54
DECAY TIME: 8858
WT: 3.5
LT: 1200.09
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	601	NET:	386
BKGD:	215		
CO60, GROSS COUNTS:	2599	NET:	2561
BKGD:	38		
BI-214, GROSS COUNTS:	2387	NET:	1916
BKGD:	471		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	1916	-	15.5751	-	609.7741	= 1290.650
TEMP. NET CO-60 =	2561	-	13.66799	-	0.88008	= 2546.451
TEMP. NET RU-106 =	386	-	273.4372	-	70.38393	= 42.17879

2ND ITERATION

TEMP. NET BI-214 =	1916	-	1.701914	-	606.3102	= 1307.987
TEMP. NET CO-60 =	2561	-	13.85159	-	0.096167	= 2547.052
TEMP. NET RU-106 =	386	-	277.1103	-	70.40052	= 38.48916

3RD ITERATION

TEMP. NET BI-214 =	1916	-	1.553037	-	606.4531	= 1307.993
TEMP. NET CO-60 =	2561	-	13.85165	-	0.087755	= 2547.060
TEMP. NET RU-106 =	386	-	277.1115	-	70.40075	= 38.48767

4TH ITERATION

TEMP. NET BI-214 =	1916	-	1.552977	-	606.4551	= 1307.991
TEMP. NET CO-60 =	2561	-	13.85163	-	0.087751	= 2547.060
TEMP. NET RU-106 =	386	-	277.1111	-	70.40075	= 38.48808

FINAL ITERATION

BI-214 COMPTON FACTOR =	277.111163
CO-60 COMPTON FACTOR =	70.4007553
	==========
TOTAL COMPTON INTERF.	347.5

SAMPLE RESULT CALCULATION
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GROSS COUNTS, RU-106:	601
SYSTEM BKGR:	215
COMPTON INTERF.:	347.511918
NET COUNTS:	38.4880815
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1200.09
VOLUME:	3.5
DECAY TIME:	8858
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.011509

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY =	1.085386
REPD ACTIVITY =	1.09
CALC. LLD =	3.116808 (4.66*S)/(CONVERSION FACTORS)
REPD. LLD =	3.1

HEIS NO: B00F93
PNL SAMPLE: 91-2708-L-1
TIME, ZERO: 3/25/91 11:04
TIME, COUNTED: 4/3/91 15:23:14
DECAY TIME: 13219.23
WT: 3.5
LT: 1200.17
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	548	NET:	333
BKGD:	215		
CO60, GROSS COUNTS:	1137	NET:	1099
BKGD:	38		
BI-214, GROSS COUNTS:	2077	NET:	1606
BKGD:	471		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	1606	-	13.43655	-	261.6719	=	1330.891
TEMP. NET CO-60 =	1099	-	14.09414	-	0.75924	=	1084.146
TEMP. NET RU-106 =	333	-	281.9626	-	29.96581	=	21.07150

2ND ITERATION

TEMP. NET BI-214 =	1606	-	0.850235	-	258.1353	=	1347.014
TEMP. NET CO-60 =	1099	-	14.26488	-	0.048043	=	1084.687
TEMP. NET RU-106 =	333	-	285.3784	-	29.98075	=	17.64076

3RD ITERATION

TEMP. NET BI-214 =	1606	-	0.711804	-	258.2639	=	1347.024
TEMP. NET CO-60 =	1099	-	14.26498	-	0.040220	=	1084.694
TEMP. NET RU-106 =	333	-	285.3805	-	29.98096	=	17.63848

4TH ITERATION

TEMP. NET BI-214 =	1606	-	0.711713	-	258.2658	=	1347.022
TEMP. NET CO-60 =	1099	-	14.26496	-	0.040215	=	1084.694
TEMP. NET RU-106 =	333	-	285.3801	-	29.98096	=	17.63885

FINAL ITERATION

BI-214 COMPTON FACTOR =	285.380177
CO-60 COMPTON FACTOR =	29.9809647
	==========
TOTAL COMPTON INTERF.	315.4

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	548
SYSTEM BKGR:	215
COMPTON INTERF.:	315.361142
NET COUNTS:	17.6388575
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1200.17
VOLUME:	3.5
DECAY TIME:	13219.2333
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.017224

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY = 0.8.0200
RPTD ACTIVITY = 0.513
CALC. LLD = 7.43022 (4.66*S)/(CONVERSION FACTORS)
RPTD. LLD = 3.0

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HEIS NO: B00FB0
PNL SAMPLE: 91-2709-L-1
TIME, ZERO: 3/25/91 14:04
TIME, COUNTED: 4/4/91 14:00:09
DECAY TIME: 14396.15
KT: 3.5
LT: 1200.12
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	450	NET:	235
BKGD:	215		
CO60, GROSS COUNTS:	828	NET:	790
BKGD:	38		
BI-214, GROSS COUNTS:	1597	NET:	1126
BKGD:	471		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21196

1ST ITERATION

TEMP. NET BI-214 =	1126	-	9.48225	-	188.099	= 928.4187
TEMP. NET CO-60 =	790	-	9.831954	-	0.5358	= 779.6322
TEMP. NET RU-106 =	235	-	196.6947	-	21.54903	= 16.75616

2ND ITERATION

TEMP. NET BI-214 =	1126	-	0.676111	-	185.6304	= 939.6934
TEMP. NET CO-60 =	790	-	9.951353	-	0.038204	= 780.0104
TEMP. NET RU-106 =	235	-	199.0834	-	21.55948	= 14.35705

3RD ITERATION

TEMP. NET BI-214 =	1126	-	0.579307	-	185.7204	= 939.7002
TEMP. NET CO-60 =	790	-	9.951425	-	0.032734	= 780.0158
TEMP. NET RU-106 =	235	-	199.0848	-	21.55963	= 14.35547

4TH ITERATION

TEMP. NET BI-214 =	1126	-	0.579243	-	185.7217	= 939.6989
TEMP. NET CO-60 =	790	-	9.951412	-	0.032730	= 780.0158
TEMP. NET RU-106 =	235	-	199.0846	-	21.55963	= 14.35573

FINAL ITERATION

BI-214 COMPTON FACTOR =	199.084626
CO-60 COMPTON FACTOR =	21.5596382
	==========
TOTAL COMPTON INTERF.	220.6

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	450
SYSTEM BKGR:	215
COMPTON INTERF.:	220.644265
NET COUNTS:	14.3557347
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1200.12
VOLUME:	3.5
DECAY TIME:	14396.15
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.018772

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. MDC [illegible] = .407737
REPT'D ACTIVITY = 0.41
CALC. LLD = 2.762527 (4.66*S)/(CONVERSION FACTORS)
RPTD. LLD = 2.8

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HEIS NO: B00FB0
PNL SAMPLE: 91-2709-L-1
TIME, ZERO: 3/25/91 14:04
TIME, COUNTED: 5/17/91 15:29
DECAY TIME: 76405
WT: 3.5
LT: 3600.67
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	591	NET:	-53
BKGD:	644		
CO60, GROSS COUNTS:	2226	NET:	2111
BKGD:	115		
BI-214, GROSS COUNTS:	1477	NET:	63
BKGD:	1414		

COMPTON FACTORS (CF)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	63	-	-2.13855	-	502.6291	=	-437.490
TEMP. NET CO-60 =	2111	-	-4.63302	-	-0.12084	=	2115.753
TEMP. NET RU-106 =	-53	-	-92.6867	-	58.47943	=	-18.7926

2ND ITERATION

TEMP. NET BI-214 =	63	-	-0.75828	-	503.7609	=	-440.002
TEMP. NET CO-60 =	2111	-	-4.65962	-	-0.04284	=	2115.702
TEMP. NET RU-106 =	-53	-	-93.2189	-	58.47801	=	-18.2590

3RD ITERATION

TEMP. NET BI-214 =	63	-	-0.73675	-	503.7487	=	-440.012
TEMP. NET CO-60 =	2111	-	-4.65972	-	-0.04163	=	2115.701
TEMP. NET RU-106 =	-53	-	-93.2209	-	58.47798	=	-18.2570

4TH ITERATION

TEMP. NET BI-214 =	63	-	-0.73667	-	503.7484	=	-440.011
TEMP. NET CO-60 =	2111	-	-4.65972	-	-0.04162	=	2115.701
TEMP. NET RU-106 =	-53	-	-93.2209	-	58.47798	=	-18.2570

FINAL ITERATION

BI-214 COMPTON FACTOR =	-93.220904
CO-60 COMPTON FACTOR =	58.4779853
	==========
TOTAL COMPTON INTERF.	-34.7

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	591
SYSTEM BKGR:	644
COMPTON INTERF.:	-34.742919
NET COUNTS:	-18.257080
D/C FACTOR:	259.97
LIVE TIME, MIN.:	3600.67
VOLUME:	3.5
DECAY TIME:	76405
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.103743

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY =	-0.18724
RPTD ACTIVITY =	-0.18
CALC. LLD =	1.179704 (4.66*S)/(CONVERSION FACTORS)
RPTD. LLD =	1.2

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HEIS NO: B00F54
PNL SAMPLE: 91-2710-L-1
TIME, ZERO: 3/25/91 11:16
TIME, COUNTED: 4/9/91 14:32:19
DECAY TIME: 21796.31
WT: 3.5
LT: 1200.27
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	282	NET:	67
BKGD:	215		
CO60, GROSS COUNTS:	1066	NET:	1028
BKGD:	38		
BI-214, GROSS COUNTS:	941	NET:	470
BKGD:	471		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	470	-	2.76345	-	244.7668	=	222.5297
TEMP. NET CO-60 =	1028	-	2.356590	-	0.15276	=	1025.490
TEMP. NET RU-106 =	67	-	47.14515	-	28.34456	=	-8.48971

2ND ITERATION

TEMP. NET BI-214 =	470	-	-0.34255	-	244.1693	=	226.1732
TEMP. NET CO-60 =	1028	-	2.395174	-	-0.01935	=	1025.624
TEMP. NET RU-106 =	67	-	47.91706	-	28.34825	=	-9.26531

3RD ITERATION

TEMP. NET BI-214 =	470	-	-0.37385	-	244.2011	=	226.1727
TEMP. NET CO-60 =	1028	-	2.395169	-	-0.02112	=	1025.625
TEMP. NET RU-106 =	67	-	47.91695	-	28.34830	=	-9.26525

4TH ITERATION

TEMP. NET BI-214 =	470	-	-0.37385	-	244.2015	=	226.1723
TEMP. NET CO-60 =	1028	-	2.395164	-	-0.02112	=	1025.625
TEMP. NET RU-106 =	67	-	47.91686	-	28.34830	=	-9.26516

FINAL ITERATION

BI-214 COMPTON FACTOR =	47.9168662
CO-60 COMPTON FACTOR =	28.3483015
	==========
TOTAL COMPTON INTERF.	76.3

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	282
SYSTEM BKGR:	215
COMPTON INTERF.:	76.2651677
NET COUNTS:	-9.2651677
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1200.27
VOLUME:	3.5
DECAY TIME:	21796.3166
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.028558

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

GA[illegible] =	-[illegible]64
RPTD ACTIVITY =	-0.27
GA[illegible] LLD =	2.290250 (4.66*S)/(CONVERSION FACTORS)
RPTD. LLD =	2.3

HEIS NO: B00FD0
PNL SAMPLE: 91-2711-L-1
TIME, ZERO: 3/27/91 13:23
TIME, COUNTED: 4/5/91 15:38
DECAY TIME: 13095
WT: 3.5
LT: 1700.22
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	548	NET:	244
BKGD:	304		
CO60, GROSS COUNTS:	1528	NET:	1474
BKGD:	54		
BI-214, GROSS COUNTS:	1902	NET:	1234
BKGD:	668		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	1234	-	9.8454	-	350.9594	= 873.1952
TEMP. NET CO-60 =	1474	-	9.247137	-	0.55632	= 1464.196
TEMP. NET RU-106 =	244	-	184.9951	-	40.47039	= 18.53447

2ND ITERATION

TEMP. NET BI-214 =	1234	-	0.747865	-	348.6251	= 884.6269
TEMP. NET CO-60 =	1474	-	9.368199	-	0.042258	= 1464.589
TEMP. NET RU-106 =	244	-	187.4170	-	40.48125	= 16.10168

3RD ITERATION

TEMP. NET BI-214 =	1234	-	0.649702	-	348.7187	= 884.6315
TEMP. NET CO-60 =	1474	-	9.368247	-	0.036711	= 1464.595
TEMP. NET RU-106 =	244	-	187.4180	-	40.48140	= 16.10055

4TH ITERATION

TEMP. NET BI-214 =	1234	-	0.649657	-	348.7200	= 884.6302
TEMP. NET CO-60 =	1474	-	9.368234	-	0.036709	= 1464.595
TEMP. NET RU-106 =	244	-	187.4177	-	40.48140	= 16.10082

FINAL ITERATION

BI-214 COMPTON FACTOR =	187.417767
CO-60 COMPTON FACTOR =	40.4814073
	==========
TOTAL COMPTON INTERF.	227.9

SAMPLE RESULT CALCULATION
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GROSS COUNTS, RU-106:	548
SYSTEM BKGR:	304
COMPTON INTERF.:	227.899174
NET COUNTS:	16.1008250
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1700.22
VOLUME:	3.5
DECAY TIME:	13095
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.017061

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

[illegible] =	0.022249
[illegible] =	0.297
[illegible] =	1.151021 (4.66*9)/(CONVERSION FACTORS)
RPID. LLD =	2.2

HEIS NO: B00FD0
PNL SAMPLE: 91-2711-L-1
TIME, ZERO: 3/27/91 13:23
TIME, COUNTED: 5/15/91 16:31:44
DECAY TIME: 70748.73
WT: 3.5
LT: 1200.17
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	224	NET:	9
BKGD:	215		
CO60, GROSS COUNTS:	1119	NET:	1081
BKGD:	38		
BI-214, GROSS COUNTS:	569	NET:	98
BKGD:	471		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	98	-	0.36315	-	257.3861	=	-159.749
TEMP. NET CO-60 =	1081	-	-1.69174	-	0.02052	=	1082.671
TEMP. NET RU-106 =	9	-	-33.8444	-	29.92503	=	12.91944

2ND ITERATION

TEMP. NET BI-214 =	98	-	0.521299	-	257.7840	=	-160.305
TEMP. NET CO-60 =	1081	-	-1.69763	-	0.029456	=	1082.668
TEMP. NET RU-106 =	9	-	-33.9622	-	29.92494	=	13.03733

3RD ITERATION

TEMP. NET BI-214 =	98	-	0.526056	-	257.7832	=	-160.309
TEMP. NET CO-60 =	1081	-	-1.69767	-	0.029725	=	1082.667
TEMP. NET RU-106 =	9	-	-33.9631	-	29.92494	=	13.03819

4TH ITERATION

TEMP. NET BI-214 =	98	-	0.526091	-	257.7832	=	-160.309
TEMP. NET CO-60 =	1081	-	-1.69767	-	0.029727	=	1082.667
TEMP. NET RU-106 =	9	-	-33.9631	-	29.92494	=	13.03819

FINAL ITERATION

BI-214 COMPTON FACTOR =	-33.963134
CO-60 COMPTON FACTOR =	29.9249421
	==========
TOTAL COMPTON INTERF.	-4.0

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	224
SYSTEM BKGR:	215
COMPTON INTERF.:	-4.0381926
NET COUNTS:	13.0381926
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1200.17
VOLUME:	3.5
DECAY TIME:	70748.7333
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.095707

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY =	0.388264
RPTD ACTIVITY =	0.4
CALC. LLD =	2.067482 (4.66*S)/(CONVERSION FACTORS)
RPTD. LLD =	2.1

jik

HEIS NO: B00F90
PNL SAMPLE: 91-2781-L-1
TIME, ZERO: 4/1/91 12:58
TIME, COUNTED: 4/10/91 14:07
DECAY TIME: 13029
WT: 3.5
LT: 1400.12
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	680	NET:	430
BKGD:	250		
CO60, GROSS COUNTS:	2728	NET:	2683
BKGD:	45		
BI-214, GROSS COUNTS:	3041	NET:	2491
BKGD:	550		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	2491	-	17.3535	-	638.8223	=	1834.827
TEMP. NET CO-60 =	2683	-	19.43082	-	0.9804	=	2662.588
TEMP. NET RU-106 =	430	-	388.7254	-	73.59395	=	-32.3204

2ND ITERATION

TEMP. NET BI-214 =	2491	-	-1.30412	-	633.9623	=	1858.341
TEMP. NET CO-60 =	2683	-	19.67783	-	-0.07369	=	2663.393
TEMP. NET RU-106 =	430	-	393.7082	-	73.61620	=	-37.3244

3RD ITERATION

TEMP. NET BI-214 =	2491	-	-1.50604	-	634.1540	=	1858.351
TEMP. NET CO-60 =	2683	-	19.67994	-	-0.08509	=	2663.405
TEMP. NET RU-106 =	430	-	393.7104	-	73.61651	=	-37.3269

4TH ITERATION

TEMP. NET BI-214 =	2491	-	-1.50614	-	634.1567	=	1858.349
TEMP. NET CO-60 =	2683	-	19.67991	-	-0.08510	=	2663.405
TEMP. NET RU-106 =	430	-	393.7098	-	73.61651	=	-37.3264

FINAL ITERATION

BI-214 COMPTON FACTOR =	393.709898
CO-60 COMPTON FACTOR =	73.6165193
	==========
TOTAL COMPTON INTERF.	467.3

SAMPLE RESULT CALCULATION
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iiL

GROSS COUNTS, RU-106:	680
SYSTEM BKGR:	250
COMPTON INTERF.:	467.326418
NET COUNTS:	-37.326418
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1400.12
VOLUME:	3.5
DECAY TIME:	13029
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.016974

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY =	-0.50711
RPTD ACTIVITY =	-0.92
CALC LLD =	3.033132 (4.66*S)/(CONVERSION FACTORS)
RPTD. LLD =	3

jm

HEIS NO: B00FB6
PNL SAMPLE: 91-2859-L-1
TIME, ZERO: 4/3/91 13:54
TIME, COUNTED: 4/11/91 16:31:53
DECAY TIME: 11677.88
WT: 3.5
LT: 1199.92
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	673	NET:	458
BKGD:	215		
CO60, GROSS COUNTS:	3386	NET:	3348
BKGD:	38		
BI-214, GROSS COUNTS:	3091	NET:	2520
BKGD:	571		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	2520	-	18.4803	-	797.1588	=	1704.360
TEMP. NET CO-60 =	3348	-	18.04918	-	1.04424	=	3328.906
TEMP. NET RU-106 =	458	-	361.0859	-	92.01097	=	4.903121

2ND ITERATION

TEMP. NET BI-214 =	2520	-	0.197840	-	792.6126	=	1727.189
TEMP. NET CO-60 =	3348	-	18.29093	-	0.011179	=	3329.697
TEMP. NET RU-106 =	458	-	365.9223	-	92.03284	=	0.044782

3RD ITERATION

TEMP. NET BI-214 =	2520	-	0.001806	-	792.8010	=	1727.197
TEMP. NET CO-60 =	3348	-	18.29101	-	0.000102	=	3329.708
TEMP. NET RU-106 =	458	-	365.9239	-	92.03315	=	0.042863

4TH ITERATION

TEMP. NET BI-214 =	2520	-	0.001729	-	792.8036	=	1727.194
TEMP. NET CO-60 =	3348	-	18.29099	-	0.000097	=	3329.708
TEMP. NET RU-106 =	458	-	365.9234	-	92.03315	=	0.043400

FINAL ITERATION

BI-214 COMPTON FACTOR =	365.923445
CO-60 COMPTON FACTOR =	92.0331543
	==========
TOTAL COMPTON INTERF.	458.9

SAMPLE RESULT CALCULATION
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iin

GROSS COUNTS, RU-106:	673
SYSTEM BKGR:	215
COMPTON INTERF.:	457.956599
NET COUNTS:	0.04340068
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1199.92
VOLUME:	3.5
DECAY TIME:	11677.8833
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.015201

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY = 6.002228
REPT ACTIVITY = -0.59
CALC. MDL = 5.423011 (4.66*S)/(CONVERSION FACTORS)
RPTD. LLD = 3.5

HEIS NO: B00FD4
PNL SAMPLE: 91-2860-L-1
TIME, ZERO: 4/4/91 13:24
TIME, COUNTED: 4/12/91 15:18:24
DECAY TIME: 11634.4
WT: 3.5
LT: 3600.48
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	1403	NET:	759
BKGD:	644		
CO60, GROSS COUNTS:	2344	NET:	2229
BKGD:	115		
BI-214, GROSS COUNTS:	4860	NET:	3446
BKGD:	1414		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04075
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21166

1ST ITERATION

TEMP, NET BI-214 =	3446	-	30.62565	-	530.7249	=	2884.649
TEMP, NET CO-60 =	2229	-	30.54843	-	1.73052	=	2196.721
TEMP, NET RU-106 =	759	-	611.1416	-	60.71736	=	87.14079

2ND ITERATION

TEMP, NET BI-214 =	3446	-	3.516131	-	523.0392	=	2919.444
TEMP, NET CO-60 =	2229	-	30.91691	-	0.198681	=	2197.884
TEMP, NET RU-106 =	759	-	618.5135	-	60.74952	=	79.73694

3RD ITERATION

TEMP, NET BI-214 =	3446	-	3.217385	-	523.3162	=	2919.466
TEMP, NET CO-60 =	2229	-	30.91714	-	0.181800	=	2197.901
TEMP, NET RU-106 =	759	-	618.5181	-	60.74998	=	79.73187

4TH ITERATION

TEMP, NET BI-214 =	3446	-	3.217181	-	523.3202	=	2919.462
TEMP, NET CO-60 =	2229	-	30.91710	-	0.181788	=	2197.901
TEMP, NET RU-106 =	759	-	618.5173	-	60.74998	=	79.73267

FINAL ITERATION

BI-214 COMPTON FACTOR =	618.517341
CO-60 COMPTON FACTOR =	60.7499864
	==========
TOTAL COMPTON INTERF.	679.3

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	1403
SYSTEM BKGR:	644
COMPTON INTERF.:	679.267329
NET COUNTS:	79.7326716
D/C FACTOR:	259.97
LIVE TIME, MIN.:	3600.48
VOLUME:	3.5
DECAY TIME:	11634.4
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.015144

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
[illegible] = CONVERSION, DPM/PCI

[illegible] = [illegible]
RMD ACT, [illegible] = [illegible]
DET. [illegible] = [illegible] (4.66E9)/(CONVERSION FACTORS)
RMD [illegible] = 1.6

HEIS NO: B00F34
PNL SAMPLE: 91-2962-L-1
TIME, ZERO: 4/4/91 13:23
TIME, COUNTED: 4/16/91 15:38:22
DECAY TIME: 17415.36
WT: 3.5
LT: 1200.19
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	318	NET:	103
BKGD:	215		
CO60, GROSS COUNTS:	767	NET:	729
BKGD:	38		
BI-214, GROSS COUNTS:	1057	NET:	586
BKGD:	471		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	586	-	4.15605	-	173.5749	= 408.2690
TEMP. NET CO-60 =	729	-	4.323569	-	0.23494	= 724.4415
TEMP. NET RU-106 =	103	-	86.49589	-	20.02356	= -3.51944

2ND ITERATION

TEMP. NET BI-214 =	586	-	-0.14200	-	172.4895	= 413.6524
TEMP. NET CO-60 =	729	-	4.380579	-	-0.00802	= 724.6274
TEMP. NET RU-106 =	103	-	87.63641	-	20.02870	= -4.66511

3RD ITERATION

TEMP. NET BI-214 =	586	-	-0.18823	-	172.5337	= 413.6544
TEMP. NET CO-60 =	729	-	4.380600	-	-0.01063	= 724.6300
TEMP. NET RU-106 =	103	-	87.63683	-	20.02877	= -4.66560

4TH ITERATION

TEMP. NET BI-214 =	586	-	-0.18825	-	172.5344	= 413.6538
TEMP. NET CO-60 =	729	-	4.380594	-	-0.01063	= 724.6300
TEMP. NET RU-106 =	103	-	87.63670	-	20.02877	= -4.66547

FINAL ITERATION

BI-214 COMPTON FACTOR =	87.6367037
CO-60 COMPTON FACTOR =	20.0287743
	==========
TOTAL COMPTON INTERF.	107.7

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	318
SYSTEM BKGR:	215
COMPTON INTERF.:	107.665478
NET COUNTS:	-4.6654781
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1200.19
VOLUME:	3.5
DECAY TIME:	17415.3666
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.022753

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY =	-0.13302
RPTD ACTIVITY =	-0.13
CALC. LLD =	1.756632 (4.66*S)/(CONVERSION FACTORS)
RPTD. LLD =	2.4

HEIS NO: B00FG4
PNL SAMPLE: 91-2962-L-1
TIME, ZERO: 4/4/91 13:23
TIME, COUNTED: 5/14/91 15:18:58
DECAY TIME: 57715.96
WT: 3.5
LT: 1200.14
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	185	NET:	-30
BKGD:	215		
CO60, GROSS COUNTS:	766	NET:	728
BKGD:	38		
BI-214, GROSS COUNTS:	427	NET:	-44
BKGD:	471		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	-44	-	-1.2105	-	173.3368	=	-216.126
TEMP. NET CO-60 =	728	-	-2.28877	-	-0.0684	=	730.3571
TEMP. NET RU-106 =	-30	-	-45.7885	-	20.18707	=	-4.39855

2ND ITERATION

TEMP. NET BI-214 =	-44	-	-0.17748	-	173.8960	=	-217.720
TEMP. NET CO-60 =	728	-	-2.30566	-	-0.01002	=	730.3156
TEMP. NET RU-106 =	-30	-	-46.1262	-	20.18592	=	-4.05964

3RD ITERATION

TEMP. NET BI-214 =	-44	-	-0.16380	-	173.8881	=	-217.724
TEMP. NET CO-60 =	728	-	-2.30570	-	-0.00925	=	730.3149
TEMP. NET RU-106 =	-30	-	-46.1270	-	20.18590	=	-4.05882

4TH ITERATION

TEMP. NET BI-214 =	-44	-	-0.16377	-	173.8879	=	-217.724
TEMP. NET CO-60 =	728	-	-2.30569	-	-0.00925	=	730.3149
TEMP. NET RU-106 =	-30	-	-46.1270	-	20.18590	=	-4.05885

FINAL ITERATION

BI-214 COMPTON FACTOR =	-46.127052
CO-60 COMPTON FACTOR =	20.1859053
	==========
TOTAL COMPTON INTERF.	-25.9

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	185
SYSTEM BKGR:	215
COMPTON INTERF.:	-25.941147
NET COUNTS:	-4.0588525
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1200.14
VOLUME:	3.5
DECAY TIME:	57715.9666
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.077413

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY = -0.12[illegible]
REPD ACTIVITY = -0.12
CALC. LLD = 1.924585 (4.66*S)/(CONVERSION FACTORS)
REPD. LLD = 4.6

HEIS NO: B00F01
PNL SAMPLE: 90-7074-L-3
TIME, ZERO: 3/18/91 12:00
TIME, COUNTED: 3/21/91 18:08:50
DECAY TIME: 4688.933
WT: 1
LT: 999.35
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	50130	NET:	49951
BKGD:	179		
CO60, GROSS COUNTS:	140	NET:	108
BKGD:	32		
BI-214, GROSS COUNTS:	2446	NET:	2054
BKGD:	392		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00225
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	2054	-	2015.522	-	25.7148	=	12.76235
TEMP. NET CO-60 =	108	-	0.135153	-	113.8882	=	-6.02343
TEMP. NET RU-106 =	49951	-	2.703831	-	-0.16648	=	49948.46

2ND ITERATION

TEMP. NET BI-214 =	2054	-	2015.429	-	-1.43417	=	40.01371
TEMP. NET CO-60 =	108	-	0.423745	-	113.8824	=	-6.30624
TEMP. NET RU-106 =	49951	-	8.477304	-	-0.17430	=	49942.69

3RD ITERATION

TEMP. NET BI-214 =	2054	-	2015.187	-	-1.50151	=	40.31369
TEMP. NET CO-60 =	108	-	0.426921	-	113.8693	=	-6.29627
TEMP. NET RU-106 =	49951	-	8.540858	-	-0.17402	=	49942.63

4TH ITERATION

TEMP. NET BI-214 =	2054	-	2015.185	-	-1.49914	=	40.31389
TEMP. NET CO-60 =	108	-	0.426924	-	113.8692	=	-6.29612
TEMP. NET RU-106 =	49951	-	8.540901	-	-0.17402	=	49942.63

FINAL ITERATION

BI-214 COMPTON FACTOR =	8.54090152
CO-60 COMPTON FACTOR =	-0.1740249
	==========
TOTAL COMPTON INTERF.	8.4

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	50130
SYSTEM BKGR:	179
COMPTON INTERF.:	8.36687655
NET COUNTS:	49942.6331
D/C FACTOR:	259.97
LIVE TIME, MIN.:	999.35
VOLUME:	1
DECAY TIME:	4688.83333
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.006075

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY =	5597.823
REPD ACTIVITY =	5690
CALC. LLD =	7.519963 (4.66*9)/(CONVERSION FACTORS)
REPD. LLD =	NR

HEIS NO: B00F01
PNL SAMPLE: 90-7074-L-6
TIME, ZERO: 3/18/91 12:00
TIME, COUNTED: 3/27/91 15:10:03
DECAY TIME: 13150.05
WT: 1
LT: 1299.14
D/C (RU-106): 259.97

RU106, GROSS COUNTS:	64377	NET:	64145
BKGD:	232		
CO60, GROSS COUNTS:	195	NET:	154
BKGD:	41		
BI-214, GROSS COUNTS:	3049	NET:	2539
BKGD:	510		

COMPTON FACTORS (Cf)

RU-106 ON CO-60:	0.00228
RU-106 ON BI-214:	0.04035
CO-60 ON RU-106:	0.02764
CO-60 ON BI-214:	0.2381
BI-214 ON CO-60:	0.01059
BI-214 ON RU-106:	0.21186

1ST ITERATION

TEMP. NET BI-214 =	2539	-	2588.250	-	36.6674	=	-85.9181
TEMP. NET CO-60 =	154	-	-0.90987	-	146.2506	=	8.659273
TEMP. NET RU-106 =	64145	-	-18.2026	-	0.239342	=	64162.96

2ND ITERATION

TEMP. NET BI-214 =	2539	-	2588.975	-	2.061772	=	-52.0373
TEMP. NET CO-60 =	154	-	-0.55107	-	146.2915	=	8.259519
TEMP. NET RU-106 =	64145	-	-11.0246	-	0.228293	=	64155.79

3RD ITERATION

TEMP. NET BI-214 =	2539	-	2588.686	-	1.966591	=	-51.6529
TEMP. NET CO-60 =	154	-	-0.54700	-	146.2752	=	8.271789
TEMP. NET RU-106 =	64145	-	-10.9431	-	0.228632	=	64155.71

4TH ITERATION

TEMP. NET BI-214 =	2539	-	2588.683	-	1.969513	=	-51.6525
TEMP. NET CO-60 =	154	-	-0.54700	-	146.2750	=	8.271971
TEMP. NET RU-106 =	64145	-	-10.9431	-	0.228637	=	64155.71

FINAL ITERATION

BI-214 COMPTON FACTOR =	-10.943118
CO-60 COMPTON FACTOR =	0.22863729
	==========
TOTAL COMPTON INTERF.	-10.7

SAMPLE RESULT CALCULATION

GROSS COUNTS, RU-106:	64377
SYSTEM BKGR:	232
COMPTON INTERF.:	-10.714481
NET COUNTS:	64155.7144
D/C FACTOR:	259.97
LIVE TIME, MIN.:	1299.14
VOLUME:	1
DECAY TIME:	13150.05
RU-106 DECAY CONSTANT:	1.2919E-06

DECAY CORR. = e^(DECAY CONSTANT*DECAY TIME) = 1.017133

ACTIVITY = (A) * (D/C) * (DECAY CORR.) / (LIVE TIME) * (VOLUME) * (2.22 DPM/PCI)

WHERE: A = NET COUNTS, RU-106 (GROSS - BKGD - COMPTON)
D/C = D/C FACTOR (DISINTEGRATIONS PER COUNT FACTOR)
DECAY CORR. = DECAY CORRECTION (CALCULATED ABOVE)
LIVE TIME = COUNTING TIME (ACTUAL) IN MINUTES
VOLUME = SAMPLE VOLUME IN LITERS
2.22 = CONVERSION, DPM/PCI

CALC. ACTIVITY =	5882.936
RPTD ACTIVITY =	5890
CALC. LLD =	5.355573 (4.66*S)/(CONVERSION FACTORS)
RPTD. LLD =	NR

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PNL TECHNICAL PROCEDURE

TITLE: PNL-ALO-471, DETERMINATION OF LOW CONCENTRATION OF ^{106}Ru IN GROUND WATER BY DIRECT COUNTING ON DUAL LARGE SODIUM IODIDE DETECTORS WITH COINCIDENCE/ANTICOINCIDENCE MULTIDIMENSIONAL ANALYSIS

SCOPE

This procedure describes a method for measuring (or determining a lower limit of detection) extremely minute amounts of ^{106}Ru in ground water by direct counting on large sodium-iodide coincidence/anticoincidence gamma-ray spectrometers. The sample volume should be at least 1.5 liters and can be as large as 4 liters provided appropriate standards are prepared and counted. A lower limit of detection (LLD) of 6 picoCuries per liter (pCi/L) of ^{106}Ru (at 2 sigma) can be achieved in the presence of up to 500 pCi/L of ^{60}Co concurrent with up to 100 pCi/L of ^{214}Bi and a counting time of ~1 day. For samples containing no more than 50 pCi/L of ^{60}Co along with 50 pCi/L of ^{214}Bi, a LLD of 2 pCi/L of ^{106}Ru can be achieved at the 95% level of confidence.

APPLICABILITY

This procedure is implemented to assure quality and is approved and written to conform with PNL-MA-70.

This procedure is applicable to the Counting Room Manager and trained and qualified personnel within the Analytical Chemistry Laboratory and Nuclear Chemistry Department of PNL.

This procedure is primarily intended to assure that the samples are counted on the gamma spectrometry equipment in the proper manner and that the data reduction is performed appropriately.

DEFINITIONS/ACRONYMS

- Laboratory Record Book - LRB
- Multidimensional Analysis (MDA) - a term referring to a gamma-ray system of analysis in which two large sodium-iodide crystals count single gamma-rays and coincidence gamma-rays. Counts from gamma-rays detected in only one of the detectors are stored in the corresponding x or y axis of the data storage array. Counts from

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Technical Reviewer / Date	**Line Mgr. / Date**	**Other / Date**
[illegible] 7/26/91	[illegible] 8-15-91	

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gamma-rays detected in both detectors simultaneously are stored in the x and y portion of the data storage array. Photopeaks arising from events in one detector only are represented as areas on an x or y axis while photopeaks arising from events in both detectors simultaneously are represented as volumes in three dimensions (XYZ). In addition, large plastic scintillators which also detect gamma-rays surround these two detectors and are in anticoincidence (whenever a pulse from the plastic scintillator is detected, the counting system is gated off for a predetermined length of time).

- Lower Limit of Detection (LLD) - in total counts is defined as: The square root of two times the total counts of interference. System background and Compton from all contributing radionuclides are included in the interference. For purposes of this procedure, 2σ confidence (i.e., two standard deviation) means that samples containing the amount of activity represented by the LLD will yield positive results 95% of the time (be categorized as above the LLD); and 5% of samples containing this amount of activity will be categorized as below the LLD. False positive results will occur for 2.50% of samples containing no ^{106}Ru. The LLD in total counts can be converted into pCi/L by multiplying or dividing by all appropriate factors as described in the body of this text.

- Clean - a term that means free of radioactivity, at least free from smearable radioactivity.

- D/C Factor (disintegrations per count) - the inverse of counting efficiency which is in counts per disintegration.

- Decay Characteristics - decay characteristics of ^{106}Ru, ^{106}Rh, ^{60}Co, ^{214}Bi, and other radionuclides can be found in Lederer and Shirley. For purposes of this procedure, ^{106}Ru is the radionuclide referred to although ^{106}Rh (daughter of ^{106}Ru) is the radionuclide actually emitting the gamma rays used to measure the activity. Since the half-life of ^{106}Ru is long (372.6 days) and the half-life of ^{106}Rh is short (29.8 seconds), secular equilibrium of ^{106}Ru-^{106}Rh is reached within a few minutes, i.e., the activity of ^{106}Rh is "equal to" the activity of ^{106}Ru within a few minutes after a sample containing ^{106}Ru has been collected. In secular equilibrium, the half-life of ^{106}Ru governs the decay of both radionuclides. The energies of the two coincident gamma rays used to measure ^{106}Ru (^{106}Rh) are 511.8 keV and 621.8 keV.

- Radon daughter(s) - Both ^{222}Rn and ^{220}Rn are found in the atmosphere from the decay of primordial uranium and thorium, respectively. The half-life of ^{220}Rn is only 55.6 seconds and its activity (and the

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activity of its daughters) found in a laboratory atmosphere is generally significantly less than that of ^{222}Rn (and daughters) which has a 3.8235 day half-life. Bi-214 has a 19.8 minute half-life and is generally the major interference from atmospheric contamination.

RESPONSIBLE STAFF

Counting Room Manager
Cognizant Staff Members/Analysts

PROCEDURE

1.0 Equipment and Materials

- A container in which the samples will be counted. The container should be of low density material such as plastic and should be about 11 inches to 12 inches in diameter and contain not less than 1.5 liters and not more than 4 liters. A Tupperware® pie storage container is one acceptable container, and directions are given for this container. If some other container is used, then adjust the directions appropriately.

- Plastic bags (19" x 21" polyethylene are adequate) in which to place each sample to facilitate keeping the sample container free of radioactive contamination.

- Plastic tape (1" wide) or electricians tape (about .75" wide) or some other tape appropriate for taping the lid to the container.

- Impulse heat sealer to seal the plastic bags.

- Disposable plastic gloves, scissors, knife or scalpel, marking pens, writing pens (black ink), and a LRB should be available.

- One MDA counting system, with detectors of sufficient size to produce the desired results, and associated electronics. The system used for developing this procedure consist of two 12" diameter by 8" thick NaI(Tl) detectors with 4" thick sodium iodide (non Tl activated) "light pipes" which shield the detectors from primordial radioactivity in the photomultiplier tubes. These detectors are contained within a plastic scintillator anticoincidence shield which is 40" in diameter and 48" in length. Four inches of borated paraffin surrounds the plastic, and all is contained within a lead shield with 4" thick walls. High voltage supplies, amplifiers, ADC's, coincidence electronics, live timers, multichannel analyzer, printers, etc., comprise the operating MDA

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systems. Data reduction is performed by computer using the appropriate data reduction program which has been verified by hand calculation.

2.0 Sample Preparation

If new containers are not used, the sample counting containers are prepared by thoroughly rinsing with deionized water, drying, and then sealing in individual plastic bags to keep them free of radioactive contamination.

A work station free of radioactive contamination is required. A clean bench (or clean paper or plastic placed on a bench) will suffice if reasonable care is taken. If the samples are radioactive, it may be necessary to determine the net weight of the samples while they are contained in a plastic bag. The following procedure keeps cross-contamination to a minimum. The average weight of an empty container, tape, and bag can be determined by individually taping, bagging, and weighing a few (3-5) empty containers. If the difference in weight is less than 10 grams, the average can be used for the tare weight for an entire set of containers (since 10 grams or less is an acceptable uncertainty for the weight or volume if the sample weight is 2000 grams or more). Typically, this uncertainty will be no more than one or two grams. Alternatively, a container can be tared, the sample added, and the sample weight read directly. In either case, the pertinent information shall be recorded in an LRB.

Specific gravity information will be supplied for each sample by the sampling organization and will be used to determine the volume based on the net weight of each sample. A specific gravity of 1.00 will be used if no specific gravity information is supplied.

Prepare a clean place to put each sample once it has been cleanly bagged. Remove each sample from its protective bag(s) in a manner that will not transfer contamination from one sample to another or to the clean section to which the sample is to be transferred. Transfer the sample into a clean polyethylene bag in such a manner that no contamination will be transferred to the outside of the clean bag. This can be accomplished if working alone by the following two steps.

Step 1: Ascertain that at least one hand is free of radioactivity i.e., "clean." Open the bag with a clean hand (disposable plastic gloves work well, and replacing gloves goes more quickly if two gloves are kept on each hand, replacing the outer one whenever it becomes potentially contaminated). Transfer the sample into the bag with the other hand (this other hand should be

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relatively clean also, so as not to cross-contaminate the sample container). Considerable care must be taken to make sure the sample container does not touch any part of the outside of the clean bag into which it is being transferred.

Step 2: Seal the bag using an impulse sealer as close to the container as practical. This bag is the protection that the counting system has from contamination that may be on the sample container (and the system's protection in case some sample should accidentally leak from the sample container). Once the samples have been cleanly transferred into clean bags and sealed, place an additional bag around each sample to help keep radon and radon daughters from contaminating the inner bag. The outer bag is to be removed just prior to placing the sample into the counting chamber. Allow the samples to stay in the bag for 24 hours or more in order for radon daughters to have time to undergo significant decay. The samples are typically counted overnight (1000 to 1400 minutes). The count may consist of one long count or a series of short counts. The advantage of the shorter counts is that the possibility of gain shifting is reduced during the counting interval. The sample is again placed into a protective bag(s) upon removal from the counting chamber. This outer protective bag helps keep radioactive contamination from coming into contact with the inner (counting system protection) bag in case a recount is necessary.

3.0 Multidimensional Analysis (MDA) Spectrometry Procedure

Counting and data reduction including error analysis and LLD calculations are performed in the manner prescribed for gamma-ray spectrometry with sodium iodide detectors. For coincidence counting, the peaks are actually volumes, but since all algorithms are identical for areas or volumes, peak areas are used in this procedure. A brief general description follows.

3.1 Energy Calibration

The gamma-ray spectrometer is calibrated for energy by adjusting the analyzer amplifier gain and ADC zero to achieve the desired peak locations. Cobalt-60 and ^{137}Cs are typically used for this operation with the 661.7 keV peak from cesium being located in channel 14 and the peak from the sum of the 1173.2 keV and the 1332.5 keV gamma-rays of cobalt located mid-way between channels 50 and 52 (other radionuclides can be used if one well resolved photopeak below one MeV and one well resolved photopeak above two MeV are present in the spectrum).

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Gain and/or zero shift during a count can radically change the number of counts in channels used to measure any particular radionuclide as well as the Compton contribution of any radionuclide to other areas. Gain and/or zero shift can sometimes be monitored by using the gamma-ray information obtained from counting the sample. Whenever this is not adequate, other radioactive sources must be placed into the counting chamber and used to ascertain that gain and zero are within acceptable limits. Gain and zero must be checked at sufficient intervals to ascertain that they are within acceptable limits. The Compton correction factors are derived by counting an aliquot of the appropriate radionuclide at a different time. It is necessary that gain and zero are set properly and are stable throughout a counting interval.

Acceptable limits can be established by counting appropriate radioactive sources at the correct gain and zero and counting them again with the gain and/or zero set slightly off and the efficiency and Compton factors compared to that obtained with correct settings. The gain and zero must be controlled such that they are acceptably close to the correct settings both before and after a sample is counted. If the temperature cannot be controlled to within a degree or two, extra caution should be used and measurements shall be made to assure that gain and/or zero are acceptably stable during a counting interval. If a computer controls data acquisition, then data can be transferred automatically periodically and the results combined algebraically. A bias error rather than a statistical error in the results may occur if gain or zero is consistently different during sample counting relative to what it was during standard counting.

3.2 Calibration Control Checks - counting a radioactive source that contains certain radionuclides periodically and determining that the results are consistent is referred to as "running controls" or "control checks". Controls shall include at least one coincidence gamma-emitting radionuclide and one or more single gamma-emitting radionuclide. Cobalt-60 and ^{137}Cs can be used for control or other suitable radionuclides. It is not necessary that the control be a "standard" nor that it be in the same geometry as the samples being counted. It is necessary that the control be in a stable geometry and be counted in the same geometry each time. See PNL-ALO-470, Procedure for Maintaining Control of Germanium Spectrometers Used for Gamma-ray Spectroscopy. The information from at least one control check taken before the samples and standards are counted

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and at least one control check taken after the samples and standards are counted shall be recorded.

3.3 System Background

A system background shall be determined. The background can be determined by counting a blank (as nearly identical as practical to that of the sample except that radioactivity is absent) for the same length of time as the sample. Alternatively, one or more backgrounds with counting intervals different, but longer than that used for the samples may be taken and the results adjusted for the difference in counting intervals according to standard practices.

3.4 Efficiency Calibration and Compton Interference Corrections

Radioactive standards shall be traceable to Nationally Recognized Standards (i.e., NIST or equivalent) and prepared as identical as possible to the samples in volume, shape, and medium. Counting efficiency in counts per disintegration is determined by counting a standard of known disintegration rate and then determining the number of net counts per disintegration. A standard of each radionuclide of interest (i.e., ^{106}Ru) shall be prepared and counted either before, during, or after the period of time in which sample analyses are being performed. In addition, aliquots of ^{60}Co and ^{214}Bi in similar geometries shall be counted to determine the interference corrections. It is recommended that these standards and interference correction samples be counted before (or near) the beginning of the sample analysis period to avoid the need for recounting samples in the event of a system failure that cannot be repaired. The activity in the standards must not be so high that significant dead time or pulse pileup or any other problems occur due to the activity. The standards shall be counted for sufficient time so that 1σ statistical errors relevant to the peak counting efficiency and Compton areas are less than 2%.

Gross peak areas are determined by summing the counts in the channels selected for each radionuclide. The selection of channels is generally made after observing the spectra produced by counting the radionuclides of interest. Enough channels shall be used to represent more than half the total peak area. About 80% of the total peak area is generally sufficient to obtain the major portion of the peak area and not include too great an amount of interference. The channels used for determining the peak area for a standard shall be used for determining that peak area for each sample.

Net peak areas shall be determined in order to calculate the activity of each radionuclide they represent. Counts from the system background and counts from Compton produced by other radionuclides shall be subtracted from the gross peak areas to obtain the net peak area. For standards containing only one radionuclide, the only interference is system background.

Compton interference shall be quantified in order to make corrections. Compton correction factors are determined from the spectra of each standard by measuring the ratio of the net counts in the channels used to measure ^{106}Ru to the net counts in the channels used to measure each radionuclide that is causing interference; and using this ratio to determine the counts in the channels for the sample by measuring the counts in the channels used to measure each interfering radionuclide and multiplying by the ratio determined from the appropriate standard. Compton correction factors can be determined for each radionuclide's effect on each of the areas used to measure all radionuclides observed in sample spectra.

When more than one radionuclide contributes to the Compton and if they are mutually interfering, an iterative process can be used to calculate the net counts for each interfering radionuclide and the net counts for ^{106}Ru (or least squares matrix inversion, or any other appropriate method can be used).

Samples shall be positioned in the counting chamber in the same stable and reproducible geometry in which the standards are counted. The length of counting interval is mandated by the activity of radionuclides in each sample and the uncertainty or LLD that is desired. For samples with very low ^{106}Ru activity such as is expected in ground water, total counting times of 1000 to 1400 minutes may be required (shorter counting times may produce acceptable LLD's for samples that have little interference). Data reduction is performed after the counting interval has ended.

3.5 Sample and Standards Counting

After verifying that the detector system to be used is in control by checking the "Detector Reliability Chart" (See PNL-ALO-470), the basic sample counting/data acquisition procedure is as follows:

3.5.1 Position

Position the sample in the detector system using the appropriate sample holder for the required geometry.

3.5.2 Analyzer Start-Up

Clear the analyzer memory. Start the analyzer counting and record the date and time on a "Counting Sheet," or record directly into memory, if appropriate. A typical counting sheet is shown in Figure 1. Fill in known information on the counting sheet. Initial the sheet with the individual's initials who started the count, and sign the bottom of the sheet. The signature at the bottom is only required once for each Counting Sheet.

3.5.3 Analyzer Shutdown

Stop the multichannel analyzer from acquiring data. Record the elapsed time and initials of the Analyst changing the count on the count sheet. If the Analyst is different than in 3.5.2, the Analyst also signs at the bottom of the sheet. This signature at the bottom is only done once on each Counting Sheet.

3.5.4 Data Transfer and Storage

If the counting system is controlled by a PC, the data will be automatically transferred to a magnetic storage device when the system is stopped. If the counting system is a separate entity, transfer the spectral data from the analyzer to the data acquisition computer system, and store the data on a magnetic storage device (hard disk, floppy disk, etc.). If the sample and counting parameters are not transferred, they will be added via keyboard from the counting sheet.

3.5.5 Data Identification

The following parameters shall accompany the spectral data, on a hard copy printout from a printer or in the associated file stored on a magnetic storage device:

a. Identification (sample description with a unique id).

b. Computer file name (if on computer) unique to the particular sample.

c. Start time of the count.

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d. Date and time of sample collection.

e. Live time of count (actual time the MCA is free to accept pulses). This should be determined by the MCA and transferred within the spectra.

f. Real time of count (the actual duration of count in regular clock time).

g. Sample mass and/or volume.

3.5.6 Data Analysis

Use a gamma-ray data reduction program to analyze the individual spectra and calculate the final concentration values. The calculated values may be verified by hand calculations, if necessary. The program used is "MDA" for multidimensional analysis.

4.0 Calculations

4.1 The calculational Methodology used to calculate activity in pCi per liter is illustrated below.

$$\text{Activity} = \frac{(\text{gross counts} - \text{background counts} - \text{Compton counts}) \times \text{D/C factor} \times \text{decay correction}}{\text{length of count in minutes} \times \text{volume in liters} \times 2.22}$$

Where: 2.22 = disintegrations per minute per pCi

D/C factor = 1 divided by the counting efficiency in counts per disintegration

Decay correction = $e^{\lambda t}$

where λ = the natural log of 2 divided by the half-life in minutes (may be called decay constant)

t = minutes from mid point of sampling to mid point of count (this is an approximation but is quite accurate where sampling and counting times are short relative to the half-life).

Example for calculation of activity:

volume of sample = 3.500 liters

length of count = 1038 minutes

decay time from mid point of sample collection to mid point of count = 5040 minutes.

Gross counts in ^{106}Ru channels = 3980 system background = 291

Gross counts in ^{60}Co channels = 103856 system background = 41

Gross counts in ^{214}Bi channels = 31927 system background = 1023

Subtract the appropriate system background from each gross

counts left in ^{106}Ru channels = 3689
counts left in ^{60}Co channels = 103815
counts left in ^{214}Bi channels = 30904
Compton factor (^{106}Ru effect on ^{60}Co) = 0.00131
Compton factor (^{106}Ru effect on ^{214}Bi) = 0.04770
Compton factor (^{60}Co effect on ^{106}Ru) = 0.02134
Compton factor (^{60}Co effect on ^{214}Bi) = 0.2257
Compton factor (^{214}Bi effect on ^{60}Co) = 0.00987
Compton factor (^{214}Bi effect on ^{106}Ru) = 0.2022

Compton correction factors are applied to the value for "counts left after background subtraction" until a net or temporary net has been determined for each radionuclide. Note that the temporary net values should be used in the equations at the first opportunity. The "counts left after subtracting background" is the value from which to subtract the Compton counts.

Temporary Net ^{214}Bi = 30904 - (3689 x .04770) - (103815 x .22570) = 7297.

Temporary Net ^{60}Co = 103815 - (7297 x .00987) - (3689 x .00131) = 103738.

Temporary Net ^{106}Ru = 3689 - (7297 x .20220) - (103738 x .02134) = -.222

Retain the new values for each of the radionuclides and repeat the exercise, ie.:

Temporary Net ^{214}Bi = 30904 - (-.222 x .04770) - (103738 x .22570) = 7490.

Temporary Net ^{60}Co = 103815 - (7490 x .00987) - (-.222 x .00131) = 103741.

Temporary Net ^{106}Ru = 3689 - (7490 x .20220) - (103741 x .02134) = -39.3

Retain the new values for each of the radionuclides and repeat once more, ie.:

Net ^{214}Bi = 30904 - (-39.3 x .04770) - (103741 x .22570) = 7492.

Net ^{60}Co = 103815 - (7492 x .00987) - (-39.3 x .00131) = 103741.

Net ^{106}Ru = 3689 - (7492 x .20220) - (103741 x .02134) = -39.7

Three or more iterations will be performed. Using these net values and the appropriate Compton factors, the Compton interference can be calculated as follows:

^{214}Bi Compton = 7492. x .20220 = 1515.
^{60}Co Compton = 103741. x .02134 = 2214.

Total Compton interference = 1515 + 2214 = 3729.

The values necessary for calculations have now been determined, and the activity of ^{106}Ru in pCi/L can be determined:

Gross counts (^{106}Ru) = 3980
System background counts = 291
Compton interference = 3729
Net counts = 3980 - 291 - 3729 = -40.
D/C factor = 220
Length of count (min) = 1038
Volume (in liters) = 3.5
Decay time (min) = 5040
Decay constant = 1.293×10^{6} minute^{-1}

Decay correction = $e^{\lambda t} = e^{(1.293 \times 10^{6}\ \text{minute}^{-1})\ (5040\ \text{minutes})}$

$$\text{Activity} = \frac{(\text{gross counts} - \text{background counts} - \text{Compton counts}) \times \text{D/C factor} \times \text{decay correction}}{\text{length of count in minutes} \times \text{volume in liters} \times 2.22}$$

$$\text{Activity} = \frac{(3980. - 291. - 3729.) \times 220. \times 1.0065}{1038. \times 3.500 \times 2.22}$$

Activity = - 1.10 pCi/L of ^{106}Ru of sample

4.2 The uncertainty is calculated as follows:

Uncertainty (in total counts) = the square root of (gross counts plus interference)
= the square root of (3980. + 291. + 3729.) = 89.44

Uncertainty (in pCi/L) is determined by multiplying or dividing the value in total counts by the appropriate factors as in the example for determination of activity listed above. This uncertainty is at 1σ confidence (68%); simply multiply by two to get 2σ confidence.

The uncertainty (in pCi/L) for this example is:

$$\text{Uncertainty} = \frac{(\text{Uncertainty in total counts}) \times \text{D/C factor} \times \text{decay correction}}{\text{length of count in minutes} \times \text{volume in liters} \times 2.22}$$

$$\text{Uncertainty} = \frac{89.7 \times 220. \times 1.0065}{1038. \times 3.500 \times 2.22} = 2.46\ \text{pCi/L of } ^{106}Ru \text{ at } 1\ \sigma$$

4.3 The LLD for ^{106}Ru in the sample used for the example shown above is calculated as follows:

The LLD for ^{106}Ru (in total counts) is:

LLD = the square root of(two times (total counts in system background + total counts Compton))

= the square root of 2(291. + 3729.) = 89.67, this value is in total counts

= this value in total counts can be converted into picocuries per liter by multiplying or dividing by all the factors used to calculate the activity in the example above.

$$\text{LLD} = \frac{89.7 \times 220. \times 1.0065}{1038. \times 3.500 \times 2.22}$$

LLD = 2.46 pCi/L of ^{106}Ru of sample (1σ)

If the sample and the system background are counted for different lengths of time, then a correction must be made for that difference in activity calculations, uncertainty calculations, and LLD determinations (see ASTM standards). Equations can be worked out to handle whatever method is chosen and data reduction by computer can be utilized.

5.0 Sample Storage and Disposal

The samples shall be returned to WHC for disposal. These samples are rather large and will take up significant space in the counting laboratory and the number of samples in the counting laboratory should be minimized.

6.0 Potential Interference and Recommended Precautions

If significant quantities of other interfering radionuclides are present, the LLD will increase. Likewise, if ^{60}Co and/or ^{214}Bi are present in larger quantities, the LLD will be higher.

Measurements may be made on samples having activity as high as a few microcuries of ^{106}Ru (per sample) provided the total activity of all radionuclides in the sample is no more than a few microcuries. If samples with higher activity are counted, care should be used to ascertain that pulse pileup or some other electronic malady does not cause erroneous results to be obtained.

The major interferences in the samples measured during development of this procedure were ^{60}Co and ^{214}Bi. Radon (and effectively, its short half-life daughters) can generally be removed by sparging with argon or helium if necessary to meet detection limit requirements, but the improvement would be rather small for these samples since cobalt is the larger contributor. If the counting can be performed about two weeks or longer after sampling, radon daughter interference will be reduced through radioactive decay and escape of the gaseous radon. For wells with low ^{60}Co activity, radon daughters become the major interference but are typically low enough to allow detection limits of 3 pCi of ^{106}Ru per liter to be achieved (even at the 2σ confidence level). Potassium-40 (if present) will contribute slightly to the ruthenium peak. The potassium peak area should be monitored and a correction made if necessary.

Radon daughter contamination from radon and daughters in the atmosphere should be controlled by keeping the samples in at least one extra

plastic bag while they are awaiting counting and removing it immediately before placing the sample into the counting chamber. If a sample must be counted soon after it has been taken or prepared for counting (i.e., soon after it has been placed into the primary plastic bag that is required before placing the sample into the counting chamber), a 2-hour period should elapse before starting the count to allow time for short half-life radon daughters to decay by about an order of magnitude. These radionuclides deposited on the outside of the sample container may produce a different Compton spectrum than that from the solution located inside the container and lead to erroneous results.

Continual vigilance for any other radionuclides that might contribute to the ruthenium peak area is always recommended. It goes without saying that the instrumentation must be maintained in good, reliable working condition and the system maintained free of contamination (especially ^{106}Ru).

The system background may vary slightly due to various primary and secondary effects from cosmic radiation. This should not be significant at the level of activity in these samples if the electronics are maintained properly. The background due to radon daughters is another matter and could be significant if not kept under control. Again, a bias may occur if some consistent pattern is inadvertently developed.

7.0 Specific Qualifications

This procedure utilizes radiochemical standards for control, and as such meets the definition to be self-qualifying per PNL-MA-70, PAP-70-901.

8.0 Records

Records shall be maintained and controlled so as to conform to requirements of PNL-MA-70, PAP-70-1701. Laboratory Record Books and Data Sheets provide a mechanism for control of most records. Laboratory Record Books will be used in accordance with Act Now Directive 89-1.

9.0 References

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APPENDIX C

DATA VALIDATION DOCUMENTATION

RADIOCHEMISTRY DATA VALIDATION CHECKLIST

Data Package ID: B00F01 Laboratory: PNL

Data Validator: L. Amyotos Date: 9/28/92

Analysis/Sample Identification/Matrix: Ru-106 / B00F01, B00F11, B00FF7, B00FB3, B00F93, B00FB0, B00F54, B00FD0 B00F90, B00FB6, B00FC4, B00FG4 / water

1. Completeness

1.1 Completeness Checklist (Complete the appropriate checklist for each analysis type and attach).

2. Calibration

2.1 Initial Calibration

Was instrument calibrated within specified time period or annually? (Y/N/NA) Y 3/18/91

If NO, qualify all associated data as unusable (R).

Was each detector used for the associated data calibrated? (Y/N/NA) Y

If NO, qualify all associated data as unusable (R).

Are calibration standards NIST traceable or equivalent? (Y/N/NA) Y

If NO, qualify all associated data as unusable (R).

Were calibration standards expired? (Y/N/NA) N

If YES, qualify all associated data as unusable (R).

Comments/Qualified Results: Detector controls were analyzed on 3/18/91

2.2 Continuing Calibration

Is check source identified by activity and radionuclides? (Y/N/NA) Y

If NO, qualify all associated data as estimated (J).

Has check source been counted daily? (Y/N/NA) N, but controls were run at least 3-4 times weekly

If NO, qualify all associated data as unusable (R).

Are check source counts within ±3S control limits? (Y/N/NA) Y Note 1

If NO, qualify all associated data as unusable (R).

Have background counts been performed at least weekly and before and after all field and QC samples associated with the SDG? (Y/N/NA) Y Note 2.

If NO, qualify all associated results as unusable (R).

Are background counts within ±3S control limits? (Y/N/NA) NA

If NO, qualify all associated results as unusable (R).

Comments/Qualified Results:

1. One check source analyzed after samples were complete data outside the limits.
2. Background checks run with each sample.

3. Blanks

Have reagent/method/field blanks been analyzed with the SDG? (Y/N/NA) N O

If NO, qualify all results >LLD as estimated (J).

Are positive results reported in the reagent/method/field blanks? (Y/N/NA) NA

If YES, qualify positive results less than the MDA as nondetects (U). Qualify sample results <10X the blank value but greater than the MDA as estimated (J).

Can blank results be verified/calculated properly? (Y/N/NA): NA

Comments/Notes/Qualified Results:

O No method blanks analyzed all results qualified as J for detects.

4. Detection Limits and Sample Results

Can LLDs and MDAs be verified? (Y/N/NA) N ①

If NO, qualify all results as estimated detects (J) or estimated nondetects (UJ).

Do reported results meet the detection limit requirements? (Y/N/NA) Y ②

Note discrepancies in the validation report narrative under representativeness.

Can reported results be verified? (Y/N/NA) Y

If NO, note missing data in the validation report. Correct results on the photocopied report forms and include in the validation report.

Comments/Notes/Qualified Results:

① LLD's not determined using formulae in validation procedure.

② Most results reported to DL requirement of Spec/C.

5. Radiometric and Gravimetric Yields

Were spikes/tracers/chemical yields analyzed in each SDG and/or sample as appropriate for the analytical method? (Y/N/NA) ~~NA~~ Y

If NO or if inappropriate tracers were used qualify associated results as unusable (R).

Was a field blank used for the spike/tracer/chemical yield analysis? (Y/N/NA) ~~NA~~ N

If YES, note in the validation narrative.

Is spike/tracer/chemical yield recovery within the limits of 30-105% for sample results <4X the spike activity? (Y/N/NA) Y

mm 12/6/95

Verify the spike recoveries and qualify associated results as follows:

%R:	<30%	30-105%	>105%	>115%
<LLD	R	acceptable	UJ	R
>LLD	R	acceptable	J	R

Comments/Notes/Qualified Results:

One blank spike was analyzed through out the samples submitted, was identified as a spike duplicate. Spike recoveries were 100%

6. Duplicate Samples and Analyses

Has at least one duplicate analysis been performed for every 10 samples in the SDG? (Y/N/NA) 4 Field Duplicates

If NO, qualify all associated results as estimated (J).

Has the field blank been used for duplicate or MS/MSD analysis? (Y/N/NA) N

Are RPD valus ≤35% for results >5X the LLD and within ±2X the LLD for results <5X the LLD? (Y/N/NA) Y

If NO, qualify associated results <LLD as estimated nondetects (UJ) and all associated results >LLD as estimated detects (J).

Comments/Notes/Qualified Results:

Sample ID	1300FC4	1300F64	%RPD
PAH's	91-2860	91-2962	
Au 106	<1.6	<2.4	---

7. Laboratory Control Samples

Are LCS results within the control limits of 80-120% (Y/N/NA): N.A ②

If NO, qualify results as follows:

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

Has at least one LCS been analyzed with the SDG? (Y/N/NA): N

If NO, qualify all associated results as estimated (J).

Comments/Notes/Qualified Results:

② Not analyzed all results J for detects.

8. Holding Times

Have all samples/analyses been completed within 5 half-lives or 180 days, whichever comes first? (Y/N/NA): Y

If NO, qualify all associated results >LLD as estimated detects (J) and all associated results <LLD as estimated non-detects (UJ). For gross exceedances (>2X criteria) qualify all associated results as unusable (R).

Comments/Notes/Qualified Results: All samples analyzed within 180 days.

9. Method Specific and Other Quality Control

9.1 Gas Proportional Counters

Are field and QC sample preparations outside the range of the self absorption curves? (Y/N/NA):

If YES, qualify all associated data as estimated (J).

Are initial detector efficiencies <20%? (Y/N/NA):

If YES, qualify all associated data as unusable (R).

Have statistical tests been performed routinely (at least weekly)? (Y/N/NA):

If NO, qualify all associated data as estimated (J).

Have stability verifications been performed after each gas change? (Y/N/NA):

If NO, qualify all associated data as estimated (J).

Comments/Notes/Qualified Results:

Kw 9/28/12 - Not applicable

9.2 Alpha Spectroscopy

Has detector system been calibrated across the energy range of interest? (Y/N/NA):_____

If NO, qualify all results as unusable (R).

Is detector resolution adequate to identify each peak centroid? (Y/N/NA):_____

If NO or if resolution cannot be determined, qualify all results as unusable (R).

Is resolution at least 20 keV FWHM? (Y/N/NA):_____

If NO, qualify all results as estimated (J).

Do check source efficiencies agree within 5% of initial calibration efficiencies or are they within the control limits or ±3S of the mean? (Y/N/NA):_____

If NO, qualify all associated results as unusable (R).

Was each sample spiked with a tracer? (Y/N/NA):_____

If NO, qualify all associated results as unusable (R).

Are tracer recoveries within the control limits of 30 to 105%? (Y/N/NA):_____

If NO, qualify all results as follows:

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

Comments/Notes/Qualified Results:_____

6/28/92 - Not applicable

9.3 Gamma Spectroscopy

Does efficiency calibration approximate a smooth semi-log curve? (Y/N/NA): NA (2)

If NO, qualify all results as unusable (R).

Have geometry or matrix factors been accounted for in all analyses? (Y/N/NA): Y

If NO, qualify all associated results as unusable (R).

Does the detector calibration cover the energy range of interest and at least 0 to 2 MeV? (Y/N/NA): Y (1)

If NO, qualify all results outside the energy range as unusable (R).

Is resolution of the detector system adequate and less than 5 FWHM? (Y/N/NA): NA (2)

If NO, qualify all results as estimated (J).

Comments/Notes/Qualified Results:

(1) Detector was calibrated using an Amersham Ru-106 standard.

(2) Analysis was run on a multidimensional detector.

9.4 Alpha Emitting Radium Isotopes

Have single radium isotopes (Ra-223, Ra-224, Ra-226) been reported? (Y/N/NA):_____

If YES, qualify all results attributed to a single radium isotope as estimated (J) if the contribution to the total from individual isotopes is unknown.

Can time from sample precipitation to counting be verified? (Y/N/NA):_____

If NO, qualify all associated results >MDA as estimated (J).

Have barium interferences been identified and accounted for? (Y/N/NA):_____

If NO, qualify all associated results with elevated barium levels as estimated (J).

Has counting efficiency for Ra-226 been determined for each SDG? (Y/N/NA):_____

If NO, qualify all associated results as unusable (R).

Have blanks been analyzed with each group to check for possible radium contamination in the reagents? (Y/N/NA):_____

If NO, qualify all associated results as estimated (J).

Are LCS recoveries with the control limits listed below? (Y/N/NA):_____

If no, qualify sample results as follows:

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

If sample was preserved at collection has analysis been completed within 180 days or 5 half-lives? (Y/N/NA):_____

If NO, qualify results >LLD as estimated detects (J) and results < LLD as estimated non-detects (UJ).

If samples were not preserved, were samples received within 5 days of sampling? (Y/N/NA):_____

- Were samples preserved at the laboratory upon receipt? (Y/N/NA):_____
- Were samples held after preservation for at least 16 days? (Y/N/NA):_____

If NO, to any of the above, qualify associated sample results as estimated (J).

Comments/Notes/Qualified Results:_____

qualify as not completed

9.5 Radium 226 Analysis using Scintillation (Lucas) Cell Counting

Is calibration data present and can it be associated with the samples? (Y/N/NA):_____

If NO, qualify associated sample results as unusable (R).

Was the counting system calibrated each day that samples were analyzed? (Y/N/NA):_____

If NO, qualify associated results as estimated (J).

Was the counting system calibrated after replacing the scintillation cell? (Y/N/NA):_____

If NO, qualify associated results as estimated (J) if the cell has a previously determined calibration constant and unusable (R) if no constant is available for the replacement cell.

Were blanks analyzed with each sample group to check for radium contamination in reagents? (Y/N/NA):_____

If NO, qualify associated results as estimated (J).

If sample was preserved at collection has analysis been completed within 180 days or 5 half-lives? (Y/N/NA):_____

If NO, qualify results >LLD as estimated detects (J) and results < LLD as estimated non-detects (UJ).

If samples were not preserved, were samples received within 5 days of sampling? (Y/N/NA):_____

- Were samples preserved at the laboratory upon receipt? (Y/N/NA):_____
- Were samples held after preservation for at least 16 days? (Y/N/NA):_____

If NO, to any of the above, qualify associated sample results as estimated (J).

Comments/Notes/Qualified Results:_____

9.6 Tritium Analysis by Liquid Scintillation Counting

Do calibration standard matrices match the sample matrices? (Y/N/NA):_____

If NO, qualify associated results as estimated (J).

Has at least one calibration standard been processed with the samples (Y/N/NA):_____

If NO, qualify results associated with runs lacking calibration standards as unusable (R).

Have results for counting efficiency determination been provided? (Y/N/NA):_____

If NO, qualify all associated results as unusable (R).

Do tritium levels in the blanks exceed the MDA? (Y/N/NA):_____

If YES, qualify associated results less than 10X the background tritium level (blanks) as estimated (J).

Have blanks been analyzed with each sample run to check for potential contamination in the chemical reagents? (Y/N/NA):_____

If NO, qualify associated results as estimated (J).

Comments/Notes/Qualified Results:_____

9/25/92 Not Applicable

9.7 Fluorometric Analysis of Uranium

Has the laboratory provided evidence that cation and anion interferences are negligible for the matrix or that matrix interferences have been accounted for? (Y/N/NA):_____

If NO, qualify associated results as estimated (J).

Has the laboratory provided a description of the method of fusion standardization or provided data supporting fusion standardization? (Y/N/NA):_____

If NO, qualify associated results as estimated (J).

Was calibration performed immediately prior to sample analysis? (Y/N/NA):_____

If NO, qualify associated results as estimated (J).

Comments/Notes/Qualified Results:_____

Not applicable

GAMMA SPECTROSCOPY

Data Package ID: B0DF01 PNL

C.0 Completeness Checklist

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

- ✓ 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

Comments/Qualified Results:

1. No LCS analyses conducted.
2. KeV line used for analyses was reported but no FWHM provided
3. No Blanks conducted.

Westinghouse
Hanford Company

OSM RCRA LEVEL C DATA ASSESSMENT

DATE 11/24/91

REVIEWED BY JA Lerch

LABORATORY PNL-325

CASE # Task 7

SDG # Report 4 + 5

SAMPLES/MATRIX B00FB3 B00FBB B00F75
B00F93 B00F90 B00F78
B00FB0 B00FB6 B00FH2
B00F54 B00FC4 B00FB4
B00FD0 B00F68 all water

DATA ASSESSMENT SUMMARY

QUALITY CONTROL CHECK	ANALYSIS CN(total)		
1. Holding Time	O		
2. Blanks	O		
3. Spike Recovery	O		
4. Duplicates	O		
5. Calibrations	O		
6.			
7.			
8.			
9.			
10.			

O = data had no problems
X = data qualified due to minor problems
M = data qualified due to major problems/some data may be unusable

OVERALL ASSESSSMENT: no problems - all results acceptable

NOTES: no free CN analysis required

o Refer to the corresponding attachments for explanation of any problems.

RCRA LEVEL C QC

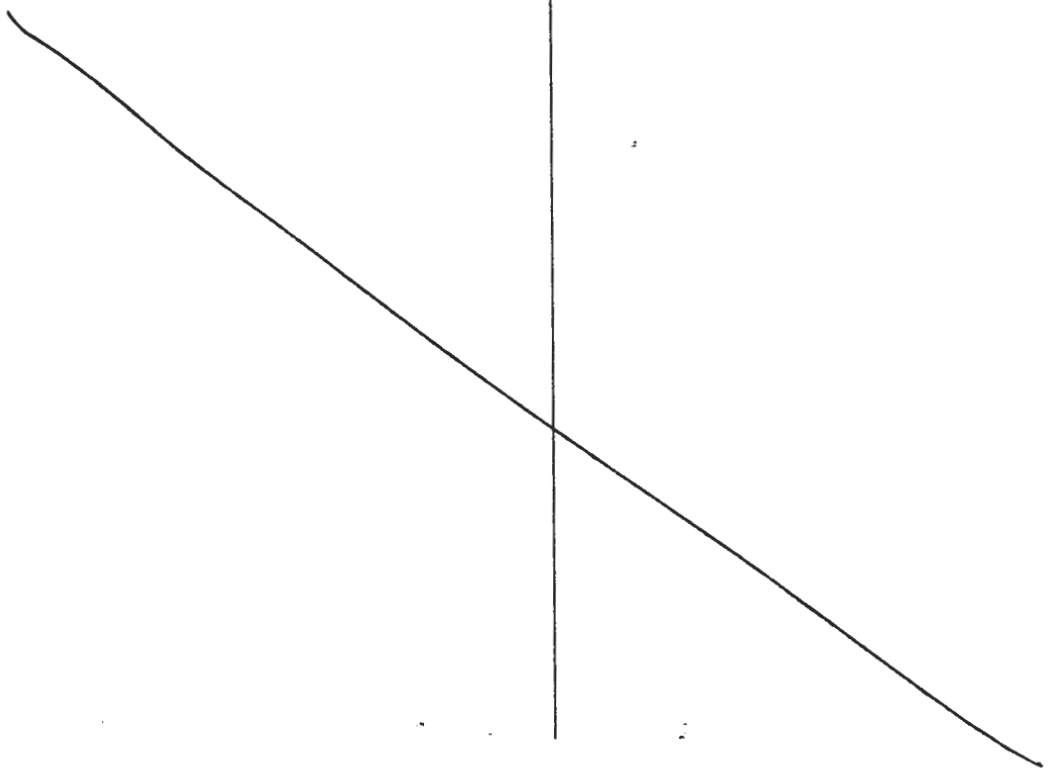
Name JA Lerch JL Date 11/24/91

QC Check: Holding Time

COMMENTS: 14 day holding time criteria met for all samples

ACTION: none

sample #	constituent	value/qual	sample #	constituent	value/qual



RCRA LEVEL C QC

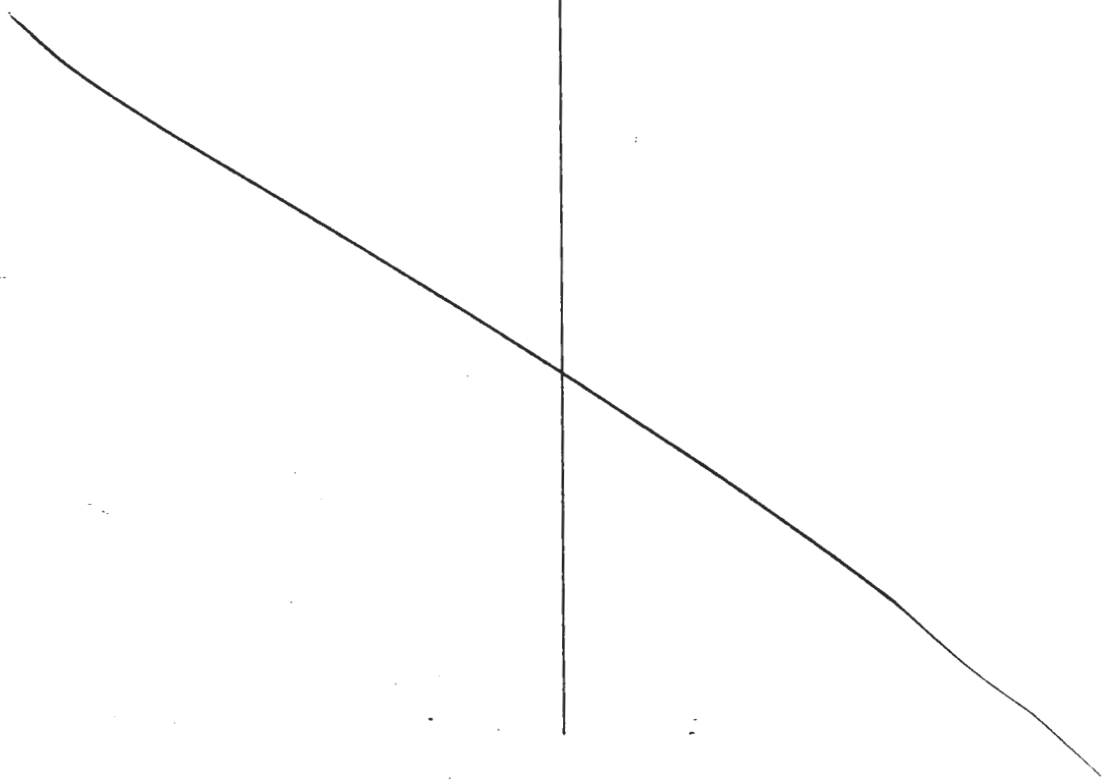
Name JA Lerch JL Date 11/24/91

QC Check: Blanks

COMMENTS: no contamination detected in any CN blanks

ACTION: none

sample #	constituent	value/qual	sample #	constituent	value/qual



RCRA LEVEL C QC

Name JA Lerch JL Date 11/24/91

QC Check: Spike Recovery

COMMENTS: all matrix spike recoveries within acceptable limits (75-125 %)

ACTION: none

sample #	constituent	value/qual	sample #	constituent	value/qual

RCRA LEVEL C QC

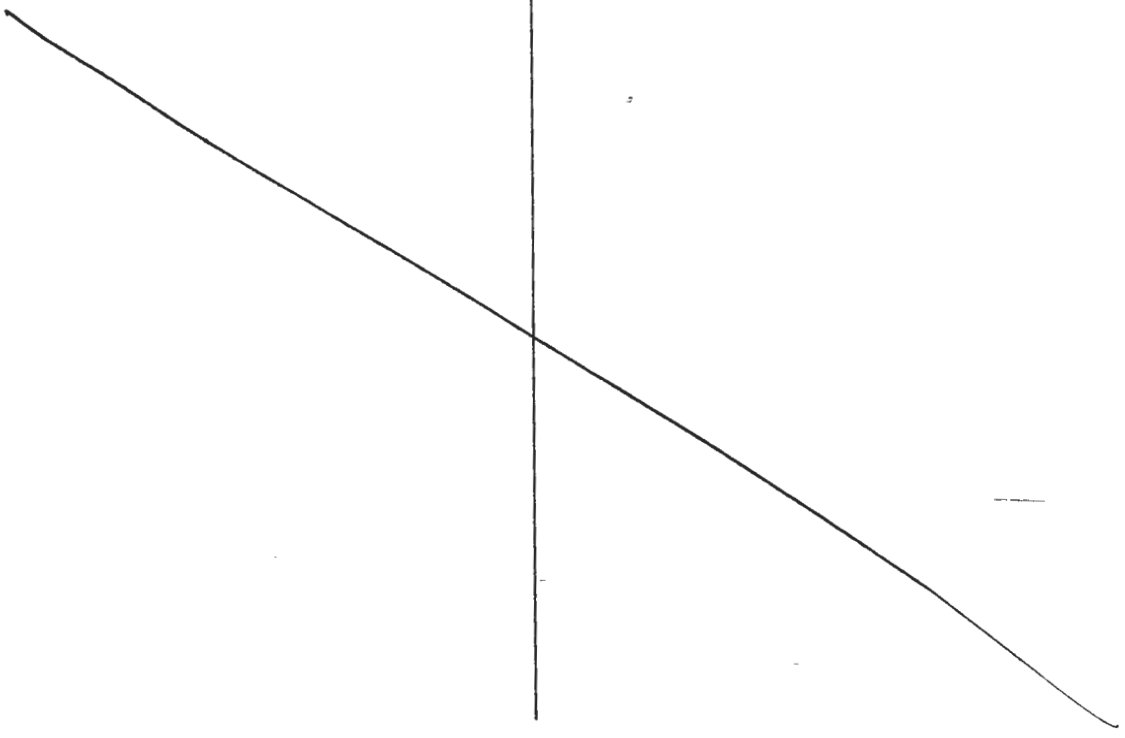
Name JA Lerch Date 11/24/91

QC Check: duplicates

COMMENTS: all duplicate RPD's < 10%

ACTION: none

sample #	constituent	value/qual	sample #	constituent	value/qual



RCRA LEVEL C QC

Name JA Lerch JL Date 11/24/91

QC Check: Calibration

COMMENTS: all calibration verification std recoveries within acceptable limits

ACTION: none

sample #	constituent	value/qual	sample #	constituent	value/qual

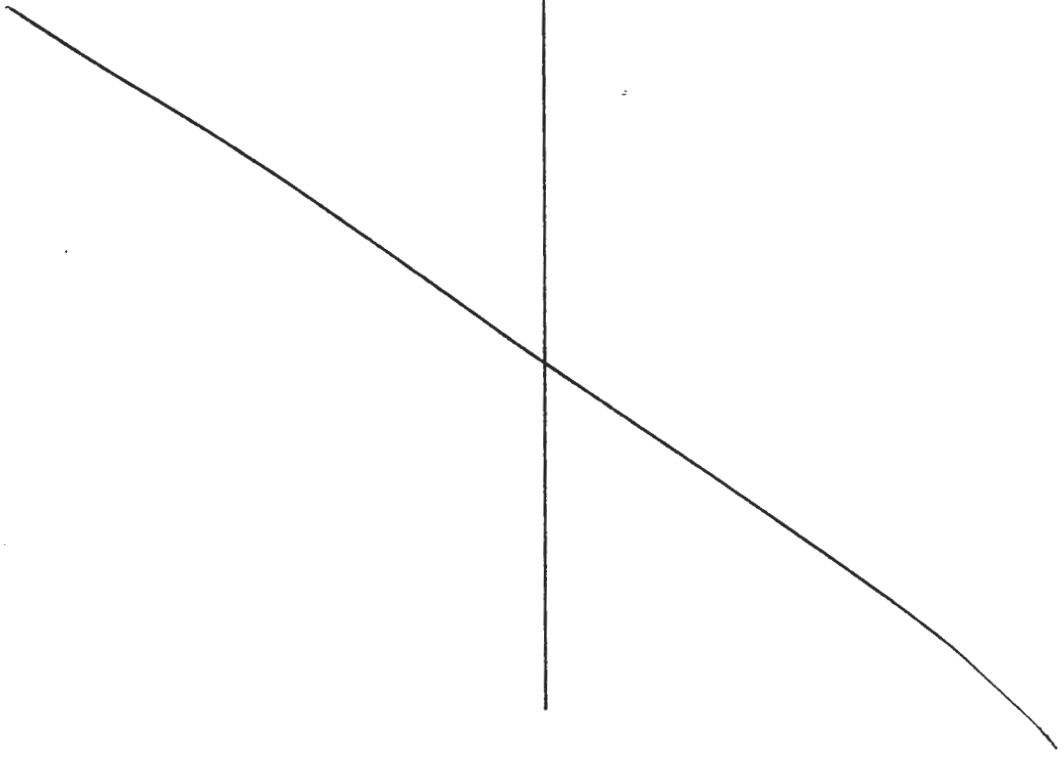


TABLE 3: TOTAL CYANIDE ANALYSIS DATA
SDG #5

Sample ID#	PNL Log#	G1 Sample (ug/L)	C	G2 Sample dup. (ug/L)	C	%RPD	G5 Blank (ug/L)	C	G3 Sample+ spike (ug/L)	G4 - ICV (mg/L)	G3 Sample+ spike recovery (%)	G4 - ICV sample recovery (%)	Flags Q	Footnote#
														1,2,3, 4, 5 (ALL)
B00F68	91-2979	5.9	U	5.9	U	N/A	5.9	U	85.4	9.93	102.6	105.7		
B00F75	91-2980	5.9	U											
B00F78	91-2981	5.9	U	5.9	U	N/A	5.9	U	105.9	9.7	95.9	103.2		
B00FH2	91-2990	5.9	U											
B00F84	91-3133	5.9	U	5.9	U	N/A	5.9	U	90.0	10.58	95.9	112.6		
											---	---		
										Mean	98.1	107.2		
										Std. Dev.	3.2	4.0		

1. Concentration of stock ICV-6=9.4 mg/L (9.4 ug of cyanide is added to each distillation flask and recovered in 250 mL of NaOH).
2. Concentration of spike added = 90.6 ug/L.
3. Contract required detection limit for water = 10 ug/L.
4. Used 250 mL of sample per distillation for samples G1, G2 and G3 due to limited sample size of 1.5L of total sample.
5. Duplicate precision under the CLP protocol must be within one CRDL when either sample or duplicate are below 5X CRDL.

CLP "C" FLAGS

U = Analyzed but not detected (IDL or less than IDL)
B = less that CRDL but greater than or equal to IDL

CLP "Q" FLAGS

N = Spiked sample recovery not within control limits
* = Duplicate analysis not within control limits

TABLE 2: TOTAL CYANIDE ANALYSIS DATA
SDG #4

Sample ID#	PNL Log#	G1 Sample (ug/L)	C	G2 Sample dup. (ug/L)	C	%RPD	G5 Blank (ug/L)	C	G3 Sample+ spike (ug/L)	G4 - ICV (mg/L)	G3 Sample+ spike recovery (%)	G4 - ICV sample recovery (%)	Flags Q	Footnote#
														1,2,3, 4, 5 (ALL)
B00FB3	91-2707	9.2	B	8.8	B	3.86	5.9	U	99.6	10.82	100.1	115.1		
B00F54	91-2710	5.9	U											
B00F93	91-2808	5.9	U	5.9	U	N/A	5.9	U	94.1	10.65	102.4	113.3		
B00FB0	91-2809	5.9	U											
B00FD0	91-2711	7.4	B	7.0	B	4.82	5.9	U	98.3	10.14	99.7	107.8		
B00FB8	91-2780	12.3		11.6		5.84	5.9	U	97.9	10.14	105.7	107.8		
B00F90	91-2781	11.6												
B00FB6	91-2859	14.7		14.3		2.6	5.9	U	103	9.62	102.6	102.3		
B00FC4	91-2860	5.9	U											
											---	---		
										Mean	102.1	109.3		
										Std. Dev.	2.1	4.5		

1. Concentration of stock ICV-6 = 9.4 mg/L(9.4 ug of cyanide is added to each distillation flask and recovered in 250 mL of NaOH).
2. Concentration of spike added = 90.6 ug/L.
3. Contract required detection limit for water = 10 ug/L.
4. Used 250 mL of sample per distillation for sample G1, G2 and G3 due to limited sample size of 1.5L of total sample.
5. Duplicate precision under the CLP protocol must be within one CRDL when either sample or duplicate are below 5X CRDL.

CLP "C" FLAGS

U = Analyzed but not detected (IDL or less than IDL)
B = Less than CRDL but greater than or equal to IDL.

CLP "Q" FLAGS

N = Spiked sampe recovery not within control limits
* = duplicate analysis not within control limits