

ENVIRONMENTAL SAMPLE DATA

1st Quarter 1990

PETROTOMICS COMPANY
Shirley Basin, WY

9010040035 900830
PDR ADCK 04006659
C PDC

1. STACK SAMPLES

No discharge stacks present - Deleted by Amendment No. 21

2. AIR SAMPLES

LOCATIONS: Site 1 - 7800' WNW of where yellowcake dryer stack had been located. Rn-222 only -
 Amendment No. 21.
 Site 2 - Discontinued - Amendment No. 21.
 Site 3 - Discontinued - Amendment No. 21.
 Site 4 - Discontinued - Amendment No. 21.
 Site 5 - 2000' NE of where yellowcake dryer stack had been located.
 Site 6 - Discontinued - Amendment No. 21.

DATE COLLECTED: 1st Quarter 1990
 LOCATION: Site 1

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> (uCi/ml)	<u>ERROR ESTIMATE</u> (uCi/ml)	<u>LLD</u> (uCi/ml)	<u>MPC</u>
Rn-222	0.70 X 10 ⁻⁹	± 0.16 X 10 ⁻⁹	0.2 X 10 ⁻⁹	23.33

DATE COLLECTED: 1st Quarter 1990
 LOCATION: Site 5

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> (uCi/ml)	<u>ERROR ESTIMATE</u> (uCi/ml)	<u>LLD</u> (uCi/ml)	<u>MPC</u>
U-nat	0.56 X 10 ⁻¹⁵		2.0 X 10 ⁻¹⁹	<0.01
Th-230	0.36 X 10 ⁻¹⁵	± 0.08 X 10 ⁻¹⁵	1.0 X 10 ⁻¹⁶	0.15
Ra-226	0.08 X 10 ⁻¹⁵	± 0.03 X 10 ⁻¹⁵	0.2 X 10 ⁻¹⁷	<0.01
Pb-210	0.27 X 10 ⁻¹⁵	± 0.06 X 10 ⁻¹⁵	3.0 X 10 ⁻¹⁶	0.01
Rn-222	1.10 X 10 ⁻⁹	± 0.11 X 10 ⁻⁹	0.2 X 10 ⁻⁹	36.67

3. LIQUID SAMPLES

DATE COLLECTED: March 6, 1930
 LOCATION: Mine Shop (el)
 TYPE OF SAMPLE: Groundwater - Pumped

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> (<u>uCi/ml</u>)	<u>ERROR ESTIMATE</u> (<u>uCi/ml</u>)	<u>LTD</u> (<u>uCi/ml</u>)
U-rat (Dissolved)	2.71 X 10 ⁻⁹	± 0.90 X 10 ⁻⁹	10.0 X 10 ⁻¹⁰
U-Nat (Suspended)	2.71 X 10 ⁻⁹	± 0.94 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Th-230 (Dissolved)	2.13 X 10 ⁻⁹	± 0.26 X 10 ⁻⁹	1.0 X 10 ⁻¹⁰
Th-230 (Suspended)	2.53 X 10 ⁻⁹	± 0.16 X 10 ⁻⁹	1.0 X 10 ⁻¹⁰
Ra-226 (Dissolved)	1.21 X 10 ⁻⁹	± 2.37 X 10 ⁻⁹	2.0 X 10 ⁻⁹
Ra-226 (Suspended)	0.32 X 10 ⁻⁹	± 6.14 X 10 ⁻⁹	2.0 X 10 ⁻⁹
Ra-228 (Dissolved)	0.00 X 10 ⁻⁹	± 1.60 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Ra-228 (Suspended)	0.00 X 10 ⁻⁹	± 1.80 X 10 ⁻⁹	2.0 X 10 ⁻⁹
Pb-210 (Dissolved)	0.36 X 10 ⁻⁹	± 0.45 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Pb-210 (Suspended)	0.17 X 10 ⁻⁹	± 0.62 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Po-210 (Dissolved)	0.00 X 10 ⁻⁹		
Po-210 (Suspended)	0.12 X 10 ⁻⁹		

* Samples not run.



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6756 West Uranium Road
Casper, Wyoming 82604
307/234-5511

76 Imperial Drive, Unit I
Evanston, Wyoming 82630
307/789-6420

Client: Petrotomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615
Attention: Steve Pfaff

Lab #: 90-1871

Sample Type : Water
Submitted By: Steve Pfaff
Analyzed By : TM, JPM, GLH, NB

Date Sampled : 03-06-90
Date Submitted: 03-06-90
Date Analyzed : 04-26-90

Sample Identification: Mine Shop Well (W18418)

Parameter	mg/L	Parameter	Dissolved mg/L	Suspended mg/L
Total Diss. Solids	446	Aluminum (Al)	<0.1	
Total Hardness (as CaCO3)	22.0	Arsenic (As)	0.004	
Conductivity @25C, umho/cm	650	Barium (Ba)	<0.05	
Sodium (Na)	144	Cadmium (Cd)	<0.01	
Potassium (K)	3.5	Chromium (Cr)	<0.01	
Calcium (Ca)	3.7	Copper (Cu)	<0.01	
Magnesium (Mg)	3.2	Iron (Fe)	<0.03	
Chloride (Cl)	5.5	Lead (Pb)	0.06	
Sulfate (SO4)	216	Manganese (Mn)	<0.01	
Bicarbonate (HCO3)	112	Mercury (Hg)	<0.001	
Carbonate (CO3)	26.9	Molybdenum (Mo)	<0.05	
pH, units	9.33	Nickel (Ni)	<0.04	
Boron (B)	0.20	Selenium (Se)	<0.001	
Fluoride (F)	0.62	Uranium (U)	0.004	0.004
Nitrate (NO3 as N)	0.14	Vanadium (V)	<0.5	
Ammonia (NH3 as N)	0.39	Zinc (Zn)	<0.01	

	Dissolved		Suspended	
	pCi/L	LLD uCi/ml	pCi/L	LLD uCi/ml
Radium 226	1.21 ± 0.26	1x10E-10	0.32 ± 0.16	1x10E-10
Radium 228	0.00 ± 2.37	2x10E-9	0.00 ± 6.14	2x10E-9
Thorium 230	2.13 ± 0.90	1x10E-9	2.53 ± 0.94	1x10E-9
Lead 210	0.36 ± 1.60	1x10E-9	0.17 ± 1.80	2x10E-9
Polonium 210	0.00 ± 0.45	1x10E-9	0.12 ± 0.62	1x10E-9

Steve Pfaff
Analyst

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307/789-6420

Client: Petrotomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615
Attention: Steve Pfaff

Lab #: 90-1871

Sample Type : Water
Submitted By: Steve Pfaff
Analyzed By : TM, JPM, GLH, NB

Date Sampled : 03-06-90
Date Submitted: 03-06-90
Date Analyzed : 04-26-90

Sample Identification: Mine Shop Well (W18418)

Parameter	mg/L	Parameter	Dissolved mg/L	Suspended mg/L
Total Diss. Solids	446	Aluminum (Al)	<0.1	
Total Hardness (as CaCO3)	22.0	Arsenic (As)	0.004	
Conductivity @25C, umho/cm	650	Barium (Ba)	<0.05	
Sodium (Na)	144	Cadmium (Cd)	<0.01	
Potassium (K)	3.5	Chromium (Cr)	<0.01	
Calcium (Ca)	3.7	Copper (Cu)	<0.01	
Magnesium (Mg)	3.2	Iron (Fe)	<0.03	
Chloride (Cl)	5.5	Lead (Pb)	0.06	
Sulfate (SO4)	216	Manganese (Mn)	<0.01	
Bicarbonate (HCO3)	112	Mercury (Hg)	<0.001	
Carbonate (CO3)	26.9	Molybdenum (Mo)	<0.05	
pH, units	9.33	Nickel (Ni)	<0.04	
Boron (B)	0.20	Selenium (Se)	<0.001	
Fluoride (F)	0.62	Uranium (U)	0.004	0.004
Nitrate (NO3 as N)	0.14	Vanadium (V)	<0.5	
Ammonia (NH3 as N)	0.39	Zinc (Zn)	<0.01	

	Dissolved		Suspended	
	pCi/L	LLD uCi/ml	pCi/L	LLD uCi/ml
Radium 226	1.21 ± 0.26	1x10E-10	0.32 ± 0.16	1x10E-10
Radium 228	0.00 ± 2.37	2x10E-9	0.00 ± 6.14	2x10E-9
Thorium 230	2.13 ± 0.90	1x10E-9	2.53 ± 0.94	1x10E-9
Lead 210	0.36 ± 1.60	1x10E-9	0.17 ± 1.80	2x10E-9
Polonium 210	0.00 ± 0.45	1x10E-9	0.12 ± 0.62	1x10E-9

Janet P. Meador

Analyst

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: March 5, 1990
 LOCATION: 1-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> (uCi/ml)	<u>ERROR ESTIMATE</u> (uCi/ml)	<u>LLD</u> (uCi/ml)
U-nat	8.80 X 10 ⁻⁹		
Th-230	0.59 X 10 ⁻⁹	± 0.68 X 10 ⁻⁹	1 X 10 ⁻⁹
Ra-226	1.96 X 10 ⁻⁹	± 0.28 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	1.70 X 10 ⁻⁹	± 1.97 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	0.67 X 10 ⁻⁹	± 1.69 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.12 X 10 ⁻⁹	± 0.33 X 10 ⁻⁹	1 X 10 ⁻⁹

DATE COLLECTED: March 5, 1990
 LOCATION: 3-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> (uCi/ml)	<u>ERROR ESTIMATE</u> (uCi/ml)	<u>LLD</u> (uCi/ml)
U-nat	216.64 X 10 ⁻⁹		
Th-230	0.20 X 10 ⁻⁹	± 0.51 X 10 ⁻⁹	8 X 10 ⁻¹⁰
Ra-226	2.85 X 10 ⁻⁹	± 0.34 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	4.21 X 10 ⁻⁹	± 2.14 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	1.07 X 10 ⁻⁹	± 2.05 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.21 X 10 ⁻⁹	± 0.50 X 10 ⁻⁹	1 X 10 ⁻⁹



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307/789-6420

Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1870-1

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

1 SC (W18402)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	1786	Boron (B)	0.06
TDS (Observed)	2029	Cadmium (Cd)	<0.01
Conductivity @25c, umho/cm	2044	Chromium (Cr)	0.03
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.01
Tot. Hardness (as CaCO3)	1550	Fluoride (F)	0.46
Sodium (Na, Calculated)	96.0	Iron (Fe)	0.07
Sodium (Na, Observed)	63.5	Lead (Pb)	0.06
Potassium (K)	11.5	Manganese (Mn)	1.81
Calcium (Ca)	311	Mercury (Hg)	<0.001
Magnesium (Mg)	91	Molybdenum (Mo)	<0.05
Chloride (Cl)	88.5	Nickel (Ni)	0.11
Sulfate (SO4)	1200	Nitrate (NO3 as N)	0.61
Bicarbonate (HCO3)	0	Selenium (Se)	<0.001
Carbonate (CO3)	0	Uranium (U)	0.013
pH, Units	4.24	Vanadium (V)	<0.5
Aluminum (Al)	13.5	Zinc (Zn)	0.17
Ammonia (NH3 as N)	0.58		
Arsenic (As)	0.007		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	1.96 ± 0.28	1x10E-10
Radium 228	1.70 ± 1.97	2x10E-9
Thorium 230	0.59 ± 0.68	1x10E-9
Lead 210	0.67 ± 1.69	2x10E-9
Polonium 210	0.12 ± 0.33	1x10E-9

Steve Pfaff
Analyst



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Client: Patrotomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90 870-3

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

3 SC (W18404)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	6141	Boron (B)	<0.05
TDS (Observed)	7189	Cadmium (Cd)	0.06
Conductivity @25c,umho/cm	6620	Chromium (Cr)	0.03
Tot.Alkalinity (%s CaCO3)	0	Copper (Cu)	0.02
Tot. Hardness (as CaCO3)	3878	Fluoride (F)	3.03
Sodium (Na, Calculated)	467	Iron (Fe)	0.04
Sodium (Na, Observed)	477	Lead (Pb)	0.06
Potassium (K)	41.9	Manganese (Mn)	28.8
Calcium (Ca)	555	Mercury (Hg)	<0.001
Magnesium (Mg)	606	Molybdenum (Mo)	<0.05
Chloride (Cl)	430	Nickel (Ni)	0.80
Sulfate (SO4)	3800	Nitrate (NO3 as N)	7.71
Bicarbonate (HCO3)	470	Selenium (Se)	0.002
Carbonate (CO3)	0	Uranium (U)	0.320
pH, Units	6.76	Vanadium (V)	<0.5
Aluminum (Al)	0.3	Zinc (Zn)	0.64
Ammonia (NH3 as N)	7.55		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	2.85 ± 0.34	2x10E-10
Radium 228	4.21 ± 2.14	2x10E-9
Thorium 230	0.20 ± 0.51	8x10E-10
Lead 210	1.07 ± 2.05	3x10E-9
Polonium 210	0.21 ± 0.50	1x10E-9

Steve Pfaff

Analyst

2. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: March 5, 1990
 LOCATION: 4-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci}/\text{ml}$)	ERROR ESTIMATE ($\mu\text{Ci}/\text{ml}$)	LLD ($\mu\text{Ci}/\text{ml}$)
C-nat	129.31 X 10 ⁻⁹		
Th-230	0.48 X 10 ⁻⁹	± 0.69 X 10 ⁻⁹	10 X 10 ⁻¹⁰
Ra-226	6.35 X 10 ⁻⁹	± 0.46 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	9.57 X 10 ⁻⁹	± 2.63 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	2.99 X 10 ⁻⁹	± 2.02 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.37 X 10 ⁻⁹	± 0.48 X 10 ⁻⁹	1 X 10 ⁻⁹

DATE COLLECTED: March 5, 1990
 LOCATION: 5-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci}/\text{ml}$)	ERROR ESTIMATE ($\mu\text{Ci}/\text{ml}$)	LLD ($\mu\text{Ci}/\text{ml}$)
C-nat	13607.70 X 10 ⁻⁹		
Th-230	1113.00 X 10 ⁻⁹	± 112.00 X 10 ⁻⁹	5 X 10 ⁻¹⁰
Ra-226	1.11 X 10 ⁻⁹	± 0.20 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	0.28 X 10 ⁻⁹	± 2.16 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	0.07 X 10 ⁻⁹	± 3.41 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.12 X 10 ⁻⁹	± 0.95 X 10 ⁻⁹	2 X 10 ⁻⁹



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Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1870-4

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

4 SC (W18405)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	4778	Boron (B)	0.15
TDS (Observed)	5325	Cadmium (Cd)	0.02
Conductivity @25°C, umho/cm	5080	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO ₃)	4.0	Copper (Cu)	0.03
Tot. Hardness (as CaCO ₃)	2996	Fluoride (F)	2.06
Sodium (Na, Calculated)	360	Iron (Fe)	<0.03
Sodium (Na, Observed)	342	Lead (Pb)	<0.05
Potassium (K)	21.9	Manganese (Mn)	6.20
Calcium (Ca)	513	Mercury (Hg)	<0.001
Magnesium (Mg)	417	Molybdenum (Mo)	<0.05
Chloride (Cl)	482	Nickel (Ni)	0.51
Sulfate (SO ₄)	3000	Nitrate (NO ₃ as N)	24.4
Bicarbonate (HCO ₃)	5.0	Selenium (Se)	<0.001
Carbonate (CO ₃)	0	Uranium (U)	0.191
pH, Units	4.82	Vanadium (V)	<0.5
Aluminum (Al)	7.6	Zinc (Zn)	0.70
Ammonia (NH ₃ as N)	0.11		
Arsenic (As)	0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	6.35 ± 0.48	1x10E-10
Radium 228	9.57 ± 2.63	2x10E-9
Thorium 230	0.48 ± 0.61	1x10E-9
Lead 210	2.99 ± 2.02	3x10E-9
Polonium 210	0.37 ± 0.48	1x10E-9

Steve Pfaff
Analyst



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Client: Petrotoomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1870-5

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

SC (W18406)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	21458	Boron (B)	<0.05
TDS (Observed)	25331	Cadmium (Cd)	0.12
Conductivity @25c, umho/cm	12800	Chromium (Cr)	1.97
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	1.15
Tot. Hardness (as CaCO3)	5400	Fluoride (F)	0.95
Sodium (Na, Calculated)	1553	Iron (Fe)	1303
Sodium (Na, Observed)	418	Lead (Pb)	0.24
Potassium (K)	4.6	Manganese (Mn)	86.8
Calcium (Ca)	439	Mercury (Hg)	<0.001
Magnesium (Mg)	1046	Molybdenum (Mo)	<0.05
Chloride (Cl)	348	Nickel (Ni)	3.74
Sulfate (SO4)	16600	Nitrate (NO3 as N)	0.43
Bicarbonate (HCO3)	0	Selenium (Se)	0.155
Carbonate (CO3)	0	Uranium (U)	20.1
pH, Units	3.27	Vanadium (V)	12.0
Aluminum (Al)	1013	Zinc (Zn)	9.65
Ammonia (NH3 as N)	286		
Arsenic (As)	0.002		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	1.11 ± 0.20	1x10E-10
Radium 228	0.28 ± 0.16	2x10E-9
Thorium 230	1413 ± 112	5x10E-8
Lead 210	0.07 ± 3.41	4x10E-9
Polonium 210	0.12 ± 0.95	2x10E-9

Steve Pfaff

Analyst

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: March 5, 1990
 LOCATION: 39-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	67.02 X 10 ⁻⁹		
Th-230	0.55 X 10 ⁻⁹	± 0.34 X 10 ⁻⁹	8 X 10 ⁻¹⁰
Ra-226	2.33 X 10 ⁻⁹	± 0.29 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	1.78 X 10 ⁻⁹	± 2.77 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	4.04 X 10 ⁻⁹	± 2.21 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.44 X 10 ⁻⁹	± 0.62 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: March 5, 1990
 LOCATION: 40-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	1.35 X 10 ⁻⁹		
Th-230	1.07 X 10 ⁻⁹	± 2.64 X 10 ⁻⁹	9 X 10 ⁻¹⁰
Ra-226	0.87 X 10 ⁻⁹	± 0.18 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	1.80 X 10 ⁻⁹	± 2.64 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	0.31 X 10 ⁻⁹	± 1.49 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.09 X 10 ⁻⁹	± 0.37 X 10 ⁻⁹	1 X 10 ⁻⁹



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Client: Petrochemicals Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1870-6

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

39 SC (W18407)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	3065	Boron (B)	0.13
TDS (Observed)	3359	Cadmium (Cd)	0.02
Conductivity @25c,umho/cm	2970	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO3)	4.0	Copper (Cu)	0.03
Tot. Hardness (as CaCO3)	2077	Fluoride (F)	1.88
Sodium (Na, Calculated)	135	Iron (Fe)	0.04
Sodium (Na, Observed)	97.1	Lead (Pb)	<0.05
Potassium (K)	14.1	Manganese (Mn)	2.56
Calcium (Ca)	458	Mercury (Hg)	<0.001
Magnesium (Mg)	227	Molybdenum (Mo)	<0.05
Chloride (Cl)	66.6	Nickel (Ni)	0.35
Sulfate (SO4)	2200	Nitrate (NO3 as N)	3.18
Bicarbonate (HCO3)	5.0	Selenium (Se)	<0.001
Carbonate (CO3)	0	Uranium (U)	0.099
pH, Units	4.86	Vanadium (V)	<0.5
Aluminum (Al)	5.0	Zinc (Zn)	0.39
Ammonia (NH3 as N)	<0.10		
Arsenic (As)	0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	2.33 ± 0.29	1x10E-10
Radium 228	1.78 ± 2.77	2x10E-9
Thorium 230	0.55 ± 0.54	8x10E-10
Lead 210	4.04 ± 2.21	3x10E-9
Polonium 210	0.44 ± 0.62	2x10E-9

Steve Pfaff

Analyst

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76 Imperial Drive, Unit 1
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307/789-6420

Client: Petrochemicals Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1870-7

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

40 SC (W18408)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	1805	Boron (B)	0.06
TDS (Observed)	1922	Cadmium (Cd)	<0.01
Conductivity @25c, umho/cm	2170	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO3)	144	Copper (Cu)	<0.01
Tot. Hardness (as CaCO3)	1156	Fluoride (F)	0.15
Sodium (Na, Calculated)	112	Iron (Fe)	0.04
Sodium (Na, Observed)	101	Lead (Pb)	<0.05
Potassium (K)	23.1	Manganese (Mn)	0.04
Calcium (Ca)	323	Mercury (Hg)	<0.001
Magnesium (Mg)	85	Molybdenum (Mo)	<0.05
Chloride (Cl)	137	Nickel (Ni)	0.09
Sulfate (SO4)	1050	Nitrate (NO3 as N)	1.02
Bicarbonate (HCO3)	175	Selenium (Se)	<0.001
Carbonate (CO3)	0	Uranium (U)	0.002
pH, Units	7.20	Vanadium (V)	<0.5
Aluminum (Al)	<0.1	Zinc (Zn)	<0.01
Ammonia (NH3 as N)	0.25		
Arsenic (As)	0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	0.87 ± 0.18	2x10E-10
Radium 228	1.80 ± 2.64	2x10E-9
Thorium 230	1.07 ± 0.62	9x10E-10
Lead 210	0.31 ± 1.49	2x10E-9
Polonium 210	0.09 ± 0.37	1x10E-9

Steve Pfaff

Analyst

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: March 1, 1990
 LOCATION: 41-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> <u>(uCi/ml)</u>	<u>ERROR ESTIMATE</u> <u>(uCi/ml)</u>	<u>LLD</u> <u>(uCi/ml)</u>
U-nat	165.19 X 10 ⁻⁹		
Th-230	0.00 X 10 ⁻⁹	± 0.42 X 10 ⁻⁹	7 X 10 ⁻¹⁰
Ra-226	0.67 X 10 ⁻⁹	± 0.16 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	1.06 X 10 ⁻⁹	± 2.58 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	1.17 X 10 ⁻⁹	± 1.89 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.19 X 10 ⁻⁹	± 0.44 X 10 ⁻⁹	1 X 10 ⁻⁹

DATE COLLECTED: March 3, 1990
 LOCATION: 42-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> <u>(uCi/ml)</u>	<u>ERROR ESTIMATE</u> <u>(uCi/ml)</u>	<u>LLD</u> <u>(uCi/ml)</u>
U-nat	1855.00 X 10 ⁻⁹		
Th-230	3058.00 X 10 ⁻⁹	±152.00 X 10 ⁻⁹	300 X 10 ⁻¹⁰
Ra-226	2.53 X 10 ⁻⁹	± 0.31 X 10 ⁻⁹	3 X 10 ⁻¹⁰
Ra-228	28.99 X 10 ⁻⁹	± 4.00 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	4.11 X 10 ⁻⁹	± 3.25 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.27 X 10 ⁻⁹	± 0.90 X 10 ⁻⁹	2 X 10 ⁻⁹



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Client: Petrochemicals Company
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Attention: Steve Pfaff

Lab Number : 90-1870-8

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

41 SC (W18409)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	2164	Boron (B)	0.11
TDS (Observed)	2437	Cadmium (Cd)	<0.01
Conductivity @25c, umho/cm	2630	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO3)	203	Copper (Cu)	0.01
Tot. Hardness (as CaCO3)	1428	Fluoride (F)	0.22
Sodium (Na, Calculated)	137	Iron (Fe)	<0.03
Sodium (Na, Observed)	136	Lead (Pb)	<0.05
Potassium (K)	7.4	Manganese (Mn)	0.05
Calcium (Ca)	462	Mercury (Hg)	<0.001
Magnesium (Mg)	67	Molybdenum (Mo)	<0.05
Chloride (Cl)	290	Nickel (Ni)	0.06
Sulfate (SO4)	1080	Nitrate (NO3 as N)	2.96
Bicarbonate (HCO3)	248	Selenium (Se)	0.001
Carbonate (CO3)	0	Uranium (U)	0.244
pH, Units	7.11	Vanadium (V)	<0.5
Aluminum (Al)	<0.1	Zinc (Zn)	<0.01
Ammonia (NH3 as N)	<0.10		
Arsenic (As)	0.003		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	0.67 ± 0.16	1x10E-10
Radium 228	1.06 ± 2.58	2x10E-9
Thorium 230	0.00 ± 0.42	7x10E-10
Lead 210	1.17 ± 1.89	2x10E-9
Polonium 210	0.19 ± 0.44	1x10E-9

Steve Pfaff

Analyst

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Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1870-9

Submitted By: Steve Pfaff
Analyzed By: G.H., NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

42 SC (W18410)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	4737	Boron (B)	<0.05
TDS (Observed)	5241	Cadmium (Cd)	0.03
Conductivity @25c, umho/cm	4800	Chromium (Cr)	0.53
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.27
Tot. Hardness (as CaCO3)	1916	Fluoride (F)	0.77
Sodium (Na, Calculated)	398	Iron (Fe)	52
Sodium (Na, Observed)	122	Lead (Pb)	0.06
Potassium (K)	5.0	Manganese (Mn)	20.8
Calcium (Ca)	433	Mercury (Hg)	<0.001
Magnesium (Mg)	203	Molybdenum (Mo)	<0.05
Chloride (Cl)	139	Nickel (Ni)	0.72
Sulfate (SO4)	3560	Nitrate (NO3 as N)	0.38
Bicarbonate (HCO3)	0	Selenium (Se)	<0.001
Carbonate (CO3)	0	Uranium (U)	2.74
pH, Units	3.52	Vanadium (V)	0.90
Aluminum (Al)	115	Zinc (Zn)	1.45
Ammonia (NH3 as N)	108		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	2.53 ± 0.31	3x10E-10
Radium 228	28.9 ± 4.0	2x10E-9
Thorium 230	3058 ± 152	3x10E-8
Lead 210	4.11 ± 3.25	4x10E-9
Polonium 210	0.27 ± 0.90	2x10E-9

Steve P. Pfaff

Analyst

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: February 27, 1990
 LOCATION: 42-SC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	9004.10 X 10 ⁻⁹		
Th-230	4280.00 X 10 ⁻⁹	± 68.00 X 10 ⁻⁹	100 X 10 ⁻¹⁰
Ra-226	1.56 X 10 ⁻⁹	± 0.25 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	1.77 X 10 ⁻⁹	± 2.70 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	3.27 X 10 ⁻⁹	± 4.15 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.78 X 10 ⁻⁹	± 0.95 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: March 5, 1990
 LOCATION: 44-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	2809.55 X 10 ⁻⁹		
Th-230	1029.00 X 10 ⁻⁹	± 68.00 X 10 ⁻⁹	300 X 10 ⁻¹⁰
Ra-226	0.38 X 10 ⁻⁹	± 0.12 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	4.35 X 10 ⁻⁹	± 2.14 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	1.81 X 10 ⁻⁹	± 3.33 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.45 X 10 ⁻⁹	± 0.89 X 10 ⁻⁹	2 X 10 ⁻⁹



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Attention: Steve Pfaff

Lab Number : 90-1860-1

Submitted By: Hydro Engineering
Analyzed By: TM, GLH, JPM

Date Submitted: 02-27-90
Date Analyzed : 04-04-90

Well 43SC
Sample taken 2-27-90

	mg/l		mg/l
TDS (Calculated)	20545	Boron (B)	0.12
TDS (Observed)	24292	Cadmium (Cd)	0.10
Conductivity @25c, umho/cm	12090	Chromium (Cr)	2.15
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	1.13
Tot. Hardness (as CaCO3)	6250	Fluoride (F)	0.74
Sodium (Na, Calculated)	1311	Iron (Fe)	1186
Sodium (Na, Observed)	397	Lead (Pb)	0.33
Potassium (K)	3.7	Manganese (Mn)	73.4
Calcium (Ca)	458	Mercury (Hg)	<0.001
Magnesium (Mg)	1003	Molybdenum (Mo)	0.07
Chloride (Cl)	343	Nickel (Ni)	2.74
Sulfate (SO4)	15100	Nitrate (NO3 as N)	0.20
Bicarbonate (HCO3)	0	Selenium (Se)	0.147
Carbonate (CO3)	0	Uranium (U)	13.3
pH, Units	2.92	Vanadium (V)	12.3
Aluminum (Al)	921	Zinc (Zn)	9.84
Ammonia (NH3 as N)	233		
Arsenic (As)	0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	1.56 ± 0.25	2x10E-10
Radium 228	1.77 ± 2.70	1x10E-9
Thorium 230	4280 ± 68	1x10E-8
Lead 210	3.27 ± 4.15	4x10E-9
Polonium 210	0.78 ± 0.95	2x10E-9

Steve P. Meador
Analyst



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Client: Petrochemicals Company
 Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
 Attention: Steve Pfaff

Lab Number : 90-1870-10

Submitted By: Steve Pfaff
 Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
 Date Analyzed : 05-02-90

44 SC (W18411)
 Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	17897	Boron (B)	<0.05
TDS (Observed)	22399	Cadmium (Cd)	0.09
Conductivity @25c,umho/cm	13200	Chromium (Cr)	1.20
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.62
Tot. Hardness (as CaCO3)	3967	Fluoride (F)	0.66
Sodium (Na, Calculated)	1147	Iron (Fe)	1632
Sodium (Na, Observed)	346	Lead (Pb)	0.22
Potassium (K)	19.5	Manganese (Mn)	84.3
Calcium (Ca)	277	Mercury (Hg)	<0.001
Magnesium (Mg)	796	Molybdenum (Mo)	<0.05
Chloride (Cl)	323	Nickel (Ni)	3.14
Sulfate (SO4)	13500	Nitrate (NO3 as N)	0.51
Bicarbonate (HCO3)	0	Selenium (Se)	0.145
Carbonate (CO3)	0	Uranium (U)	4.15
pH, Units	2.82	Vanadium (V)	5.4
Aluminum (Al)	764	Zinc (Zn)	6.77
Ammonia (NH3 as N)	239		
Arsenic (As)	0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	0.38 ± 0.12	1x10E-10
Radium 228	4.35 ± 2.14	2x10E-9
Thorium 230	1029 ± 68	3x10E-8
Lead 210	1.81 ± 3.33	4x10E-9
Polonium 210	0.45 ± 0.89	2x10E-9

Steve Pfaff
 Analyst

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3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: March 5, 1990
 LOCATION: 45-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	454.27 X 10 ⁻⁹		
Th-230	692.00 X 10 ⁻⁹	± 37.00 X 10 ⁻⁹	200 X 10 ⁻¹⁰
Ra-226	3.89 X 10 ⁻⁹	± 0.35 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	43.70 X 10 ⁻⁹	± 5.10 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	2.31 X 10 ⁻⁹	± 4.00 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.12 X 10 ⁻⁹	± 1.13 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: February 27, 1990
 LOCATION: 49-SC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	36.56 X 10 ⁻⁹		
Th-230	0.00 X 10 ⁻⁹	± 2.00 X 10 ⁻⁹	40 X 10 ⁻¹⁰
Ra-226	6.43 X 10 ⁻⁹	± 0.49 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	45.70 X 10 ⁻⁹	± 8.90 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	1.97 X 10 ⁻⁹	± 2.22 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.39 X 10 ⁻⁹	± 0.92 X 10 ⁻⁹	2 X 10 ⁻⁹



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Attention: Steve Pfaff

Lab Number : 90-1870-11

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

45 SC (W18412)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	21255	Boron (B)	<0.05
TDS (Observed)	27642	Cadmium (Cd)	0.07
Conductivity @25c, umho/cm	13900	Chromium (Cr)	0.77
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.06
Tot. Hardness (as CaCO3)	6412	Fluoride (F)	1.02
Sodium (Na, Calculated)	1079	Iron (Fe)	1805
Sodium (Na, Observed)	477	Lead (Pb)	0.22
Potassium (K)	22.5	Manganese (Mn)	111
Calcium (Ca)	239	Mercury (Hg)	<0.001
Magnesium (Mg)	1413	Molybdenum (Mo)	<0.05
Chloride (Cl)	352	Nickel (Ni)	4.90
Sulfate (SO4)	16000	Nitrate (NO3 as N)	0.38
Bicarbonate (HCO3)	0	Selenium (Se)	0.047
Carbonate (CO3)	0	Uranium (U)	0.671
pH, Units	3.51	Vanadium (V)	3.3
Aluminum (Al)	881	Zinc (Zn)	5.38
Ammonia (NH3 as N)	65.6		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	3.89 ± 0.35	1x10E-10
Radium 228	43.7 ± 5.1	2x10E-9
Thorium 230	692 ± 37	2x10E-8
Lead 210	2.31 ± 4.00	4x10E-9
Polonium 210	0.12 ± 1.13	2x10E-9

Steve Pfaff

Analyst



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Client: Petrotoomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1860-2

Submitted By: Hydro Engineering
Analyzed By: TM, GLH, JPM

Date Submitted: 02-27-90
Date Analyzed : 04-04-90

Well 49SC
Sample taken 2-27-90

	mg/l		mg/l
TDS (Calculated)	9053	Boron (B)	0.06
TDS (Observed)	10756	Cadmium (Cd)	<0.01
Conductivity @25c, umho/cm	81755	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.02
Tot. Hardness (as CaCO3)	5353	Fluoride (F)	4.77
Sodium (Na, Calculated)	332	Iron (Fe))
Sodium (Na, Observed)	448	Lead (Pb)	()
Potassium (K)	28.8	Manganese (Mn)	67.6
Calcium (Ca)	529	Mercury (Hg)	<0.001
Magnesium (Mg)	986	Molybdenum (Mo)	<0.05
Chloride (Cl)	428	Nickel (Ni)	0.79
Sulfate (SO4)	6366	Nitrate (NO3 as N)	0.09
Bicarbonate (HCO3)	26	Selenium (Se)	0.021
Carbonate (CO3)	0	Uranium (U)	0.054
pH, Units	5.04	Vanadium (V)	<0.2
Aluminum (Al)	5.3	Zinc (Zn)	0.12
Ammonia (NH3 as N)	5.85		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	6.43 ± 0.49	1x10E-10
Radium 228	45.7 ± 8.9	1x10E-9
Thorium 230	0.00 ± 2.0	4x10E-9
Lead 210	1.97 ± 2.22	4x10E-9
Polonium 210	0.39 ± 0.92	2x10E-9

Sam T Meador
Analyst

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: March 5, 1990

LOCATION: 51-SC

TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci}/\text{ml}$)	ERROR ESTIMATE ($\mu\text{Ci}/\text{ml}$)	LLD ($\mu\text{Ci}/\text{ml}$)
U-nat	59.73×10^{-9}		
Th-230	18.50×10^{-9}	$\pm 4.20 \times 10^{-9}$	50×10^{-10}
Ra-226	33.00×10^{-9}	$\pm 1.00 \times 10^{-9}$	1×10^{-10}
Ra-228	57.90×10^{-9}	$\pm 6.00 \times 10^{-9}$	2×10^{-9}
Pb-210	3.16×10^{-9}	$\pm 2.97 \times 10^{-9}$	4×10^{-9}
Po-210	0.33×10^{-9}	$\pm 1.01 \times 10^{-9}$	2×10^{-9}

DATE COLLECTED: February 27, 1990

LOCATION: 52-SC

TYPE OF SAMPLE: Groundwater - Dry

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci}/\text{ml}$)	ERROR ESTIMATE ($\mu\text{Ci}/\text{ml}$)	LLD ($\mu\text{Ci}/\text{ml}$)
U-nat	$\times 10^{-9}$		
Th-230	$\times 10^{-9}$	$\pm \times 10^{-9}$	$\times 10^{-10}$
Ra-226	$\times 10^{-9}$	$\pm \times 10^{-9}$	$\times 10^{-10}$
Ra-228	$\times 10^{-9}$	$\pm \times 10^{-9}$	$\times 10^{-9}$
Pb-210	$\times 10^{-9}$	$\pm \times 10^{-9}$	$\times 10^{-9}$
Po-210	$\times 10^{-9}$	$\pm \times 10^{-9}$	$\times 10^{-9}$



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Client: Petrotomics Company
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Attention: Steve Pfaff

Lab Number : 90-1870-12

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

51 SC (W18413)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	23560	Boron (B)	0.07
TDS (Observed)	28813	Cadmium (Cd)	0.07
Conductivity @25c,umho/cm	13700	Chromium (Cr)	0.12
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.05
Tot. Hardness (as CaCO3)	6129	Fluoride (F)	1.36
Sodium (Na, Calculated)	1528	Iron (Fe)	2590
Sodium (Na, Observed)	485	Lead (Pb)	0.24
Potassium (K)	46.2	Manganese (Mn)	120
Calcium (Ca)	281	Mercury (Hg)	<0.001
Magnesium (Mg)	1319	Molybdenum (Mo)	<0.05
Chloride (Cl)	358	Nickel (Ni)	4.65
Sulfate (SO4)	17600	Nitrate (NO3 as N)	0.32
Bicarbonate (HCO3)	0	Selenium (Se)	0.041
Carbonate (CO3)	0	Uranium (U)	0.103
pH, Units	3.47	Vanadium (V)	0.6
Aluminum (Al)	771	Zinc (Zn)	9.48
Ammonia (NH3 as N)	110		
Arsenic (As)	0.002		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	33.0 ± 1.0	1x10E-10
Radium 228	57.9 ± 6.0	2x10E-9
Thorium 230	18.5 ± 4.2	5x10E-9
Lead 210	3.16 ± 2.97	4x10E-9
Polonium 210	0.33 ± 1.01	2x10E-9

Steve P. Meador

Analyst

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: March 5, 1990
 LOCATION: 53-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	148.26 X 10 ⁻⁹		
Th-230	3.91 X 10 ⁻⁹	± 0.65 X 10 ⁻⁹	7 X 10 ⁻¹⁰
Ra-226	11.70 X 10 ⁻⁹	± 0.63 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	16.40 X 10 ⁻⁹	± 2.80 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	2.47 X 10 ⁻⁹	± 2.11 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.40 X 10 ⁻⁹	± 0.36 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: March 5, 1990
 LOCATION: 54-SC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	4.06 X 10 ⁻⁹		
Th-230	3.99 X 10 ⁻⁹	± 3.16 X 10 ⁻⁹	50 X 10 ⁻¹⁰
Ra-226	11.00 X 10 ⁻⁹	± 0.56 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	30.00 X 10 ⁻⁹	± 4.30 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	1.62 X 10 ⁻⁹	± 1.87 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.29 X 10 ⁻⁹	± 0.36 X 10 ⁻⁹	1 X 10 ⁻⁹



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76 Imperial Drive, Unit I
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307/789-6420

Client: Petrochemicals Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1870-13

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

53 SC (W18414)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	4279	Boron (B)	0.13
TDS (Observed)	4779	Cadmium (Cd)	0.02
Conductivity @25c, umho/cm	3710	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.04
Tot. Hardness (as CaCO3)	3017	Fluoride (F)	1.49
Sodium (Na, Calculated)	151	Iron (Fe)	0.28
Sodium (Na, Observed)	114	Lead (Pb)	<0.05
Potassium (K)	17.6	Manganese (Mn)	8.05
Calcium (Ca)	513	Mercury (Hg)	<0.001
Magnesium (Mg)	422	Molybdenum (Mo)	<0.05
Chloride (Cl)	62.3	Nickel (Ni)	0.35
Sulfate (SO4)	3150	Nitrate (NO3 as N)	13.7
Bicarbonate (HCO3)	0	Selenium (Se)	<0.001
Carbonate (CO3)	0	Uranium (U)	0.219
pH, Units	4.48	Vanadium (V)	<0.5
Aluminum (Al)	7.4	Zinc (Zn)	0.54
Ammonia (NH3 as N)	1.20		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	11.7 ± 0.63	1x10E-10
Radium 228	16.4 ± 2.8	2x10E-9
Thorium 230	3.91 ± 0.65	7x10E-10
Lead 210	2.47 ± 2.11	3x10E-9
Polonium 210	0.40 ± 0.36	2x10E-9

Steve Pfaff
Analyst



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Client: Petrochemicals Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1870-14

Submitted By: Steve Pfaff
Analyzed By: G.H, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

54 SC (W18415)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	10535	Boron (B)	0.06
TDS (Observed)	12626	Cadmium (Cd)	0.04
Conductivity @25c, umho/cm	834 J	Chromium (Cr)	0.53
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	<0.01
Tot. Hardness (as CaCO3)	4200	Fluoride (F)	3.08
Sodium (Na, Calculated)	806	Iron (Fe)	628
Sodium (Na, Observed)	452	Lead (Pb)	0.09
Potassium (K)	47.4	Manganese (Mn)	54.3
Calcium (Ca)	420	Mercury (Hg)	<0.001
Magnesium (Mg)	766	Molybdenum (Mo)	1.10
Chloride (Cl)	378	Nickel (Ni)	1.33
Sulfate (SO4)	7600	Nitrate (NO3 as N)	0.29
Bicarbonate (HCO3)	0	Selenium (Se)	0.066
Carbonate (CO3)	0	Uranium (U)	0.006
pH, Units	4.11	Vanadium (V)	<0.5
Aluminum (Al)	220	Zinc (Zn)	0.04
Ammonia (NH3 as N)	23.7		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	11.0 ± 0.56	1x10E-10
Radium 228	30.0 ± 4.3	2x10E-9
Thorium 230	3.99 ± 3.16	5x10E-9
Lead 210	1.62 ± 1.87	2x10E-9
Polonium 210	0.29 ± 0.36	1x10E-9

Steve Pfaff

Analyst

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: February 27, 1990
 LOCATION: 55-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci}/\text{ml}$)	ERROR ESTIMATE ($\mu\text{Ci}/\text{ml}$)	LLD ($\mu\text{Ci}/\text{ml}$)
U-nat	39.27×10^{-9}		
Th-230	33.80×10^{-9}	$\pm 1.60 \times 10^{-9}$	8×10^{-10}
Ra-226	8.22×10^{-9}	$\pm 0.55 \times 10^{-9}$	1×10^{-10}
Ra-228	19.30×10^{-9}	$\pm 3.80 \times 10^{-9}$	1×10^{-9}
Pb-210	3.33×10^{-9}	$\pm 2.87 \times 10^{-9}$	3×10^{-9}
Po-210	0.26×10^{-9}	$\pm 0.47 \times 10^{-9}$	2×10^{-9}

DATE COLLECTED: February 27, 1990
 LOCATION: 56-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci}/\text{ml}$)	ERROR ESTIMATE ($\mu\text{Ci}/\text{ml}$)	LLD ($\mu\text{Ci}/\text{ml}$)
U-nat	60.93×10^{-9}		
Th-230	1.33×10^{-9}	$\pm 3.05 \times 10^{-9}$	50×10^{-10}
Ra-226	10.20×10^{-9}	$\pm 0.62 \times 10^{-9}$	2×10^{-10}
Ra-228	24.40×10^{-9}	$\pm 5.00 \times 10^{-9}$	1×10^{-9}
Pb-210	2.99×10^{-9}	$\pm 2.95 \times 10^{-9}$	3×10^{-9}
Po-210	0.37×10^{-9}	$\pm 0.76 \times 10^{-9}$	2×10^{-9}



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Client: Petrotoomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number :
Date Submitted: 02-27-90
Date Analyzed : 04-04-90

Submitted By: Hydro Engineering
Analyzed By: TM, GLH, JPM

Well 55SC
Sample taken 2-27-90

	mg/l		mg/l
TDS (Calculated)	10258	Boron (B)	0.11
TDS (Observed)	11122	Cadmium (Cd)	<0.01
Conductivity @25c, umho/cm	7900	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.01
Tot. Hardness (as CaCO3)	5633	Fluoride (F)	9.33
Sodium (Na, Calculated)	271	Iron (Fe)	785
Sodium (Na, Observed)	474	Lead (Pb)	0.15
Potassium (K)	36.2	Manganese (Mn)	57.3
Calcium (Ca)	750	Mercury (Hg)	<0.001
Magnesium (Mg)	914	Molybdenum (Mo)	<0.05
Chloride (Cl)	383	Nickel (Ni)	0.58
Sulfate (SO4)	6900	Nitrate (NO3 as N)	0.14
Bicarbonate (HCO3)	17.4	Selenium (Se)	0.033
Carbonate (CO3)	0	Uranium (U)	0.058
pH, Units	5.06	Vanadium (V)	<0.2
Aluminum (Al)	5.9	Zinc (Zn)	0.11
Ammonia (NH3 as N)	8.30		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	8.22 ± 0.55	1x10E-10
Radium 228	19.3 ± 3.8	1x10E-8
Thorium 230	33.8 ± 1.6	8x10E-10
Lead 210	3.33 ± 2.87	3x10E-9
Polonium 210	0.26 ± 0.47	2x10E-9

Janet P. Madon
Analyst



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Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1860-4

Submitted By: Hydro Engineering
Analyzed By: TM, GLH, JPM

Date Submitted: 02-27-90
Date Analyzed : 04-04-90

Well 56SC
Sample taken 2-27-90

	mg/l		mg/l
TDS (Calculated)	9091	Boron (B)	0.20
TDS (Observed)	10650	Cadmium (Cd)	<0.01
Conductivity @25c, umho/cm	7700	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.02
Tot. Hardness (as CaCO3)	4763	Fluoride (F)	2.37
Sodium (Na, Calculated)	326	Iron (Fe)	545
Sodium (Na, Observed)	407	Lead (Pb)	0.15
Potassium (K)	43.7	Manganese (Mn)	64.2
Calcium (Ca)	515	Mercury (Hg)	<0.001
Magnesium (Mg)	849	Molybdenum (Mo)	<0.05
Chloride (Cl)	264	Nickel (Ni)	1.36
Sulfate (SO4)	6400	Nitrate (NO3 as N)	0.11
Bicarbonate (HCO3)	0	Selenium (Se)	0.071
Carbonate (CO3)	0	Uranium (U)	0.090
pH, Units	4.26	Vanadium (V)	<0.2
Aluminum (Al)	71.2	Zinc (Zn)	0.25
Ammonia (NH3 as N)	38.3		
Arsenic (As)	0.002		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	10.2 ± 0.62	2x10E-10
Radium 228	24.4 ± 5.0	1x10E-9
Thorium 230	1.33 ± 3.05	5x10E-9
Lead 210	2.99 ± 2.95	3x10E-9
Polonium 210	0.37 ± 0.76	2x10E-9

Janet P. Masdon
Analyst

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: February 27, 1990
 LOCATION: 57-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIOISOTOPE</u>	<u>CONCENTRATION</u> <u>(uCi/ml)</u>	<u>ERROR ESTIMATE</u> <u>(uCi/ml)</u>	<u>LLD</u> <u>(uCi/ml)</u>
U-nat	47.10 X 10 ⁻⁹		
Th-230	3.39 X 10 ⁻⁹	± 0.69 X 10 ⁻⁹	6 X 10 ⁻¹⁰
Ra-226	5.56 X 10 ⁻⁹	± 0.11 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	6.99 X 10 ⁻⁹	± 1.47 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	1.72 X 10 ⁻⁹	± 2.65 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.15 X 10 ⁻⁹	± 0.68 X 10 ⁻⁹	2 X 10 ⁻⁹

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: February 27, 1990
 LOCATION: 58-SC
 TYPE OF SAMPLE: Groundwater - Pumped

<u>RADIOISOTOPE</u>	<u>CONCENTRATION</u> <u>(uCi/ml)</u>	<u>ERROR ESTIMATE</u> <u>(uCi/ml)</u>	<u>LLD</u> <u>(uCi/ml)</u>
U-nat	79.89 X 10 ⁻⁹		
Th-230	138.00 X 10 ⁻⁹	± 13.00 X 10 ⁻⁹	100 X 10 ⁻¹⁰
Ra-226	8.77 X 10 ⁻⁹	± 0.52 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	101.00 X 10 ⁻⁹	± 9.00 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	1.22 X 10 ⁻⁹	± 2.39 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.39 X 10 ⁻⁹	± 0.80 X 10 ⁻⁹	2 X 10 ⁻⁹



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Client: Petrochemicals Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1860-5

Submitted By: Hydro Engineering
Analyzed By: TM, GLH, JPM

Date Submitted: 02-27-90
Date Analyzed : 04-04-90

Well 57SC
Sample taken 2-27-90

	mg/l		mg/l
TDS (Calculated)	5011	Boron (B)	0.19
TDS (Observed)	5809	Cadmium (Cd)	0.02
Conductivity @25c, umho/cm	5025	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.04
Tot. Hardness (as CaCO3)	2982	Fluoride (F)	2.48
Sodium (Na, Calculated)	230	Iron (Fe)	131
Sodium (Na, Observed)	250	Lead (Pb)	0.11
Potassium (K)	29.7	Manganese (Mn)	26.3
Calcium (Ca)	501	Mercury (Hg)	<0.001
Magnesium (Mg)	421	Molybdenum (Mo)	<0.05
Chloride (Cl)	194	Nickel (Ni)	0.66
Sulfate (SO4)	3480	Nitrate (NO3 as N)	0.58
Bicarbonate (HCO3)	5	Selenium (Se)	0.033
Carbonate (CO3)	0	Uranium (U)	0.070
pH, Units	4.38	Vanadium (V)	<0.2
Aluminum (Al)	19.1	Zinc (Zn)	0.39
Ammonia (NH3 as N)	10.9		
Arsenic (As)	0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	5.56 ± 0.44	2x10E-10
Radium 228	6.99 ± 4.47	1x10E-9
Thorium 230	5.38 ± 0.69	6x10E-10
Lead 210	1.72 ± 2.65	3x10E-9
Polonium 210	0.13 ± 0.68	2x10E-9

Janet P. Meador
Analyst

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: February 27, 1990
 LOCATION: 59-SC
 TYPE OF SAMPLE: Groundwater - Pumped

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	9.48 X 10 ⁻⁹		
Th-230	75.20 X 10 ⁻⁹	± 10.49 X 10 ⁻⁹	100 X 10 ⁻¹⁰
Ra-226	11.10 X 10 ⁻⁹	± 0.80 X 10 ⁻⁹	3 X 10 ⁻¹⁰
Ra-228	121.00 X 10 ⁻⁹	± 9.00 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	1.36 X 10 ⁻⁹	± 3.02 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.45 X 10 ⁻⁹	± 0.88 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: March 29, 1990
 LOCATION: 60-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	3161.60 X 10 ⁻⁹		
Th-230	39.90 X 10 ⁻⁹	± 3.40 X 10 ⁻⁹	20 X 10 ⁻¹⁰
Ra-226	16.70 X 10 ⁻⁹	± 0.60 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	43.80 X 10 ⁻⁹	± 4.20 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	2.25 X 10 ⁻⁹	± 2.97 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.36 X 10 ⁻⁹	± 0.59 X 10 ⁻⁹	2 X 10 ⁻⁹



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Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1860-7

Submitted By: Hydro Engineering
Analyzed By: TM, G.H, JPM

Date Submitted: 02-27-90
Date Analyzed : 04-04-90

Well 59SC
Sample taken 2-27-90

	mg/l		mg/l
TDS (Calculated)	18904	Boron (B)	0.07
TDS (Observed)	23289	Cadmium (Cd)	0.03
Conductivity @25c, umho/cm	11200	Chromium (Cr)	<0.01
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.03
Tot. Hardness (as CaCO3)	5762	Fluoride (F)	0.49
Sodium (Na, Calculated)	1622	Iron (Fe)	1410
Sodium (Na, Observed)	424	Lead (Pb)	0.29
Potassium (K)	28.8	Manganese (Mn)	74.0
Calcium (Ca)	536	Mercury (Hg)	<0.001
Magnesium (Mg)	1075	Molybdenum (Mo)	<0.05
Chloride (Cl)	318	Nickel (Ni)	3.06
Sulfate (SO4)	14400	Nitrate (NO3 as N)	0.082
Bicarbonate (HCO3)	0	Selenium (Se)	0.068
Carbonate (CO3)	0	Uranium (U)	0.014
pH, Units	3.78	Vanadium (V)	3.3
Aluminum (Al)	526	Zinc (Zn)	3.63
Ammonia (NH3 as N)	186		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	11.1 ± 0.8	3x10E-10
Radium 228	121 ± 9	1x10E-9
Thorium 230	75.2 ± 10.4	1x10E-8
Lead 210	1.36 ± 3.02	4x10E-9
Polonium 210	0.45 ± 0.88	2x10E-9

Janet P. Meadows
Analyst



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Client: Petrochemicals Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1909

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM

Date Submitted: 03-30-90
Date Analyzed : 05-07-90

60 SC (W18419)
Sample taken 3-29-90

	mg/l		mg/l
TDS (Calculated)	7393	Boron (B)	0.20
TDS (Observed)	8082	Cadmium (Cd)	0.03
Conductivity @25c, umho/cm	7065	Chromium (Cr)	0.23
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.11
Tot. Hardness (as CaCO3)	4323	Fluoride (F)	1.54
Sodium (Na, Calculated)	163	Iron (Fe)	244
Sodium (Na, Observed)	128	Lead (Pb)	<0.05
Potassium (K)	35.3	Manganese (Mn)	28.6
Calcium (Ca)	936	Mercury (Hg)	<0.001
Magnesium (Mg)	483	Molybdenum (Mo)	<0.05
Chloride (Cl)	151	Nickel (Ni)	1.01
Sulfate (SO4)	5260	Nitrate (NO3 as N)	0.75
Bicarbonate (HCO3)	0	Selenium	0.042
Carbonate (CO3)	0	Uranium (U)	4.67
pH, Units	4.15	Vanadium (V)	1.88
Aluminum (Al)	95	Zinc (Zn)	2.54
Ammonia (NH3 as N)	46.2		
Arsenic (As)	0.005		
Barium (Ba)	<0.05		

	pCi/l	LLD uCi/ml
Radium 226	10.7 ± 0.6	1x10E-10
Radium 228	43.8 ± 4.2	2x10E-9
Thorium 230	39.9 ± 3.4	2x10E-9
Lead 210	2.25 ± 2.97	3x10E-9
Polonium 210	0.36 ± 0.59	2x10E-9

Robert L. Pfaff
Analyst

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: March 5, 1990

LOCATION: 5-DC

TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci/ml}$)	ERROR ESTIMATE ($\mu\text{Ci/ml}$)	LLD ($\mu\text{Ci/ml}$)
U-nat	4.74×10^{-9}		
Th-230	2.68×10^{-9}	$\pm 3.28 \times 10^{-9}$	50×10^{-10}
Ra-226	3.33×10^{-9}	$\pm 0.31 \times 10^{-9}$	1×10^{-10}
Ra-228	23.60×10^{-9}	$\pm 3.40 \times 10^{-9}$	2×10^{-9}
Pb-210	4.72×10^{-9}	$\pm 3.39 \times 10^{-9}$	4×10^{-9}
Po-210	0.61×10^{-9}	$\pm 0.87 \times 10^{-9}$	2×10^{-9}



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Client: Petrochemicals Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab Number : 90-1870-16

Submitted By: Steve Pfaff
Analyzed By: GLH, NB, TM, JPM

Date Submitted: 03-06-90
Date Analyzed : 05-02-90

5 DC (W18417)
Sample taken 3-5-90

	mg/l		mg/l
TDS (Calculated)	15007	Boron (B)	0.09
TDS (Observed)	17022	Cadmium (Cd)	0.05
Conductivity @25c, umho/cm	9400	Chromium (Cr)	0.03
Tot. Alkalinity (as CaCO3)	0	Copper (Cu)	0.03
Tot. Hardness (as CaCO3)	5636	Fluoride (F)	4.02
Sodium (Na, Calculated)	1072	Iron (Fe)	1475
Sodium (Na, Observed)	456	Lead (Pb)	0.11
Potassium (K)	35.5	Manganese (Mn)	99.6
Calcium (Ca)	357	Mercury (Hg)	<0.001
Magnesium (Mg)	1153	Molybdenum (Mo)	<0.05
Chloride (Cl)	293	Nickel (Ni)	2.96
Sulfate (SO4)	11000	Nitrate (NO3 as N)	0.31
Bicarbonate (HCO3)	0	Selenium (Se)	0.056
Carbonate (CO3)	0	Uranium (U)	0.007
pH, Units	4.20	Vanadium (V)	<0.5
Aluminum (Al)	184	Zinc (Zn)	0.66
Ammonia (NH3 as N)	52.4		
Arsenic (As)	<0.001		
Barium (Ba)	<0.05		
		pCi/l	LLD uCi/ml
		Radium 226	3.33 ± 0.31 1x10E-10
		Radium 228	23.6 ± 3.4 2x10E-9
		Thorium 230	2.68 ± 3.28 5x10E-9
		Lead 210	4.72 ± 3.39 4x10E-9
		Polonium 210	0.61 ± 0.87 2x10E-9

Steve Pfaff

Analyst

4. VEGETATION, FOOD, AND FISH SAMPLES

Deleted by Amendment No. 21

5. SOIL AND SEDIMENT SAMPLES

Deleted by Amendment No. 21

6. DIRECT RADIATION MEASUREMENTS

DATE: 1st Quarter 1990

<u>LOCATION</u>	<u>EXPOSURE RATE</u> <u>(mr/qr)</u>	<u>ERROR ESTIMATE</u> <u>(mr/qr)</u>
Site 1	38.8	±11.9
Site 5	62.0	± 5.5

LOCATIONS: Site 1 - 7800' WNW of where yellowcake dryer stack had been located.
Site 2 - Discontinued.
Site 3 - Discontinued.
Site 4 - Discontinued.
Site 5 - 1800' NE of where yellowcake dryer stack had been located.
Site 6 - Discontinued.

LLD CALCULATIONS

$$\text{LLD} = \frac{4.66 \sqrt{C_b * T}}{(2.22)(E)(R)(V)(T)} \quad \text{in pCi/units used (V)}$$

WHERE:

C_b = BACKGROUND COUNT RATE

T = COUNT TIME (SAME FOR SAMPLE AND BACKGROUND)

E = DETECTOR EFFICIENCY (CPM/DPM)

R = FRACTIONAL RECOVERY

V = SAMPLE SIZE LITERS OF AIR OR WATER
 GRAMS OF SOIL
 KILOGRAMS OF VEGETATION

2.22 = DPM/pCi

Since the LLD is a function of sample volume, counting efficiency, radicchemical yield, etc., it may vary for different sampling and analysis procedures. The following are some of the normal values used.

Ra^{226}

C_b = 0.05 to 0.30 counts per minute

T = 50 minutes

E = about 0.9

R = about 0.9 frequently less in soil and vegetation

V = 1 liter of water

= 20 grams of soil

= air volume taken is usually 1/4 of volume sampled

= vegetation weight is usually 1/2 of sample provided

Th²³⁰

C_B = 0.04 to 0.20 cpm

T = 200 minutes, may be less for "hot" samples like tailings pond

E+R = combined recovery and efficiency from Th²³⁰ tracer varies greatly from 0.02 to 0.20

V = 1 liter of water, or less if high in iron. Iron interferes and volumes as low as 25 or 50 ml. may be used.
= 1.0 grams soil
= air volume taken is usually 1/4 of volume sampled (about 7 x 10⁶ L)

Pb²¹⁰

C_B = 1 to 2 cpm

T = 100 to 200 minutes

E = 0.25 to 0.33

R = usually 0.75 to 0.90 but may be less for vegetation and waters high in TDS

V = 1 liter of water, again samples high in iron will be less to lessen its interference.
= air volume taken is usually 1/4 of sample (about 7 x 10⁶ L)
= vegetation weight is usually 1/2 of sample provided.

Po²¹⁰

C_B = about 0.2 cpm

T = 100 to 200 minutes

E = 0.15 to 0.20

R = 0.5 to 0.8

V = 1 liter of water, iron causes interference so smaller volumes of samples high in iron are used, down to about 200 ml.

%MPC CALCULATION

The %MPC is calculated using the values obtained from 10 CFR 20 appendix B for unrestricted limits in air.

The calculation is as follows:

$$\%MPC = \frac{\text{sample concentration}}{\text{unrestricted limit}}$$

unrestricted limits for air from 10 CFR 20 Appendix B

U nat	5000×10^{-15}
Th ²³⁰	80×10^{-15}
Ra ²²⁶	3000×10^{-15}
Pb ²¹⁰	4000×10^{-15}
Rn ²²²	3×10^{-9}

ENVIRONMENTAL SAMPLE DATA

2ND Quarter 1990

PETROTOMICS COMPANY
Shirley Basin, WY

1. STACK SAMPLES

No discharge stacks present - Deleted by Amendment No. 21

2. AIR SAMPLES

LOCATIONS: Site 1 - 7800' WNW of where yellowcake dryer stack had been located. Rn-222 only - Amendment No. 21.
 Site 2 - Discontinued - Amendment No. 21.
 Site 3 - Discontinued - Amendment No. 21.
 Site 4 - Discontinued - Amendment No. 21.
 Site 5 - 2000' NE of where yellowcake dryer stack had been located.
 Site 6 - Discontinued - Amendment No. 21.

DATE COLLECTED: 2nd Quarter 1990
 LOCATION: Site 1

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> (uCi/ml)	<u>ERROR ESTIMATE</u> (uCi/ml)	<u>LLD</u> (uCi/ml)	<u>MPC</u>
Rn-222	1.20×10^{-9}	$\pm 0.11 \times 10^{-9}$	0.2×10^{-9}	40.00

DATE COLLECTED: 2nd Quarter 1990
 LOCATION: Site 5

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> (uCi/ml)	<u>ERROR ESTIMATE</u> (uCi/ml)	<u>LLD</u> (uCi/ml)	<u>MPC</u>
U-nat	0.11×10^{-15}		2.0×10^{-19}	<0.01
Th-230	0.07×10^{-15}	$\pm 0.03 \times 10^{-15}$	0.5×10^{-16}	0.09
Ra-226	0.07×10^{-15}	$\pm 0.01 \times 10^{-15}$	0.2×10^{-17}	<0.01
Pb-210	0.05×10^{-15}	$\pm 0.10 \times 10^{-15}$	0.8×10^{-16}	<0.01
Rn-222	1.60×10^{-9}	$\pm 0.13 \times 10^{-9}$	0.2×10^{-9}	53.33

3. LIQUID SAMPLES

DATE COLLECTED: June 11, 1990
 LOCATION: Mine Shop Well
 TYPE OF SAMPLE: Groundwater - Pumped

<u>RADIONUCLIDE</u>	<u>CONCENTRATION</u> (uCi/ml)	<u>ERROR ESTIMATE</u> (uCi/ml)	<u>LLD</u> (uCi/ml)
U-nat (Dissolved)	<0.68 X 10 ⁻⁹		
U-Nat (Suspended)	2.03 X 10 ⁻⁹		
Th-230 (Dissolved)	2.46 X 10 ⁻⁹	± 0.90 X 10 ⁻⁹	10.0 X 10 ⁻¹⁰
Th-230 (Suspended)	0.99 X 10 ⁻⁹	± 0.46 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Ra-226 (Dissolved)	6.29 X 10 ⁻⁹	± 0.40 X 10 ⁻⁹	2.0 X 10 ⁻¹⁰
Ra-226 (Suspended)	0.47 X 10 ⁻⁹	± 0.11 X 10 ⁻⁹	1.0 X 10 ⁻¹⁰
Ra-228 (Dissolved)	0.00 X 10 ⁻⁹	± 2.69 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Ra-228 (Suspended)	0.83 X 10 ⁻⁹	± 2.12 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Pb-210 (Dissolved)	0.13 X 10 ⁻⁹	± 1.23 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Pb-210 (Suspended)	0.56 X 10 ⁻⁹	± 1.92 X 10 ⁻⁹	2.0 X 10 ⁻⁹
Po-210 (Dissolved)	0.21 X 10 ⁻⁹	± 0.33 X 10 ⁻⁹	1.0 X 10 ⁻⁹
Po-210 (Suspended)	0.23 X 10 ⁻⁹	± 0.54 X 10 ⁻⁹	1.0 X 10 ⁻⁹

* Samples not run.



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807/789-6420

Client: Petrotoomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2030-13

Sample Type : Water
Submitted By: Hydro Engineering
Analyzed By : KAH, GLH, JPM

Date Sampled : 06-11-90
Date Submitted: 06-13-90
Date Analyzed : 08-24-90

Sample Identification: Mine Shop Well

Parameter	mg/L	Parameter	Dissolved mg/L	Suspended mg/L
Total Diss. Solids	532	Aluminum (Al)	<0.1	
Total Hardness (as CaCO3)	85.3	Arsenic (As)	<0.001	
Conductivity @25C, umho/cm	815	Barium (Ba)	<0.05	
Sodium (Na)	133	Cadmium (Cd)	<0.01	
Potassium (K)	3.9	Chromium (Cr)	<0.02	
Calcium (Ca)	20	Copper (Cu)	<0.01	
Magnesium (Mg)	8.6	Iron (Fe)	0.06	
Chloride (Cl)	5.1	Lead (Pb)	<0.05	
Sulfate (SO4)	240	Manganese (Mn)	0.02	
Bicarbonate (HCO3)	176	Mercury (Hg)	<0.001	
Carbonate (CO3)	0.13	Molybdenum (Mo)	0.10	
pH, units	8.44	Nickel (Ni)	<0.03	
Boron (B)	0.06	Selenium (Se)	0.002	
Fluoride (F)	0.11	Uranium (U)	<0.001	0.003
Nitrate (NO3 as N)	0.15	Vanadium (V)	0.2	
Ammonia (NH3 as N)	<0.10	Zinc (Zn)	<0.01	

Dissolved

Suspended

	pCi/L	LLD uCi/ml		pCi/L	LLD uCi/ml
Radium 226	6.29 ± 0.40	2x10E-10		0.47 ± 0.11	1x10E-10
Radium 228	0.00 ± 2.69	1x10E-9		0.83 ± 2.12	1x10E-9
Thorium 230	2.46 ± 0.90	1x10E-9		0.99 ± 0.46	1x10E-9
Lead 210	0.13 ± 1.23	1x10E-9		0.56 ± 1.92	2x10E-9
Polonium 210	0.21 ± 0.33	1x10E-9		0.23 ± 0.54	1x10E-9

Sanit P. Meador
Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 13, 1990
 LOCATION: 1-S
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	8.81 X 10 ⁻⁹		
Th-230	0.39 X 10 ⁻⁹	± 0.33 X 10 ⁻⁹	0.5 X 10 ⁻⁹
Ra-226	0.69 X 10 ⁻⁹	± 0.13 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	2.10 X 10 ⁻⁹	± 1.51 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	0.32 X 10 ⁻⁹	± 1.77 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.00 X 10 ⁻⁹	± 0.41 X 10 ⁻⁹	1 X 10 ⁻⁹

DATE COLLECTED: June 13, 1990
 LOCATION: 3-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	225.44 X 10 ⁻⁹		
Th-230	3.93 X 10 ⁻⁹	± 0.66 X 10 ⁻⁹	7 X 10 ⁻¹⁰
Ra-226	2.11 X 10 ⁻⁹	± 0.23 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	5.48 X 10 ⁻⁹	± 1.61 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	2.02 X 10 ⁻⁹	± 1.97 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.07 X 10 ⁻⁹	± 0.39 X 10 ⁻⁹	1 X 10 ⁻⁹



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307/789-6420

Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2031-2

Submitted By: Steve Pfaff
Analyzed By: KAH, GLH, JPM

Date Submitted: 06-14-90
Date Analyzed: 08-28-90

1 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	4.42
Total Dissolved Solids, mg/l	2083
Chloride (Cl), mg/l	84
Sulfate (SO4), mg/l	1200
Nitrate (NO3 as N), mg/l	0.65
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	0.02
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.07
Selenium (Se), mg/l	0.006
Uranium (U), mg/l	0.013

Radium 226, pCi/l	0.69 = 0.13
Radium 228, pCi/l	2.10 = 1.51
Thorium 230, pCi/l	0.39 = 0.33
Lead 210, pCi/l	0.32 = 1.77
Polonium 210, pCi/l	0.00 = 0.41

LLD
uCi/l

1x10E
1x10E
5x10E-1
2x10E-9
1x10E-9

Janet P. Madon

Chief Chemist



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307/789-6420

Client: Petrotonics Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2031-4

Submitted By: Steve Pfaff
Analyzed By: KAH, GLH, JPM

Date Submitted: 06-14-90
Date Analyzed: 08-28-90

3 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	6.46
Total Dissolved Solids, mg/l	7863
Chloride (Cl), mg/l	401
Sulfate (SO ₄), mg/l	3400
Nitrate (NO ₃ as N), mg/l	7.0
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.05
Chromium (Cr), mg/l	<0.02
Lead (Pb), mg/l	0.06
Nickel (Ni), mg/l	0.75
Selenium (Se), mg/l	0.088
Uranium (U), mg/l	0.333

Radium 226, pCi/l	2.11 ± 0.23
Radium 228, pCi/l	5.48 ± 1.61
Thorium 230, pCi/l	3.93 ± 0.66
Lead 210, pCi/l	2.02 ± 1.97
Polonium 210, pCi/l	0.07 ± 0.39

LLD
uCi/ml

2x10E-1
1x10E-9
7x10E-1
2x10E-9
1x10E-9

Janet P. Meador
Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 13, 1990
 LOCATION: 1-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	136.08 X 10 ⁻⁹		
Th-230	0.00 X 10 ⁻⁹	± 0.35 X 10 ⁻⁹	6 X 10 ⁻¹⁰
Ra-226	3.01 X 10 ⁻⁹	± 0.30 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	13.20 X 10 ⁻⁹	± 3.60 X 10 ⁻⁹	2 X 10 ⁻⁹
Pb-210	1.65 X 10 ⁻⁹	± 2.23 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.22 X 10 ⁻⁹	± 0.42 X 10 ⁻⁹	1 X 10 ⁻⁹

DATE COLLECTED: June 12, 1990
 LOCATION: 7-SC
 TYPE OF SAMPLE: Groundwater - Pumped

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	27012.03 X 10 ⁻⁹		
Th-230	1348.00 X 10 ⁻⁹	± 35.00 X 10 ⁻⁹	10 X 10 ⁻¹⁰
Ra-226	0.98 X 10 ⁻⁹	± 0.18 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	10.30 X 10 ⁻⁹	± 2.90 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	1.05 X 10 ⁻⁹	± 3.22 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.03 X 10 ⁻⁹	± 0.97 X 10 ⁻⁹	2 X 10 ⁻⁹



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307/789-6420

Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2031-5

Submitted By: Steve Pfaff
Analyzed By: KAH, GLH, JPM

Date Submitted: 06-14-90
Date Analyzed: 08-28-90

4 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	4.95	
Total Dissolved Solids, mg/l	5556	
Chloride (Cl), mg/l	457	
Sulfate (SO4), mg/l	3000	
Nitrate (NO3 as N), mg/l	24.9	
Arsenic (As), mg/l	<0.001	
Barium (Ba), mg/l	<0.05	
Cadmium (Cd), mg/l	<0.01	
Chromium (Cr), mg/l	<0.02	
Lead (Pb), mg/l	<0.05	
Nickel (Ni), mg/l	0.45	
Selenium (Se), mg/l	0.019	
Uranium (U), mg/l	0.201	
		ILD uCi/ml
Radium 226, pCi/l	3.91 ± 0.30	2x10E-10
Radium 228, pCi/l	13.2 ± 3.6	2x10E-9
Thorium 230, pCi/l	0.00 ± 0.35	6x10E-10
Lead 210, pCi/l	1.65 ± 2.23	2x10E-9
Polonium 210, pCi/l	0.22 ± 0.42	1x10E-9

Sanet P. Meador
Chief Chemist



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307/789-6420

Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2030-2

Submitted By: Hydro Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 06-12-90
Date Analyzed: 08-24-90

5 SC
Sample taken 6-12-90

WATER ANALYSIS

pH, units	3.17
Total Dissolved Solids, mg/l	26849
Chloride (Cl), mg/l	293
Sulfate (SO ₄), mg/l	16600
Nitrate (NO ₃ as N), mg/l	0.52
Arsenic (As), mg/l	0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.11
Chromium (Cr), mg/l	1.8
Lead (Pb), mg/l	0.27
Nickel (Ni), mg/l	4.3
Selenium (Se), mg/l	0.122
Uranium (U), mg/l	39.9

Radium 226, pCi/l
Radium 228, pCi/l
Thorium 230, pCi/l
Lead 210, pCi/l
Polonium 210, pCi/l

0.98 ± 0.78
10.9 ± 2.9
1348 ± 35
1.05 ± 3.22
0.03 ± 0.97

LLD
uCi/ml

1x10E-10
1x10E-9
4x10E-9
3x10E-9
2x10E-9

Sanit P Meador
Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 13, 1990
 LOCATION: 09-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	100.87 X 10 ⁻⁹		
Th-230	0.64 X 10 ⁻⁹	± 0.52 X 10 ⁻⁹	8 X 10 ⁻¹⁰
Ra-226	5.12 X 10 ⁻⁹	± 0.35 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	2.03 X 10 ⁻⁹	± 2.10 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	2.66 X 10 ⁻⁹	± 2.40 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.25 X 10 ⁻⁹	± 0.37 X 10 ⁻⁹	1 X 10 ⁻⁹

DATE COLLECTED: June 13, 1990
 LOCATION: 40-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	1.25 X 10 ⁻⁹		
Th-230	0.00 X 10 ⁻⁹	± 0.93 X 10 ⁻⁹	20 X 10 ⁻¹⁰
Ra-226	1.10 X 10 ⁻⁹	± 0.17 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	1.37 X 10 ⁻⁹	± 2.19 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	0.45 X 10 ⁻⁹	± 1.61 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.19 X 10 ⁻⁹	± 0.39 X 10 ⁻⁹	1 X 10 ⁻⁹



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307/789-6420

Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2031-6

Submitted By: Steve Pfaff
Analyzed By: KAH, GLH, JPM

Date Submitted: 06-14-90
Date Analyzed: 08-28-90

39 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	4.69
Total Dissolved Solids, mg/l	3071
Chloride (Cl), mg/l	43
Sulfate (SO4), mg/l	2080
Nitrate (NO3 as N), mg/l	4.0
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	<0.02
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.26
Selenium (Se), mg/l	0.019
Uranium (U), mg/l	0.149

		LLD uCi/ml
Radium 226, pCi/l	5.12 ± 0.35	2x10E-1
Radium 228, pCi/l	2.03 ± 2.10	1x10E-1
Thorium 230, pCi/l	0.64 ± 0.52	8x10E-1
Lead 210, pCi/l	2.66 ± 2.40	2x10E-1
Polonium 210, pCi/l	0.25 ± 0.37	1x10E-1

James P. Mador
Chief Chemist



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Evanston, Wyoming 82930
307/789-6420

Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2031-7

Submitted By: Steve Pfaff
Analyzed By: KAH, GLH, JPM

Date Submitted: 06-14-90
Date Analyzed: 08-28-90

40 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	6.83
Total Dissolved Solids, mg/l	2112
Chloride (Cl), mg/l	134
Sulfate (SO4), mg/l	1080
Nitrate (NO3 as N), mg/l	1.4
Arsenic (As), mg/l	0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	<0.02
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	<0.03
Selenium (Se), mg/l	0.020
Uranium (U), mg/l	0.002

Radium 226, pCi/l	1.10 ± 0.17
Radium 228, pCi/l	1.37 ± 2.19
Thorium 230, pCi/l	0.00 ± 0.93
Lead 210, pCi/l	0.45 ± 1.61
Polonium 210, pCi/l	0.19 ± 0.39

ILD
uCi/ml

2x10E-10
1x10E-9
2x10E-9
2x10E-9
1x10E-9

Janet P. Meador
Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 13, 1990
 LOCATION: 41-5C
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	269.45 X 10 ⁻⁹		
Th-230	0.00 X 10 ⁻⁹	± 0.56 X 10 ⁻⁹	10 X 10 ⁻¹⁰
Ra-226	0.57 X 10 ⁻⁹	± 0.10 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	1.57 X 10 ⁻⁹	± 1.98 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	1.73 X 10 ⁻⁹	± 1.80 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.35 X 10 ⁻⁹	± 0.38 X 10 ⁻⁹	0.9 X 10 ⁻⁹

DATE COLLECTED: June 13, 1990
 LOCATION: 42-5C
 TYPE OF SAMPLE: Groundwater - Dumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	1496.17 X 10 ⁻⁹		
Th-230	1984.00 X 10 ⁻⁹	± 28.00 X 10 ⁻⁹	20 X 10 ⁻¹⁰
Ra-226	9.19 X 10 ⁻⁹	± 0.56 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	22.50 X 10 ⁻⁹	± 3.70 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	4.72 X 10 ⁻⁹	± 2.65 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.45 X 10 ⁻⁹	± 0.88 X 10 ⁻⁹	2 X 10 ⁻⁹



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Client: Petrotoomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2031-8

Submitted By: Steve Pfaff
Analyzed By: KAH, GLH, JPM

Date Submitted: 06-14-90
Date Analyzed: 08-28-90

41 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	8.95
Total Dissolved Solids, mg/l	2579
Chloride (Cl), mg/l	278
Sulfate (SO ₄), mg/l	1080
Nitrate (NO ₃ as N), mg/l	3.72
Arsenic (As), mg/l	0.002
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	<0.02
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	<0.03
Selenium (Se), mg/l	0.068
Uranium (U), mg/l	0.398

		LLD uCi/ml
Radium 226, pCi/l	0.57 ± 0.13	2x10E-10
Radium 228, pCi/l	1.57 ± 1.98	1x10E-9
Thorium 230, pCi/l	0.00 ± 0.66	1x10E-9
Lead 210, pCi/l	1.73 ± 1.80	2x10E-9
Polonium 210, pCi/l	0.35 ± 0.38	9x10E-10

Scott P. Madon
Chief Chemist



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92 Imperial Plaza, Unit 1
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307/785-6420

Client: Petrochemical Company
Address: P O Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2020-3

Submitted By: Hydro Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 06-12-90
Date Analyzed: 08-24-90

42 SC
Sample taken 6-11-90

WATER ANALYSIS:

pH, units	3.45
Total Dissolved Solids, mg/l	4997
Chloride (Cl), mg/l	103
Sulfate (SO4), mg/l	2640
Nitrate (NO3 as N), mg/l	0.88
Arsenic (As), mg/l	0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.011
Chromium (Cr), mg/l	0.48
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.65
Selenium (Se), mg/l	0.020
Uranium (U), mg/l	2.21

Radium 226, pCi/l	9.49 ± 0.56
Radium 228, pCi/l	22.5 ± 3.7
Thorium 230, pCi/l	1984 ± 28
Lead 210, pCi/l	4.72 ± 2.65
Polonium 210, pCi/l	0.45 ± 0.88

LLD
uCi/ml

1x10E-10
1x10E-9
2x10E-9
3x10E-9
2x10E-9

Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 12, 1990
 LOCATION: 43-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	21731.70 X 10 ⁻⁹		
Th-230	2920.00 X 10 ⁻⁹	± 55.00 X 10 ⁻⁹	50 X 10 ⁻¹⁰
Ra-226	0.34 X 10 ⁻⁹	± 0.12 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	4.01 X 10 ⁻⁹	± 2.86 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	2.77 X 10 ⁻⁹	± 3.58 X 10 ⁻⁹	4 X 10 ⁻⁹
Po-210	0.20 X 10 ⁻⁹	± 1.21 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: June 13, 1990
 LOCATION: 44-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	3385.00 X 10 ⁻⁹		
Th-230	826.00 X 10 ⁻⁹	± 35.00 X 10 ⁻⁹	60 X 10 ⁻¹⁰
Ra-226	2.47 X 10 ⁻⁹	± 0.30 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	1.54 X 10 ⁻⁹	± 2.12 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	2.01 X 10 ⁻⁹	± 2.52 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.37 X 10 ⁻⁹	± 0.91 X 10 ⁻⁹	2 X 10 ⁻⁹

Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2030-4

Submitted By: Hydro Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 08-13-90
Date Analyzed: 08-24-90

43 SC
Sample taken 6-12-90

WATER ANALYSIS

pH, units	7.82
Total Dissolved Solids, mg/l	25434
Chloride (Cl), mg/l	303
Sulfate (SO ₄), mg/l	16000
Nitrate (NO ₃ as N), mg/l	0.53
Arsenic (As), mg/l	0.003
Barium (Ba), mg/l	<0.55
Cadmium (Cd), mg/l	0.10
Chromium (Cr), mg/l	1.92
Lead (Pb), mg/l	0.20
Nickel (Ni), mg/l	4.1
Selenium (Se), mg/l	0.140
Uranium (U), mg/l	32.1

		LLD uCi/ml
Radium 226, pCi/l	0.34 ± 0.12	2x10E-10
Radium 228, pCi/l	4.01 ± 2.86	1x10E-9
Thorium 230, pCi/l	2920 ± 55	5x10E-9
Lead 210, pCi/l	2.77 ± 3.58	4x10E-9
Polonium 210, pCi/l	0.20 ± 1.21	2x10E-9

Sanet P. Meado
Chief Chemist



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Client: Petrotoomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2031-9

Submitted By: Steve Pfaff
Analyzed By: AH, GLH, JPM

Date Submitted: 06-14-90
Date Analyzed: 6-28-90

44 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	2.72
Total Dissolved Solids, mg/l	22769
Chloride (Cl), mg/l	283
Sulfate (SO4), mg/l	14400
Nitrate (NO3 as N), mg/l	0.61
Arsenic (As), mg/l	0.002
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.07
Chromium (Cr), mg/l	1.12
Lead (Pb), mg/l	0.17
Nickel (Ni), mg/l	3.0
Selenium (Se), mg/l	0.136
Uranium (U), mg/l	5.00

Radium 226, pCi/l	2.47 ± 0.30
Radium 228, pCi/l	1.54 ± 2.12
Thorium 230, pCi/l	826 ± 35
Lead 210, pCi/l	2.01 ± 2.52
Polonium 210, pCi/l	0.27 ± 0.91

LLD
uCi/ml

2x10E-10
1x10E-9
6x10E-9
3x10E-9
2x10E-9

Janet P. Meador
Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 15, 1990
 LOCATION: 45-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	556.49 X 10 ⁻⁹		
Th-230	804.00 X 10 ⁻⁹	± 43.00 X 10 ⁻⁹	200 X 10 ⁻¹⁰
Ra-226	2.27 X 10 ⁻⁹	± 0.29 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	34.10 X 10 ⁻⁹	± 3.60 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	2.04 X 10 ⁻⁹	± 3.77 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.00 X 10 ⁻⁹	± 1.25 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: June 12, 1990
 LOCATION: 49-SC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	37.23 X 10 ⁻⁹		
Th-230	16.80 X 10 ⁻⁹	± 5.80 X 10 ⁻⁹	70 X 10 ⁻¹⁰
Ra-226	4.69 X 10 ⁻⁹	± 0.37 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	10.40 X 10 ⁻⁹	± 3.50 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	2.66 X 10 ⁻⁹	± 2.53 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.12 X 10 ⁻⁹	± 0.90 X 10 ⁻⁹	2 X 10 ⁻⁹



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Client: Petrotoomics Company
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Attention: Steve Pfaff

Lab #: 90-2031-10

Submitted By: Steve Pfaff
Analyzed By: KAH, GLH, JPM

Date Submitted: 06-14-90
Date Analyzed : 08-26-90

45 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	3.47
Total Dissolved Solids, mg/l	28647
Chloride (Cl), mg/l	334
Sulfate (SO4), mg/l	18000
Nitrate (NO3 as N), mg/l	0.59
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.03
Chromium (Cr), mg/l	0.81
Lead (Pb), mg/l	0.20
Nickel (Ni), mg/l	4.8
Selenium (Se), mg/l	0.003
Uranium (U), mg/l	0.822

Radium 226, pCi/l	2.27 ± 0.29	LLD uCi/ml
Radium 228, pCi/l	34.1 ± 3.6	2x10E-10
Thorium 230, pCi/l	804 ± 43	1x10E-9
Lead 210, pCi/l	2.04 ± 3.77	2x10E-8
Polonium 210, pCi/l	0.00 ± 1.25	3x10E-9
		2x10E-9

Chief Chemist



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Attention: Steve Pfaff

Submitted By: Hydro Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 06 13 90
Date Analyzed : 08-24-90

49 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	4.56
Total Dissolved Solids, mg/l	9577
Chloride (Cl), mg/l	396
Sulfate (SO4), mg/l	5760
Nitrate (NO3 as N), mg/l	0.16
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	<0.02
Lead (Pb), mg/l	0.08
Nickel (Ni), mg/l	0.81
Selenium (Se), mg/l	0.002
Uranium (U), mg/l	0.055

Radium 226, pCi/l	4.69 = 0.37
Radium 228, pCi/l	10.4 = 3.5
Thorium 230, pCi/l	16.8 = 5.8
Lead 210, pCi/l	2.66 = 2.53
Polonium 210, pCi/l	0.12 = 0.90

LLD
uCi/ml

2x10E-10
1x10E-9
7x10E-9
3x10E-9
2x10E-9

Janet P. Meador
Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 12, 1990
 LOCATION: 51-SC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci}/\text{ml}$)	ERROR ESTIMATE ($\mu\text{Ci}/\text{ml}$)	LLD ($\mu\text{Ci}/\text{ml}$)
U-nat	68.38 X 10 ⁻⁹		
Th-230	23.50 X 10 ⁻⁹	± 6.00 X 10 ⁻⁹	70 X 10 ⁻¹⁰
Ra-226	29.00 X 10 ⁻⁹	± 1.00 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	60.20 X 10 ⁻⁹	± 4.90 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	2.78 X 10 ⁻⁹	± 3.51 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.51 X 10 ⁻⁹	± 1.11 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: June 12, 1990
 LOCATION: 50-SC
 TYPE OF SAMPLE: Groundwater - Dry

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci}/\text{ml}$)	ERROR ESTIMATE ($\mu\text{Ci}/\text{ml}$)	LLD ($\mu\text{Ci}/\text{ml}$)
U-nat	X 10 ⁻⁹		
Th-230	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-226	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻¹⁰
Ra-228	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Pb-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹
Po-210	X 10 ⁻⁹	± X 10 ⁻⁹	X 10 ⁻⁹



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Attention: Steve Pfaff

Lab #: 90-2031-11

Submitted By: Steve Pfaff
Analyzed By: KAH, GLH, JPM

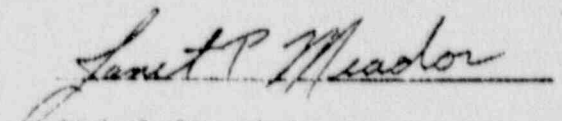
Date Submitted: 06-14-90
Date Analyzed: 08-28-90

51 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	3.58
Total Dissolved Solids, mg/l	29161
Chloride (Cl), mg/l	339
Sulfate (SO ₄), mg/l	18400
Nitrate (NO ₃ as N), mg/l	0.46
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.02
Chromium (Cr), mg/l	0.05
Lead (Pb), mg/l	0.20
Nickel (Ni), mg/l	4.2
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.101

		LLD uCi/mi
Radium 226, pCi/l	29.0 ± 1.0	2x10E-10
Radium 228, pCi/l	60.2 ± 4.9	1x10E-9
Thorium 230, pCi/l	23.5 ± 6.0	7x10E-9
Lead 210, pCi/l	2.78 ± 3.51	3x10E-9
Polonium 210, pCi/l	0.51 ± 1.11	2x10E-9


Chief Chemist.

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 13, 1990
 LOCATION: 53-SC
 TYPE OF SAMPLE: Groundwater - Paired

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	151.65×10^{-9}		
Th-230	0.79×10^{-9}	$\pm 0.66 \times 10^{-9}$	10×10^{-10}
Ra-226	4.43×10^{-9}	$\pm 0.41 \times 10^{-9}$	2×10^{-10}
Ra-228	5.58×10^{-9}	$\pm 2.22 \times 10^{-9}$	2×10^{-9}
Pb-210	1.13×10^{-9}	$\pm 1.88 \times 10^{-9}$	2×10^{-9}
Po-210	0.36×10^{-9}	$\pm 0.42 \times 10^{-9}$	1×10^{-9}

DATE COLLECTED: June 13, 1990
 LOCATION: 54-SC
 TYPE OF SAMPLE: Groundwater - Pumped

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	2.03×10^{-9}		
Th-230	9.39×10^{-9}	$\pm 4.28 \times 10^{-9}$	60×10^{-10}
Ra-226	17.40×10^{-9}	$\pm 0.70 \times 10^{-9}$	1×10^{-10}
Ra-228	29.50×10^{-9}	$\pm 4.80 \times 10^{-9}$	1×10^{-9}
Pb-210	2.31×10^{-9}	$\pm 2.06 \times 10^{-9}$	2×10^{-9}
Po-210	0.31×10^{-9}	$\pm 0.42 \times 10^{-9}$	1×10^{-9}



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Client: Petrochemicals Company

Lab #: 90-2031-12

Address: P.O. Box 8509, Shirley Basin, WY 82615-8509

Attention: Steve Pfaff

Submitted By: Steve Pfaff

Date Submitted: 06-14-90

Analyzed By: KAH, GLH, JPM

Date Analyzed: 08-28-90

53 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	4.59
Total Dissolved Solids, mg/l	4850
Chloride (Cl), mg/l	76
Sulfate (SO ₄), mg/l	3200
Nitrate (NO ₃ as N), mg/l	18.2
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	<0.02
Lead (Pb), mg/l	<0.05
Nickel (Ni), mg/l	0.30
Selenium (Se), mg/l	0.020
Uranium (U), mg/l	0.224

Radium 226, pCi/l	4.43 ± 0.41
Radium 228, pCi/l	5.58 ± 2.22
Thorium 230, pCi/l	0.79 ± 0.66
Lead 210, pCi/l	1.13 ± 1.88
Polonium 210, pCi/l	0.36 ± 0.42

LLD
uCi/ml

2x10E-10
2x10E-9
1x10E-9
2x10E-9
1x10E-9

Janet P. Meador

Chief Chemist



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Client: Petrotoomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2030-6

Submitted By: Hydro Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 06-13-90
Date Analyzed: 08-24-90

54 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	3.88
Total Dissolved Solids, mg/l	20928
Chloride (Cl), mg/l	365
Sulfate (SO4), mg/l	13280
Nitrate (NO3 as N), mg/l	0.22
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.01
Chromium (Cr), mg/l	0.18
Lead (Pb), mg/l	0.16
Nickel (Ni), mg/l	3.2
Selenium (Se), mg/l	0.007
Uranium (U), mg/l	0.003

LLD
uCi/ml

Radium 226, pCi/l	17.4 ± 0.7	1x10E-10
Radium 228, pCi/l	29.5 ± 4.8	1x10E-9
Thorium 230, pCi/l	9.39 ± 4.28	8x10E-9
Lead 210, pCi/l	2.31 ± 2.06	2x10E-9
Polonium 210, pCi/l	0.31 ± 0.42	1x10E-9

James T. Madon
Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 13, 1990

LOCATION: 55-5C

TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	15.57 X 10 ⁻⁹		
Th-230	250.00 X 10 ⁻⁹	± 20.00 X 10 ⁻⁹	200 X 10 ⁻¹⁰
Ra-226	6.21 X 10 ⁻⁹	± 0.39 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	14.80 X 10 ⁻⁹	± 3.40 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	3.53 X 10 ⁻⁹	± 2.81 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.49 X 10 ⁻⁹	± 0.51 X 10 ⁻⁹	1 X 10 ⁻⁹

DATE COLLECTED: June 13, 1990

LOCATION: 56-5C

TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	14.22 X 10 ⁻⁹		
Th-230	0.00 X 10 ⁻⁹	± 2.89 X 10 ⁻⁹	50 X 10 ⁻¹⁰
Ra-226	9.66 X 10 ⁻⁹	± 0.47 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	28.80 X 10 ⁻⁹	± 4.30 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	3.17 X 10 ⁻⁹	± 3.02 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.48 X 10 ⁻⁹	± 0.66 X 10 ⁻⁹	2 X 10 ⁻⁹



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Client: Petrochemical Company
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Attention: Steve Pfaff

Lab #: 90-2030-7

Submitted By: Hydro Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 06-13-90
Date Analyzed: 08-24-90

55 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	4.53
Total Dissolved Solids, mg/l	14020
Chloride (Cl), mg/l	360
Sulfate (SO4), mg/l	8640
Nitrate (NO3 as N), mg/l	0.12
Arsenic (As), mg/l	0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	0.07
Lead (Pb), mg/l	0.12
Nickel (Ni), mg/l	0.68
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.023

Radium 226, pCi/l	6.21 ± 0.39
Radium 228, pCi/l	14.8 ± 3.4
Thorium 230, pCi/l	360 ± 20
Lead 210, pCi/l	3.53 ± 2.81
Polonium 210, pCi/l	0.49 ± 0.51

LLD
uCi/ml

1x10 ⁻¹⁰
1x10 ⁻⁹
2x10 ⁻⁸
3x10 ⁻⁹
1x10 ⁻⁹

Janet P. Meador

Chief Chemist



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Client: Petrochemicals Company
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Attention: Steve Pfaff

Lab #: 90-2030-H

Submitted By: Hydro Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 06-13-90
Date Analyzed: 08-24-90

56 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	4.07
Total Dissolved Solids, mg/l	12033
Chloride (Cl), mg/l	267
Sulfate (SO4), mg/l	9280
Nitrate (NO3 as N), mg/l	0.21
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	0.02
Lead (Pb), mg/l	0.08
Nickel (Ni), mg/l	1.6
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.021

		LLD uCi/ml
Radium 226, pCi/l	9.66 ± 0.47	1x10E-10
Radium 228, pCi/l	28.8 ± 4.3	1x10E-9
Thorium 230, pCi/l	0.00 ± 2.89	5x10E-9
Lead 210, pCi/l	3.17 ± 3.02	3x10E-9
Polonium 210, pCi/l	0.48 ± 0.66	2x10E-9

Janet P. Meade
Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 13, 1990
 LOCATION: 57-SC
 TYPE OF SAMPLE: Groundwater - Bailed

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	3.39 X 10 ⁻⁹		
Th-230	0.09 X 10 ⁻⁹	± 0.34 X 10 ⁻⁹	20 X 10 ⁻¹⁰
Ra-226	4.02 X 10 ⁻⁹	± 0.31 X 10 ⁻⁹	3 X 10 ⁻¹⁰
Ra-228	13.30 X 10 ⁻⁹	± 3.30 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	1.04 X 10 ⁻⁹	± 1.89 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.10 X 10 ⁻⁹	± 0.52 X 10 ⁻⁹	1 X 10 ⁻⁹

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 12, 1990
 LOCATION: 38-SC
 TYPE OF SAMPLE: Groundwater - Pumped

<u>RADIONUCLIDE</u>	<u>CONCENTRATION (uCi/ml)</u>	<u>ERROR ESTIMATE (uCi/ml)</u>	<u>LLD (uCi/ml)</u>
U-nat	13.54 X 10 ⁻⁹		
Th-230	12.20 X 10 ⁻⁹	± 3.20 X 10 ⁻⁹	40 X 10 ⁻¹⁰
Ra-226	17.70 X 10 ⁻⁹	± 0.80 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	118.00 X 10 ⁻⁹	± 8.00 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	1.95 X 10 ⁻⁹	± 2.78 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.69 X 10 ⁻⁹	± 0.87 X 10 ⁻⁹	2 X 10 ⁻⁹



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Client: Petrochemicals Company
Address: P.O. Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2030-9

Submitted By: Hydro Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 06-12-90
Date Analyzed: 08-24-90

57 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	4.12
Total Dissolved Solids, mg/l	9970
Chloride (Cl), mg/l	257
Sulfate (SO ₄), mg/l	6080
Nitrate (NO ₃ as N), mg/l	0.20
Arsenic (As), mg/l	0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	<0.01
Chromium (Cr), mg/l	<0.02
Lead (Pb), mg/l	0.12
Nickel (Ni), mg/l	1.4
Selenium (Se), mg/l	0.003
Uranium (U), mg/l	0.005

		LLU uCi/ml
Radium 226, pCi/l	4.02 ± 0.32	3x10E-10
Radium 228, pCi/l	13.3 ± 3.8	1x10E-9
Thorium 230, pCi/l	0.00 ± 0.34	2x10E-9
Lead 210, pCi/l	1.04 ± 1.89	2x10E-9
Polonium 210, pCi/l	0.10 ± 0.52	1x10E-9

Janet P. Meador
Chief Chemist



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Client: Petrotoomics Company
Address: P.O.Box 8509, Shirley Basin, WY 82615-8509
Attention: Steve Pfaff

Lab #: 90-2030-10

Submitted By: Hydre Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 06-13-90
Date Analyzed: 08-24-90

58 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	3.66
Total Dissolved Solids, mg/l	29189
Chloride (Cl), mg/l	329
Sulfate (SO4), mg/l	20000
Nitrate (NO3 as N), mg/l	0.27
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.03
Chromium (Cr), mg/l	0.39
Lead (Pb), mg/l	0.22
Nickel (Ni), mg/l	4.5
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	0.020

Radium 226, pCi/l	17.7 ± 0.0
Radium 228, pCi/l	118 ± 8
Thorium 230, pCi/l	12.2 ± 3.2
Lead 210, pCi/l	1.95 ± 2.78
Polonium 210, pCi/l	0.69 ± 0.87

LLD
uCi/ml

2x10E-1
1x10E-9
4x10E-9
3x10E-9
2x10E-9

Janet T. Meador
Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 13, 1990
 LOCATION: 59-SC
 TYPE OF SAMPLE: Groundwater - Pumped

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	6.62 X 10 ⁻⁹		
Th-230	0.60 X 10 ⁻⁹	± 2.19 X 10 ⁻⁹	40 X 10 ⁻¹⁰
Ra-226	0.82 X 10 ⁻⁹	± 0.54 X 10 ⁻⁹	2 X 10 ⁻¹⁰
Ra-228	27.00 X 10 ⁻⁹	± 6.60 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	2.27 X 10 ⁻⁹	± 3.11 X 10 ⁻⁹	3 X 10 ⁻⁹
Po-210	0.59 X 10 ⁻⁹	± 0.83 X 10 ⁻⁹	2 X 10 ⁻⁹

DATE COLLECTED: June 13, 1990
 LOCATION: 60-SC
 TYPE OF SAMPLE: Groundwater - Bailed

RADIONUCLIDE	CONCENTRATION (uCi/ml)	ERROR ESTIMATE (uCi/ml)	LLD (uCi/ml)
U-nat	1069.66 X 10 ⁻⁹		
Th-230	9.08 X 10 ⁻⁹	± 2.71 X 10 ⁻⁹	40 X 10 ⁻¹⁰
Ra-226	11.60 X 10 ⁻⁹	± 0.60 X 10 ⁻⁹	1 X 10 ⁻¹⁰
Ra-228	31.90 X 10 ⁻⁹	± 5.60 X 10 ⁻⁹	1 X 10 ⁻⁹
Pb-210	3.04 X 10 ⁻⁹	± 2.12 X 10 ⁻⁹	2 X 10 ⁻⁹
Po-210	0.61 X 10 ⁻⁹	± 0.45 X 10 ⁻⁹	1 X 10 ⁻⁹



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Client: Petrochemicals Company
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Attention: Steve Pfaff

Lab #: 90-2030-11

Submitted By: Hydro Engineering
Analyzed By: KPH, JPM, GLH

Date Submitted: 06-13-90
Date Analyzed: 08-24-90

59 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	3.67
Total Dissolved Solids, mg/l	24550
Chloride (Cl), mg/l	293
Sulfate (SO ₄), mg/l	15600
Nitrate (NO ₃ as N), mg/l	0.31
Arsenic (As), mg/l	<0.001
Barium (Ba), mg/l	<0.05
Cadmium (Cd), mg/l	0.02
Chromium (Cr), mg/l	0.15
Lead (Pb), mg/l	0.17
Nickel (Ni), mg/l	3.5
Selenium (Se), mg/l	<0.001
Uranium (U), mg/l	<0.001

		LID uCi/ml
Radium 226, pCi/l	9.88 ± 0.54	2x10E-10
Radium 228, pCi/l	95.0 ± 8.6	1x10E-9
Thorium 230, pCi/l	0.00 ± 2.19	4x10E-9
Lead 210, pCi/l	2.27 ± 3.11	3x10E-9
Polonium 210, pCi/l	0.59 ± 0.83	2x10E-9

Janet P. Madon
Chief Chemist



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Client: Petrochemicals Company
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Attention: Steve Pfa'f

Lab #: 90-2030-12

Submitted By: Hydro Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 06-13-90
Date Analyzed: 08-24-90

60 SC
Sample taken 6-13-90

WATER ANALYSIS

pH, units	4.17	
Total Dissolved Solids, mg/l	6042	
Chloride (Cl), mg/l	157	
Sulfate (SO ₄), mg/l	3440	
Nitrate (NO ₃ as N), mg/l	0.07	
Arsenic (As), mg/l	0.002	
Barium (Ba), mg/l	<0.05	
Cadmium (Cd), mg/l	<0.01	
Chromium (Cr), mg/l	0.07	
Lead (Pb), mg/l	<0.05	
Nickel (Ni), mg/l	0.79	
Selenium (Se), mg/l	0.002	
Uranium (U), mg/l	1.58	
		LLD uCi/ml
Radium 226, pCi/l	11.5 ± 0.5	1x10E-10
Radium 228, pCi/l	31.9 ± 5.6	1x10E-9
Thorium 230, pCi/l	9.08 ± 2.71	4x10E-9
Lead 210, pCi/l	3.04 ± 2.12	2x10E-9
Polonium 210, pCi/l	0.61 ± 0.45	1x10E-9

Janet P. Meador
Chief Chemist

3. LIQUID SAMPLES (CONTINUED)

DATE COLLECTED: June 12, 1969

LOCATION: 3-D

TYPE OF SAMPLE: Groundwater - Fajal

RADIONUCLIDE	CONCENTRATION ($\mu\text{Ci}/\text{ml}$)	ERROR ESTIMATE ($\mu\text{Ci}/\text{ml}$)	LLD ($\mu\text{Ci}/\text{ml}$)
U-nat	2.71×10^{-9}		
Th-230	6.17×10^{-9}	$\pm 0.59 \times 10^{-9}$	2.0×10^{-10}
Sa-226	3.46×10^{-9}	$\pm 0.56 \times 10^{-9}$	2×10^{-10}
Ra-228	20.10×10^{-9}	$\pm 3.20 \times 10^{-9}$	1×10^{-9}
Pb-210	1.62×10^{-9}	$\pm 3.01 \times 10^{-9}$	3×10^{-9}
Po-210	0.29×10^{-9}	$\pm 0.75 \times 10^{-9}$	2×10^{-9}



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Lab #: 90-2030-1

Submitted By: Hydro Engineering
Analyzed By: KAH, JPM, GLH

Date Submitted: 08 12 90
Date Analyzed: 08-24-90

5 DC
Sample taken 6-12-90

WATER ANALYSIS

pH, units	4.28	
Total Dissolved Solids, mg/l	12755	
Chloride (Cl), mg/l	211	
Sulfate (SO ₄), mg/l	7840	
Nitrate (NO ₃ as N), mg/l	0.34	
Arsenic (As), mg/l	0.002	
Barium (Ba), mg/l	<0.05	
Cadmium (Cd), mg/l	0.011	
Chromium (Cr), mg/l	0.02	
Lead (Pb), mg/l	0.12	
Nickel (Ni), mg/l	2.6	
Selenium (Se), mg/l	<0.001	
Uranium (U), mg/l	0.004	
		LLD uCi/ml
Radium 226, pCi/l	8.46 ± 0.56	2x10E-10
Radium 228, pCi/l	20.1 ± 3.2	1x10E-9
Thorium 230, pCi/l	6.17 ± 6.38	1x10E-8
Lead 210, pCi/l	1.62 ± 3.01	3x10E-9
Polonium 210, pCi/l	0.29 ± 0.75	2x10E-9

Janet P. Meador
Chief Chemist

4. VEGETATION, FOOD, AND FISH SAMPLES

Deleted by Amendment No. 21

5. SOIL AND SEDIMENT SAMPLES

Deleted by Amendment No. 21

4. VEGETATION, FOOD, AND FISH SAMPLES

Deleted by Amendment No. 21

5. SOIL AND SEDIMENT SAMPLES

Deleted by Amendment No. 21

6. DIRECT RADIATION MEASUREMENTS

DATE: 2nd Quarter 1990

<u>LOCATION</u>	<u>EXPOSURE RATE</u> <u>(mr/qr)</u>	<u>ERROR ESTIMATE</u> <u>(mr/qr)</u>
Site 1	40.6	±10.1
Site 5	66.8	± 5.9

LOCATIONS: Site 1 - 7800' WNW of where yellowcake dryer stack had been located.
Site 2 - Discontinued.
Site 3 - Discontinued.
Site 4 - Discontinued.
Site 5 - 1800' NE of where yellowcake dryer stack had been located.
Site 6 - Discontinued.

LLD CALCULATIONS

$$\text{LLD} = \frac{4.66 \sqrt{C_b \cdot T}}{(2.22)(E)(R)(V)(T)} \quad \text{in pCi/units used (V)}$$

WHERE:

C_b = BACKGROUND COUNT RATE

T = COUNT TIME (SAME FOR SAMPLE AND BACKGROUND)

E = DETECTOR EFFICIENCY (CPM/DPM)

R = FRACTIONAL RECOVERY

V = SAMPLE SIZE LITERS OF AIR OR WATER
 GRAMS OF SOIL
 KILOGRAMS OF VEGETATION

2.22 = DPM/pCi

Since the LLD is a function of sample volume, counting efficiency, radiochemical yield, etc., it may vary for different sampling and analysis procedures. The following are some of the normal values used.

Ra^{226}

C_b = 0.05 to 0.30 counts per minute

T = 50 minutes

E = about 0.9

R = about 0.9 frequently less in soil and vegetation

V = 1 liter of water

 = 20 grams of soil

 = air volume taken is usually 1/4 of volume sampled

 = vegetation weight is usually 1/2 of sample provided

Th²³⁰

C_a = 0.04 to 0.20 cpm

T = 200 minutes, may be less for "hot" samples like tailings pond

E•R = combined recovery and efficiency from Th²²⁸ tracer varies greatly from 0.02 to 0.20

V = 1 liter of water, or less if high in iron. Iron interferes and volumes as low as 25 or 50 ml. may be used.
= 1.0 grams soil
= air volume taken is usually 1/4 of volume sampled (about 7 x 10⁶ L)

Pb²¹⁰

C_a = 1 to 2 cpm

T = 100 to 200 minutes

E = 0.25 to 0.33

R = usually 0.75 to 0.90 but may be less for vegetation and waters high in TDS

V = 1 liter of water, again samples high in iron will be less to lessen its interference.
= air volume taken is usually 1/4 of sample (about 7 x 10⁶ L)
= vegetation weight is usually 1/2 of sample provided.

Po²¹⁰

C_a = about 0.2 cpm

T = 100 to 200 minutes

E = 0.15 to 0.20

R = 0.5 to 0.8

V = 1 liter of water, iron causes interference so smaller volumes of samples high in iron are used, down to about 200 ml.

%MPC CALCULATION

The %MPC is calculated using the values obtained from 10 CFR 20 appendix B for unrestricted limits in air.

The calculation is as follows:

$$\%MPC = \frac{\text{sample concentration}}{\text{unrestricted limit}}$$

unrestricted limits for air from 10 CFR 20 Appendix B

U nat	5000×10^{-15}
Th ²³⁰	80×10^{-15}
Ra ²²⁶	3000×10^{-15}
Pb ²¹⁰	4000×10^{-15}
Rn ²²²	3×10^{-9}