

October 30, 1996

Mr. R. S. Ziegler, Project Manager  
Atlantic Richfield Company  
Bluewater Mill  
P.O. Box 638  
Grants, New Mexico 87020

SUBJECT: REVISIONS TO RADON BARRIER FOR ACID AND CARBONATE TAILINGS  
PILES, AMENDMENT 34 TO SOURCE MATERIAL LICENSE SUA-1470

Dear Mr. Ziegler:

Atlantic Richfield Company (ARCO) requested by letter dated May 10, 1995, an amendment to Source Material License SUA-1470 to revise various tailings pile radon barriers previously approved by the NRC staff for its Bluewater uranium mill and tailings site near Grants, New Mexico.

The proposed revisions to the approved Reclamation Plan were evaluated by the NRC staff and determined to be acceptable. Therefore, pursuant to 10 CFR Part 40, Source Material License SUA-1470 is hereby amended by revising License Condition (LC) No. 36. A copy of the staff's Technical Evaluation Report for the license amendment is Enclosure 1.

The license is being reissued to incorporate the revised LC 36 (Enclosure 2). All other conditions of the license shall remain the same. An environmental report is not required from ARCO because the amendment does not meet the criteria of 10 CFR 51.60(b)(2), in that there will be no significant change in the types, or increases in the amounts, of effluents released. For the same reasons, an NRC environmental assessment for this action is not required since this license revision is categorically excluded under 10 CFR 51.22(c)(11).

If you have any questions regarding this letter or the enclosures, please contact Mr. Kenneth Hooks, the NRC Project Manager, at (301) 415-7777.

Sincerely,

Original Signed By:]

Joseph J. Holonich, Chief  
Uranium Recovery Branch  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards

Docket No. 40-8902 - Case closed L51261  
Amendment No. 34

Enclosures: As stated

cc: J. Virgona, DOE-Grand Junction  
R. Ohrbom, NMED

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## TECHNICAL EVALUATION REPORT

DATE: October 7, 1996

DOCKET NO: 40-8402, License No. SUA-1470

LICENSEE: Atlantic Richfield Company

FACILITY: Bluewater Uranium Mill

PROJECT MANAGER: Kenneth Hooks

TECHNICAL REVIEWERS: Elaine Brummett and Dan Rom

### SUMMARY AND CONCLUSIONS:

Atlantic Richfield Company (ARCO) submitted a license amendment request for the Bluewater Mill Site dated May 10, 1995, that was, in part, to respond to license condition 36C, that requires ARCO to provide a final radon barrier design for NRC approval, for the Acid Tailings Pile and the Carbonate Tailings Pile Northwest Extension (Carbonate Extension). The request included a revised radon barrier thickness for the main portion of the Carbonate Tailings Pile, based on re-characterization of the source term. An additional request on June 2, 1995, was for approval of the radon barrier thickness for the rail spur section of the Plant Site and the Knob Area, both newly delineated portions of the Carbonate Tailings Pile.

Average radon barrier thicknesses  
proposed by ARCO:

Already placed:

0.5 foot	Acid Tailings Pile	at least 0.5 foot
0.5 foot	Carbonate Pile NW Extension	3.5 feet
4.2 feet	Main Carbonate Tailings Pile	7.0 feet
1.1 feet	Carbonate Pile Plant Site	1.5 feet
2.0 feet	Carbonate Pile Knob Area	2.0 feet

In response to staff comments, ARCO submitted revised radon flux modeling dated June 6 and corrected data tables dated August 2, 1995. Based on review of the submittals and independent analyses, the staff considers that long-term control of the radon flux from the Acid Tailings Pile, Carbonate Extension, and Main Carbonate Pile requires a radon barrier thickness of at least 0.5 foot, 1 foot, and 5 feet, respectively. In addition, the proposed average radon barrier thicknesses for the Plant Site and the Knob Area of the Carbonate Pile are acceptable.

### BACKGROUND:

The Acid Tailings Pile (23 acres) is adjacent to the Main Tailings Pile (250 acres) and is considered a portion of the Main Pile as the cover will be continuous over both. Evaporation pond material (from ponds 1A, 1B, and 1C) was placed on top of the acid tailings, adding about 9 feet to the height of the

Enclosure

pile. The pond material placed on the Acid Tailings Pile includes clean fill and windblown contamination so the average Ra-226 value should be much lower than the value used in the model to determine the radon barrier thickness that was approved with the reclamation plan. Therefore, ARCO proposed (December 1993) a testing program to characterize the source term of the upper 8 feet of the completed Acid Pile in order to determine the appropriate radon barrier thickness. The NRC staff evaluation of this proposal in Amendment 22, indicated that because the sub-pond material could contain elevated levels of Th-230, analysis for this radionuclide was needed in order to determine the 1000-year Ra-226 concentration in the upper layers of the Acid Pile.

ARCO performed the requested Th-230 analyses, calculated the 1000-year Ra-226 value, and provided a revised model for the radon flux. Based on that model, ARCO completed placement of at least 6 inches of final radon barrier on the Acid Pile (letter dated May 25, 1995).

The northwest extension to the Carbonate Pile (Carbonate Extension) is a 4.4-acre area (see Attachment A) that consists primarily of windblown tailings interspersed with the underlying lava rock. Since the area would be very difficult to clean, ARCO decided to consider this as an addition to the Carbonate Pile (December 1993) and additional windblown contamination was placed there. ARCO indicated that 3.5 feet of radon barrier was placed on this area during the summer of 1994.

The Main Carbonate Tailings Pile (26 acres) was originally 43 acres. The main portion of the pile now excludes the northwest extension, Disposal Areas #2 and #3, Plant Site, and the Knob Area because these areas have separate radon barrier designs. The NRC approval of the reclamation plan indicates that 7.8 feet of radon barrier will be placed on this pile, in addition to the cover placed as of August 1990. ARCO indicated that approximately 7 feet of radon barrier has been placed to date.

The Plant Site portion (3.3 acres) of the Carbonate Pile contains the former rail spur to the mill, and tailings were not placed there. The area is an extension of the Plant Site Area addressed in the reclamation plan. The reclamation plan calls for covering slightly contaminated soil and building foundations with 1.1 feet of engineered fill and an erosion protection cover. ARCO stated that most of the area has been covered by a minimum of 18 inches of radon barrier and the NRC-approved rock erosion protection layer.

The Knob Area (0.8 acres) of the Carbonate Pile consists of an outcrop of lava that was partially covered by a thin layer of windblown tailings. ARCO stated that the radon barrier has been placed on this area at varying depths up to 4-feet thick, appropriate for promoting continuous surface water drainage across the pile. The NRC-approved rock erosion protection layer has also been placed.

ARCO staff has indicated that radon barrier material, beyond what is sufficient to control the long-term radon flux, has been placed on most areas in order to provide additional design conservatism and to protect the radon barrier from freeze-thaw and biointrusion damage.

#### AMENDMENT REQUEST:

ARCO proposed radon barrier designs for the Acid Tailings Pile and the Carbonate Extension, as required by license condition 36C, based on recent characterization of the source term. The radon barrier thickness proposed for each area is 6 inches. ARCO also proposed to revise (reduce) the Main Carbonate Pile approved radon barrier thickness to 4.2 feet, based on re-characterization of the source term. In addition, ARCO delineated the Plant Site and the Knob Area as separate portions of the Carbonate Pile and proposed average radon barrier thicknesses of 1.1 and 2.0 feet, respectively.

#### TECHNICAL EVALUATION:

Because the amendment request addresses only modification of the radon barrier thickness for the Acid Tailings Pile and Main Carbonate Pile, only the radon attenuation aspect of the design was evaluated. The geotechnical and erosion protection aspects of the cover designs for the Acid and Carbonate Piles were evaluated during review of the reclamation plan and subsequent amendment requests (see license amendment number 24). However, a geotechnical engineer evaluated the constructability of the proposed 6-inch-thick radon barrier for the Acid Tailings Pile.

#### Geotechnical Aspects

The proposed covers of the Carbonate Extension and the Knob Areas were evaluated for stability and long-term performance. The only concern noted by staff was the potential for excessive differential settlement and cover cracking above the old dike. The concern was expressed since the relatively deep pond fill to either side of the dike may have the potential to settle, whereas the dike could be relatively stable. The licensee informed staff that the dike was constructed out of controlled and compacted soil. Furthermore, the licensee added that the ponds were backfilled with material similar to that from which the dike was constructed. Since both materials are of similar composition, and both were placed and compacted in a similar manner, the potential for excessive differential settlement can be discounted. Therefore, the licensee's response satisfactorily closed the issue.

#### Radon Flux Models

Staff determined that the radon flux model for each area under consideration appropriately represents the constructed disposal area (material type, sequence, and layer thickness). ARCO did not present Ra-226 data for material deeper than 8 feet for the Carbonate Extension since the contaminated material did not extend to a depth of 10 feet. To be conservative, ARCO modeled another 2-foot layer (8 to 10-foot depth) with the same parameters as the 6 to 8-foot layer.

Radon flux models and analyses for the Plant Site and Knob Area were not submitted. Staff considers this acceptable because of the low volume of tailings involved, the amount of radon barrier placed on these areas, and the small area involved (4.1 acres) in comparison to the total impoundment (49.2 acres). The radon flux from the Plant Site and Knob Area would have little or no impact on the average radon flux from the Carbonate Pile.

ARCO utilized the RAECOM computer code to calculate the estimated long-term radon flux for each model submitted. The staff performed independent flux calculations using the RADON computer code, which is a slight modification of the RAECOM code.

### Model Parameters and Results

#### 1. Acid Tailings Pile

ARCO did boreholes on the Acid Pile at 10 locations to a depth of 8 feet. Samples were composited over 2-foot intervals for each location, according to the NRC-approved procedure (Amendment 22). Samples were analyzed for Ra-226 and Th-230 activity concentrations and the results were used to calculate the resulting Ra-226 from decay of the two radionuclides at 100-year intervals. The data indicate that the maximum Ra-226 value within 1000 years is at 1000 years, and this value was used for each 2-foot layer in the model.

ARCO supported the radon barrier design with test results of off-pile (pond material, windblown tailings) material placed on top of the acid tailings. The data indicate that the average dry density is 1.78 g/cc with 14.9 percent moisture by weight. In the radon flux model, ARCO used the placement density and corresponding porosity with the long-term moisture value of 9.5 percent that was used in reclamation plan Acid Pile radon model. However, staff determined that the average density value used in the model did not correspond to the test result average. ARCO then submitted corrected data tables (August 2, 1995). The staff confirmed that the correct density value is 1.72 g/cc and the corresponding porosity is 0.35.

A radon emanation fraction value of 0.20 was used in the model. ARCO said this was conservative based on data in the reclamation plan indicating that radon emanation test results averaged 0.17 for evaporation pond material. However, the staff noted that the plan indicates that the average measured emanation value for windblown material was 0.32. Since a mixture of the two materials was placed on the Acid Pile, the staff modeled a radon emanation value of 0.25.

ARCO calculated that the long-term radon flux for the Acid Pile without any radon barrier would be less than the limit of 20 pCi/m<sup>2</sup>/s, but proposed to add 6 inches (average thickness) of radon barrier material as a working surface on which the erosion protection layer will be applied. Staff modeled the radon barrier design using the parameters changes discussed above, as well as more appropriate (conservative) density and porosity values for the uncompacted acid tailings. The calculated long-term radon flux was 18.0 pCi/m<sup>2</sup>/s when the model included a 6-inch radon barrier.

Staff considers that a minimum of 6 inches (15.2 cm) of radon barrier is required to insure a stable layer to prevent drying and disruption of the upper layer of contaminated material and to control the radon flux. Construction of a layer averaging 6 inches could produce some areas with a very thin barrier layer. Such a thin layer could be disrupted by heavy equipment, rocks, and natural material defects. If significant drying and cracking of the thin barrier areas occurred, the radon flux from this portion of the disposal cell could be elevated as the



upper layer of contaminated material dried to below 9.5 percent moisture content in the semi-arid climate. The staff realizes that the Acid Tailings Pile is a small portion of the 273-acre Main Tailings Pile, so that a small elevation of radon flux above of the standard from the Acid Tailings Pile would have no impact on the average flux from the main disposal cell. However, given the uncertainties associated with maintaining the integrity of the thin radon barrier over the long design period (200 to 1000 years), the staff considers it prudent to require a minimum, as opposed to an average, 6-inch-thick radon barrier.

## 2. Carbonate Extension

ARCO did three borings to a depth of 8 feet and formed samples from each 2-foot interval for Ra-226 analysis. Because the windblown tailings contaminated soil is similar to the radon barrier material, ARCO assumed a long-term moisture value of 9.5 percent and a density of 1.78 g/cc. The code-calculated diffusion coefficient was used and the estimated radon flux was 17 pCi/m<sup>2</sup>/s without any radon barrier.

The staff commented on the use of porosity and density values corresponding to material compacted to 95 percent standard Proctor when data was not available to substantiate that such a level of compaction was achieved. Also, the 0.2 radon emanation fraction for the upper layers (windblown material) was considered inappropriate, given the windblown material emanation data in the reclamation plan. ARCO then provided a revised flux calculation (June 6, 1995) with supportable parameter values (porosity 0.38, density 1.68 g/cc, and radon emanation fraction 0.3). The analysis indicates that 10.2 inches (25.8 cm) of radon barrier is required to meet the long-term radon flux limit. The staff considers that, to provide reasonable assurance that the long-term flux limit will not be exceeded, a 1-foot thick (30.5 cm) radon barrier is required.

## 3. Main Carbonate Pile

ARCO obtained samples of the main portion of the carbonate pile at 12 locations to a depth of 8 feet, and composited material over 2-foot intervals at each location for Ra-226 analysis. The test results were much lower than the Carbonate Pile Ra-226 values in the reclamation plan.

ARCO's flux model included the recently measured Ra-226 values and the other parameter values were the same as the reclamation plan model. The staff pointed out that the moisture content value (20 percent) was based on data obtained from samples that were primarily slimes tailings (Ra-226 greater than 1000 pCi/g) while the new Ra-226 average value for each layer was below 400 pCi/g. ARCO then provided (June 6, 1995) a revised RAECOM analysis using a moisture value of 12 percent for the tailings and the corresponding (code calculated) diffusion coefficient. The results indicate that 5 feet (152.6 cm) of radon barrier are required to meet the flux limit. Given the conservatism in the design of other areas of the Carbonate Pile, the staff considers that 5 feet of radon barrier on the main portion of the Carbonate Pile should be adequate to meet the long-term radon flux limit for the pile.

## Durability of the Radon Barrier

The radon barrier for all the areas under review is to be constructed from the same material and placed according to the same construction specifications as radon barriers that NRC has approved for the Main Tailings Pile and the Carbonate Pile. Resolution of any remaining issues concerning erosion protection design and seismicity will assist in providing for long-term durability (integrity) of the radon barrier. Other elements to be considered as possibly effecting barrier integrity, and thus its radon attenuation capacity, are freeze-thaw and biointrusion damage to the barrier.

ARCO addressed the possibility of freeze-thaw damage to the radon barrier material used for all site disposal cells and concluded (letter of March 10, 1994) that the risk of such damage is low. If some damage were to occur, it would not significantly affect the radon attenuation capacity of the barrier. NRC staff agrees with ARCO's evaluation based on consideration of the low moisture content and soils types in the piles and covers that should prevent significant freeze-thaw damage to the radon barrier layer.

ARCO also concluded that there was minimal concern for deep-rooted plants on any of the piles on the Bluewater site due to the semi-arid climate and the type of indigenous plants. In conversations, ARCO staff indicated that the local burrowing animals are unlikely to choose the rock mulch covered piles for habitat. NRC staff agrees that root or animal intrusion into the radon barrier layer is not likely to be extensive enough to significantly affect the radon attenuation capabilities of the barrier, given the conservatism in most of the barrier designs. If conditions change such that extensive damage occurs, staff recognizes that the long-term surveillance plan would provide for corrective action.

## RECOMMENDED LICENSE CHANGE:

Based on the staff review of the licensee's submittals, the staff recommends that Source Materials License SUA-1470 be amended to revise condition 36 C such that License Condition 36 reads as follows:

36. The licensee shall reclaim the tailings disposal area as stated in their March 21, 1990 reclamation plan submittal as revised by submittals dated July 12, July 19, July 23, August 2, and August 8, 1990; November 25, 1991 (with the exception of Section 7.0); December 22, 1993; July 28 and August 31, 1994; March 6, May 15, May 25, June 2, June 6, June 16, and August 24, 1995. In addition, the licensee shall:
  - A. Construct the radon barrier for the main tailings pile to minimum average thicknesses of 73 centimeters (cm) for the sands area, 30.5 cm for the mixed tailings area, and 73 cm for contaminated outcrops. The radon barrier will be a minimum thickness of 15 cm for the slimes area.
  - B. Submit for NRC review and approval the correlation of nuclear gauge to sand cone results prior to using the nuclear gauge for field construction control.

- C. Construct the radon barrier to a minimum thickness of 15.2 cm (6 inches) for the acid pile, and to an average thickness of 30.5 cm (1 foot) for the carbonate pile extension, and 152.6 cm (5 feet) for the main portion of the carbonate pile.
- D. Construct the outslope for the Northeast portion of the main tailings impoundment in accordance with Section 3 of the report submitted by letter dated December 22, 1993, with the exception that the radon barrier shall be constructed in accordance with Condition No. 36(A) of this license.

#### 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. The 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.

An environmental report is not required from the licensee since the amendment does not meet the criteria of 10 CFR 51.60 (b)(2) which are: (1) significant expansion of the site; (2) significant change in the types of effluents; (3) significant increase in individual or cumulative occupational radiation exposure; (5) significant increase in the potential for radiological accidents; or (6) significant increase in spent fuel storage capacity or activity listed in paragraph (b)(1) of this section.