

September 27, 2006

Mr. T.W. Hardgrove  
Pathfinder Mines Corporation  
935 Pendell Boulevard  
P.O. Box 730  
Mills, WY 82644

SUBJECT: REVIEW OF PATHFINDER LUCKY MC MILL TAILINGS SITE RECLAMATION  
COMPLETION REPORT, AMENDMENT NO. 69 TO SOURCE MATERIALS  
LICENSE SUA-672 (TAC LU0099)

Dear Mr. Hardgrove:

By letter dated April 21, 2005, Pathfinder Mines Corporation (PMC) submitted to U.S. Nuclear Regulatory Commission (NRC) staff the "Lucky Mc Mine Tailings Reclamation Project Completion Report" (Completion Report), to document the completion of tailings and soils reclamation at the Lucky Mc site in Fremont County, Wyoming. NRC staff conducted its final inspection on September 20, 2005, at which time PMC was to submit radon flux tests for Evaporation Pond 4. PMC submitted the additional radon flux data on October 24, 2005. NRC staff has completed its review of the Completion Report and supplemental information and documents the results of the review in the enclosed technical evaluation report (Enclosure 1).

Based on its review, the staff concludes that reclamation of the Lucky Mc tailings site was performed in accordance with the requirements of Appendix A, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content," to Title 10, Part 40, "Domestic Licensing of Source Material," of the *Code of Federal Regulations* (10 CFR Part 40), and the approved PMC Lucky Mc Mine Tailings Reclamation Plan, as amended. Accordingly, the NRC has deleted License Condition 54 to indicate that the reclamation project completed by PMC is acceptable. Amendment No. 69 to Source Materials License SUA-672 (Enclosure 2) incorporates the deletion of License Condition 54. All other conditions of the license shall remain the same.

If you have any questions, please contact Mr. Stephen J. Cohen, Project Manager, at 301-415-7182, or by email, at [sjc7@nrc.gov](mailto:sjc7@nrc.gov).

In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's Rules of Practice, the agency will make a copy of this letter available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's Agencywide Document Access and Management System (ADAMS). ADAMS is accessible from the NRC public Web site at <http://www.nrc.gov/reading-rm/adams.html>.

Sincerely,

/RA/

Gary S. Janosko, Chief  
Fuel Cycle Facilities Branch  
Division of Fuel Cycle Safety  
and Safeguards  
Office of Nuclear Material Safety  
and Safeguards

Docket No. 40-2259  
License No. SUA-672

Enclosures: 1. Technical Evaluation Report  
2. License Amendment No. 69

cc: D. Wichers, COGEMA  
A. Kleinrath, DOE  
D. Finley, WDEQ  
R. Chancellor, WDEQ

In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's Rules of Practice, the agency will make a copy of this letter available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's Agencywide Document Access and Management System (ADAMS). ADAMS is accessible from the NRC public Web site at <http://www.nrc.gov/reading-rm/adams.html>.

Sincerely,

/RA/

Gary S. Janosko, Chief  
Fuel Cycle Facilities Branch  
Division of Fuel Cycle Safety  
and Safeguards  
Office of Nuclear Material Safety  
and Safeguards

Docket No. 40-2259  
License No. SUA-672

Enclosures: 1. Technical Evaluation Report  
2. License Amendment No. 69

cc: D. Wichers, COGEMA  
A. Kleinrath, DOE  
D. Finley, WDEQ  
R. Chancellor, WDEQ

**(CLOSES TAC LU0099)**

**DISTRIBUTION:**

BSpitzberg,RIV

FCFB r/f

MMoriarty

**ML062680396**

<b>OFC</b>	FCFB		FCFB		FCFB		FCFB	
<b>NAME</b>	S. Cohen		B. Garrett		W. von Till		G. Janosko	
<b>DATE</b>	9/26/06		9/26/06		9/26/06		9/28/06	

**OFFICIAL RECORD COPY**

**TECHNICAL EVALUATION REPORT  
PATHFINDER MINES CORPORATION  
LUCKY MC SITE, FREMONT COUNTY, WYOMING  
RECLAMATION CONSTRUCTION COMPLETION REPORT**

**DOCKET NO.:** 40-2259

**LICENSEE:** Pathfinder Mines Corporation

**FACILITY:** Lucky Mc Site, Fremont County, Wyoming

**PROJECT MANAGER:** Stephen J. Cohen

**TECHNICAL REVIEWERS:** Julia Barto, Elaine Brummett, Stephen J. Cohen, Center for Nuclear Waste Repository Analysis, Ted Johnson

**SUMMARY AND CONCLUSIONS**

By letter dated March 30, 1992, Pathfinder Mines Corporation (PMC) submitted to U.S. Nuclear Regulatory Commission (NRC) staff a decommissioning plan (PMC, 1992) for its Lucky Mc uranium mill tailings site in Fremont County, Wyoming. PMC modified this plan by supplements dated (1) July 20, 1993 (PMC, 1993a), (2) July 23, 1993 (PMC, 1993b), (3) January 12, 1996 (PMC, 1996a), (4) March 21, 1996 (PMC, 1996b), (5) May 9, 1996 (PMC, 1996c), (6) May 13, 1996 (PMC, 1996d), and (7) August 2, 2000 (PMC, 2000). Uranium milling facilities, at the site, were decommissioned from 1993 through 1994, and windblown tailings and contaminated soils were reclaimed in 1996 (PMC, 1999). An interim cover was placed on the tailings before milling operations ceased and was completed in 1993; by 2004, PMC installed the final grading and tailings cover (PMC, 2005). PMC documented the completed construction in the report, "Lucky Mc Mine, Tailings Reclamation Project, Construction Completion Report," issued April 2005 (Completion Report) (PMC, 2005). NRC staff performed the construction completion inspection on September 20, 2005 (NRC, 2005). Based on NRC staff's review of the Completion Report and the staff's site inspection results, NRC staff has determined that PMC properly implemented the reclamation plan, as amended, and approves the final construction.

**BACKGROUND**

PMC operated the Lucky Mc mill from 1958 until 1988. The site is located approximately 45 miles south-southeast of Riverton in eastern Fremont County, Wyoming, in the Gas Hills Mining District. The Lucky Mc mill processed approximately 10.6 million metric tons (tonnes) (11.6 million tons) of uranium ore. It consisted of (1) an ore pad and mill buildings at the south end of the facility, (2) three solid tailings ponds designated as Ponds 1, 2, and 2A (in south-to-north order), and (3) three solution ponds (Ponds 3, 3A, and 4) to the north of the solid tailings ponds. The No. 4 tailings embankment defined the north end of the site and acted as the failsafe containment structure for the entire tailings system.

PMC designed the Lucky Mc site reclamation plan to meet the requirements of Criterion 6 of Appendix A to 10 CFR Part 40 for radon emissions and gamma radiation. The plan was also designed to meet the requirements of Criterion 6 regarding tailings isolation from erosive intrusion for 1000 years without active maintenance. Basic features of the reclamation plan

include mill decommissioning (completed in 1994), interim cover installation (completed in 1993), windblown tailings and soil reclamation (completed in 1996), and tailings reclamation (completed in 2004).

Mill decommissioning commenced with the installation of an interim cover over Pond 2 before milling operations ceased. After mill closure (in 1988), an interim cover was installed over Ponds 1 and 2A (PMC, 2005). The interim cover was completed in 1993. After mill decommissioning and interim cover installation, PMC undertook tailings and soils reclamation. Tailings and soils reclamation involved grading and installing permanent radon barriers. The grading plan used the existing topography, as much as possible, to avoid excessive cuts and fills on the tailings. The plan also incorporated the subdivision of the overall drainage basins, resulting in shorter slope runs, and smaller design peak flows that would be channelized.

Because of the designed drainage subbasins, the plan entailed the construction of numerous channels to convey runoff from the reclaimed tailings surface to the periphery. Exhibit 3.0-1 in the Completion Report illustrates the locations of these various channels. Channels were primarily armored with riprap, the size of which depended upon the hydraulic characteristics of each channel. The design specified Riprap  $D_{50}$  (50-percentile diameter or median) sizes of 0.30 meter (m) (1 foot (ft)), 0.24 m (0.8 ft), 0.15 m (0.5 ft), and 0.10 m (0.33 ft).

The final radon barrier clay cap varied in thickness depending on the activity of the source term. The ore pad was covered with 0.30 m (1 ft) of clay. PMC installed 0.61 m (2 ft) of clay over the mill site and 0.46 m (1.5 ft) of clay over areas adjacent to the mill site. PMC also installed 0.91 m (3 ft) of clay over Ponds 1 and 2, 0.61 m (2 ft) of clay on Pond 2A, and typically 0.46 m (1.5 ft) of clay on the regraded dam outslopes. PMC also installed 0.33 m (1.1 ft) of clay on the solution ponds, and 0.66 m (2.2 ft) of clay on the No. 3 dam outslopes. Radon barrier clay was borrowed from sites on the east and west sides of the solution ponds. A total of 24.7 hectares (ha) (or 61 acres (ac)) were covered with topsoil and seeded, and 176 ha (435 ac) were covered with rock.

## **TECHNICAL EVALUATION**

### Radon and Gamma Emissions

PMC provided laboratory reports for the radon flux testing and a sample location map showing the flux value for each sample site (Exhibit E-1 in Appendix E to the Completion Report). It conducted a total of 188 tests on the completed radon barrier. The overall average radon flux from the completed barrier was less than 0.8 picocuries per square meter per second ( $\text{pCi}/\text{m}^2/\text{s}$ ), which is significantly below the Criterion 6 limit of 20  $\text{pCi}/\text{m}^2/\text{s}$ . Additionally, many of the measured radon flux values were less than the survey equipment detection limit of 0.5  $\text{pCi}/\text{m}^2/\text{s}$ .

Exhibit E-1 also showed gamma values recorded at the flux test sites. Overall gamma dose was 10 microRoentgen per hour ( $\mu\text{R}/\text{hr}$ ), depending upon location. NRC staff could not directly compare this dose to preconstruction background because background data consisted of concentrations of radium-226 and radium/uranium ratios (PMC, 1999). However, the staff estimated the dose from the average radium-226 concentration. These calculations indicated that the average radium-226 concentration of 14.86 picocuries per gram ( $\text{pCi}/\text{g}$ ) results in a dose of 13.8  $\mu\text{R}/\text{hr}$ . Therefore, the overall postconstruction gamma dose is generally less than

the estimated preconstruction background dose. It should be noted that NRC staff's preconstruction dose estimate does not include data from naturally high radioactivity areas; therefore, this estimate is likely conservative. PMC also provided laboratory reports on radium-226 levels for the Cody shale radon barrier material, which were acceptably low.

Based on the information presented in the application and a detailed review of the site characterization information of the former Lucky Mc uranium mill facility, NRC staff concludes that the radon and gamma attenuation and the radioactivity content associated with the tailings impoundment cover comply with Criteria 6(1) through 6(3) and 6(5) of Appendix A to 10 CFR Part 40.

### Geotechnical Engineering Review

NRC staff reviewed the Completion Report to determine whether the geotechnical engineering aspects of the remedial action were completed in accordance with specifications in the tailings reclamation plan and, thus, comply with NRC regulations in Appendix A to 10 CFR Part 40. NRC staff reviewed the as-built drawings, construction inspection reports, quality assurance summaries, and field and laboratory test data. NRC staff also inspected the completed reclamation project during a site visit on September 20, 2005.

The reclamation plan required installing a radon barrier of varying thickness over the six ponds and grading the surface to the existing general topography. The plan also required a protective cover on the radon barrier and the construction of several channels for the safe drainage of surface runoff. The geotechnical engineering review of the reclamation focused on the material properties and final thickness of the radon barrier.

Information provided by PMC in Chapter 8, "Quality Assurance/Quality Control," of the Completion Report indicates that the borrow areas for the clay soil used for the radon barrier were sampled and tested systematically to determine whether the material satisfied the particle-size requirement that at least 90 percent of the particles pass through a No. 200 sieve [75 micrometers (0.003 inches (in.))]. Borrow areas that did not meet the requirement were isolated and not used as a radon barrier. NRC staff reviewed the test results provided in Appendix C to the Completion Report. To meet the required placement water content for the radon-barrier clay, PMC prewetted the clay at the borrow site using an irrigation system and, when necessary, mixed the placed clay with additional water before compaction.

The clay was placed in incremental 15-cm (6-in.) lifts and compacted using a sheeps-foot compactor, in addition to the wheel weight of the scrapers. Each lift of placed clay was tested for its degree of compaction and moisture content. NRC staff reviewed the test results provided in Appendix D to the Completion Report. The staff also inspected the construction of the radon barrier through physical observation of the completed sections and a review of testing and inspection records during a site visit in July 2001.

PMC provided a map of radon barrier thickness based on postconstruction boring data (Exhibit 8.0-2 of the Completion Report), which indicates a finished radon barrier thickness of greater than 0.91 m (3 ft) over Ponds 1 and 2, 0.61–0.91 m (2–3 ft) over Ponds 2A and 3, and 0.3–0.61 m (1–2 ft) over Ponds 3A and 4. The as-built thickness provided by the licensee is consistent

with the approved design (Appendix A to the Completion Report), which requires at least 0.91 m (3 ft) of radon barrier over tailings Ponds 1 and 2, 0.61 m (2 ft) over Pond 2A, and 0.3 m (1 ft) over the solution ponds.

Based on the geotechnical review, NRC staff concluded the following:

- The licensee performed the appropriate tests and inspections to ensure that the radon barrier used the proper type of material. The licensee routinely inspected the placement and compaction of construction materials to ensure that they met the moisture and density requirements. The licensee took adequate measures to ensure the uniformity of moisture content throughout each compacted soil lift.
- The licensee conducted laboratory and field testing in accordance with acceptable test procedures, using trained and qualified personnel.
- The frequencies of material testing and inspection complied with the approved technical specifications.
- As-built drawings adequately documented that the completed remedial action was consistent with the NRC-approved design.

Based on the above observations, NRC staff concludes that the geotechnical engineering aspects of the tailings cell design and construction are in accordance with the applicable specifications in the Tailings Reclamation Plan and the requirements of Criteria 4(c) and 6(1) in Appendix A to 10 CFR Part 40.

#### Surface Water Hydrology and Erosion Protection Review

NRC staff reviewed the surface water hydrology and erosion protection aspects of reclamation activities at the Lucky Mc site to ensure that erosion protection and drainage channels were constructed in accordance with the applicable specifications, as stipulated in the reclamation plan. Areas of review included construction operations, laboratory and field testing, and quality assurance audits. In addition, the evaluation included NRC observations of remedial actions, site inspections, and reviews of records and testing during site inspections.

The reclamation design included erosion protection in several specific areas, including top slopes, side slopes, drainage channels, and rock toes at the outlets of the drainage channels. Riprap for the top and side slopes was designed to prevent long-term erosion and gully migration of the cover. Riprap toes were installed to prevent erosion and gully migration.

NRC staff reviewed each of these features and determined that testing, placement, gradations, and riprap configurations complied with specifications in the reclamation plan. The evaluation included NRC staff observations and reviews of onsite records during the reclamation activities, as well as an assessment of the verification results presented in the Completion Report. In addition, the staff reviewed records of the riprap placement on the top slopes, side slopes, and drainage channels.

During the review, the staff noted the following observations:

- The licensee performed tests (gradation and durability) and inspections to ensure the proper selection of erosion protection materials. A review of the documentation indicated that the placement of materials was routinely inspected to ensure that the materials met the rock size and gradation specifications. Likewise, the thickness of the rock layers was verified to ensure compliance with the specifications.
- The licensee conducted laboratory and field testing in accordance with specified test procedures.
- Testing and inspection frequencies for materials used for erosion protection complied with the frequencies specified in the reclamation plan.

Based on NRC staff observations and reviews of onsite records during remedial actions, as well as an assessment of the verification results presented in the Completion Report, NRC staff concludes that the licensee performed the required durability and gradation tests during the remedial action. The riprap is of adequate quality and has been placed in an acceptable manner. The NRC staff concludes that the erosion-protection aspects of the design and construction are in accordance with the specifications in the reclamation plan, as amended, and the requirements of Criteria 1(c), 4(d), 6(1), and 12 in Appendix A to 10 CFR Part 40.

## **LICENSE AMENDMENT**

54. DELETED by Amendment No. 69.

## **REFERENCES**

Pathfinder Mines Corporation. 1992. Mill Decommissioning Plan for the Lucky Mc Mine. March 30, 1992 [Legacy Accession No. 9205050327].

Pathfinder Mines Corporation. 1993a. Letter to Mr. Ramon E. Hall Revising the Decommissioning Schedule. July 20, 1993 [ADAMS Accession No. ML062690239].

Pathfinder Mines Corporation. 1993b. Replacement Pages for the Lucky Mc Decommissioning Plan. July 23, 1993 [ADAMS Accession No. ML062690229].

Pathfinder Mines Corporation. 1996a. Revised Soil Cleanup Verification Survey and Sampling Plan for the Lucky Mc Mill Tailings Site. January 12, 1996 [Legacy Accession No. 9601180320].

Pathfinder Mines Corporation. 1996b. Revisions to Lucky Mc Tailings Reclamation Plan for Contaminated Soils. March 21, 1996 [Legacy Accession No. 9603270120].

Pathfinder Mines Corporation. 1996c. Letter to Mr. Joseph J. Holonich Transmitting Proposed Modifications to Soil Cleanup Program. May 9, 1996 [ADAMS Accession No. ML062690241].



Pathfinder Mines Corporation. 1996d. Revised Pages to Appendix H, Volume II, of Lucky Mc Mine Tailings Reclamation Plan. May 13, 1996 [Legacy Accession No. 9605210536].

Pathfinder Mines Corporation. 1999. Lucky Mc Mill Site Completion Report. February 1999 [Legacy Accession No. 9902220261].

Pathfinder Mines Corporation. 2000. Page Changes to Lucky Mc Mill Tailings Reclamation Plan. August 2, 2000 [ADAMS Accession No. ML003738636].

Pathfinder Mines Corporation. 2005. Lucky Mc Mine Tailings Reclamation Project Completion Report. April 21, 2005 [ADAMS Accession No. ML051720392].

U.S. Nuclear Regulatory Commission. 2005. Summary of Construction Completion Inspection. September 20, 2005 [ADAMS Accession No. ML052790605].