



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 27, 1995

Mr. Bill Ferdinand, Manager
Radiation Safety, Licensing and
Regulatory Compliance
Quivira Mining Company
6305 Waterford Bldg., Suite 325
Oklahoma City, Oklahoma

Amendment 31

SUBJECT: AMENDMENT REQUEST TO REDUCE RADON BARRIER THICKNESS AT
AMBROSIA LAKE SITE

By letter dated February 7, 1994, Quivira Mining Company (Quivira) requested an amendment to their Ambrosia Lake Reclamation Plan to incorporate proposed changes to the radon barrier portion of the tailings impoundment cover. Quivira proposes to use additional soil types (classifications) for the radon barrier layer of the cover and to reduce the approved thickness of this layer in each of the various areas of tailings Impoundments 1 and 2. Also, a radon barrier design is proposed for the portion of Pond 3 that will be covered by the east slope of Impoundment 1.

The U. S. Nuclear Regulatory Commission staff reviewed the amendment request and Quivira's submittals dated August 2, September 2, November 4, and November 28, 1994, that were provided in response to staff requests for information. The staff has determined that the proposed radon barrier design is adequate to ensure that the long-term radon flux from the cover will not exceed the standard.

Therefore, pursuant to Title 10 of the Code of Federal Regulations (10 CFR), Part 40, Source Material License SUA-1473 is hereby amended by revising License Condition 37A. All other conditions of this license shall remain the same. A copy of the staff's Technical Evaluation Report for the license amendment is Enclosure 1. The license is being reissued to incorporate the above modification (Enclosure 2). An environmental review was not performed, since this action is categorically excluded under 10 CFR 51.22(c)(10).

If you have any questions concerning this letter or the enclosures, please contact Ken Hooks, the NRC Project Manager for the Quivira site, at (301) 415-7777.

A handwritten signature in cursive script, appearing to read "Joseph Holonich".

Joseph Holonich, Chief
High-Level Waste and Uranium Recovery
Projects Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

Docket No. 40-8905
License No. SUA-1473, Amend. No. 31

TECHNICAL EVALUATION REPORT

DOCKET NO: 40-8905

LICENSE NO: SUA-1473

LICENSEE: Quivira Mining Company

FACILITY: Ambrosia Lake

PROJECT MANAGER: Kenneth Hooks

TECHNICAL REVIEWERS: Elaine Brummett and Daniel Rom

SUMMARY AND CONCLUSIONS:

By letter dated February 7, 1994, Quivira Mining Company (Quivira) requested to amend the approved reclamation plan in order to utilize soils classified as Lean Clay (CL), Fat Clay (CH), and Clayey Sand (SC) for the radon barrier material in the cover. The enclosure presented the revised radon cover design for the tailings disposal area (Impoundments 1 and 2), with test results and radon flux analyses to support the design. It also included a request to approve a reduction in the radon barrier thicknesses required by the approved design.

NRC staff reviewed this submittal and requested more information by letter dated July 14, 1994. Quivira responded with submittals dated August 2 and September 2, 1994. Further clarification and documentation were provided in the submittal of November 4, 1994.

NRC staff determined that Quivira used some inappropriate values in modeling the long-term radon flux and did not support their claim of a very conservative radon attenuation design. However, there is sufficient conservatism in the proposed design, in combination with the construction commitments, to provide reasonable assurance that the long-term radon flux standard will be met.

BACKGROUND:

The three tailings areas (Impoundments or Ponds 1, 2, and 3) are adjacent to each other (see Attachment A), will have a continuous cover, and are considered to be one disposal area. The disposal area contains approximately 33 million tons of tailings and covers nearly 350 acres.

By letters dated September 28, and October 4, 1990, Quivira submitted a revised radon attenuation design for the tailings impoundment (formerly Ponds 1 and 2), in addition to a justification for reclaiming Pond 3 in place. This design was approved by License Amendment No. 19 on October 5, 1990. The approved design indicates only Silty Sand (SM) and Silt (ML) will be used for the radon barrier soil. The proposed radon barrier includes layers of recompacted Mancos shale (high clay content with soil classification CL), with layers of SC mixed with SM

Enclosure 1

and non-Mancos shale Lean Clay (CL) soil (SM-SC-CL material). The radon barrier will continue to have various thicknesses based on the type and depth of underlying contaminated material (see Attachment B).

The approved cover design incorporates 4.4 to 5.6 feet and 4.4 to 7.1 feet of radon barrier soil for the various areas of Impoundments 1 and 2, respectively. The approved cover also includes 1 foot of erosion protection material.

The proposed cover design has 2.0 to 2.5 feet and 2.7 to 4.3 feet of radon barrier soil for the areas of Impoundments 1 and 2, respectively. A portion of Pond 3 will be covered by the east side slope of Impoundment 1. The proposed reduction in the thickness of radon barrier required to meet the radon flux standard is based primarily on specific physical characteristics of the CL and SC soil. The cover would also include erosion protection consisting of a 6-inch-thick filter layer and 6 inches of riprap on the side slopes, and 3 inches of riprap on the top slope, but the erosion protection design has not been submitted for approval at this time.

AMENDMENT REQUEST:

Quivira proposes a radon barrier composed of layers of Mancos shale alternating with layers of SM-SC-CL material. The layer sequence and thicknesses vary for eight areas of the tailings impoundment, based primarily on the type and depth of underlying contaminated material (Attachment B).

TECHNICAL EVALUATION:

Barrier Construction

The construction specifications for the radon barrier include placement at a minimum of 95 percent standard Proctor dry density, at plus or minus 2 percent of optimum moisture (September 24, 1990). The Shale material is to be characterized using ASTM D422 to assure that it has a minimum of 55 percent passing the #200 sieve, and a Plasticity Index greater than 7. Quivira indicated that all model barrier-layer thicknesses are the minimum thickness that have been, or will be placed (August 2, 1994).

Quivira committed (November 4, 1994) to placing the radon barrier soils at an average compaction of at least 97 percent of standard Proctor, for added conservatism. Quivira has placed most of the radon barrier layers on Impoundment 1, and approximately half the barrier material on Impoundment 2 (November 4, 1994). Placement test data was provided (November 28, 1994) to substantiate that the radon barrier is being constructed more conservatively (more moisture and higher density) than indicated by the radon flux model parameter values.

Quivira has indicated that an extra foot of SM-SC-CL material has been placed on the side slopes, and an additional layer of at least 3 inches of SM-SC-CL material will be placed on the top of Impoundments 1 and 2. NRC staff determined that the additional 3-inch layer has little impact on the radon flux but will serve primarily for frost protection and to conserve the moisture of the other cover layers.

Although Quivira did not take credit for any of these construction conservatisms in their flux modeling, NRC staff found that they were necessary in the model to provide assurance that the disposal cell cover will meet the long-term radon flux standard.

Radon Flux Model

The proposed barrier design is supported by RADON computer code analysis for each of the two areas of Impoundment 1 (sands and slimes), the five areas of Impoundment 2 (based on the thickness of the slimes layer), and two areas of Pond 3 (windblown and covered by the east slope of Impoundment 1). The barrier design and acreage of the various areas are indicated in Attachment B.

Model Input Parameters

Quivira indicated that the input values for the tailings and SM soil were approved with the September 28, 1990, cover design modification, but this is incorrect. The NRC memorandum to docket dated September 24, 1990, approved the over-all cover design after analyzing models with various combinations of parameters values. It was the overall balance of conservatism in the code input values, including the radon barrier thickness, that was the basis for the approval. The individual input parameters were not approved.

Quivira's model uses layer sequence and minimum thickness values that represent material that has been, or will be placed. The other input values are indicated below.

QUIVIRA RADON INPUT SUMMARY

based on September 2, 1994 submittal

AREA/MATERIAL	POROSITY	DRY DENSITY (g/cm ²)	Ra-226 (pCi/g)	EMANAT. FRACT.	MOISTURE Percent (by wt.)	DIFF. COEFF. (cm ² /s)
Slime T.	0.38	1.66	1131	0.19	7.52	.018
Sand T.	0.38	1.66	237	0.19	7.52	.018
SM,SC,CL	0.32	1.76	0	-	10.9	.006
CL Shale	0.38	1.65	0	-	16.4	.003

The slime tailings values, except for Ra-226, are based on tests of sand tailings because access to the wet slime areas was restricted at the time of sampling. While these values are unrealistic for slime tailings, NRC staff determined that they are conservative.

Most of the sand tailings input values for the computer code are based on limited (three or four samples) test results, therefore it is difficult to determine if they are representative values. Staff determined that the porosity and density values are only appropriate for the compacted tailings. The emanation fraction is not conservative when compared to the code default value and values from other

sites. Also, the diffusion coefficient is not conservative as the material was tested at a higher moisture than the long-term value. Quivira supported the higher moisture value with in-situ tailings moisture data, but that method is not acceptable for determining a long-term moisture value. The in-situ method is recommended only for use with radon barrier borrow material (NRC Regulatory Guide 3.64).

The SM-SC-CL layer values are volume-weighted measured values, except the diffusion coefficient is code-calculated. The diffusion coefficient is not conservative when compared to the measured values, and the average moisture value includes a value for the SC soil that is not conservative.

The shale layer long-term moisture value of 16.4 percent is based on seven capillary moisture test results that averaged 17.1 percent, minus two standard error of the mean. Quivira supported the 17.1 percent value with the results of the Rawls equation, but used an incorrect clay value. Staff determined that the percentage of clay for some of the hydrometer testing was performed on the finer fraction of material instead of the total sample. Staff used the Rawls equation with the corrected percent clay value and the resulting long-term moisture estimate was 15.0 percent. Considering this, and that the shale standard Proctor optimum moisture content values range from 13 to 20 percent, staff determined that the long-term moisture value should be approximately 16.0 percent. In addition, Quivira used the code-calculated diffusion coefficient value, and it is not conservative compared to the average measured value (Table 2, February 7, 1994).

Quivira's flux models (August 2, 1994) for the portion of Pond 3 covered by the east slope of Impoundment 1, and the windblown portion, reflect the as-built layer sequence and thicknesses (Attachments A and B of this report). The radon attenuation model does utilize the projected 1000-year Ra-226 value, as recommended by NRC staff. This projected value is the amount resulting from the decay of both the current Ra-226 and Th-230. The Ra-226 value for pond sediment had previously been 75 pCi/g, while the projected value is 391 pCi/g. Quivira used tailings data for the other input values for the pond sediments. While these values are not representative of the material, the moisture and diffusion coefficient values should be very conservative.

Quivira's Ra-226 value for the windblown material in Pond 3 is the average of eight samples taken from around Ponds 4 and 5. During a December 12, 1994, conversation with Mr. Ferdinand, he indicated that some of the windblown material came from other areas, and cleanup of windblown material is continuing. NRC staff indicated that samples of representative windblown material in Pond 3 would need to be analyzed for Ra-226, or a conservative value should be used in the modeling.

NRC staff evaluated the contaminated materials and soil parameter input values used in the code for the proposed model and determined that some values were conservative, but others were not, as indicated above. NRC staff modeled the slime tailings with more representative physical values, and the sand tailings with the code-calculated diffusion coefficient (0.021). The uncompacted sand tailings were modeled as a separate layer with appropriate porosity, density and diffusion coefficient values.

Staff assigned a lower (more conservative) moisture value for the SM-SC-CL and the shale layers, 10.2 and 16 percent, respectively. These layers were also assigned the porosity and density values associated with compaction to 97 percent standard Proctor to reflect the current minimum placement values. The additional layers of barrier, listed by Quivira as construction conservatism, were also used in the NRC model.

Staff modeled the Pond 3 windblown area with representative values for the sludge material. A long-term moisture value of 7.0 percent and a conservative Ra-226 value of 35 pCi/g were chosen for the windblown material.

Since frost penetration could lead to freeze-thaw damage to the shale layer, NRC staff modeled the upper 9 inches of barrier on the top slope with the porosity value increased by 8 percent, and the corresponding changes in density and diffusion coefficient values. This represents 1 foot of freeze-thaw damage in a cover with 3 inches of riprap on the surface. The side slopes will have 12 inches of material above the radon barrier, thus, there should be no freeze-thaw damage to the barrier in that region.

Radon Flux Estimates

The long-term radon flux estimate is to represent an average over the entire surface of the disposal area, and over a period of at least 1 year. The standard of 20 pCi/m²/s applies only to emissions from uranium byproduct materials, so the flux estimates do not include the contribution from the cover soils. The cover soils have been shown to meet the requirement for background levels of radioactivity, so the estimated radon emissions from the covering materials would be minimal.

Quivira calculated a long-term radon flux of 16.5 pCi/m²/s for the sand areas, and 17.3 pCi/m²/s for the slime areas of Impoundment 1, and less than 16 pCi/m²/s for each area of Impoundment 2. The area-weighted average of the two impoundments is 14.2 pCi/m²/s (September 2, 1994). Quivira estimated the long-term radon flux from the portion of Pond 3 covered by the east slope as 20.01 pCi/m²/s, and the portion with windblown material as 10.5 pCi/m²/s (August 2, 1994). This model for Pond 3 did not utilize Quivira's current input values for the radon barrier. Quivira concluded that the windblown portion of Pond 3 did not require a radon barrier, only the erosion protection cover (design to be submitted later).

NRC staff determined that the 263 acres of Impoundment 1 (72 percent of the disposal surface area) would have an average long-term radon flux of 15.3 pCi/m²/s, and most areas of Impoundment 2 would be less than 12 pCi/m²/s. NRC staff modeled the areas of Pond 3 with the modified values for the cover and tailings layers as discussed above. The resulting radon flux estimate was 21.6 pCi/m²/s for the 10-acre portion of Pond 3 under the east slope of Impoundment 1, and a maximized value (assuming a Ra-226 value of 35 pCi/g) of 46.1 pCi/m²/s for the 25-acre windblown area. The area-weighted average long-term radon flux for the entire disposal area would be approximately 17.2 pCi/m²/s. Therefore, the disposal area meets the design standard of 20 pCi/m²/s.

Cover Stability

The stability of the tailings disposal area (impoundments) has been addressed in previous NRC reviews. However, Quivira was asked (July 14, 1994) to address the effects of frost penetration (freeze-thaw damage) and biointrusion on the radon attenuation capability of the cover. Quivira responded that damage from these sources would not be significant.

For potential freeze-thaw damage, Quivira discussed soil studies, site frost intensity and duration, cover drainage, winter moisture, and radon flux measurements. NRC staff determined that some frost penetration into the radon barrier could occur, based on modeling with the Berggren Equation. Therefore, potential damage to the clay layer due to frost penetration was taken into account during the modeling for the long-term radon flux estimate. Careful material selection and verification of placement conditions will be provided by Quivira to minimize the occurrence of freeze-thaw damage.

Quivira indicated that deep-rooted plants were unlikely to survive on the cover since the riprap layer would not retain moisture. Also, the highly compacted radon barrier layers could not be easily penetrated by the roots, and would present an unfavorable nutritional environment. Quivira compared the disposal area to the one at Shiprock, New Mexico, (Title I) as having similar climate and the same impermeable shale radon barrier material (August 2, 1994). NRC staff is aware of a report (Burt and Cox, Waste Management, 1993) that indicates approximately 360,000 plants were growing on the Shiprock pile, and many roots had penetrated into the radon barrier 5 years after completion of the cover. Examination of five areas with plants revealed a rock layer 20 cm or less in depth, while two areas without plants had a rock cover at least 36 cm deep. Therefore, the report recommends that future rock-covered cells have at least 30 cm of rock devoid of soil to deter plant growth. This is in contrast to the Quivira design that indicates 7 cm of riprap (average diameter of one inch) may be placed on the top of Impoundment 1.

Quivira quoted the Department of Energy's (DOE's) conclusion for the near-by Title I Ambrosia Lake tailings cell that, "Due to the sparse vegetation and limited numbers of burrowing animals in the vicinity of the tailings site, penetration of the stabilized tailings pile by plant roots or animals would not be expected to affect the stability of the pile or promote dispersion of the tailings." This does not address damage to the radon barrier that could affect radon attenuation, and the fact that the DOE site has twice as much cover over the radon barrier as the Quivira pile. Staff determined that there is not sufficient data at this point to ascertain if the potential plant growth on the Quivira cover will significantly impact the radon attenuation capacity and require excessive costs for control of plant growth during the design life.

Cover Requirements of Criterion 6

Criterion 6 of Appendix A to 10 CFR Part 40 requires, in part, that:

The cover design provide reasonable assurance of control to limit releases of radon-222 from uranium byproduct materials so as to not exceed an average over

each disposal area of 20 pCi/m²/s to the extent practicable throughout the effective design life (1000 years to the extent reasonably achievable).

NRC staff determined that the average estimated long-term radon flux from the cover of the tailings disposal cell should meet that standard.

The gamma exposure from the tailings or waste should be reduced to background levels.

This should be achieved with the cover thicknesses proposed. In any case, the final closure inspection will confirm that this requirement has been met.

Soils used for near surface cover material must be essentially the same, as far as radioactivity is concerned, as that of surrounding surface soils.

Quivira's decommissioning plan approved a background Ra-226 value of 3.0 pCi/g. NRC staff determined that the Ra-226 concentration of the proposed cover soils approximates background values, based on the data provided in the February 7, 1994, submittal.

Therefore, the radon barrier soils and the radon barrier design proposed in the amendment request meet the requirements of Criterion 6.

RECOMMENDED LICENSE CHANGE:

The staff recommends a change to Source Material License SUA-1473, License Condition 37 A, to reflect the change in radon barrier composition and thickness proposed/required for tailings pile. The revised license condition will read as follows:

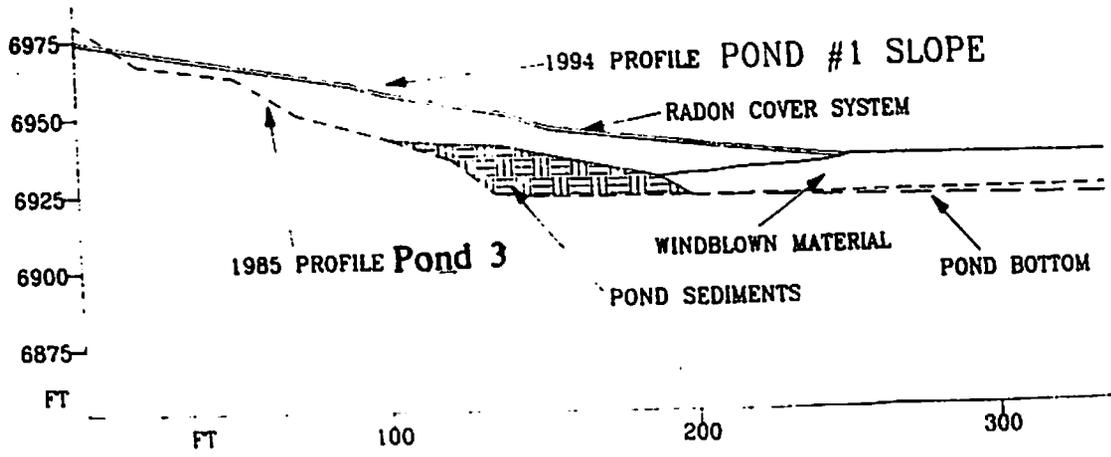
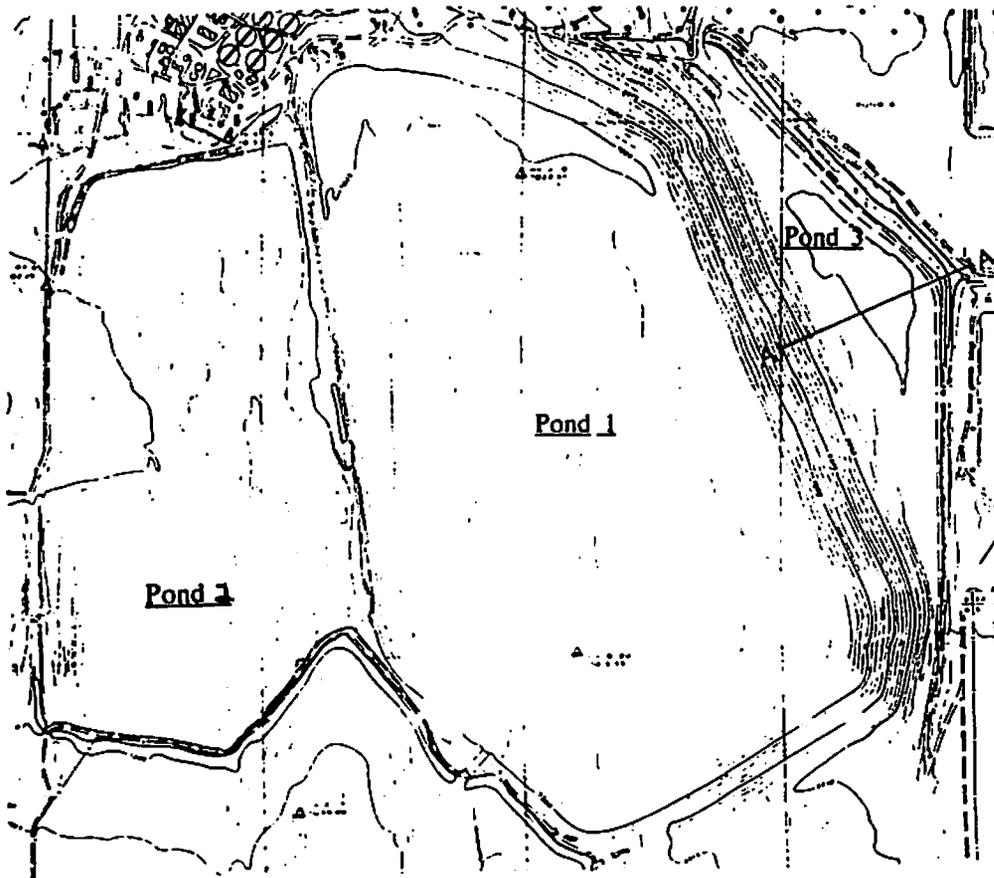
37. The licensee shall reclaim the disposal area as stated in the September 24, 1990, and January 7, 1994, submittals as supplemented by the following conditions. Though recognized as conservative, these conditions were assumed when evaluating the acceptability of the reclamation plan as submitted, and are identified pending submittal of acceptable design alternatives. Justification for any design alternatives must be submitted for NRC review and approval prior to implementation.
 - A. The radon barrier shall be constructed as specified in the licensee's September 28, 1990, submittal, as amended by the February 7, August 2, September 2, and November 4, 1994, submittals. Prior to placement of any material onto the interim cover, the procedure defined in the licensee's October 4, 1990, submittal for establishing the integrity of the in-place material must be performed.

ENVIRONMENTAL IMPACT EVALUATION:

In accordance with the categorical exclusion contained in paragraph (c)(11) of 10 CFR 51.22, an environmental assessment is not required for this licensing action. That paragraph states that the categorical exclusion applies to the issuance of amendments to licenses for uranium mills provided that: (1) there is no significant change in the types or significant increase in the amounts of any effluents that may be released off site; (2) there is no significant increase in individual or cumulative occupational radiation exposure; (3) there is no significant construction impact; and (4) there is no significant increase in the potential for or consequences from radiological accidents.

The licensing action discussed in this memorandum modifies the radon barrier design in accordance with Criterion 6 of 10 CFR Part 40, Appendix A. An environmental report is not required from the licensee since the amendment does not meet the criteria of 10 CFR 51.60 (b)(2).

QUIVIRA MINING COMPANY AMBROSIA LAKE TAILINGS DISPOSAL AREA
(FROM AUGUST 2, 1994, SUBMITTAL)

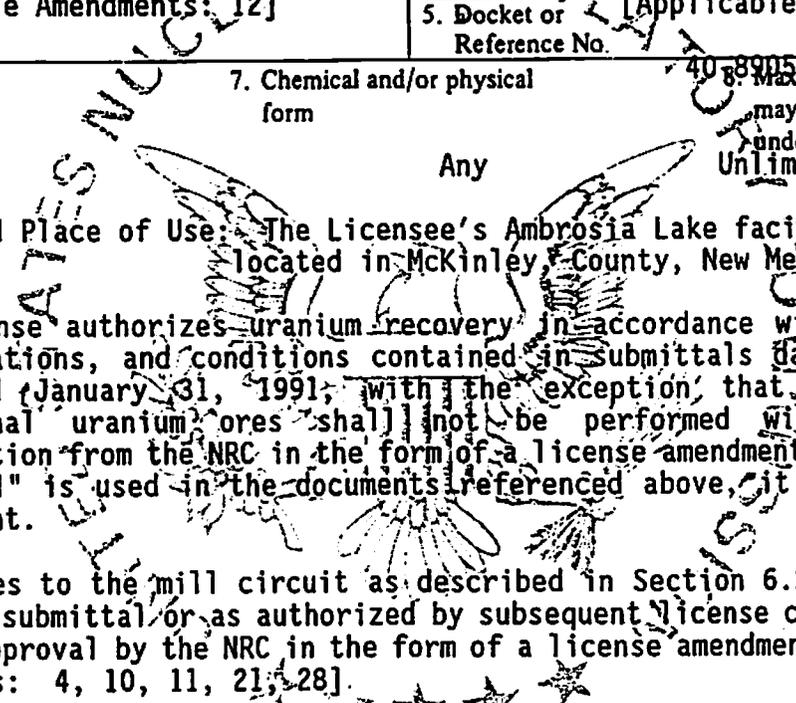


Section A--A

MATERIALS LICENSE

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter 1, Parts 30, 31, 32, 33, 34, 35, 39, 40 and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee		
1.	Quivira Mining Company	3. License number SUA-1473, Amend. No. 31
2.	6305 Waterford Blvd., Suite 325 Oklahoma City, Oklahoma 73118 [Applicable Amendments: 12]	4. Expiration date Until terminated
		5. Docket or Reference No. [Applicable amends: 29]
6. Byproduct, source, and/or special nuclear material	7. Chemical and/or physical form	8. Maximum amount that licensee may possess at any one time under this license
Uranium	Any	Unlimited
9. Authorized Place of Use: The licensee's Ambrosia Lake facility located in McKinley County, New Mexico.		
10. This license authorizes uranium recovery in accordance with statements, representations, and conditions contained in submittals dated August 30, 1990, and January 31, 1991, with the exception that processing of conventional uranium ores shall not be performed without specific authorization from the NRC in the form of a license amendment. Anywhere the word "will" is used in the documents referenced above, it shall denote a requirement.		
Any changes to the mill circuit as described in Section 6.2 of the August 30, 1990, submittal or as authorized by subsequent license conditions shall require approval by the NRC in the form of a license amendment. [Applicable Amendments: 4, 10, 11, 21, 28].		
11. The licensee shall designate a Radiation Safety Officer (RSO) who will be responsible for the establishment and maintenance of a facility radiation protection program including personnel and environmental monitoring programs. The RSO shall possess minimum qualifications as specified in Section 2.4.1 of Regulatory Guide 8.31.		
12. The licensee is authorized to possess byproduct material in the form of uranium process tailings and other byproduct wastes generated by the licensee's uranium processing operations. Mill tailings, other than small samples for purposes such as research or analysis, shall not be transferred from the restricted area without prior approval of the NRC in the form of a license amendment.		
13. The licensee is authorized to operate mine water uranium recovery treatment facilities at Ambrosia Lake, New Mexico. These facilities		



MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number

SUA-1473, Amend No. 31

Docket or Reference number

40-8905

include treatment plants at the main facility, Section 35-36, and individual ion exchange units located above or underground at the Quivira Mining Company mine sites. The radiological effluent monitoring and radiological safety program in effect at the licensee's mill shall include these water treatment facilities. All U.S. DOT requirements shall be followed in the transport of the ion exchange resin. A listing of the individual ion exchange units currently in operation shall be provided by January 1, 1987, and shall be updated at least annually thereafter.

14. Written standard operating procedures (SOPs) shall be established for all operational process activities involving radioactive materials that are handled, processed or stored. These procedures shall specify radiation safety practices to be followed. An up-to-date copy of each written procedure shall be kept in the mill area to which it applies for employee reference. All SOPs shall be reviewed annually to update procedures and be approved by the RSO to ensure that proper radiation protection principles are being applied.
15. The licensee shall be required to use a Radiation Work Permit (RWP) for all work where the potential for significant exposure to radioactive material exists and for which no SOPs exist. All RWPs shall be approved by the Radiation Safety Officer (RSO), or his designee qualified by way of specialized radiation protection training. The RWP shall describe the following:
 - A. The scope of the work to be performed.
 - B. Any precautions necessary to reduce exposures to radioactive materials.
 - C. Supplemental monitoring required prior to, during, and after the completion of the work.
16. The licensee shall establish written procedures for all surveillance activities including in-plant and environmental monitoring bioassay analysis and radiation monitoring instrument calibration. These procedures shall be reviewed and approved by the RSO annually to ensure that proper and current radiation protection principles are being applied.
17. Occupational exposure calculations shall be performed and documented within one (1) week of the end of each regulatory compliance period as specified in 10 CFR 20.103(a)(2) and 10 CFR 20.103(b)(2). Routine airborne ore dust and yellowcake samples shall be analyzed in a timely manner to allow exposure calculations to be performed in accordance with this condition. RWP ore dust and yellowcake samples shall be analyzed and the results reviewed by the RSO or his designee within two (2) working days after sample collection.
18. DELETED by Amendment No. 4.

**MATERIALS LICENSE
SUPPLEMENTARY SHEET**

License number	SUA-1473, Amend No. 31
Docket or Reference number	40-8905

19. The results of all effluent and environmental monitoring required by this license shall be reported semiannually and in accordance with 10 CFR 40, Section 40.65, with copies of the report sent to the NRC. Monitoring data shall be reported in the format shown in the attachment to SUA-1473

entitled, "Sample Format for Reporting Monitoring Data." [Applicable Amendments: 25]

20. The results of sample analyses, monitoring surveys, equipment calibration, reports of audits and inspections, meetings, and training sessions required by applicable regulations or this license and any subsequent reviews, investigations, and corrective actions shall be documented. Unless otherwise specified in this license or in NRC regulations, all documentation shall be maintained for a period of five (5) years.

21. The licensee shall operate the tailings retention systems in accordance with the "Tailings Stabilization Report" submitted October 1, 1986, as approved by the NRC and in compliance with 10 CFR 40, Appendix A. Any changes in the tailings retention system that would significantly deviate from the above shall require the licensee to provide a written evaluation of the changes and obtain approval from the NRC in the form of an amendment to the license.

In addition, the licensee shall implement a tailings dam inspection program as specified in Section A3 of the submittal dated, November 12, 1986, with the exceptions that annual technical evaluations of embankment performance need to be performed, and daily inspections of the tailings embankments need only be performed on regularly scheduled work days. [Applicable Amendments: 4, 21, 26]

22. The licensee shall maintain an NRC-approved financial surety arrangement, consistent with 10 CFR 40, Appendix A, Criteria 9 and 10, adequate to cover the estimated costs, if accomplished by a third party, for decommissioning and decontamination of the mill and mill site, reclamation of any tailings or waste disposal areas, ground water restoration as warranted, and the long-term surveillance fee.

Annual updates to the surety amount, required by 10 CFR 40, Appendix A, Criteria 9 and 10, shall be submitted to the NRC by June 30 of each year. Along with each proposed revision or annual update, the licensee shall submit supporting documentation showing a breakdown of the costs and the basis for the cost estimates with adjustments for inflation, maintenance of a minimum 15 percent contingency fee, changes in engineering plans, activities performed, and any other conditions affecting estimated costs for site closure. The basis for the cost estimate is the NRC approved reclamation/decommissioning plan as supplemented by the NRC assumptions identified in License Condition No. 37, or NRC approved revisions to the plan. The attachment to this license, entitled "Recommended Outline for Site Specific Reclamation and Stabilization Cost Estimates" outlines the minimum considerations used by the NRC in the review of site closure estimates. Reclamation/decommissioning plans and annual updates should follow this outline.

**MATERIALS LICENSE
SUPPLEMENTARY SHEET**

License number	SUA-1473, Amend No. 31
Docket or Reference number	40-8905

The licensee's currently approved surety, a parent Company Guarantee issued by Rio Algom Limited, shall be continuously maintained in an amount no less than \$15,220,000 for the purpose of complying with 10 CFR 40, Appendix A, Criteria 9 and 10, until a replacement is authorized by the NRC. The use of a parent company guarantee necessitates a complete evaluation of the corporate parent by the NRC as part of the annual surety update. In addition to the cost information required above, the annual submittal must include updated documentation of the (1) letter from the chief financial officer of the parent company, (2) auditor's special report confirmation of chief financial officer's letter, (3) schedule reconciling amounts in chief financial officer's letter to amounts in financial statements, and (4) parent company guarantee document if changes are required. [Applicable Amendments: 18, 19, 22, 24, 30]

23. Prior to termination of this license, the licensee shall provide for transfer of title to byproduct material and land, including any interests therein (other than land owned by the United States or the State of New Mexico), which is used for the disposal of such byproduct material or is essential to ensure the long-term stability of such disposal site to the United States or the State of New Mexico, at the State's option.
24. The licensee shall have a contingency plan for responding to unexpected releases of liquids or tailings from the mill facility, tailings impoundments, and lined evaporation ponds and for the accidental release of uranium concentrates during shipment and transport.
25. Release of equipment or packages from the restricted areas for unrestricted release or disposal shall be in accordance with the attachment to SUA-1473 entitled, "Guidelines for Decontamination for Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Materials," dated, September, 1984.
26. Before engaging in an activity not previously authorized by the license, the licensee shall prepare and record an environmental evaluation of such activity. Should the evaluation indicate that such activity may result in a significant adverse environmental impact that was not previously assessed or that is greater than that previously assessed, the licensee shall provide a written evaluation of the activity and obtain prior approval of the NRC in the form of a license amendment.
27. The licensee shall implement an interim stabilization program for tailings areas as specified in the "Tailings Stabilization Report" submitted October 1, 1986, as modified by Section 4.6 submitted by letter dated, March 20, 1987. This program shall include written operating procedures and shall prevent or minimize dispersal of blowing tailings to the extent reasonably achievable and in accordance with Criterion 8 of 10 CFR 40, Appendix A. The effectiveness of the control methods used shall be evaluated in accordance with the procedure submitted by letter dated June 17, 1987. Corrective actions taken shall be documented in response to inspection findings.

The licensee shall adhere to the interim stabilization schedule for cleanup

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number

SUA-1473, Amend No. 31

Docket or Reference number

40-8905

- of contaminated areas as addressed in the submittal dated October 15, 1987. [Applicable Amendments: 4, 7]
28. The licensee is hereby exempted from the posting requirements of 10 CFR 20.203(e)(2) for areas within the mill provided that all entrances to the mill are conspicuously posted in accordance with Section 20.203(e)(2) and with the words, "Any area within this mill may contain radioactive material."
 29. The licensee shall submit a detailed decommissioning plan to the NRC at least six (6) months prior to the planned start of decommissioning activities.
 30. Damaged yellowcake drums may be returned for disposal in Tailings Pond No. 2 as described in the licensee's submittals dated January 2, and March 5, 1987, and October 6, 1989. All such disposal shall be documented. In addition, no drums shall be disposed within 150 feet of the dam crest. [Applicable Amendments: 2, 14]
 31. The licensee is authorized to process alternate feed materials (raffinate and calcium fluoride sludges) from Sequoyah Fuels Corporation's Gore, Oklahoma, facility in accordance with the submittals dated March 31, July 15, and August 6, 1987, and May 15, 1990, with the exception that the yellowcake product shall be maintained in slurry form or dried in accordance with Condition No. 38 of this license. [Applicable Amendments: 3, 5, 7, 28]
 32. The licensee is authorized to dispose and bury contaminated waste materials resulting from past milling operations into tailings ponds No. 1 and No. 2, in accordance with submittals dated June 10 and August 5, 1987. In addition, the licensee shall adhere to the following requirements. The licensee will maintain detailed disposal records indicating quantities and locations of all waste material disposed in tailings ponds; prior to the disposal of any wastes the licensee shall establish a detailed procedure to describe the handling, preparation, placement and covering of wastes in the specified disposal location; and the licensee shall restrict any disposals in tailings pond No. 2 to locations greater than 150 feet from the dam crest. [Applicable Amendments: 6]
 33. The licensee is hereby authorized to inject chemically fortified mine waters in accordance with their July 14, 1987 submittal. The following upper control limits shall be observed: calcium = 35 mg/l, sodium = 253 mg/l, sulfate = 450 mg/l, carbonate/bicarbonate = 303 mg/l, pH = 10.0 standard units. Should any of these limits be exceeded, based upon monthly sampling, the licensee shall immediately suspend injection of chemically fortified waters, notify the NRC, in writing within 5 days sample for the above parameters on a weekly frequency, and within an additional 25 days, submit a plan to remediate the situation. [Applicable Amendments: 8]
 34. The licensee shall implement a groundwater compliance monitoring program containing the following:

**MATERIALS LICENSE
SUPPLEMENTARY SHEET**

License number

SUA-1473, Amend No. 31

Docket or Reference number

40-8905

- A. Sample Dakota Sandstone wells 17-01, 30-02, 30-48, 32-45, and 36-06 for antimony, arsenic, beryllium, cadmium, cyanide, lead, molybdenum, nickel, selenium, combined radium-226 and -228, natural uranium, thorium-230, lead-210, gross alpha, chloride, sulfate, nitrate, pH, and electrical conductivity.

Sample Tres Hermanos A wells 31-01 and 33-01 for cyanide, molybdenum, nickel, selenium, radium-226 and -228, natural uranium, thorium-230, lead-210, gross alpha, chloride, sulfate, nitrate, pH, and electrical conductivity.

Sample Tres Hermanos B wells VH19-2, 31-66, 31-67, 36-01 and 36-02 for cyanide, molybdenum, nickel, selenium, combined radium-226 and -228, natural uranium, thorium-230, lead-210, gross alpha, chloride, sulfate, nitrate, pH, and electrical conductivity.

Sample alluvium wells 5-03, 32-59, 31-61, and MW-24, for molybdenum, nickel, selenium, combined radium-226 and -228, thorium-230, natural uranium, lead-210, gross alpha, chloride sulfate, nitrate, pH, and electrical conductivity.

- B. Comply with the following groundwater protection standards at Dakota Sandstone point of compliance well 30-02, 30-48, 32-45, and 35-06, with background being recognized at well 17-01: antimony = 0.05 mg/l; arsenic = 0.1 mg/l, beryllium = 0.01 mg/l; cadmium = 0.01 mg/l; cyanide = 0.04 mg/l; lead = 0.14 mg/l; molybdenum = 0.06 mg/l; nickel = 0.03 mg/l, selenium = 0.04 mg/l; gross alpha = 56 pCi/l; combined radium-226 and -228 = 5.0 pCi/l natural uranium = 0.02 mg/l; thorium-230 = 2.3 pCi/l; lead-210 = 1.9 pCi/l.

Comply with the following groundwater protection standards at Tres Hermanos A point of compliance well 31-01, with background being recognized at well 33-01: cyanide = 0.01 mg/l; molybdenum = 0.03 mg/l; nickel = 0.05 mg/l; selenium = 0.03 mg/l; gross alpha = 18.0 pCi/l; combined radium-226 and -228 = 5.0 pCi/l; natural uranium = 0.01 mg/l; thorium-230 = 4.3 pCi/l; lead-210 = 4.14 pCi/l.

Comply with the following groundwater protection standards at Tres Hermanos B point of compliance wells 31-66, 31-67, 36-01, and 36-02, with background being recognized at well VH19-12: cyanide = 0.01 mg/l; molybdenum = 0.08 mg/l; nickel = 0.06 mg/l; selenium = 0.04 mg/l; gross alpha = 21.0 pCi/l; combined radium-226 and -228 = 7.4 pCi/l; natural uranium = 0.02 mg/l; thorium-230 = 2.2 pCi/l; lead-210 = 0.9 pCi/l.

Comply with the following groundwater protection standards at alluvium point of compliance wells 32-59, 31-61, and MW-24, with background being recognized at well 5-03: molybdenum = 0.06 mg/l; nickel = 0.06 mg/l; selenium = 0.05 mg/l; gross alpha = 57 pCi/l; combined radium-226 and -228 = 5.0 pCi/l; thorium-230 = 3.1 pCi/l; natural uranium = 0.06 mg/l; lead-210 = 4.9 pCi/l.

**MATERIALS LICENSE
SUPPLEMENTARY SHEET**

License number SUA-1473, Amend No. 31	
Docket or Reference number 40-8905	

- C. Implement a corrective action program as described in the September 25, 1989, submittal with the objective of returning the concentrations of hazardous constituents to the concentration limits specified in Subsection (B). The program shall, at a minimum, consist of mine dewatering and maintenance and operation of the interceptor trench.
 - D. Submit, by August 1 of each year, a review of the corrective action program and its effect on the aquifers. [Applicable Amendments: 9, 11, 13, 15, 25]
35. The licensee shall submit to the NRC, copies of all correspondence with the New Mexico Environmental Improvement Division. [Applicable Amendments: 11]
36. The licensee is authorized to dispose of byproduct material waste from the Rio Algom Mining Corp. Smith Ranch in-situ leach facility in accordance with the submittals dated, February 19, 1990, and September 26, 1991, with the following modifications or additions:
- A. The written procedures, included in the February 19, 1990, submittal shall be reviewed and revised in accordance with License Condition No. 14.
 - B. Prior to disposal of drums containing sludge material, the licensee shall obtain written confirmation from Rio Algom Mining Company that the drums have been verified to be full or the verification shall be performed by Ambrosia Lake personnel.
 - C. Drums containing wastes other than sludges shall be opened and the wastes disposed directly into excavated trenches.
 - D. All disposal activities shall be documented. [Applicable Amendments: 16, 23]
37. The licensee shall reclaim the disposal area as stated in the September 24, 1990, and January 7, 1994, submittals as supplemented by the following conditions. Though recognized as conservative, these conditions were assumed when evaluating the acceptability of the reclamation plan as submitted, and are identified pending submittal of acceptable design alternatives. Justification for any design alternatives must be submitted for NRC review and approval prior to implementation.
- A. The radon barrier shall be constructed as specified in the licensee's September 28, 1990, submittal, as amended by the February 7, August 2, September 2, and November 4, 1994, submittals. Prior to placement of any material onto the interim cover, the procedure defined in the licensee's October 4, 1990, submittal for establishing the integrity of the in-place material must be performed.
 - B. DELETED by Amendment No. 19.
 - C. The relocated contaminated material shall be placed in lifts not to exceed 12 inches and compacted to at least 90 percent of the maximum standard dry density after a stable work base has been established.

**MATERIALS LICENSE
SUPPLEMENTARY SHEET**

License number

SUA-1473, Amend No. 31

Docket or Reference number

40-8905

- D. In place density and moisture laboratory compaction, soil classification, and rock quality testing shall be performed in accordance with the licensee's September 23, 1990, submittal. If test procedures other than the sand cone test or oven dry moisture are used in the construction quality control, procedures that will be used to establish correlation between the tests must be submitted for NRC review and approval prior to implementation.
- E. A detailed cover design for Ponds 11-21 must be submitted for NRC review and approval. All contaminated materials in Pond 3 that are not covered by the reclaimed Pond 1 outslope shall be relocated to Pond 2 unless an erosion protection plan is submitted for NRC review and approval.
- F. The settlement survey data shall be submitted for NRC review and approval prior to placement of the radon barrier on the interim cover.
- G. The fresh water dam mill reservoir must be breached during final reclamation activities.
- H. Settlement monuments shall consist of a steel bar welded to a 1-foot square steel plate, or equivalent, placed at least 3 feet below the surface.
- I. The fill associated with the Pond 1 spillway shall be constructed to the same specifications and quality control program as the radon barrier material.
- J. If a rock source other than the Homestake Quarry is selected, the licensee shall submit the results of durability tests as outlined in the Final Staff Technical Position on Design of Erosion Protection, August 1990, for NRC review and approval prior to placement of any of the material.
- K. All rip rap shall be placed in a manner that prevents segregation of the material. The material placed shall be reasonably well graded and shall be within the following gradation specifications.

D₅₀ = 1.0"

D₅₀ = 3.2"

<u>Sieve Size</u>	<u>Percent Passing (by weight)</u>	<u>Sieve Size</u>	<u>Percent Passing (by weight)</u>
3 inch	100	6 inch	100
2 inch	70-100	5 inch	78-100
1 inch	25- 55	4 inch	35-100
¾ inch	15- 40	3 inch	12- 45
½ inch	0- 25	2 inch	0- 20

**MATERIALS LICENSE
SUPPLEMENTARY SHEET**

License number

SUA-1473, Amend No. 31

Docket or Reference number

40-8905

$D_{50} = 7.7''$

<u>Sieve Size</u>	<u>Percent Passing (by weight)</u>
13 inch	100
12 inch	80-100
10 inch	49-100
8 inch	26- 54
6 inch	7- 32
4 inch	0- 13

- L. A minimum 6-inch bedding layer with a D_{50} of 1 inch shall be placed under all riprap on the disposal area having a D_{50} of 2 inches or larger.

The bedding material shall be reasonably well graded to prevent migration of the base material into the riprap. The quality of the bedding material shall be equivalent to that of the riprap.

- M. A riprap filled toe trench shall be placed on the West side of Pond 2 where the existing steep slopes transition onto the flatter surface of Pond 2.

The licensee shall submit a proposed design of the trench for NRC review and approval prior to construction.

- N. The spillway riprap shall be extended 45 feet onto the top of Pond 1 to prevent erosion.

- O. Riprap with a D_{50} of 1 inch shall be placed in all areas of the South Diversion Ditch which are not excavated in rock.

- P. As an alternative to the erosion protection design of the top surfaces of Ponds 1 and 2, which was approved in Amendment No. 18, the licensee may use a 3-inch layer of riprap having a minimum median stone diameter (D_{50}) of 1-inch.

[Applicable Amendments: 18, 19, 29, 31]

- 38. The licensee is authorized to perform yellowcake drying in accordance with the submittal dated, October 22, 1990. In addition to commitments contained in the October 22 submittal, the licensee shall comply with the following:

- A. Air sampling used to determine the exposure of yellowcake operators to airborne uranium shall include breathing zone sampling at the yellowcake barrelling station.

- B. Water flow rates for the wet scrubber servicing the yellowcake dryer shall be checked and recorded hourly during operation and a range of flow rates established which assure optimum performance of the scrubber.

**MATERIALS LICENSE
SUPPLEMENTARY SHEET**

License number

SUA-1473, Amend No. 31

Docket or Reference number

40-8905

C. Detailed inspection, cleaning, and needed preventive maintenance shall be performed and documented at least annually on all yellowcake area emission control equipment.

D. Written procedures shall be reviewed and approved in accordance with License Condition No. 14. [Applicable Amendments: 20]

39. The licensee shall conduct an annual survey of land use (grazing, residences, water supply wells, etc.) in the area within two miles of the mill and submit a report of this survey annually to the NRC. This report shall indicate any differences in land use from that described in the licensee's previous annual report, and shall specifically address occupancy of the Berryhill Ranch. The report shall be submitted by July 1 of each year. [Applicable Amendments: 21]

40. The licensee shall complete site reclamation in accordance with an approved reclamation plan and groundwater corrective plan, as authorized by License Condition Nos. 37 and 34, respectively, in accordance with the following schedules.

A. To ensure timely compliance with target completion dates established in the Memorandum of Understanding with the Environmental Protection Agency (56 FR 55432, October 25, 1991), the licensee shall complete reclamation to control radon emissions as expeditiously as practicable, considering technological feasibility, in accordance with the following schedule:

(1) Windblown tailings retrieval and placement of the pile - July 31, 1997.

(2) Placement of the interim cover to decrease the potential for tailings dispersal and erosion -

For impoundment No. 1 - December 31, 1993

For impoundment No. 2, excluding portions used for approved byproduct material disposal - December 31, 1993.

(3) Placement of a final radon barrier designed and constructed to limit radon emissions to an average flux of no more than 20 pCi/m²/s above background -

For impoundment No. 1 - December 31, 1997.

For impoundment No. 2, excluding portions used for approved byproduct material disposal - December 31, 1997.

B. Reclamation, to ensure required longevity of the covered tailings and groundwater protection, shall be completed as expeditiously as is reasonably achievable, in accordance with the following target dates for completion:

(1) Placement of erosion protection as part of reclamation to comply with Criterion 6 of Appendix A of 10 CFR Part 40 -

**MATERIALS LICENSE
SUPPLEMENTARY SHEET**

License number
SUA-1473, Amend No. 31
Docket or Reference number
40-8905

For impoundment No. 1 - December 31, 1999.
For impoundment No. 2, excluding portions used for approved
byproduct material disposal - December 31, 1999.

(2) Projected completion of groundwater corrective actions to meet
performance objectives specified in the groundwater corrective
action plan - December 31, 2043.

C. Any license amendment request to revise the completion dates specified
in Section A must demonstrate that compliance was not technologically
feasible including inclement weather, (litigation which compels delay to
reclamation, or other factors beyond the control of the licensee).

D. Any license amendment request to change the target dates in Section B
above, must address added risk to the public health and safety and the
environment, with due consideration to the economic costs involved and
other factors justifying the request such as delays caused by inclement
weather, regulatory delays, litigation, and other factors beyond the
control of the licensee.

FOR THE NUCLEAR REGULATORY COMMISSION



Joseph J. Holonich, Chief
High-Level Waste and Uranium Recovery
Projects Branch
Division of Waste Management

Dated: 1/27/95