



State of Utah

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*Governor*

GREG BELL  
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Department of  
Environmental Quality

Amanda Smith  
*Executive Director*

DIVISION OF RADIATION CONTROL  
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January 22, 2013

Harold Roberts  
Executive Vice President and Chief Operating Officer  
Energy Fuels Resources (USA) Inc.  
225 Union Blvd., Suite 600  
Lakewood, CO 80228

RE: Radioactive Material License (RML) Number UT 1900479: Request for Information on Proposed Alternate Feed Material from Dawn Mining.

Dear Mr. Roberts:

On April 11, 2012 Energy Fuels Resources (EFR) submitted to the Utah Division of Radiation Control (DRC) a request to amend RML 1900479 by adding a new Alternate Feed stock to the approved list of alternate feed being processed at the White Mesa Uranium Mill. This alternate feed material is from the Dawn Mining Corporation's Midnite Mine located in the State of Washington. On November 8, 2012, representatives from Energy Fuels and Dawn Mining met with the DRC to discuss the proposed license amendment request. It was decided in that meeting that the review of the amendment request would be done by the DRC's contractor URS Corp. The following are comments and requested information from URS's review:

“Application by Denison Mines (USA) Corp. (‘Denison’) for an Amendment to State of Utah Radioactive Materials License No. 1900479 for the White Mesa Mill (the “Mill”) from Dawn Mining Corporation (“DMC”) Midnite Mine to process an Alternate Feed Material (the “Uranium Material”) dated April 27, 2011; and

“State of Utah Radioactive Materials License No. 1900479 April 27, 2011 Amendment Request to Process and Alternate Feed Material from Dawn Mining Company, Transmittal of Supplementary Information”, Energy Fuels Resources (USA) Inc. (EFR), dated December 5, 2012 [letter report].

URS has reviewed the Denison license amendment application and EFR's Supplementary Information letter report identified above requesting authority to process alternate feed material (Uranium Material) from the Dawn Mining Corporation Midnite Mine at the White Mesa Uranium Mill. The following general and specific comments and requests for additional information have resulted from this review.

## GENERAL COMMENTS

1. Specific comments stated below address the Applicant's repeated statements that the Uranium Material proposed to be processed in the White Mesa Mill has characteristics that are within the envelope of material characteristics previously authorized to be processed at the Mill.

Once the specific comments stated below have been addressed, please review and evaluate the correctness of conclusions stated throughout the text of the amendment application that previously accepted or authorized analyses, plans, programs, procedures, practices, equipment, etc. need not be extended or revised. Justify each new conclusion. To the extent necessary, extend or revise previously accepted or authorized analyses, plans, programs, procedures, practices, equipment, etc. and submit them for the Division's consideration and approval.

Previously accepted or authorized analyses, plans, programs, procedures, practices, equipment, etc. include (but are not necessarily limited to) the following:

- a. "... there will be no incremental public health, safety or environmental impacts over and above previously licensed activities" stated on Page 11 of the Amendment Request.
- b. "... it is not expected that transportation impacts associated with the movement of the Uranium Material by truck from the Midnite Mine WTP facility to the mill will be significant."
- c. "...the Uranium Material is stable under ambient environmental conditions and does not require any special handling...the TCLP data evidences that the material does not readily leach and does not exhibit hazardous waste characteristics when exposed to more severe conditions than would be anticipated on the ore storage pad" stated on page 13 of the Amendment request.
- d. "... there will be no new or incremental risk of discharge to surface waters resulting from the receipt and processing of Uranium Material at the Mill or the disposition of the resulting tailings" stated on page 16 of the Amendment Request.
- e. "The existing air particulate monitoring program is equipped to handle all such ores" stated on Page 16 of the Amendment Request.
- f. "... the Uranium Material will therefore poses less of a gamma and radon hazard than other ores and alternate feed materials that have been processed or licensed for processing at the Mill" stated on Page 16 of the Amendment Request.
- g. "Gamma exposure to workers will be managed in accordance with existing Mill standard operating procedures" stated on Page 17 of the Amendment Request.

- h. "Radon exposures to workers will be managed in accordance with existing Mill standard operations" stated on Page 17 of the Amendment Request.
- i. "The Mill . . . can safely handle the Uranium Material in accordance with existing Mill standard operating procedures" stated on Page 17 of the Amendment Request.
- j. "Existing monitoring programs are therefore adequate and no new monitoring procedures are required" stated on Page 18 of the Amendment Request.
- k. ". . . there will be no decommissioning, decontamination or reclamation impacts associated with processing the Uranium Material, over and above previously licensed Mill operations" stated on Page 18 of the Amendment Request.

### **SPECIFIC COMMENTS**

1. Pages 6 and 7, Section 2.6.1 of the April 2011 DMC LAR: Please justify by providing documentation of the following parameter values stated in the narrative:
  - a. Uranium Material average uranium content of approximately 1.4% on a dry weight basis.
  - b. High grade Arizona Strip breccia pipe uranium ore content ranging from 0.4% to 2%  $U_3O_8$  or higher.
  - c. Estimated average Thorium-232 content 0.005% on a dry weight basis.
  - d. Radium-226, Thorium-230, and Lead-210 concentrations of 24.1 pCi/L, 20.7 pCi/L, and 33.3 pCi/L, respectively.
  - e. Radium-226, Thorium-230, and Lead-210 concentrations of 825 pCi/L each in Colorado Plateau ore with  $U_3O_8$  content of 0.25%.
2. Page 10, Section 3.3.3: Justify by furnishing additional documentation the assertion that "The five volatile organic compounds detected...in the Uranium Material have been attributed to laboratory contamination..."
3. Page 17, Section 4.10.2(d): Estimate and document the range of "Derived Air Concentration" values that might result from processing the proposed Uranium Material. State and justify the impact this range of DACs might have on estimated worker exposures to airborne particulate matter.
4. Tab (Attachment) 2, Page 5 of 11: Provide historical testing results to demonstrate that the uranium content has averaged 0.18% on a wet basis.
5. Tab 2, Page 7 of 11: Correct the discrepancies for Arsenic and Cadmium between values in the columns and the values stated as the "Max".

6. Tab 2, Pages 8, 9, and 10 of 11: Add columns to each table indicating allowable concentrations for each analyte (e.g., TCLP threshold values), where applicable.
7. Tab 2, summary tables and Tab (Attachment) 4, Table 4 of the April 2011 DAR LAR:
  - a. Compare the range of concentrations of the following constituents that could occur in the Uranium Material with reported ranges of concentrations of the same constituents present in Colorado Plateau uranium ores typical of those that are accepted and processed at the Mill and/or are reported to be present in typical uranium mill tailings in the Utah region (e.g., Abdelouas 2006; Morrison 1991; Meisch 1963):
    - Barium (Ba); and
    - Beryllium (Be)

Information in Abdelouas 2006, based on data from Morrison 1991, allows the following comparison between the average chemical composition of uranium mill tailings from different locations in Utah (for acid-leached uranium ores) and the Dawn Mining Uranium Material:

Analyte	Average Concentration in Utah area uranium mill tailings	Analytical Results of Dawn WTP Solids (p. 9 of 11 of Attachment 2 of LAR)
Ba	1,010 ug/g	7,200 – 8,100 ug/g (7,733 ug/g ave.)
Be	Not Reported	33 – 36 ug/g (35 ug/g ave.)

Information in Miesch 1963 (Table 2) allows the following comparison between typical (mean) chemical compositions of uranium ore from a uranium mine deposit and mill pulp samples from over 200 mine sites on the Colorado Plateau and the DRC Mining Uranium Material:

Analyte	Average Concentration in Colorado Plateau Uranium Ores and Mill Pulp Samples	Analytical Results of Dawn WTP Solids (p. 9 of 11 of Attachment 2 of LAR)
Ba	550 - 750 ug/g	7,200 – 8,100 ug/g (7,733 ug/g ave.)
Be	~ 0.3 0- 0.4 ug/g	33 – 36 ug/g (35 ug/g ave.)

The above information suggests that concentrations of beryllium and barium in the DRC Uranium Material appear to be somewhat elevated compared to Colorado Plateau-derived ores that may have been processed at the Mill and/or present in typical uranium mill tailings in the Utah area. The same situation may occur relative to one or more other alternate feed materials previously accepted and processed at the Mill. The implications of elevated Be levels in the Uranium Material compared to ores and other alternate feed materials

previously processed at the Mill and with respect to potentially applicable and relevant personnel health criteria should be further assessed.

- b. Discuss and compare the range of concentrations of the constituents listed in Specific Comment a above in the Uranium Material to potentially applicable/relevant RCRA hazardous waste/characteristic waste limits, EPA-recommended Soil Screening Levels (SSLs), including updated recommended Risk-Based Concentration (RBC) levels (e.g., EPA 2012) for various types of soils issued by one or more EPA regional offices; relative to current, relevant “action levels” established for protecting workers from exposure to elevated levels of constituents in air, such as beryllium, etc...; and/or other criteria as may be appropriate.
  - c. Assess radiological and non-radiological impacts of releases from the facility to other media (including release through air to adjacent uncontrolled lands) attributable to concentrations in Uranium Material in excess of those previously authorized for receipt and processing at the White Mesa mill. Demonstrate that the airborne effluent monitoring program is adequately designed and implemented to ensure that acceptability of airborne releases to adjacent areas will be known and reported.
8. Discuss any additional requirements, activities, or measures that would be implemented at the White Mesa Mill either during processing the Uranium Material, or following its processing, due to potentially elevated concentrations of barium, and beryllium) compared to applicable and relevant risk or health-based criteria (e.g., ACGIH 8-hr average TLVs or other recommended action levels, as applicable) and/or compared to concentrations typically present in uranium ores processed at the Mill and/or present in Utah-area uranium mill tailings (Abdelouas 2006; Morrison 1991; Meisch 1963). For example, evaluate and discuss: (i) the potential need for additional controls to limit individual exposures to elevated beryllium, etc... levels that may be present in dust that could be released from the Dawn Uranium Material prior to, during, or following its processing; and (ii) the possible need for implementing more aggressive air sampling and/or material surface sampling criteria for elements such as beryllium.
  9. Tab 4 and Tab 5: Provide credentials and summarize the experience of the author of these Technical Memoranda to demonstrate that the author is qualified to draw the conclusions and make the recommendations contained in Tab 4, Section 6 and on Tab 5, Pages 20 and 21. Provide documentation (signature) attesting that the author has issued these memoranda.
  10. Tab 5, Sections 4.3 and 8.1 of the April 2011 DAR LAR on pages 16- 20:
    - a. Provide historical testing results to demonstrate that the stated ranges of concentrations of nitrates, chlorides, fluorides, sulfates, and ammonia have been introduced into the uranium circuit at the White Mesa Mill; and

- b. For review/documentation purposes, please provide an updated geomembrane manufacturer's product performance sheet listing chemicals and their chemical compatibility criteria for an HDPE geomembrane liner that is representative of the HDPE liners installed in Cells 4A and 4B.
11. Reference Section 4.6 and Section 8.1 of Attachment 5 to the LAR (Application by Denison Mines (USA) Corp. ('Denison') for an amendment to State of Utah Radioactive Materials License No. 1900479 for the White Mesa Mill (the "Mill") from Dawn Mining Corporation ("DMC") Midnite Mine to process an Alternate Feed Material (the "Uranium Material") dated April 27, 2011):
- a. Provide additional information, including reference citations, to justify and support the identification of an appropriate revised range of values of the distribution coefficient ( $K_d$ ) for barium for representing conditions at the White Mesa Mill Site, including the tailings environment in particular. Provide a discussion of how such a revised range of barium  $K_d$ s impacts the potential for barium to negatively affect groundwater beneath/downgradient of the tailings cells into which processed Uranium Material residuals would be placed. State and justify how the range of pH observed and expected in White Mesa tailings might affect the range of  $K_d$  values for barium for the processed Uranium Material residuals introduced into the tailings.
  - b. Provide additional information and one or more reference citation(s) to support the statement included in this section indicating that barium would be sufficiently represented by monitoring (groundwater) for calcium.
  - c. Provide additional information regarding the need to add barium as an additional monitoring parameter in the facility's groundwater monitoring plan, especially given that, under acid conditions, some (otherwise) water-insoluble barium compounds (e.g., barium sulfate) may become soluble and move into groundwater (e.g., see US EPA, 1984), and given the Groundwater Quality Standard value of 2 mg/l included in UAC R317-006.

Section 4.6 of the Request to Amend Radioactive Materials License, Denison Mines USA Corp. White Mesa Uranium Mill, San Juan County, Utah, and Environmental Report includes a statement that the distribution coefficient ( $K_d$ ) for barium is 100 to 150,000 L/kg for sandy to clayey soil types and that Denison therefore concludes that barium would be less mobile in groundwater than calcium. No reference sources are cited to support either the  $K_d$  range stated or the conclusion made regarding the relative mobility of barium compared to calcium, for conditions occurring at the White Mesa tailings Cells 4A and 4B. Kennedy et al. (1992; Table 6.7), for example, lists a  $K_d$  value of 52 mL/g for barium. EPA 2012 (Section 4.11 and Exhibit C-4 of Appendix C) provides a range of recommended  $K_d$  values for barium as a function of pH (e.g.,  $K_d = 52$  mL/g at pH = 8.0,  $K_d = 41$  mL/g at pH = 6.8, etc..., with  $K_d$  values decreasing with decreasing pH; the  $K_d$  value at pH = 4.9 is listed as 11 mL/g.) Allison 2005 referenced several citations reporting soil/water  $K_d$  values of barium all less than

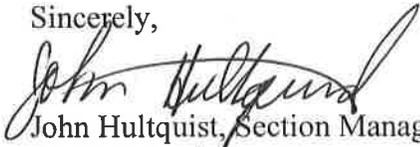
10 L/kg, and cited several risk assessment studies that used  $K_d$  values ranging from 11 to 52 L/kg. By comparison, the UDEQ Statement of Basis for the Groundwater Discharge Permit indicates assumes  $K_d$  values for calcium ranging from 5 to 100 L/kg (i.e., equal to or higher than those reported in the above references for barium).

Additionally, EFR has not provided information to describe or substantiate how the mobilization behavior for barium that may be expected to occur in the (e.g., acidic) tailings and the near-field tailings embankment environment may differ from, or be similar to, that of calcium. EPA (1984), for example, reported that barium, when present in the form of barium sulfate in soils, is not expected to be very mobile because of the formation of water-insoluble salts and its inability to form soluble complexes with humic and fulvic materials, but noted, however, that, under acid conditions, some of the water-insoluble barium compounds (e.g., barium sulfate) may become soluble and move into groundwater.

12. Filter Press Pilot Testing Report: The report should include a log of all tests and test results so that the Division can independently review and evaluate them.
13. Filter Press Pilot Testing Report: Page 3: Please discuss the relationship between the equipment used to perform the pilot tests reported in the document reviewed and that to be used in producing the filter cake that will actually be shipped to the White Mesa Uranium Mill for processing as alternate feed material. Describe differences in equipment that might affect the physical or radiological [properties of the filter cake shipped for processing. Describe measures that will be taken and documentation that will be provided to ensure that characteristics of filter cake shipped to White Mesa will not diverge in a substantive way from those reported in the pilot testing report.
14. Filter Press Pilot Testing Report: Page 4: The meaning of the phrase “extremely competent” is not clear and should be revised to eliminate ambiguity and clearly communicate the characteristics of the cake that was tested.
15. Filter Press Pilot Testing Report: Page 9, Table 3, and Laboratory Report: The contradictory results reported for Thorium-233 concentrations should be resolved (page 9 and Table 3 indicate the Th-233 concentration to be 2.7 pCi/g while the Laboratory Report (page 5 of 15) indicates 2.4 pCi/g.
16. Filter Press Pilot Testing Report: Laboratory Report, Table 3: Describe how the values of the parameter named “Solids – Calculated (Lab)” were determined. Provide calculations prepared for each value reported. Explain the significance of differences between values reported for “Solids – Calculated (Lab)” and for “Solids – Field (Avg)”.

17. Filter Press Pilot Testing Report: Laboratory Report: Please provide documentation and other evidence that identify relevant laboratory certifications held by Energy Laboratories.

Sincerely,



John Hultquist, Section Manager  
LLRW/Uranium Mill Licensing Section

JH:URS/RJ/rj

Cc: Jo Ann Tischler, Director, Compliance and Permitting

**REFERENCES:**

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- NRC 2003 U.S. NRC 2003. "Standard Review Plan (NUREG-1620) for Staff Reviews of Reclamation Plans for Mill Tailings Sites Under Title II of The Uranium Mill Tailings Radiation Control Act", NUREG-1620, June 2003