



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

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REGION IV  
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W. Paul Goranson, Manager  
Radiation Safety, Licensing,  
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Quivira Mining Company  
6305 Waterford Building, Suite 325  
Oklahoma City, Oklahoma 73118

SUBJECT: NRC INSPECTION REPORT 40-8905/98-02

Dear Mr. Goranson:

On November 19, 1998, the NRC completed an onsite inspection at the Ambrosia Lake uranium mill in McKinley County, New Mexico. The enclosed report presents the results of the inspection. The inspection disclosed that activities at the site have been conducted in accordance with NRC regulations and the conditions of the license.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be placed in the NRC Public Document Room.

Should you have any questions concerning this inspection, please contact Mr. Louis C. Carson II at (817) 860-8221 or the undersigned at (817) 860-8191.

Sincerely,

*Joe Vincent Everett*  
for D. Blair Spitzberg, PhD., Chief  
Fuel Cycle and Decommissioning Branch

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

Enclosure: NRC Inspection Report  
40-8905/98-02

Quivira Mining Company

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**ENCLOSURE**

**U. S. NUCLEAR REGULATORY COMMISSION**

**REGION IV**

**Docket No.:** 40-8905

**License No.:** SUA-1473

**Report No.:** 40-8905/98-02

**Licensee:** Quivira Mining Company

**Facility:** Ambrosia Lake Facility

**Location:** McKinley County, New Mexico

**Dates:** November 18-19, 1998

**Inspector:** Louis C. Carson II, Health Physicist  
Fuel Cycle and Decommissioning Branch  
Division of Nuclear Materials Safety

**Accompanied by:** Ken R. Hooks, Project Manager  
Uranium Recovery Branch  
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Uranium Recovery Branch  
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**Approved By:** D. Blair Spitzberg, PhD., Chief  
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Division of Nuclear Materials Safety

**Attachment:** Supplemental Information

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## **EXECUTIVE SUMMARY**

### **Ambrosia Lake Facility NRC Inspection Report 40-8905/98-02**

This inspection included a review of the site status and remediation, management organization and controls, radiation protection, waste management, and environmental protection.

#### **Site Status and Decommissioning for Uranium Mill Sites**

- Site remediation and standby activities were found to have been conducted in accordance with applicable regulatory requirements. No health or safety concern was identified during site tours (Section 1).

#### **Management Organization and Controls**

- The licensee's organization structure met license requirements. Adequate oversight had been provided for site activities. Procedures were reviewed and were deemed adequate (Section 2).

#### **Radiation Protection**

- The licensee had implemented a radiation protection program that met the requirements established in 10 CFR Part 20 and the license. Records of occupational exposures at the site were well below the dose limits established in 10 CFR Part 20 (Section 3).

#### **Radioactive Waste Management and Environmental Protection**

- Reviews of the licensee's radioactive waste management, environmental protection, groundwater monitoring, and land use survey programs indicated that the licensee was in compliance with license requirements (Section 4).
- All reports related to the groundwater corrective action and environmental monitoring programs had been submitted to the NRC as required. A review of the reports and the laboratory data revealed that releases of licensed materials to the environment during 1998 were within regulatory limits (Section 4).

## Report Details

### **1 Site Status and Decommissioning Inspection Procedure for Uranium Mill Sites (87654)**

#### **1.1 Inspection Scope**

The site status and remediation activities were reviewed to determine if licensee activities were being conducted in accordance with the Quivira license.

#### **1.2 Observations and Findings**

##### **a. Site Status**

Quivira's Ambrosia Lake facility was the nation's largest uranium ore processing facility. The conventional mill ceased operation in 1985 and has remained in "standby" condition since then. With the addition of two ion exchangers that were placed into service in late 1997, the licensee was capable of producing 20,000 pounds of yellowcake per month by extracting uranium from mine water. The licensee currently ships yellowcake slurry offsite for drying.

Since the last inspection, remediation activities were limited to mill tailings pile maintenance, the groundwater corrective action program, and surveys of equipment for release offsite. Two tailings piles remain onsite. Pile 1 contains 30 million tons of mill tailings spread over 260 acres, and tailings Pile 2 contains 3 million tons of tailings spread over 90 acres. At the time of this inspection, no active mill tailings reclamation work was being conducted. Both mill tailings piles were covered with the final radon barrier in 1995 and 1996, respectively. Radon flux measurements were performed on both impoundments in 1996.

##### **b. Site Tour**

A facility tour was performed to verify that site activities were being conducted in accordance with applicable regulations and the conditions of the license to ensure that operational controls were adequate to protect the health and safety of workers and the public. During the plant tour, site buildings, fences, gates, and operating equipment were observed, and the inspector conducted radiation surveys using a microRoentgen meter. Although Quivira has no specific regulatory requirements for site security, the inspector observed security guards controlling access and traffic into the site. The licensee routinely kept the access gate closed to prevent unauthorized access to the property. Security guards were on duty at the site gate around-the-clock. The inspector noted all visitors and contract workers had to sign logbooks to gain access to the site. In addition, the restricted area was surrounded with a barbed wire fence. The inspector determined that licensed material was secure within the site property as required by 10 CFR 20.1801. Additionally, fences were posted with radioactive material signs as

required by 10 CFR 20.1902 and the license. No problem areas or health and safety hazards were identified during the site tour.

1.3 Conclusions

Site remediation and standby activities were reviewed and found to have been conducted in accordance with applicable license and regulatory requirements. Site fences were in good condition and perimeter postings were appropriate. No health or safety hazards were identified. The licensee's site status and remediation activities were reviewed and found to be adequate.

2 **Management Organization and Controls (88005)**

2.1 Inspection Scope

The organization was reviewed to ensure that the licensee had established a structure with defined responsibilities and functions. The site standard operating procedures were reviewed to evaluate the effectiveness of the licensee's control of site activities.

2.2 Observations and Findings

a. Management Organization

The organization was reviewed to ensure that the licensee had maintained an organization structure that was consistent with requirements specified in the license. There were 31 employees on site, which included 7 personnel involved in uranium ion exchanger operations and other personnel involved in radiation protection, environmental monitoring, tailings reclamation work, and site maintenance. The senior company official located at the site was the general manager who reported to the vice president. The radiation safety and environmental affairs supervisor, also the radiation safety officer (RSO), reported to the general manager. Two environmental technicians reported to the RSO. The licensee's Corporate Manager of Radiation Safety, Regulatory Compliance & Licensing was onsite during this inspection.

The inspector concluded that the licensee's staff and organization were appropriate and in accordance with license requirements.

b. Management Controls

The inspector reviewed the licensee's compliance with the license to determine the effectiveness of management controls. License Conditions 14 and 16 require that written procedures be established and reviewed by the RSO at least annually for non-operational and surveillance activities including environmental and radiation monitoring, instrument calibrations, and bioassays. The inspector reviewed each procedure in the RSO's controlled procedure manual and found that the RSO had performed the annual procedure review in February 1998. License Condition 20 requires that the licensee

document the results of personnel monitoring, surveys, calibrations, sampling, audits, inspections, meetings, training sessions, investigations, and corrective actions. The inspector reviewed licensee records for 1998 and found that the licensee's program adequately met the requirements.

## **2.3 Conclusions**

The licensee's organization structure was adequate, and adequate oversight had been provided for the current site status. Procedures established at the site had been sufficiently reviewed and were found to be appropriate for the site work in progress.

## **3 Radiation Protection (83822)**

### **3.1 Inspection Scope**

This portion of the inspection effort was to determine if the licensee's radiation protection program was in compliance with the requirements established in the license and 10 CFR Part 20 regulations.

### **3.2 Observations and Findings**

#### **a. Occupational Exposure Monitoring Programs**

The licensee's personnel monitoring program included use of thermoluminescent dosimeters (TLDs) to monitor for external exposures. Calculations were used to determine internal dose. During the 1997 calendar year, the highest TLD external exposure recorded for an individual was 186 millirems.

Exposures to radon daughters were calculated using a time-weighted average format. During 1998, the highest annual radon daughter exposure for an individual was 0.15 working level months, or approximately 4 percent of the annual allowable occupational exposure limit. Internal exposures to uranium were determined by analyzing air samples for gross alpha activity and calculating average air concentrations for a particular area. Internal doses were calculated based on the individual's time in any given area of the facility. The calculated average exposure to uranium received by employees was less than one percent of the annual limit on intake.

Bioassays are required by License Condition 10. The inspector reviewed the 1998 bioassay records. The licensee's bioassay program required routine urine testing for natural uranium on employees working in the restricted area and on workers involved with the mill tailings reclamation project. Bioassay samples were analyzed by a vendor laboratory. All sample shipments included blank and spiked samples for quality assurance. The licensee used an action level of 15 micrograms per liter ( $\mu\text{g/l}$ ). During 1998, urine sample results had not exceeded the investigation level of 35  $\mu\text{g/l}$ .



During the 1998 calendar year, the highest total effective dose equivalent received by an individual was 439 millirems or 9 percent of the occupational dose limit. The inspector concluded that site doses were well below the occupational dose limits established in 10 CFR 20.1201.

b. Radiation Work Permits

License Condition 15 requires the licensee to use radiation work permits (RWPs) for all work where a potential for significant exposure to radioactive material exists. The inspector reviewed RWPs issued since the last inspection. RWPs were a combination of maintenance work orders and radiation safety instructions. The RWPs provided an adequate level of information about the scope of work to be performed and the corresponding radiological restrictions. The implementation of the RWP program was adequate.

c. Release of Equipment for Unrestricted Use

License Condition 25 establishes the requirements for the release of equipment from the site for unrestricted use. During 1998 some equipment was released for unrestricted use. No material was identified with radioactive material that exceeded NRC's release limits.

d. Employee Training

The inspector reviewed the licensee's training program to determine if it met the requirements of 10 CFR 19.12 which requires that workers be provided radiation safety training. This training was required prior to beginning work at the site and annually thereafter. New employee training was provided to all new site workers in 1998. Refresher training was provided to all site employees in March 1998. All workers successfully completed written radiation safety training tests. The inspector also determined that the licensee's training met the requirements of the license and 10 CFR 19.12.

e. Equipment Calibrations

License Condition 20 requires, in part, that calibration of equipment be documented. The inspector reviewed the licensee's instrument calibration records. Equipment being calibrated by the licensee included a variety of air samplers and radiological survey instruments. The licensee had documented that all equipment had been properly calibrated at the respective frequencies and prior to use, if the calibration had expired.

3.3 Conclusions

The licensee had implemented a radiation protection program that met the requirements established in 10 CFR Part 20 and the conditions of the license. Records from the licensee's personnel monitoring program confirmed that occupational exposures were below 10 percent of the 10 CFR Part 20 limits.

**4 Radioactive Waste Management (88035)  
Environmental Monitoring (88045)**

**4.1 Scope**

The inspector reviewed the licensee's environmental monitoring program to determine compliance with applicable regulations and requirements specified in the license. This portion of the inspection included review of the implementation of the radiological environmental monitoring, groundwater corrective action, and radioactive waste management programs.

**4.2 Observations and Findings**

**a. Radioactive Waste Management**

License Condition 21 requires that daily inspections of the tailings piles be performed on regularly scheduled work days. Based on interviews of the staff and reviews of records, the inspector determined that daily inspections were being performed and documented.

**b. Semiannual Effluent Report and Environmental Monitoring**

License Condition 19 requires the licensee to submit the results of environmental and effluent samples to the NRC on a semiannual basis. Additional environmental monitoring requirements are identified in License Condition 34. The inspector reviewed the semiannual reports for the second half of 1997 and the first half of 1998, which were submitted to the NRC on February 28, 1998, and November 16, 1998, respectively. The licensee's environmental monitoring program included sampling of airborne particulate, radon gas, direct radiation, groundwater, surface water, soil, and vegetation. The licensee had obtained the required number of samples at the specified intervals. The licensee had reported the sample results to the NRC in a timely manner.

Five sample locations were used by the licensee, including one station located near a public residence and one background control location. Each sample location included an air particulate monitor, a radon gas canister, and a TLD. Air particulate samples were analyzed quarterly for natural uranium, thorium-230, radium-226, and lead-210. The inspector observed an operational sample location during the site tour.

Air particulate results in both semiannual reports indicated that the radionuclide concentrations were less than the effluent concentration limits (ECLs) established in 10 CFR Part 20, Appendix B. Thorium-230 air monitoring results in the mill diversion area during the first half of 1998 were found to be 21 percent of the 10 CFR Part 20 ECL. However, the inspector determined the results were comparable with previous sample results. During the two semiannual report periods, the highest TLD measurement was 93 millirem onsite near the Puertocito Creek. The ambient gamma radiation level at the onsite location was 51 millirems above the background and the

location nearest to a public residence. The inspector determined that potential exposure to any member of the public from licensed material was below the annual 10 CFR Part 20 limit of 100 millirems.

Soil and sediment sampling were required on an annual basis. Soil samples were taken at the five sample stations. Sediment samples were taken at various creek locations. The samples were analyzed for natural uranium, radium-226, thorium-230, and lead-210. In 1998, the highest radioactivity concentration measured was 17 picocuries per gram (pCi/g) of thorium-230 in sediment along the Puertocito Creek. This is in comparison to the previous year highest reading of 200 pCi/g, the 1998 which indicated a downward trend.

Vegetation samples were required to be taken twice a year near the five sample stations. The samples were analyzed for natural uranium, thorium-230, radium-226, lead-210 and polonium-210. No limits for vegetative samples are incorporated in the license. The inspector did not identify any trends in the vegetation results.

c. Groundwater Compliance Monitoring Program

License Condition 34 requires the licensee to implement a groundwater Corrective Action Plan (CAP) and to annually submit a report on the CAP progress. Quivira submitted the annual CAP report by letter dated July 31, 1998, covering the period from July 1997 to June 1998. The inspectors toured the area covered by the groundwater CAP, and reviewed the results of the licensee's groundwater remediation efforts. The report adequately provided information related to Quivira's progress toward groundwater cleanup.

The data presented in the 1998 CAP report indicated that the groundwater cleanup effort, while effective, was reaching a point of diminishing return in the bedrock aquifer. Quivira informed the inspectors that they were studying the possibility of alternate concentration limits (ACLs) for some of the constituents in the bedrock aquifer under the site. Quivira stated they are not considering ACLs for the alluvial aquifer at this time.

A review of the groundwater CAP data showed that the remediation efforts were still effective in the alluvial aquifer. Differences in the contaminant plumes in the alluvial aquifer between the last two years of data showed significant movement of contaminants toward the interception trench where the contaminated groundwater was being removed. High concentrations of the constituents showed a marked decrease in the contaminated area. Contaminant plumes were being swept across the contaminated area and removed at the interception trench. The trench also dewatered the tailings pile. However, the mix of tailings water and groundwater sweep water collected in the trench could not be determined with present methods. While progress has been evident, remediation will be required for several more years to fully cleanup in this area.

d. Grace Site Material

The inspectors reviewed the receipt and disposal of 11e.(2) material received from the three Grace Energy sites in New Mexico as permitted by License Condition 41. Receipt of the material occurred between September 30 and November 6, 1998. The Grace site material was buried in Tailings Impoundment 2. The disposal was completed with installation of the final cover over the material on November 18, 1998. The inspectors observed the cover installation and reviewed the 11e.(2) disposal RWP, radiation surveys, and other associated records. Receipt and disposal of the material appeared to have been performed in accordance with applicable license and regulatory requirements.

e. Annual Land Use Survey

License Condition 39 requires that a land use survey be performed annually. An annual land use survey report was submitted to the NRC on June 30, 1998. The licensee's report did not identify any significant changes that had occurred for uses of residential and nonresidential properties, grazing lands, and water supplies.

4.3 Conclusions

A review of the annual land use survey, groundwater, and environmental monitoring programs indicated that the licensee was in compliance with license and regulatory requirements. All reports related to the groundwater and environmental monitoring programs had been submitted to the NRC as required, and releases of licensed materials to the environment during 1998 were within regulatory limits.

6 Exit Meeting Summary

An exit meeting was conducted onsite on November 19, 1998. During this meeting, the inspectors reviewed the scope and findings of the inspection. The licensee did not identify as proprietary any information provided to or reviewed by the Inspector.

**ATTACHMENT**

**SUPPLEMENTAL INSPECTION INFORMATION**

**PARTIAL LIST OF PERSONS CONTACTED**

**Licensee**

T. Fletcher, General Manager  
P. Goranson, Manager Radiation Safety, Regulatory Compliance & Licensing  
P. Luthiger, Supervisor, Radiation Safety and Environmental Affairs

**State of New Mexico Environmental**

S. Fitch, Radiation Specialist, Radiation Control Program

**INSPECTION PROCEDURES USED**

IP 83822	Radiation Protection
IP 87654	Decommissioning Inspection Procedure for Uranium Mill Sites
IP 88005	Management Controls and Controls
IP 88035	Radioactive Waste Management
IP 88045	Environmental Protection

**ITEMS OPENED, CLOSED AND DISCUSSED**

**Opened**

None

**Closed**

None

**Discussed**

None

**LIST OF ACRONYMS USED**

ACLs	alternate concentration limits
CAP	Corrective Action Program
ECLs	effluent concentration limits
gpm	gallons per minute
µg/l	micrograms per liter
NMSS	Office of Nuclear Material Safety and Safeguards
pCi/g	picocuries per gram
RWP	radiation work permit
RSO	radiation safety officer
TLD	thermoluminescent dosimeter