State of Utah
GARY R HERBERT
Governor

GREG BELL
Lieutenant Governor

Department of
Environmental Quality

Amanda Smith
Executive Director

DIVISION OF RADIATION CONTROL
Rusty Lundberg
Director

FILE
DEC 2012
SR

December 4, 2012

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

DRC-2012-002657

Subject. Comments from Review of "Application by Denison Mines (USA) Corp ('Denison') for an amendment to State of Utah Radioactive Materials License No 1900479 for the White Mesa Uranium mill (the 'Mill') to authorize processing of Sequoyah Fuels Corporation, Inc ('SFC') alternate feed material ('Uranium Material')" dated December 15, 2011

Dear Mr. Roberts.

The Division of Radiation Control (DRC) along with its consultant URS Corp, has reviewed the formerly Denison Mines (USA) Corp, license amendment application identified above requesting authority to process alternate feed material (Uranium Material) from Sequoyah Fuels Corporation, Inc at the White Mesa Uranium Mill The following 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

   a. 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

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

- " there will be no incremental public health, safety or environmental impacts over and above previously licensed activities" stated on Page 9 of the Amendment Request
- " there are no anticipated impacts to the environment above those already anticipated in the existing environmental statements and environmental assessments associated with the Mill's approved license " stated on Pages 9 and 13 of the Amendment Request
- " there will be no significant incremental radiological impacts associated with transportation of Uranium Material to the Mill, over and above other previously licensed ores and alternate feed materials at the Mill" stated on Page 11 of the Amendment Request
- "Existing accident response and spill response procedures are therefore sufficient for management of potential transportation accidents or spills of the Uranium Material " stated on Page 12 of the Amendment Request
- " the Uranium Material poses no additional hazards during transport above previously licensed activities" stated on Page 12 of the Amendment Request
- " the receipt and processing of Uranium Material at the Mill will not have any incremental impacts on groundwater over and above existing licensed operations" stated on Page 16 of the Amendment Request
- " there will be no incremental [surface water] impacts over and above previously licensed activities" stated on Page 17 of the Amendment Request
- "The existing air particulate monitoring program is equipped to handle all such ores and alternate feeds" stated on Page 17 of the Amendment Request
- " the Uranium Material will therefore pose a comparable or lower gamma and radon hazard as other ores and alternate feed materials that have already been processed or licensed for processing at the Mill" stated on Page 17 of the Amendment Request
- "Gamma exposure to workers will be managed in accordance with existing Mill standard operating procedures" stated on Page 18 of the Amendment Request
- "Radon exposures to workers will be managed in accordance with existing Mill standard operating procedures" stated on Page 18 of the Amendment Request.
- "The Mill can safely handle the Uranium Material in accordance with existing Mill standard operating procedures" stated on Page 18 of the Amendment Request
- "Existing monitoring programs are therefore adequate and no new monitoring procedures are required" stated on Page 19 of the Amendment Request
- " 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 19 of the Amendment Request

2 Several internal references appear, on the basis of pages presented in the amendment request, to be incorrect, either because the respective title pages are missing or the

referenced material was not submitted Such is the case with internal references to Attachment D1 Table 1, Attachment D1Cii, Attachment D1ciii, Attachment D1civ, and Attachment E4a

Please correct these internal referencing problems in the revised amendment request and submit currently missing referenced attachments (if any).

3 **SPECIFIC COMMENTS**

3a Reference Section 4.3 of the December 15, 2011 Application for Amendment to Authorize Processing of Sequoyah Fuels Corporation Alternate Feed Material (Amendment Request)

Please define the range of time over which delivered Uranium Material might remain in storage at the Mill within the SuperSaks. State how the integrity of the SuperSaks might degrade over the time in storage and the increased potential for radioactive releases with time. Estimate potential exposure of workers and the environment due to the Uranium Material storage and from potential radioactive releases from the storage area resulting from potential loss of integrity of the Supersaks.

3b. Reference Sections 4.9 and 4 10 of the December 15, 2011 Amendment Request

Please clarify the intent of the statements in Section 4.9 of the Amendment Request on gamma radiation and the discussion of radon and gamma impacts. Comment on the levels of gamma emissions expected after Th-228 has established equilibrium with Th-232.

3c. The radon discussion in Section 4.9 refers to radon-220, but the context indicates a reference to radon-222 would have been more appropriate The gamma discussion refers to Rn-226[sic], when the intent appears to have been Rn-222 The discussion of gamma emissions from the thorium decay series includes a reference to Th-238[sic] and a statement that gamma emissions from the thorium series will be low because of the disequilibrium between Th-232 and Th-228 While the statement about the disequilibrium is correct when considering mill operations and worker exposures, it is not true for longer term exposures from the tailings cell Thorium-228 will essentially come into equilibrium with Th-232 within a few decades The intent of the statements on gamma radiation emissions needs to be clarified The potential gamma emissions from the tailings cell after Th-228 has come into equilibrium with Th-232 needs to be discussed

Please provide information on expected gamma radiation and radon emission rates from the Uranium Material as delivered to the White Mesa site in its

existing form (contained in Supersaks). Demonstrate that such data support the conclusions presented in Section 4.10 that gamma radiation levels and radon levels associated with the Uranium Material are within levels associated with other ores and alternate feed materials processed in the past or which the Mill is or has been licensed to process.

3d Section 4 10 of the Amendment Request indicates that gamma-radiation and radon levels associated with the SFC Uranium Material are within levels of gamma-radiation and radon levels associated with other ores and alternate feed materials processed or licensed for processing at the Mill in the past, and that gamma and radon exposures to workers will be managed in accordance with existing Mill standard operating procedures However, data for supporting those conclusions could not be located in Denison's Amendment Request or the associated attachments Prior information on these parameters obtained by SFC at the Gore, Oklahoma facility, including projected or actual radon concentrations in the area around the dewatered raffinate sludge materials stored in Supersaks at the Sequoyah Gore facility dewatered sludge storage area is available and may fulfill this need (e g , see SFC 2004, SFC 2006, and NRC 2005)

Reference Table 1 and the laboratory analysis reports in the "Radioactive Material Profile Record, Dewatered Raffinate Sludge, February 2010" in Attachment 2 and Attachment 4

According to the Radioactive Material Profile Record submitted by Denison, Th-232 levels in the dewatered raffinate sludge (SFC Uranium Material) samples tested by Outreach Laboratory ranged from 1,060 to 4,990 pCi/g Th-232 (weighted average of 2,385 pCi/g)

Information in Abdelouas 2006, based on data from Morrison 1991, NCRP 1993 and Cardarelli undated, allows the following comparison between the average analytical results for uranium mill tailings from different locations in Utah (for acid-leached uranium ores) and the SFC Uranium Material·

Analyte	Average Concentrations in Uranium Mill Tailings or Concentration Range in Uranium Ores	Analytical Results of Dewatered Raffinate Sludge as Furnished in Attachment 2
Th-230	Avg Concentration ~ 873 pCi/g (32,300 Bq/kg) – Monticello acid pile, uranium mill tailings from acid-leached ores)	16,200 – 74,400 pCi/g
Th-232	Concentration Range ~ 0.2 to 2 2 pCi/g (8 to 80 Bq/kg) – typical uranium ores	1,060 to 4,990 pCi/g (weighted average of 2,385 pCi/g)

ELI 2005 also reported the following analytical results for two samples obtained from the SFC Uranium Material (dewatered sludge material) stored at the Gore, OK SFC facility in July 2005

Analyte	Concentrations (Results reported on dry weight basis, Received samples had ~50% moisture content))
Th-230	30,900 pCi/g and 60,500 pCi//g)
Th-232	454 pC/g and 679 pCi/g

The above information suggests that concentrations of Th-230 and Th-232 in the SFC Uranium Material appear to be elevated compared to their average level in Utah area uranium mill tailings for acid-leached ores (likely typical of those that may have been processed at the White Mesa Mill), and relative to the range of Th-232 levels found in typical uranium ores, respectively. The same situation may occur relative to one or more other alternate feed materials previously accepted and processed at the Mill The potential for higher concentrations of Th-230 and Th-232 present in dust derived from the SFC Uranium Material during processing and/or in dust from the resulting tailings to represent a pathway for radiation exposures should be further evaluated The implications of potential exposures from these higher thorium concentrations (both Th-230 and Th-232) in the SFC Uranium Material with respect to compliance with potentially applicable and relevant personnel health criteria should be further assessed

Compare the range of Th-230 and Th-232 levels (in pCi/g) that could be expected to occur in the SFC Uranium Material to the range of Th-230 concentrations and Th-232 concentrations in Colorado Plateau uranium ores typical of those that are accepted and processed at the Mill and/or that are present in typical uranium mill tailings in the Utah region (e.g., NCRP 1993; Abdelouas 2006; Morrison 1991; Meisch 1963).

Provide information on specific additional radiological protection requirements that may be implemented at the White Mesa Mill when processing the SFC Uranium Material, including but not limited to, additional protections/controls for limiting exposures to mill workers from increased radon emission and associated radon daughter inhalation exposure levels [Note: The data in Table 1, information provided in Attachment 2 furnished by Denison, and other available data indicate that the SFC Uranium Material could have considerably higher Th-230 and Th-232 levels than typical Colorado Plateau uranium ore-derived uranium mill tailings in the Utah area and typical uranium ores, respectively (e.g., Abdelouas 2006; Morrison 1991; Meisch 1963; NCRP 1993; Cardarelli undated.

3e 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 SFC Uranium Material

Analyte	Average Concentration in Utah area uranium mill tailings	Analytical Results of Dewatered Raffinate Sludge as furnished in Attachment 2
As	74 ug/g	3,030 ug/g
Pb	158 ug/g	1,010 ug/g
Ba	1,010 ug/g	4,150 ug/g
Be	Not Reported	18 7 ug/g

Information in Miesch 1963 (Tables 2 and 3) 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 SFC Uranium Material·

Analyte	Average Concentration in Colorado Plateau Uranium Ores and Mill Pulp Samples	Analytical Results of Dewatered Raffinate Sludge as furnished in Attachment 2
As	120 ug/g	3,030 ug/g
Pb	31 – 90 ug/g	1,010 ug/g
Ba	550 - 750 ug/g	4,150 ug/g
Be	~ 0 3 0- 0 4 ug/g	18 7 ug/g

Additionally, ELI 2005 also reported the following analytical results for two samples obtained from the SFC dewatered sludge material stored at the Gore, OK SFC facility in July 2005

Analyte	Concentrations (Results reported on dry weight basis, Received samples had ~50% moisture content))
As	1,370 ug/g and 1,470 ug/g

Pb	101 ug/g and 165 ug/g[1]
Ba	190 ug/g and 454 ug/g[2]
Be	2 3 ug/g and 2 9 ug/g

Additionally, a sample of the raw raffinate sludge collected from Basin 1 of Clarifier A at the Gore, Oklahoma facility in the RCRA Facility Investigation (RFI) contained 1,350 ug/g arsenic, 515 ug/g lead, 2,750 ug/g barium, and 4 12 ug/g beryllium.

The above information suggests that concentration of arsenic, beryllium, barium, and (possibly) lead in the SFC Uranium Material appear to be elevated compared to Colorado Plateau-derived ores that may have been processed at the Mill and/or present in 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 As, Be, and/or Pb 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

i. ***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 present in typical uranium mill tailings in the Utah region (e.g., Abdelouas 2006; Morrison 1991; Meisch 1963):***

- ***Arsenic;***
- ***Barium;***
- ***Beryllium; and***
- ***Lead.***

ii ***Discuss and compare the range of concentrations of the constituents listed in Specific Comment 2.c 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.***

[1] Note The reported values compare to a value of 1,010 ug/g Pb for a sample of the dewatered sludge reported in Table 1 furnished by Denison

[2] Note The reported values compare to a value of 4,150 ug/g Ba for a sample of the dewatered sludge reported in Table 1 furnished by Denison

iii. *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.*

iv. *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 arsenic, barium, beryllium, and/or possibly lead) 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 the potential need for additional controls to limit individual exposures to elevated arsenic, beryllium, lead, etc...levels that may be present in dust that could be released from the SFC Uranium Material prior to, during, or following its processing; the possible need for implementing more aggressive air sampling and/or material surface sampling criteria for elements such as beryllium and lead.*

3f Section 6 0 of Attachment 4 indicates that " . One Uranium Material sample collected during 1994 and one collected during 2003 were analyzed for RCRA TCLP constituents No analyzed contaminant exceeded its respective TCLP threshold for RCRA toxicity characteristic as defined in Table 1 of 40 CFR Part 261 24(b) " However the sample tested in 1994 using the TCLP procedures was apparently a sample of raw raffinate sludge, not the dewatered raffinate sludge (Uranium Material) contemplated for processing at White Mesa Additionally, the sample of Uranium Material tested in 2003 is not described, but appears to be sample ID MISC raff-filter press only leachate, SF03-278, which was extracted using the "7-day Distilled Water Leachate Test Procedures" in Texas Administrative Code (TAC) Chapter 335, Section 335 521 (d), rather than using the TCLP procedure Because the extract derived from the 2003 dewatered sludge sample appears to have been obtained using distilled water, the extract results cannot be directly compared to TCLP regulatory levels (see also discussion below) The implications of using these different test methods and the use of raw vs dewatered sludge sample, and the degree of relevance of each set of test results with regard to comparison of the test results to TCLP regulatory thresholds, and expected conditions at the White Mesa facility, need to be clearly stated

Section 6 3 9 of NRC 2009 indicates the following: ". To demonstrate compliance with 10 CFR Part 40, Appendix A, Criterion 6(7), SFC addressed nonradiological hazardous constituents of the byproduct material in the Draft Corrective Actions Report (CMS), dated October 27, 1997 In the CMS report, Section 2 5 and Tables 1 and 2 summarize source and soil sampling results Treatability studies, including conducting the toxicity characteristic leaching procedure (TCLP) extraction of sludges, were performed, as well as metal analyses Subsequent to the TCLP extraction, the results indicated that the raffinate sludge [is] not characteristically hazardous "

According to Table 1 in Appendix 2, the analytical results reported under the column heading "Dewatered Sludge Leachate" are the result of testing using the "7-day Distilled Water Leachate Test Procedures" included in Texas Administrative Code (TAC) Chapter 335, Section 335 521 (d) According to TAC Rule 335 507, the relevant "standard" against which test results from such testing should be compared when assessing the (in)solubility of a constituent is the applicable groundwater MCL for that constituent, as listed in Table 3 of Appendix 1 of TAC Rule 335.521 (d)

The TCLP Procedure (Method 1311) is much more widely recognized and accepted than the method (See TAC 2012) that was used (7-day Distilled Water Leachate Test Procedures, TAC, Chapter 335, Section 335.521 (d)) for classifying the (in)solubility of the dewatered raffinate sludge material based on the resulting leachate analytical results. Rationale needs to be provided to support the test method that was employed, rather than using the TCLP Procedure, since the latter procedure, for example, uses an acidic extractant that is more representative of the acidic conditions that exist in the tailings environment It therefore has not been demonstrated why the analytical data provided for the "Dewatered Sludge Leachate" (6th column of Table 1 in Attachment 2) would be considered representative of the conditions that the processed sludge material residuals would be exposed to if the dewatered sludge were to be processed at the Mill

i. ***Provide additional information regarding the selection of the test method used in extraction testing of the SFC Uranium Material instead of using the Toxicity Characteristic Leaching Procedure (TCLP) Method 1311. Discuss and qualify the comparisons between analytical results for the dewatered sludge leachate presented in Table 1 compared to applicable regulatory thresholds (e.g., EPA or Utah Drinking Water Standard MCLs vs. the TCLP Regulatory Levels that are listed in Table 1). Revise the text in Section 6.0 of Attachment 4 to correctly state the specific test methods that were used for analyzing each specific type of sludge sample tested (e.g., one TCLP test in 1994 on a raw sludge sample; Texas Administrative Code 7-day distilled water leachate test in 2003 on a dewatered sludge sample).***

ii. ***Perform TCLP testing using EPA Method 1311 for representative sample of raffinate sludge material proposed for processing at the White Mesa facility. Demonstrate that the raffinate sludge material is not hazardous waste using results of this additional TCLP testing. Submit results of this additional TCLP testing for the Division's considerations in demonstrating that the material is not hazardous waste. and in demonstrating compliance with 10 CFR40, Appendix A, Criterion 6(7) requirements relating to nonradiological hazardous constituents present in the sludge materials.***

iii. ***Provide additional information to justify the appropriateness of using the procedure in Texas Administrative Code (TAC) Chapter 335, Section 335.521 (d) for testing the Uranium Material, instead of using Method 1311, Toxicity Characteristic Leaching Procedure, referenced in 40 CFR Part 261, Appendix II, for classifying the SFC Uranium Material for potential processing at the Mill. Demonstrate that data from this testing of the SFC Uranium Material, which***

involved the use of distilled water as the extractant, would be considered relevant and representative of the (acidic) liquid conditions that exist within the tailings disposal cells at the Mill site.

iv. ***Provide additional information on appropriate regulatory threshold levels that should be listed in Table 1 and used for evaluating/comparing the analytical results as reported for the Dewatered Sludge Leachate and/or the "Dewatering Filtrate" in Table 1;***

v. ***Provide additional information on the specific analytical method and the nature of any matrix involved in the analytical testing done with regard to the "Dewatering Filtrate" results provided in Table 1.***

3g The analytical report for the "Dewatering Filtrate" (5th column of Table 1 in Attachment 2) specifies "Other" as the matrix involved in the testing. From the information provided it is unclear as to the specific testing method and/or specific characteristics of any matrix that was involved in this particular testing campaign Additional information needs to be provided regarding these testing details to allow the relevance of the resulting data to the proposed alternate feed processing request to be determined

Explain whether the holding time requirement specified in EPA SW-846 for mercury (28 days or less) having been exceeded for the analytical tests for mercury completed on the "Dewatered Sludge", "Dewatering Filtrate", and "Dewatered Sludge Leachate" (4th through 6th columns of Table 1 in Attachment 2) invalidates these mercury test results. Alternatively, provide justification for the acceptability of any of the reported mercury analytical results.

3h Footnotes in Table 1 of Attachment 2 indicate that the dewatered sludge samples were obtained in May 2003 The analytical laboratory reports for mercury for this dewatered sludge testing included in Attachment 2 also indicate that the samples were obtained on May 1, 2003, but were submitted for laboratory analysis in October 2003 and were analyzed for mercury content on 11/11/2003 This information indicates that the EPA SW-846 (Chapter 3) –specified holding time requirement for mercury analyses of 28 days or less was not met for the three mercury analytical results provided

Reference Table 4 in "Review of Chemical Contaminant in SFC Uranium Materials to Determine the Potential Presence of RCRA Characteristic or RCRA Listed Hazardous Waste, December 15, 2011 in Attachment 5 and Sections 4 5 1 and 4.10 in the December 15, 2011 Amendment Request, and Attachment 4

Please correct or provide additional discussion of Table 4 in Attachment 5 and correct errors or inconsistencies in information presented in that table. As a result of any changes made to Table 4, please revise the conclusions in Section 4.5.1 (first paragraph, last sentence) of the amendment request and Attachment 5, Section 10.0, item 4, if necessary.

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, Energy Fuels Resources, Inc , 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

> ***Please 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.***

If you have any questions please contact John Hultquist, at 801-536-4250

Sincerely,

Rusty Lundberg

Rusty Lundberg, Director
Utah Division of Radiation Control

RL/JH jh

Cc Jo Ann Tischler, Energy Fuels Resources, Inc

3i Attachment 5, Table 4 appears to have many errors or inconsistencies Column C gives the range of constituent concentrations and Column D shows the average concentration In some cases, the average concentration in Column D is outside the range given in Column C For example, the average cadmium concentration in Column D is lower than the minimum value in Column C, while the average aluminum concentration is above the maximum Column C value

The percentages in Table 4, Column I appear incorrect Footnote 8 explains that the Column I values are meant to express the Column H values as percentages, but the calculation is incorrect For example, aluminum changes from 3,154 ppm to 3,806 ppm, but the percentage change is shown as 0 065% in Column I. If changes are made to Table 4, the conclusions in Section 4 5.1 (first paragraph, last sentence) of the amendment request and Attachment 5, Section 10 0, item 4 (which state that processing the SFC Uranium Material will affect the concentrations in the tailings by no more than a fraction of one percent) need to be reassessed and revised if necessary

Reference Section 9.2 of Attachment 5 ("Review of Chemical Contaminants in SFC Uranium Material to Determine Worker Safety and Environmental Issues and Chemical Compatibility at the EnergyFuels Resources, Inc , White Mesa Mill")

i. ***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 this revised range of barium K_d's was used to assess the potential for barium to impact groundwater beneath/downgradient of the tailings cells into which processed SFC' raffinate sludge residuals would be placed.***

ii. ***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.***

iii. ***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.***

3j Section 9.2 of Attachment 5 ("Review of Chemical Contaminants in SFC Uranium Material to Determine Worker Safety and Environmental Issues and Chemical Compatibility at the Energy Fuels Resources, Inc , White Mesa Mill") 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 Energy Fuels Resources, Inc , 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

REFERENCES:

Abdelouas 2006 "Uranium Mill Tailings Geochemistry, Mineralogy, and Environmental Impact," in Elements, Vol 2, pp. 335-341 December 2006 URL http://gnews wustl edu/elements/e2_6/e2_6_art_abdelouas pdf

Allison 2005 Partition Coefficients for Metals in Surface Water, Soil, and Waste U S. Environmental Protection Agency, Office of Research and Development, Washington, DC (EPA/600/R-05/074). July 2005 URL http //www epa gov/athens/publications/reports/Ambrose600R05074PartitionCoefficients.pdf

Cardarelli undated "Attachment 1- Occupational Exposure Assessment Modeling" to NIFC (National Interagency Fire Center) Redbook, Radiation Document URL http //www nifc gov/policies/red_book/doc/RadiationDocument.pdf

ELI 2005 Energy Laboratory, Inc (ELI) July 19, 2005 Analytical Report for Two Samples of Sequoyah Fuels Corporation Dewater Raffinate Sludge Material (Note Samples tested had 50% moisture content, all analytical results were reported on a dry weight basis).

Kennedy 1992 Residual Radioactive Contamination from Decommissioning – Technical Basis for Translating Contamination Levels to Annual Total Effective Dose Equivalent Final Report, NUREG/CR-5512, PNL-7794, Vol 1 October 1992 NRC ADAMS Accession No ML05222031 Available at URL http //www nrc gov/about-nrc/regulatory/decommissioning/reg-guides-comm/guidance html

Meisch, 1963 Distribution of Elements in Colorado Plateau Uranium Deposits - A Preliminary Report U S Geological Survey Bulletin 1147-E U S Government Printing Office, Washington, D C . 1963 URL http //pubs usgs gov/bul/1147e/report pdf

Morrison 1991 "Mineralogical Residence of Alpha-Emitting Contamination and Implications for Mobilization from Uranium Mill Tailings", in Journal of Contaminant Hydrology 8 1-21

NRCP 1993 NCRP Report No 118. Radiation Protection in the Mineral Extraction Industry August 1993.

SFC 2004 Sequoyah Fuels Corporation 2004 Applicants Environmental Report for Raffinate Sludge Dewatering Project Enclosure 1 to Amendment Request for Raffinate Sludge Dewatering Project (ADAMS Website. Accession No ML0401504631), dated January 7, 2004

SFC 2006 Sequoyah Fuels Corporation 2006 Sequoyah Fuels Corporation, Docket - 40-8027 Request for Additional Information for Environmental Review of Proposed Reclamation Plan Letter to NRC dated December 8, 2006 ADAMS Website Accession No ML080180115

TAC 2012 — Texas Administrative Code (TAC) 2012 Title 30, Part 1, Chapter 335, Subchapter R, Rule §335 507, et seq

EPA 1984 — U S Environmental Protection Agency (EPA) 1984 Health Effects Assessment for Barium Prepared for the Office of Emergency and Remedial Response, US Environmental Protection Agency, Washington, DC Cincinnati, OH, US Environmental Protection Agency, Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office (EPA 540/1-86-021)

EPA 2012 — Risk-Based Concentration Table – Generic Tables, Mid-Atlantic Risk Assessment URL: http://www epa gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index htm

NRC 1992 — U S Nuclear Regulatory Commission (NRC) 1992 "Preparation of Environmental Reports for Uranium Mills," Regulatory Guide 3 8, October 1992

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

NRC 2005 — "Sequoyah Fuels Corporation – Materials License No SUB-1010- Environmental Assessment of Raffinate Sludge Dewatering Project (TAC LU0061)" January 12, 2005 NRC ADAMS Website Accession No ML050120184

NRC 2009 — Final Safety Evaluation Report for the proposed reclamation plan for the Sequoyah Fuels Corporation Site in Gore, Oklahoma, Materials License No SUB-1010, Docket No 40-8027, Sequoyah Fuels Corporation U S Nuclear Regulatory Commission, Office of Federal and State Materials and Environmental Management Programs, April 20, 2009 NRC ADAMS Website Accession No. ML090260323