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(79-AFC-4C)

STATE OF CALIFORNIA—RESOURCES AGENCY

GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF WATER RESOURCES
Geysers Facilities, D.F.D.
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DOCKET
79-AFC-4C
DATE: FEB 10 1987
RECD: FEB 13 1987

February 10, 1987

Mr. Lloyd Dillon, Manager
Compliance Management Section
California Energy Commission
1516 Ninth Street, Mail Stop 2000
Sacramento, CA 95814

Dear Mr. Dillon:

As required by Condition 19 of the California Energy Commission's modified DOC for operation of DWR's Bottle Rock Geothermal Powerplant, enclosed is a copy of the quarterly analysis of the incoming steam covering the following analytes:

1. Non-condensible gas phase: Radon-222 and daughters, ammonia and benzene.

2. Condensate phase: Arsenic, mercury, vanadium, boron, silica and (total) suspended solids.

The above non-critera pollutant analyses were performed under contract to DWR by Anatec Laboratories located in Santa Rosa, California.

If there are any questions concerning these results, please let me know.

Sincerely,

James M. Ray

James Ray, Public Health Chemist II
Geysers Facilities, Delta Field Division
Division of Operations and Maintenance

ANATEC LABORATORIES INC.

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Jim Ray
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February 4, 1987
ANATEC Log No: **8678** (1-3)
Series No: 156[7]001
Client Ref: B-55671

Subject: Analysis of Incoming Steam and Sweet Gas Samples Collected at the California Department of Water Resource's Bottle Rock Generating Plant on January 5, 1987

Dear Mr. Ray:

Analysis of the samples referenced above has been completed. Samples were collected on January 5, 1987 by an ANATEC Field Chemist using a two-stage (water/ice water), stainless steel condenser. The condenser was connected to a sampling tap on the incoming steam line which had been installed by DWR personnel.

Noncondensable gases were collected in 600 mL, glass, stem-type gas bombs. Condensate was collected in several laboratory-cleaned polyethylene bottles.

Benzene and radon-222 content of the noncondensable gases were determined by gas chromatography and Lucas cell scintillation counting, respectively. Ammonia was measured electrometrically. Arsenic and mercury in condensate were determined by graphite furnace and cold vapor generation atomic absorption spectrometry, respectively. Condensate also was analyzed to determine suspended solids by gravimetry after drying to 103°C. Silica and boron were measured using inductively coupled argon plasma atomic emission spectroscopy.

Analytical results for the quarterly monitoring are summarized in Tables 1 and 2. Please feel welcome to contact us should you have questions regarding procedures or results.

Sincerely,

William G. Rotz, Supervising
Chemist, Gas Analysis

Table 1. Summarized Results of Incoming Steam and Sweet Gas Analysis

Descriptor	Lab No.	Radon[1] (pCi/L)	Ammonia (mg/L)[2]	ppm[3]	ppm[4]
Incoming Steam A 1235	8678-1	12,600	110	26	0.31
Sweet Gas A 1255	8678-2	6,200	--	--	--

[1]Units are pico Curies per liter noncondensable gas.
[2]Units are milligrams ammonia per liter condensate.
[3]Units are moles per million moles noncondensable gas.
[4]Units are milligrams per liter condensate.

Table 2. Summarized Results of Condensate Analysis for "Incoming Steam A"

Parameter	Results (mg/L)[1]
Arsenic	0.048
Mercury	0.004
Boron	8.4
Silica	<0.5
Suspended solids	10

[1]Units are milligrams per liter condensate.

CALCULATION OF RADON-222 LEVEL IN

COOLING TOWER EFFLUENT

Method 1: By Flow Rate

1. Design criterion: Air velocity is 1.453×10^6 cu. ft. $min.^{-1}$ per cell, a 5-celled cooling tower would have a total air velocity of 7.165×10^6 cu. ft. $min.^{-1}$
2. Conversion factor: 1 cu. ft. gas = 28.3 liters at STP.
3. Therefore, 28.3 liters x 7.165×10^6 cu. ft. $min.^{-1}$ = 2.028×10^8 liters $min.^{-1}$
4. Therefore, Radon-222 Level in C. T. = $\frac{7.26 \times 10^4 \text{ PCi/liter (incoming steam)}}{2.028 \times 10^8 \text{ liters min.}^{-1}}$

   [Radon-222] = 6.2×10^{-5} pCi/L $min.^{-1}$

Method 2: By Weight per Volume of Non-Condensible Gas (N-C gas)

1. N-C gas = 0.5% of incoming steam flow.
2. Incoming steam flow = ~940,000 lbs. $hr.^{-1}$
3. Therefore, weight of N-C gas = 940,000 lbs. $hr.^{-1}$ x 0.005 = 4,700 lbs. $hr.^{-1}$ (or 78.3 lbs. $min.^{-1}$)
4. $\frac{78.3 \text{ lbs}}{\text{min.}} \times \frac{453.6 \text{ g}}{\text{lb.}}$ = 35,517 grams per minute of non-condensible gas or N-C gas.
5. Molecular Weight of N-C gas = 28 grams.
6. Therefore, $\frac{35{,}517 \text{ grams}}{\text{min.}} \times \frac{1 \text{ mole N-C gas}}{28 \text{ grams}}$ = 1,268 moles N-C gas $min.^{-1}$
7. Conversion factor: 1 mole of any gas = 22.4 liters at STP.
8. Therefore, $\frac{1{,}268 \text{ moles min.}^{-1}}{\text{N-C gas}} \times \frac{22.4\text{L}}{\text{mole}}$ = 28,403 L $min.^{-1}$ of N-C gas at STP.
9. STP sampling conditions:

   Pressure at 2,500 feet = 700 Torrs

   Temperature (20° Rankin) = 293° R

   Therefore, $\frac{760 \text{ Torrs}}{700 \text{ Torrs}} \times \frac{293°\text{R}}{273°\text{R}}$ = 1.16525
10. [Radon-222] = $\frac{28{,}403\text{L min.}^{-1} \text{ N-C gas}}{2.028 \times 10^8 \text{ L min.}^{-1}\text{air}} \times \frac{1.16525}{1} \times \frac{6.2 \times 10^3 \text{ pCi}}{\text{L}} = \frac{1.01 \text{ pCi}}{\text{Liter}}$

    N-C gas