EFFLUENT MONITORING REPORT

STACK EMISSIONS

ABSTRACT

To comply with license condition 26 of license number SUA-1354, air samples were taken from five (5) stacks to determine the average and maximum concentrations (μCi/cc) and release rates (μCi/sec) for $U_{(n)}$, Ra-226 and Th-230, and the total quantity of uranium released (μCi).

Stack sampling was carried out by standard stack sampling techniques for air particulate sampling, employing the apparat s (Fi 5-1) and sampling procedures shown in the Federal Register, Vol. 36, No. 47 dated December 23, 1971. (Attachment I).

Isokenetic samples were taken in the vertical section of the stacks at 25, 50, and 75 percent of the diameter, using a one way traverse. Five samples were taken from each stack with a minimum sampling time of 30 minutes per sample. Sampling time, rates and volumes are summarized in Tables I and II.

Daily grab samples were taken at each stack and composited for a one week period. The composite samples were placed in a plastic bag and sent to a commercial laboratory (EAL Corp. of Richmond, Calif.) for analysis of $U_{(n)}$, Ra-226, and Th-230. Data taken during each sampling period was recorded on standard EPA data sheets. A copy of one set of data sheets used for a single sample is attached. (Attachment II)

Methods of calculation are shown in the attached calculation data sheets, pages 1 thru 11, (Attachment III). Results of the calculations are summarized in Tables III & IV, along with a copy of the radionuclide concentrations reported by EAL Laboratories. (Attachment IV.)

Data in Table III shows that the concentrations of U (nat), Th-230, Ra-226 are below the MPC limits as specified in 10 CFR-20, Appendix B, Table II for all stacks

ATTACHMENT I

SAMPLING EQUIPMENT AND PROCEDURES

ATTACHMENT I

4.2 Gas volume.

$$V_{m_{std}} = V_m \left(\frac{P_m}{P_{std}}\right)\left(\frac{T_{std}}{T_m}\right) = 17.71 \frac{°R}{\text{in. Hg}} \left(\frac{V_m P_m}{T_m}\right) \quad \text{equation 4-2}$$

where:

$V_{m_{std}}$ = Dry gas volume through meter at standard conditions, cu. ft.

V_m = Dry gas volume measured by meter, cu. ft.

P_m = Barometric pressure at the dry gas meter, inches Hg.

P_{std} = Pressure at standard conditions, 29.92 inches Hg.

T_{std} = Absolute temperature at standard conditions, 530° R.

T_m = Absolute temperature at meter (°F + 460), °R.

4.3 Moisture content.

$$B_{wo} = \frac{V_{w_{std}}}{V_{w_{std}} + V_{m_{std}}} + B_{wm} = \frac{V_{w_{std}}}{V_{w_{std}} + V_{m_{std}}} + (0.025) \quad \text{equation 4-3}$$

where:

B_{wo} = Proportion by volume of water vapor in the gas stream, dimensionless.

$V_{w_{std}}$ = Volume of water vapor collected (standard conditions), cu. ft.

$V_{m_{std}}$ = Dry gas volume through meter (standard conditions), cu. ft.

B_{wm} = Approximate volumetric proportion of water vapor in the gas stream leaving the impingers, 0.025.

5. *References.*

Air Pollution Engineering Manual, Danielson, J. A. (ed.), U.S. DHEW, PHS, National Center for Air Pollution Control, Cincinnati, Ohio, PHS Publication No. 999-AP-40, 1967.

Devorkin, Howard, et al., Air Pollution Source Testing Manual, Air Pollution Control District, Los Angeles, Calif., November 1963.

Methods for Determination of Velocity, Volume, Dust and Mist Content of Gases, Western Precipitation Division of Joy Manufacturing Co., Los Angeles, Calif., Bulletin WP-50, 1968.

METHOD 5—DETERMINATION OF PARTICULATE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and applicability.*

1.1 Principle. Particulate matter is withdrawn isokinetically from the source and its weight is determined gravimetrically after removal of uncombined water.

1.2 Applicability. This method is applicable for the determination of particulate emissions from stationary sources only when specified by the test procedures for determining compliance with New Source Performance Standards.

2. *Apparatus.*

2.1 Sampling train. The design specifications of the particulate sampling train used by EPA (Figure 5-1) are described in APTD-0581. Commercial models of this train are available.

2.1.1 Nozzle—Stainless steel (316) with sharp, tapered leading edge.

2.1.2 Probe—Pyrex[1] glass with a heating system capable of maintaining a minimum gas temperature of 250° F. at the exit end during sampling to prevent condensation from occurring. When length limitations (greater than about 8 ft.) are encountered at temperatures less than 600° F., Incoloy 825[1], or equivalent, may be used. Probes for sampling gas streams at temperatures in excess of 600° F. must have been approved by the Administrator.

2.1.3 Pitot tube—Type S, or equivalent, attached to probe to monitor stack gas velocity.

[1] Trade name.

2.1.4 Filter Holder—Pyrex[1] glass with heating system capable of maintaining minimum temperature of 225° F.

2.1.5 Impingers / Condenser—Four impingers connected in series with glass ball joint fittings. The first, third, and fourth impingers are of the Greenburg-Smith design, modified by replacing the tip with a ½-inch ID glass tube extending to one-half inch from the bottom of the flask. The second impinger is of the Greenburg-Smith design with the standard tip. A condenser may be used in place of the impingers provided that the moisture content of the stack gas can still be determined.

2.1.6 Metering system—Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 5° F., dry gas meter with 2% accuracy, and related equipment, or equivalent, as required to maintain an isokinetic sampling rate and to determine sample volume.

2.1.7 Barometer—To measure atmospheric pressure to ±0.1 inches Hg.

2.2 Sample recovery.

2.2.1 Probe brush—At least as long as probe.

2.2.2 Glass wash bottles—Two.

2.2.3 Glass sample storage containers.

2.2.4 Graduated cylinder—250 ml.

2.3 Analysis.

2.3.1 Glass weighing dishes.

2.3.2 Desiccator.

2.3.3 Analytical balance—To measure to ±0.1 mg.

2.3.4 Trip balance—300 g. capacity, to measure to ±0.05 g.

3. *Reagents.*

3.1 Sampling.

3.1.1 Filters—Glass fiber, MSA 1106 BH[1], or equivalent, numbered for identification and preweighed.

3.1.2 Silica gel—Indicating type, 6–16 mesh, dried at 175° C. (350° F.) for 2 hours.

3.1.3 Water.

3.1.4 Crushed ice.

3.2 Sample recovery.

3.2.1 Acetone—Reagent grade.

3.3 Analysis.

3.3.1 Water.

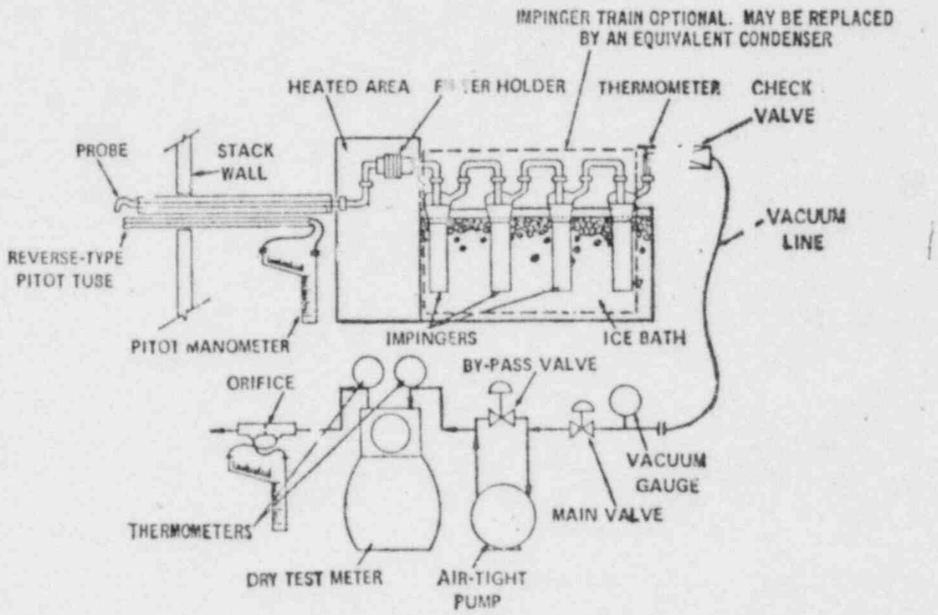

Figure 5-1. Particulate-sampling train.

3.3.2 Desiccant—Drierite[1] indicating.

4. *Procedure.*

4.1 Sampling.

4.1.1 After selecting the sampling site and the minimum number of sampling points, determine the stack pressure, temperature, moisture, and range of velocity head.

4.1.2 Preparation of collection train. Weigh to the nearest gram approximately 200 g. of silica gel. Label a filter of proper diameter, desiccate[2] for at least 24 hours and weigh to the nearest 0.5 mg. in a room where the relative humidity is less than 50%. Place 100 ml. of water in each of the first two impingers, leave the third impinger empty, and place approximately 200 g. of preweighed silica gel in the fourth impinger. Set up the train without the probe as in Figure 5-1. Leak check the sampling train at the sampling site by plugging up the inlet to the filter holder and pulling a 15 in. Hg vacuum. A leakage rate not in excess of 0.02 c.f.m. at a vacuum of 15 in. Hg is acceptable. Attach the probe and adjust the heater to provide a gas temperature of about 250° F. at the probe outlet. Turn on the filter heating system. Place crushed ice around the impingers. Add more ice during the run to keep the temperature of the gases leaving the last impinger as low as possible and preferably at 70° F., or less. Temperatures above 70° F. may result in damage to the dry gas meter from either moisture condensation or excessive heat.

4.1.3 Particulate train operation. For each run, record the data required on the example sheet shown in Figure 5-2. Take readings at each sampling point, at least every 5 minutes, and when significant changes in stack conditions necessitate additional adjustments in flow rate. To begin sampling, position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Sample for at least 5 minutes at each traverse point; sampling time must be the same for each point. Maintain isokinetic sampling throughout the sampling period. Nomographs are available which aid in the rapid adjustment of the sampling rate without other computations. APTD-0576 details the procedure for using these nomographs. Turn off the pump at the conclusion of each run and record the final readings. Remove the probe and nozzle from the stack and handle in accordance with the sample recovery process described in section 4.2.

[1] Trade name.

[2] Dry using Drierite[1] at 70° F. ±10° F.

ATTACHMENT II

STACK SAMPLING DATA SHEETS

EPA Forms

2564 AVE. ft./MIN.

PARTICULATE FIELD DATA

Plant: Utah

Plant Rep.

Location: Uranium stack

Test No.: DS-101

Date: 6-1-81

Operator: RWH

Sample Box NO.

Meter Box NO.

Meter H@: 1.63

C Factor: .94

Δp

Thimble No.

Thimble Wt.

Filter No.: DS 101

Filter Wt.

Impinger ml.

Water collected

Silica gel grams

Grams H_2O collected

Assumed Moisture: 2.5%

Probe Tip Dia.: .250

Dry Bulb: 29°C 84F

Wet Bulb: 22°C 72F

Start Time: 16:25

Bar. Pressure: 25.47

.16" H_2O +S,

Stack Pressure: 25.48

Sample Interval: 10 min

3 point

Additional Data

Stack dimensions - 24" Ø

Point	Dry Gas Meter Cu. Ft.	Pitot Manometer (Δp) in. H_2O	Orifice Manometer ΔH	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum In. Hg Gauge	Impinger Temp. °F	St. T.
				94	91		90	8
6"	493.2	.4	1.5	96	89	4	82	
12"	501.1	.41	1.55	101	90	5	92	
18"	509.3	.42	1.55	105	90	5	91	
	517.6			107	91			

24.4 √.41 1.53 100.6 90.2

.64

95°F

Test No________

Date________

Process________

DATA SUMMATION

Schematic of Stack

As	3.14
Ps	25.48
Barometric pressure	25.47
Cp	.85
Average square root of velocity head	.64
Average pressure differential across orifice	1.53
Average dry gas meter temperature	95°F
Average stack temperature	84
Number of traverse points	3
Vm	24.4
Total particulate catch	
Meter correction factor	.969
Total beryllium catch	

Test No.__________

Date__________

Process__________

CALCULATIONS

1) Volume of water collected.

$$V_{wc} = (V_{fc} - V_{ic}) \frac{pH_2O}{M_{H_2O}} \frac{T_{std}}{P_{std}} R$$

$$= (0.0474 \frac{cu.\ ft.}{m.}) (V_{fc} - V_{ic})$$

$$= (0.0474) (\quad)$$

V_{wc} = ft^3 at 70^o F and 29.92 in. Hg.

2) Volume of air metered.

$$V_{m_{std}} = V_m \left(\frac{T_{std}\ 530}{T_m\ 555}\right) \left(\frac{P_{bar}\ 25.47 + \frac{\Delta H\ 1.53}{13.6}\ .113}{P_{std}\ 29.92}\right) .969\ (mcf)$$

24.4 X .955 X .855 X .969 = 19.3

3) Moisture Content.

$$B_{wo} = \frac{V_{wc_{std}}}{V_{m_{std}} + V_{wc_{std}}} =$$

% H_2O = B_{wo} X 100 = .025 X 100

% H_2O = 2.5%

Test No. ________

Date ________

Process ________

4) $M_d = (\% \, CO_2 \times \frac{44}{100}) +$

$(\% \, O_2 \times \frac{32}{100}) +$

$(\% \, CO \times \frac{28}{100}) +$

$(\% \, N_2 \times \frac{28}{100})$

$= 28.82$

5) Molecular weight of stack gases.

$M_s = M_d (1-B_{wo}) + 18 (B_{wo})$

$M_s = M_d (.975) + 18 (.025)$ .45

$M_s = 28.55$

6) Velocity of exit gases.

$V_s = K_p C_p \sqrt{\frac{T_s}{P_s M_s}} \sqrt{\Delta p} = 85.48 \times .85 \sqrt{\frac{544}{25.48 \times 28.55}} \times .64$ .86 727

$V_s = 40.0$ fps

(7) Total flow of stack gases.

$Q_s = A_s V_s \times 60 = 7{,}536$ ACFM

($3.14 \times 40.0 \times 60$)

(Q_s) std $= Q_s \left(\frac{P_s}{P_{std}}\right) \left(\frac{T_{std}}{T_s}\right) (1-B_{wo})$

$(25.48 / 29.92 = .8516) \quad (530 / 544 = .9743) \quad (.975)$

(Q_s) std $= 5{,}901$ SCFM

V_s std $= \frac{5{,}901}{3.14 \times 60} = 31.3$ Fps

188.4

Test No. ____________________

Date ____________________

Process ____________________

8) Emissions from stack

a) Particulate

$$C_s = \frac{m_n \times 0.0154}{V_{m_{std}}} =$$

C_s = gr/scf

$$pmr = \frac{(m_n)}{V_{m_{std}}} \frac{(Q)_s \text{ std } (60)}{(454{,}000)} =$$

b) Beryllium

$$R = \frac{Wt\ (V_s)\ std\ As}{V_{m_{std}}} \times \frac{86{,}400 \text{ secs/day}}{10^6\ \gamma/g}$$

R = g/day

9) Percent Isokinetic = $\frac{V_{m_{std}}}{A_n\ \theta\ V_s \text{ std}} = \frac{19.3}{.0003408 \times 30 \times 31.3 \times 60} \times 10$

19.2

10) Summary of emission data:

100.5%

a) Regulation 123.13 "Particulate"

Allowable Emissions	Measured Emissions
0.02 grains per SFF	

Regulation 61.32 "Beryllium"

10 grams/day
0.01 γ/M^3 monthly average

ATTACHMENT III

CALCULATIONS

Stack Sampling Data

Average Concentration and Release Rates for Uranium

License Condition 26A

1. Average and maximum uranium concentration (μCi/cc) measured at the uranium recovery operations stack.

μCi/sample = 4.4 $\pm$ 0.2 pCi/sample x 10^{-6} μCi/pCi
= 4.4 $\pm$ 0.2 x 10^{-6} μCi/sample

μCi/ft.^{3} = 4.4 x 10^{-6} μCi/sample $\div$ 131.82 ft.^{3}/sample
= 0.0335 x 10^{-6} μCi/ft.^{3}

μCi/M^3 = 0.0335 x 10^{-6} μCi/ft.^{3} x 35.3 ft.^{3}/M^3
1.183 x 10^{6} μCi/M^3

μCi/cc = 1.183 x 10^{-6} μCi/M^3 x M^3/10^6 cc
= 1.1[illegible] x 10^{-12} μCi/cc

License Condition 26B

a. Uranium Stack

1. Average Uranium Release Rate (μCi/sec)

Average velocity of exit gases = 30.82 fps
Area of stack 3.14 ft^2

ft^3/sec = 30.82 fps x 3.14 ft^2
= 96.79 ft^3/sec

cc/sec = 96.79 ft^3/sec x 2.832 x 10^4 cc/ft^3
= 274 x 10^4 cc/sec

μCi/sec = 1.183 x 10^{-12} μCi/cc x 274 x 10^4 cc/sec
= 324.14 x 10^{-8}
= 3.24 x 10^{-6} μCi/sec.

2. Total Quantity of Uranium Released (μCi)

μCi = 3.24 x 10^{-6} μCi/sec x 86,400 sec/day x 140 days
= 39.19 μCi

b. Old Leach Stack

1. Average uranium release rate (μCi/sec)

Average velocity of exit gases	= 5.4 fps
Area of stack	= 3.14 ft^2
Sample volume	= 135.5 ft^3

μCi/sample = 0.4 $\pm$ pCi/sample x 10^{-6} μCi/pCi
= 0.4 x 10^{-6} μCi/sample

μCi/ft^3 = 0.4 x 10^{-6} μCi/sample $\div$ 135.5 ft^3/sample
= .00295 x 10^{-6} μCi/ft^3

μCi/M^3 = .00295 x 10^{-6} μCi/ft^3 x 35.3 ft^3/M^3
= 0.1041 x 10^{-6}

μCi/cc = 0.1041 x 10^{-6} μCi/M^3 - $\frac{M^3}{10^{-6}\ cc}$
= 0.1041 x 10^{-12} μCi/cc

ft^3/sec = 5.4 fps x 3.14 ft^2
= 16.96 ft^3/sec.

cc/sec = 16.96 ft^3/sec x 2.832 x 10^4 cc/ft^3
= 48.03 x 10^4 cc/sec.

μCi/sec = 0.1041 x 10^{-12} μCi/cc x 48.03 x 10^4 cc/sec
= 4.995 x 10^{-8} μCi/sec.

2. Total quantity of uranium released (μCi)

μCi = 4.995 x 10^{-8} μCi/sec x 86,400 sec/day x 140 days
= 60,419,520 x 10^{-8}
= 0.6 μCi

C. New Leach Stack

1. Average uranium release rate (μCi/sec)

Average velocity of exit gases	=	13.44 fps
Area of stack	=	3.14 ft^2
Sample volume	=	113.3 ft^3

μCi/sample = 0.4 ± 0.1 pCi/sample x 10^{-6} μCi/pCi

= $0.4 \pm 0.1 \times 10^{-6}$ μCi/sample

μCi/ft^3 = 0.4×10^{-6} μCi/sample $\div$ 113.3 ft^3/sample

= 0.0035×10^{-6} μCi/ft^3

μCi/M^3 = 0.0035×10^{-6} μCi/ft^3 x 35.3 ft^3/M^3

= 0.1246×10^{-6} μCi/M^3

μCi/cc = 0.1246×10^{-6} μCi/M^3 x $M^3/10^6$ cc

= 0.1246×10^{-12} μCi/cc

ft^3/sec = 13.44 fps x 3.14 ft^2

= 42.20 ft^3/sec

cc/sec = 42.20 ft^3/sec x 2.832×10^4 cc/ft^3

= 119.01×10^4 cc/sec

μCi/sec = 0.1246×10^{-12} μCi/cc x 119.01×10^4 cc/sec

= 14.83×10^{-8} μCi/sec

2. Total quantity of uranium released (μCi)

μCi = 14.83×10^{-8} μCi/sec x 86,400 sec/day x 140 days

= $179,383,680 \times 10^{-8}$ μCi

= 1.79 μCi

D. Be-Hydrolysis Drumming Stack

1. Average Uranium release rate (μCi/sec)

Average velocity of exit gases = 7.3 fps
Area of stack = 3.14 ft^2
Sample Volume = 119.8 ft^3

$\mu Ci/sample = 0.5 \pm pci/sample \times 10^{-6} \mu Ci/pCi$
$= 0.5 \pm 0.1 \times 10^{-6} \mu Ci/sample$

$\mu Ci/ft^3 = 0.5 \times 10^{-6} \mu Ci/sample \div 119.8\ ft^3/sample$
$= .0042 \times 10^{-6} \mu Ci/ft^3$

$\mu Ci/M^3 = 0.0042 \times 10^{-6} \mu Ci/ft^3 \times 35.3\ ft^3/M^3$
$= 0.1483 \times 10^{-6} \mu Ci/M^3$

$\mu Ci/cc = 0.1483 \times 10^{-6} \mu Ci/M^3 \times M^3/10^6\ cc$
$= 0.1483 \times 10^{-12} \mu Ci/cc$

$ft^3/sec = 7.3\ fps \times 3.14\ ft^2$
$= 22.92\ ft^3/sec.$

$cc/sec = 22.92\ ft^3/sec \times 2.832 \times 10^4\ cc/ft^3$
$= 64.92 \times 10^4\ cc/sec$

$\mu Ci/sec = 0.1483 \times 10^{-12} \mu Ci/cc \times 64.92 \times 10^4\ cc/sec$
$= 9.62 \times 10^{-8} \mu Ci/sec$

2. Total Quantity of Uranium released (μCi)

$\mu Ci = 9.62 \times 10^{-8} \mu Ci/sec \times 86,400\ sec/day \times 140\ days$
$= 116,363,520 \times 10^{-8} \mu Ci$
$= 1.16 \mu Ci$

E. Be-Hydrolysis Scrubber Stack

1. Average Uranium release rate (μCi/sec)

Average velocity of exit gases	= 3.6 fps
Area of stack	= 1.766 ft^2
Sample volume	= 81 ft^3

μCi/sample = 2.2 ± 0.2 pCi/sample x 10^{-6} μCi/pCi
= 2.2 ± 0.2 x 10^{-6} μCi/sample

μCi/ft^3 = 2.2 x 10^{-6} μCi/sample ÷ 81 ft^3/sample
= .0272 x 10^{-6} μCi/ft^3

μCi/M^3 = .0272 x 10^{-6} μCi/ft^3 x 35.3 ft^3/M^3
= 0.960 x 10^{-6} μCi/M^3

μCi/cc = 0.960 x 10^{-6} μCi/M^3 x M^3/10^6 cc
= 0.960 x 10^{-12} μCi/cc

ft^3/sec = 3.6 fps x 1.766 ft^2
= 6.36 ft^3/sec

cc/sec = 6.36 ft^3/sec x 2.832 x 10^4 cc/ft^3
= 18.01 x 10^4 cc/sec

μCi/sec = 0.960 x 10^{-12} μCi/cc x 18.01 x 10^4 cc/sec
= 17.29 x 10^{-8} μCi/sec

2. Total Quantity of Uranium Released (μCi)

μCi = 17.29 x 10^{-8} μCi/sec x 86,400 $\frac{\text{sec.}}{\text{day}}$ x 140 days
= 209,139,840 x 10^{-8} μCi
= 2.09 μCi

Stack Sampling Data
Average Concentration and Release Rates for Ra-226

License Condition 26-C

A. Uranium Stack

1. Average Concentration for Radium 226 (μCi/cc)

μCi/sample = 0.29 ± 0.08 pCi/sample x 10^{-6} μCi/pCi
= $0.29 \pm 0.08 \times 10^{-6}$ μCi/sample

μCi/ft^3 = 0.29×10^{-6} μCi/sample $\div$ 131.82 ft^3/sample
= 0.0022×10^{-6} μCi/ft^3

μCi/M^3 = 0.0022×10^{-6} μCi. ft^3 x 35.3 ft^3/M^3
= 0.0777×10^{-6} μCi/M^3

μCi/cc = 0.0777×10^{-6} μCi/M^3 x M^3/10^6cc
= 0.0777×10^{-12} μCi/cc

2. Release rates for Radium 226 (μCi/sec)

ft^3/sec = 30.82 fps x 3.14 ft^2
= 96.79 ft^3/sec

cc/sec = 96.79 ft^3/sec x 2.832×10^4 cc/ft^3
= 274×10^4 cc/sec

μCi/sec = 0.0777×10^{-12} μCi/cc x 274×10^4 cc/sec

= 21.29×10^{-8} μCi/sec
= $.213 \times 10^{-6}$ μCi/sec

B. Old Leach Stack

1. Average Concentration for Ra-226 (μCi/cc)

μCi/sample	$= 0.11 \pm 0.08$ pCi/sample x 10^{-6} μCi/pCi
	$= 0.11 \pm 0.08 \times 10^{-6}$ μCi/sample
$\mu Ci/ft^3$	$= 0.11 \times 10^{-6}$ μCi/sample $\div$ 135.5 ft^3/sample
	$= 0.0008 \times 10^{-6}$ $\mu Ci/ft^3$
$\mu Ci/M^3$	$= 0.0008 \times 10^{-6}$ $\mu Ci/ft^3 \times 35.3\ ft^3/M^3$
	$= 0.0287 \times 10^{-6}$ $\mu Ci/M^3$
μCi/cc	$= 0.0287 \times 10^{-6}$ $\mu Ci/M^3 \times \frac{M^3}{10^6\ cc}$
	$= 0.0287 \times 10^{-12}$ μCi/cc

2. Release Rates for Ra-226 (μCi/sec)

ft^3/sec	$= 5.4$ fps $\times 3.14\ ft^2$
	$= 16.96\ ft^3$/sec
cc/sec	$= 16.96\ ft^3/sec \times 2.832 \times 10^4\ cc/ft^3$
	$= 48.03 \times 10^4$ cc/sec
μCi/sec	$= 0.0287 \times 10^{-12}$ μCi/cc $\times 48.03 \times 10^4$ cc/sec
	$= 1.376 \times 10^{-8}$ μCi/sec
	$= .0138 \times 10^{-6}$ μCi/sec

C. New Leach Stack

1. Average Concentration for Ra-226 (μCi/cc)

μCi/sample	= 0.14 $\pm$ 0.08 pCi/sample x 10^{-6} μCi/pCi
	= 0.14 $\pm$ 0.08 x 10^{-6} μCi/sample
μCi/ft^3	= 0.14 x 10^{-6} μCi/sample $\div$ 113.3 ft^3/sample
	.00123 x 10^{-6} μCi/ft^3
μCi/M^3	= 0.01123 x 10^{-6} μCi/ft^3 x 35.3 ft^3/M^3
	= 0.0434 x 10^{-6} μCi/M^3
μCi/cc	= 0.0434 x 10^{-6} μCi/M^3 x $M^3/10^6$ cc
	= 0.0434 x 10^{-12} μCi/cc

2. Release Rate for Ra-226 (μCi/sec)

ft^3/sec	= 13.44 fps x 3.14 ft^2
	= 42.20 ft^3/sec
cc/sec	= 42.20 ft^3/sec x 2.832 x 10^4 cc/ft^3
	= 119.01 x 10^4 cc/sec
μCi/sec	= 0.0434 x 10^{-12} μCi/cc x 119.01 x 10^4 cc/sec
	= 5.165 x 10^{-8} μCi/sec

D. Beryllium Hydrolysis Drumming Stack

1. Average concentration for Ra-226 (μCi/cc)

μCi/sample = 0.13 ± 0.08 pCi/sample x 10^{-6} μCi/pCi
= $0.13 \pm 0.08 \times 10^{-6}$ μCi/sample

μCi/ft^3 = 0.13×10^{-6} μCi/sample $\div$ 119.8 ft^3/sample
= 0.0011×10^{-6} μCi/ft^3

μCi/M3 = $.0011 \times 10^{-6}$ μCi/ft^3 x 35.3 ft^3/M^3
= 0.0388×10^{-6} μCi/M^3

μCi/cc = 0.0388×10^{-6} μCi/M^3 x M^3/10^6 cc
= 0.0388×10^{-12} μCi/cc

2. Release Rate for Ra-226 (μCi/sec)

ft^3/sec = 7.3 fps x 3.14 ft^2
= 22.92 ft^3 /sec

cc/sec = 22.92 ft^3/sec x 2.832×10^4 cc/ft^3
= 64.92×10^4 cc/sec

μCi/sec = 0.0388×10^{-12} μCi/cc x 64.92×10^4 cc/sec
= 2.52×10^{-8} μCi/sec

E. Beryllium Hydrolysis Scrubber Stack

1. Average Concentration for Ra-226 (μCi/cc) = 0

2. Release rate for Ra-226 (μCi/sec) = 0

Analysis report shows Ra-226 = 0 $\pm$ 0.09 pCi/sample

Stack Sampling Data

Average Concentration and Release Rate for Thorium - 230

License Condition 26-C

The average concentration and release rates for thorium-230 are below limits of detection as shown by Table III and by the analytical report (Attachment IV).

ATTACHMENT IV

CHEMICAL ANALYSIS OF STACK SAMPLES

ATTACHMENT IV RESULTS

Sample Number	Analysis	Results pCi/sample ± 2 σ
D-9343 Uranium Stack	^{226}Ra	0.29 ± 0.08
	^{230}Th	0 ± 0.2
	^{238}U	4.4 ± 0.2
D-9344 Old Leach Stack	^{226}Ra	0.11 ± 0.08
	^{230}Th	0 ± 0.3
	^{238}U	0.4 ± 0.1
D-9345 New Leach Stack	^{226}Ra	0.14 ± 0.08
	^{230}Th	0 ± 0.2
	^{238}U	0.4 ± 0.1
D-9346 Be-Hyd Drumming	^{226}Ra	0.13 ± 0.08
	^{230}Th	0 ± 0.2
	^{238}U	0.5 ± 0.1
D-9347 Be-Hyd Scrubber	^{226}Ra	0 ± 0.09
	^{230}Th	0 ± 0.3
	^{238}U	2.2 ± 0.2

TABLE I
Stack Sampling Data
1st Half 1981

Date	Sample Volume Vm CF	Vm. Std. SCF	Sample Time (Min.)	% H_2O	Stack Velocity Vs. fps	Vs. Std. fps	% Iso-Kenetic	Stack Temp. °F
A) Uranium Stack								
6-1-81	24.40	19.3	30	2.5	40.0	31.3	100.5	84
6-2-81	21.15	16.9	30	2.2	38.1	31.1	88.7	79
6-3-81	23.80	18.5	30	2.4	34.1	28.1	107.6	75
6-4-81	47.20	38.7	60	2.0	38.7	31.9	99.0	79
6-5-81	48.80	38.4	60	2.4	38.8	31.7	98.7	82
B) Old Leach Stack								
6-8-81	35.4	27.7	60	25.0	9.7	5.4	104.5	149
6-9-81	38.7	30.7	60	22.0	10.3	6.0	104.0	144
6-9-81	38.9	30.5	60	22.0	10.3	6.0	103.4	144
6-10-81	30.5	23.9	60	35.0	10.8	5.1	95.6	167
6-10-81	28.4	22.7	60	26.0	8.4	4.6	101.2	154
C) New Leach Stack								
6-3-81	24.1	19.7	30	41.0	32.0	13.5	105.9	171
6-4-81	45.0	36.2	60	46.0	31.1	12.0	109.4	176
6-5-81	24.7	19.3	30	41.0	32.7	13.9	100.5	171
6-8-81	25.0	19.5	30	41.0	33.0	13.9	101.6	171
6-9-81	23.7	18.6	30	41.0	33.0	13.9	96.9	171
D) Be-Hydrolysis Drumming								
6-1-81	23.5	18.7	30	5.0	10.1	7.8	97.9	93
6-2-81	10.7	8.5	30	5.0	7.8	6.0	103.7	93
6-3-81	19.8	15.6	30	5.0	8.3	6.4	99.4	92
6-5-81	50.3	39.3	60	6.0	10.9	8.3	96.6	97
6-6-81	48.3	37.7	60	5.0	10.1	7.8	98.4	93
E) Be-Hydrolysis Scrubber								
6-3-81	14.2	11.5	30	30.0	8.6	4.4	106.5	158
6-4-81	22.6	17.7	60	32.0	7.1	3.5	103.5	160
6-5-81	22.9	17.8	60	31.0	7.0	3.5	103.5	158
6-6-81	22.7	17.5	60	36.0	7.2	3.3	108.0	165
6-8-81	21.0	16.5	60	27.0	6.3	3.4	98.8	156

TABLE II

Stack Sampling Data

Sample No.	Stack Identification	Date Collected	Sample Volume SCF	Sample Time (min)	Stack Vel. FPS (Avg.)	Stack Area ft^2	Stack Temp (Avg.)	Stack $\%H_2O$ (Avg.)
D-9343	Uranium Stack	6-1 6-5	131.8	210	30.82	3.14	79.8	2.3
D-9344	Old Leach Stack	6-8 6-10	135.5	300	5.4	3.14	151.6	26.0
D-9345	New Leach Stack	6-3 6-9	113.3	180	13.4	3.14	172.0	42.0
D-9346	Be-Hyd. Drumming	6-1 6-6	119.8	210	7.3	3.14	93.6	5.2
D-9347	Be-Hyd. Scrubber	6-3 6-8	81.0	270	3.6	1.77	159.4	31.2

TABLE III

Stack Sampling Data

Sample No.	Stack Ident.	Radionuclide Conc. pCi/sample U-238	Ra-226	Th-230	Avg.&Max. U-Conc. (μCi/cc) 1x10^{-12}	Avg. U-Rel. Rate (μCi/sec) 1x10^{-6}	Quant. U-Rel. (μCi)	Avg. Conc. (μCi/cc) 1x10^{-12} Ra-226	Th-230	Avg. Release (μCi/sec) [illegible] 10^{-6} Ra-226	Th-230
D-9343	U Stack	4.4±0.2	0.29±.08	0±0.2	1.183	3.24	39.19	0.0888	0	0.213	0
D-9344	Old Leach	0.4±0.1	0.11±.08	0±0.3	0.1041	0.0499	0.6	0.0287	0	0.0138	0
D-9345	New Leach	0.4±0.1	0.14±.08	0±0.2	0.1246	0.1483	1.79	0.0434	0	.0517	0
D-9346	Be-Hyd.Dr.	0.5±[illegible]	0.13±.08	0±0.2	0.1483	0.0962	1.16	0.0388	0	0.0252	0
D-9347	Be-Hyd.Scr.	2.2±0.2	0 ±.09	0±0.3	0.9600	0.1729	2.09	0	0	0	0
	Total						44.83				
MPC[a]					5.0x10^{-12}			2.0x10^{-12}		3x10^{-13}	
LLD[b]					5.0x10^{-13}			2.0x10^{-13}		3x10^{-14}	

a As stated in Table II, appendix B, of 10CFR-20
b As stated in Regulatory Guide 4.14

TABLE IV

Stack Sampling Data

Stack I.D.	Dates Collected	Radionuclids Conc. $\mu Ci/M^3$ U(nat)	Th-230	Ra-226	Effluent Flow Rate Ft/sec.
U- Stack	6-1 to 6.5	1.183	0.000	0.0777	30.82
Old Leach	6-8 to 6-10	0.1041	0.000	0.0287	5.40
New Leach	6-3 to 6.9	0.1246	0.000	0.0434	13.44
Be-Hyd. Drum	6.1 to 6.6	0.1483	0.000	0.0388	7.3
Be-Hyd. Scrub	6.3 to 6-8	0.9600	0.000	0.000	3.6