UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

40-8905

September 9, 1996

ML16113A383

Bill Ferdinand, Manager
Radiation Safety, Licensing, and
Regulatory Compliance
Quivira Mining Company
6305 Waterford Building, Suite 325
Oklahoma City, Oklahoma 73118

SUBJECT: NRC INSPECTION REPORT 40-8905/96-02

Dear Mr. Ferdinand:

On July 24, 1996, the NRC completed an onsite inspection of your Ambrosia Lake Facility. Further information was derived from discussions with you on August 29, 1996. The enclosed report presents the results of the inspection.

The inspection included a review of your program for measuring the radon flux emission rate from two remediated tailings impoundments. In summary, the inspection revealed that the method used to perform the measurements complied with the requirements in 10 CFR Part 40, Appendix A. This regulation requires use of the procedures described in EPA regulation 40 CFR Part 61, Appendix B, Method 115. No violations were identified during the inspection.

However, the inspector noted two differences between your method and Method 115. As discussed in the telephone conversation of August 29, 1996, we understand that you intend to review and address these differences in the final report of the measurements that is to be submitted to our Rockville, Maryland, office in accordance with 10 CFR Part 40, Appendix A, Criterion 6(4). These differences include the following:

1. Method 115, Section 4.0, states, "A background count using unexposed charcoal should also be made at the beginning and at the end of each counting day to check for inadvertent contamination of the detector or other changes affecting the background." Our inspector noted that you were counting the unexposed charcoal only once, at the beginning of the day. Please discuss the effect of this practice in your final report.

2. The inspection disclosed that you have stored and manipulated raw sampling data in a computerized database. The verification and validation of the computer program results were found not to have been clearly discussed in the site procedures. Validation and verification of the computer results are deemed necessary to ensure that the computer program's output is reliable and accurate. Please discuss your actions taken to ensure that the computer output is reliable and accurate.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response will be placed in the NRC Public Document Room (PDR). To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be placed in the PDR without redaction.

Should you have any questions concerning this inspection, please contact Mr. Robert Evans at (817) 860-8234 or Mr. Charles L. Cain at (817) 860-8186.

Sincerely,

Ross A. Scarano, Director
Division of Nuclear Materials Safety

Docket No.: 40-8905
License No.: SUA-1473

Enclosure: Inspection Report 40-8905/96-02

cc w/enclosure:

Art Gebeau, Manager
Quivira Mining Company
Ambrosia Lake Operations
P.O. Box 218
Grants, New Mexico 87020

New Mexico Radiation Control Program Director

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*RIV File (5th Floor)

*W/IFS Form

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ENCLOSURE

U. S. NUCLEAR REGULATORY COMMISSION

REGION IV

Docket No.: 40-8905
License No.: SUA-1473

Report No.: 40-8905/96-02

Licensee: Quivira Mining Company

Facility: Ambrosia Lake Facility

Location: McKinley County, New Mexico

Dates: July 23-24, 1996

Inspector: Robert J. Evans, P.E., Health Physicist
Nuclear Materials Inspection and
Fuel Cycle/Decommissioning Branch
Division of Nuclear Materials Safety

Approved By: Charles L. Cain, Technical Assistant
Division of Nuclear Materials Safety

Attachments: Partial List of Persons Contacted; Items Opened, Closed and Discussed; List of Acronyms Used

Photographs Taken at the Ambrosia Lake Facility

EXECUTIVE SUMMARY

Ambrosia Lake Facility
NRC Inspection Report 40-8905/96-02

This inspection included a review of the site status and the licensee's radon flux measurement program. In addition, the licensee's soil verification program was briefly reviewed.

Closeout Inspection and Survey

- The licensee had prepared and was implementing a program for measuring the radon flux emissions from the two tailings impoundments that complied with Environmental Protection Agency (EPA) requirements referenced in 10 CFR Part 40.

- The licensee had maintained flux counting equipment in proper working order. Calibration records were up-to-date, and records of the sampling process were properly maintained. The quality assurance program differed somewhat from the requirements in regard to background counting of unexposed charcoal and validation of computer-generated data.

- Written procedures existed for performing soil cleanup and sampling. The licensee has performed a characterization survey and has remediated windblown material as necessary. Remediation continues at some areas of the site property.

Report Details

1 Site Status

Quivira's Ambrosia Lake facility is the nation's largest uranium ore processing facility. During recent years, the licensee's mines and conventional mill have been placed in a standby condition. The licensee continues to produce yellowcake by extracting uranium from mine water.

Two tailings impoundments remain on site. Pond 1 contains roughly 30 million tons of mill tailings and covers 263 acres. Pond 2 contains about 3 million tons of tailings and covers 78 acres. Pond 2 has not been filled to capacity and may be used by the licensee for disposal of additional tailings if the mill is restarted in the future. Activities completed at the site prior to this inspection included installation of the radon barriers on both ponds.

At the time of the inspection, the radon flux measurements had just been completed on Pond 1. Final contouring of Pond 1 was in progress. The licensee was attempting to eliminate "ponding" by adding soil to the low spots on Pond 1. Radon flux measurements were in progress on Pond 2 during the inspection. The licensee started sampling Pond 2 on July 22, 1996, and had completed testing on about one-fourth of the pond by the end of the inspection period.

In addition, the licensee planned to add a 3-inch rock cover over the ponds in the near future. The rock barrier is expected to provide erosion protection for the tailings impoundments. The licensee planned to begin the installation of the rock cover on Pond 1 during August 1996. The licensee planned to perform final contouring of Pond 2 in the fall of 1996. The rock cover would then be installed on Pond 2 after final contouring.

A third pond was located onsite. Pond 3 was not used as a tailings storage impoundment, although some pond sediments are located at the bottom of the pond. At the time of the inspection, these sediments were covered with about eight feet of windblown material that had been collected and disposed of in the pond. Following the completion of cleanup of windblown material and remediation of the pond, the licensee plans to test Pond 3 for its radon-222 emissions using a grid system similar to the one used on Pond 1.

2 Closeout Inspection and Survey (83890)

2.1 Inspection Scope

The objective of the inspection was to verify that portions of the facility had been adequately reclaimed. Specifically, the inspection focused on a review of the licensee's program for measuring the radon flux emission rate from the onsite tailings impoundments. The methods

used for analyzing and interpreting the radon flux measurements were also reviewed. The inspector also reviewed the licensee's soil sampling and cleanup program.

2.2 Observations and Findings

2.2.1 Radon Flux Monitoring

a. Background

10 CFR Part 40, Appendix A, Criterion 6(2), states:

"As soon as reasonably achievable after emplacement of the final cover (over the tailings and wastes at the end of milling operations) to limit releases of radon-222 from uranium byproduct material and prior to placement of erosion protection barriers or other features necessary for long term control of the tailings, the licensee shall verify through appropriate testing and analysis that the design and construction of the final radon barrier is effective in limiting releases of radon-222 to a level not exceeding 20 picocuries per square meter per second (pCi/m^2s) averaged over the entire pile or impoundment using the procedures described in 40 CFR 61, Appendix B, Method 115, or another method of verification approved by the Commission as being at least as effective in demonstrating the effectiveness of the final radon barrier."

Since the licensee had not submitted an alternate method, the inspector reviewed the licensee's sampling procedures in regard to EPA Method 115.

Method 115, "Monitoring for Radon-222 Emissions," describes the monitoring methods which must be used in determining the radon-222 emissions from uranium mill tailings and other piles of waste material emitting radon, an inert radioactive gas with a half-life of 3.8 days. Method 115 states that a mill tailings pile is considered to be one region, and a minimum of 100 individual measurements are required for each region. The licensee has determined that its two tailings impoundments, Ponds 1 and 2, constitute two regions; therefore, the licensee had planned to take a minimum of 100 radon flux measurements on each of the two impoundments.

Method 115 also states that the detailed procedure for measurement of the radon flux on uranium mill tailings is provided in Appendix A of the EPA Document 520/5-85-0029, "Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles Near Tampa and Mulberry, Florida." This EPA document reports the results of field tests on passive radon collection devices.

In an attempt to meet the requirements established in 10 CFR 40, the licensee performed radon flux sampling on Ponds 1 and 2 during the fall of 1995. The sampling process was performed in batches (under 15 samples at a time) because the licensee did not have the equipment

needed to perform sampling at all 100 locations at the same time. During the testing process, the ambient temperature dropped below 35 degrees Fahrenheit. Method 115, Section 2.1.4, states that measurements shall not be performed if the ambient temperature is below 35 degrees Fahrenheit. Therefore, some of the sample results were deemed invalid. However, the licensee continued to perform the measurements of radon flux for in-house use only.

At the time of this inspection, a total of 115 valid samples had been obtained by the licensee for Pond 1. Of this number, 51 samples had been obtained in the fall of 1995, mostly on the slopes of the pond. The remaining 64 samples had been obtained during June-July 1996. Since all samples obtained from Pond 2 in October 1995 were considered invalid, the licensee planned to take about 102 additional radon flux samples on this pond. (The exact number had not been determined at the time of this inspection.)

b. Measurement of Radon Flux

In accordance with the EPA-approved process, the radon flux measurements were required to be obtained using radon-absorbing charcoal installed in large-area activated charcoal canisters (referred to as LAACCs). These canisters consisted of 10-inch diameter polyvinyl chloride pipe end caps. Screens, scrubber pads, support grids, and retainer springs/wires were inserted to retain the charcoal within the LAACC while allowing the radon gas to be absorbed by the charcoal.

Prior to the placement of the LAACCs on a tailings pile, the charcoal was required to be heated for at least 24 hours at a temperature above 230 degrees Fahrenheit (110 degrees Centigrade) to purge all radon from the charcoal. The charcoal was then placed in an air-tight container following the heating process. The EPA document referred to the use of "taped plastic bags or buckets with sealable lids"; however, the licensee used metal containers. The metal containers were deemed acceptable alternatives, since they were expected to be air-tight containers and were used consistently throughout the measurement and analysis processes. (Other licensees in the vicinity of this site have used metal containers during the testing of their tailings impoundments. In these instances, a comparison of results from plastic and metal containers have yielded comparable results.)

Next, the unexposed charcoal was analyzed using gamma spectroscopy to determine the background radioactivity level of the charcoal and the metal containers. The licensee counted the background exposure rate of every sample, although the EPA requirements indicated that only one representative sample was required to be counted from each batch of charcoal. This background count rate was subsequently subtracted from the exposed charcoal sample count rate.

Following the background count, the metal containers were unsealed in the field just prior to installation of the charcoal into the LAACCs. The charcoal from each metal container was then loaded into a partially disassembled LAACC, and the LAACC was reassembled. The inspector observed no spillage of charcoal during the transfers he observed. The LAACCs were then placed in predetermined locations on the tailings impoundments. A soil seal was placed around each LAACC. The LAACCs on Pond 1 were sealed with soil obtained from the borrow area because the soil on this pond was too compacted to be obtained from the local area surface. The LAACCs on Pond 2 were being sealed with soil from the general area surface.

Following placement on the tailings impoundment surface, the charcoal was exposed to the radon flux being emitted from that specific location for 24 hours. After the 24-hour exposure period, the charcoal was removed from the LAACC and returned to its original metal container. The metal container was then resealed. A 4-hour delay was required between the removal of the charcoal from the field and the final analysis of the exposed charcoal to allow for equilibrium of the radon and radon daughter products. Following the final analysis, the charcoal was typically recycled by reheating the charcoal to eliminate the radon from the charcoal.

A review of the licensee's method for obtaining the radon flux measurements was performed. The licensee had a written program that followed the EPA-approved method for obtaining the radon flux measurements. The licensee heated the charcoal to the required temperature, used the correct volume of charcoal in each sample, and used a LAACC that was functionally similar to the LAACC described in the EPA documentation. In addition, the licensee utilized a chain of custody form to ensure proper control of each sample. The licensee did not specify a maximum amount of time that the LAACCs could remain on the pile (the EPA documentation implies that the upper time limit is 36 hours). However, the licensee was noted to have been retrieving the charcoal in a timely manner immediately after the 24-hour time period had elapsed.

c. Analysis of Samples

Following the 24-hour exposure period, and the 4-hour delay to allow for the in-growth of radon daughter products, the charcoal is measured by gamma spectrographic techniques. The decay peak for bismuth-214 is typically used to quantify the radon concentrations in the charcoal samples. The EPA requires that two standard charcoal sources (containing radium-226) be used to determine the counter's efficiency. The radon flux is subsequently calculated, in part, on the number of counts measured and the efficiency of the detector.

The licensee's gamma spectroscopy equipment was inspected. The equipment appeared to be properly calibrated and in good working order.

Two standards, traceable to the National Institute of Standards and Technology (NIST), were used on a daily basis to determine system performance. The licensee had obtained these two samples from a laboratory located in Casper, Wyoming. The laboratory provided traceability documentation to the licensee when the samples were procured. The licensee was able to produce documentation showing that the counting equipment had been calibrated in accordance with site procedures.

The licensee's sample analysis and interpretation process was compared with the procedure provided in EPA 520/5-85-029. This document stated that "If time is available, the blanks [samples of unexposed charcoal] should be counted over a longer time period than the normal radon flux samples. This longer count time will improve the counting statistics for this low-level sample." The licensee was counting all samples, including the background samples, in 10-minute intervals. The licensee's method of counting the blank samples was deemed acceptable for ensuring adequate counting statistics.

Also, the licensee planned to subtract a background flux measurement from the radon flux measured on the tailings impoundments. This concept, the calculation of a net radon flux rate, was not discussed in the EPA documents; however, the data that was reviewed indicated that the results would be less than the limit, regardless of whether the background was deducted from the radon flux measurement.

d. Quality Assurance Program

Quality assurance requirements for measuring radon-222 flux are provided in Section 4.0 of Method 115 and Appendix A of EPA 520/5-85-029. These requirements include sampling procedures; sample custody; calibration procedures; internal quality control checks; and data precision, accuracy, and completeness.

The licensee's program did not clearly match the requirements listed in the reference documents in one instance. Method 115 states, "A background count using unexposed charcoal should also be made at the beginning and at the end of each counting day to check for inadvertent contamination of the detector or other changes affecting the background." The licensee was noted to be counting the unexposed charcoal only once, at the beginning of the day.

Method 115 indicates that 5 percent of the samples analyzed shall be either blanks (unexposed charcoal) or samples spiked with known quantities of radium-226. The licensee stated that they met the intent of this requirement by the routine counting of blanks and NIST-traceable standards on a daily basis. The licensee was not counting any spiked samples other than the standards.

The licensee was recounting 10 percent of the samples to check for the reproducibility of the counting technique. This activity was specified in both EPA documents.

Method 115 states that precision (a measure of the reproducibility of the measurements) and accuracy (the correctness of a measurement) must be within 10 percent for samples greater than 1.0 pCi/m^{2}s. The licensee's documentation did not yet discuss these two quality assurance parameters. The licensee stated that these parameters will be addressed in the licensee's final report of sampling results.

The licensee stored and manipulated the raw data in a computerized database. The verification and validation of the computer program results were not clearly discussed in the site procedures. Validation and verification of the computer results are deemed necessary to ensure that the computer program's output was reliable and accurate.

e. Reporting Requirements

10 CFR Part 40, Appendix A, Criterion 6(4) requires that, within 90 days of the completion of all testing and analysis, the licensee shall report to the NRC the results of these efforts. Method 115, Section 2.1.8, states that the results of individual flux measurements, the approximate locations on the pile, the mean radon flux for each region, and the mean radon flux for the total stack shall be included in the emission test report. Also, any condition or unusual event that occurred during the measurements that could significantly affect the results should be reported.

At the time of the inspection, the licensee's report had not been submitted to the NRC. Raw data for Pond 1 indicated that the radon flux emission rate averaged under 4 pCi/m^{2}s, prior to correction for background readings. Raw data was not available for Pond 2, since the sampling of this tailings impoundment was in progress during the inspection. The licensee planned to submit the final report for both ponds to the NRC in the near future.

2.2.2 Soil Verification Program

10 CFR Part 40, Appendix A, Criterion 6(6), states:

"The design requirements in this criterion for longevity and control of radon releases apply to any portion of a licensed and/or disposal site unless such portion contains a concentration of radium in land, averaged over 100 square meters, which, as a result of byproduct material, does not exceed the background level by more than: (i) 5 picocuries per gram of radium-226...averaged over the first 15 centimeters below the surface and (ii) 15 picocuries per gram of radium-226...averaged over 15-centimeter thick layers more than 15 centimeters below the surface."

The status of the licensee's program for soil sampling for radium-226 was briefly reviewed. Written procedures existed for performing soil cleanup and sampling. The licensee has performed a characterization survey and has remediated windblown material as necessary. Remediation continues at some areas of the site property.

2.3 Conclusions

The licensee had a written program for measuring the radon flux emissions from the two tailings impoundments. The licensee had maintained the counting equipment in proper working order. The calibration records were up-to-date. Also, records of the sampling process (such as chain of custody forms) were properly maintained.

The licensee had prepared a program for measuring the radon flux emissions from the two tailings impoundments that complied with Environmental Protection Agency (EPA) requirements referenced in 10 CFR Part 40. However, the quality assurance program differed somewhat from the regulatory requirements in regard to background counting of unexposed charcoal and validation of computer-generated data.

Written procedures existed for performing soil cleanup and sampling. The licensee has performed a characterization survey and has remediated windblown material as necessary. Remediation continues at some areas of the site property.

3 EXIT MEETING SUMMARY

The inspector from Region IV presented the inspection results to the representatives of the licensee on site at the conclusion of the inspection on July 24, 1996. Licensee representatives acknowledged the findings as presented. Further discussions of the findings were held with licensee management on August 29, 1996.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

T. Fletcher, General Manager
P. Luthiger, Supervisor, Radiation Safety and Environmental Affairs
D. Sweeney, Environmental Technician

ITEMS OPENED, CLOSED AND DISCUSSED

Opened

None

Closed

None

Discussed

None

LIST OF ACRONYMS USED

EPA	Environmental Protection Agency
pCi/g	picocuries per gram
pCi/m^2s	picocuries per square meter per second
LAACC	Large-Area Activated Charcoal Canister
NIST	National Institute of Standards and Technology

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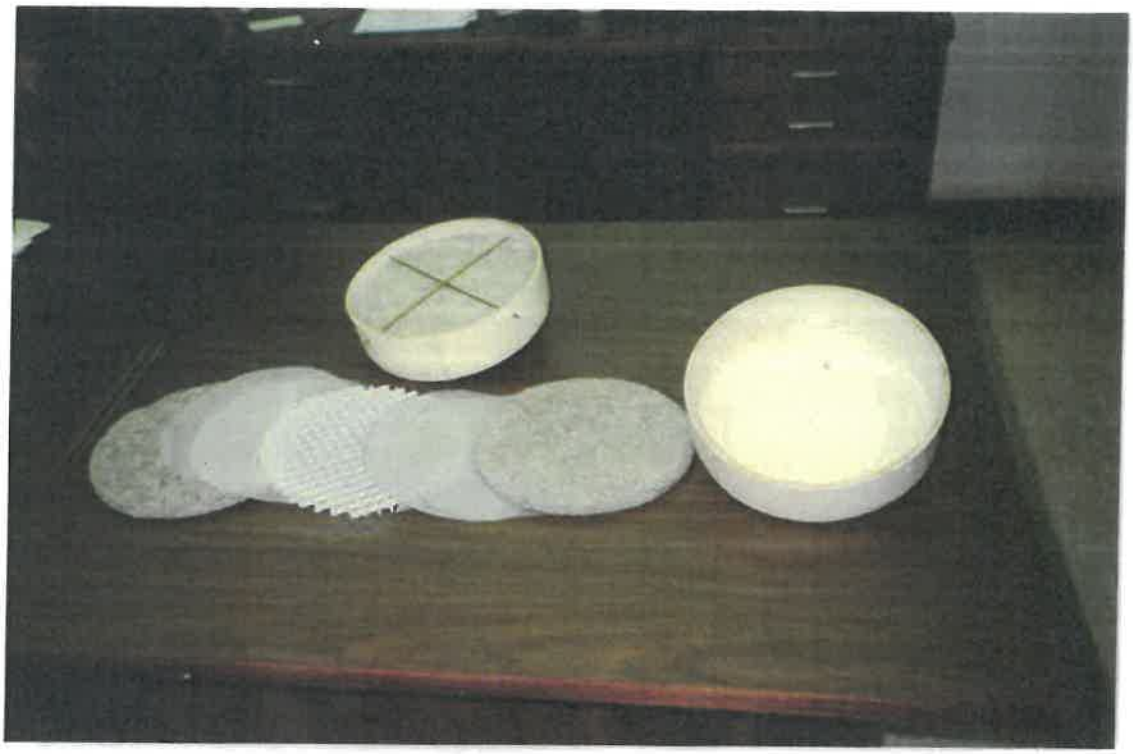
40-8905

Attachment 2

PHOTOGRAPHS TAKEN AT THE AMBROSIA LAKE FACILITY

Photograph 1 - Quivira's Ambrosia Lake Facility.

Photograph 2 - Environmental technician performing analysis of exposed charcoal for radon concentration.



Photograph 3 - Two LAACCs, one assembled and the second disassembled.

Photograph 4 - Environmental technician pouring charcoal into LAACC.

Photograph 5 - LAACC being installed on Pond 2.

Photograph 6 - LAACC installed on Pond 2 for 24-hour time frame.