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SAFETY EVALUATION REPORT

for

Amendment Request to Process an Alternate Feed Material (the SFC Uranium Material) at White Mesa Mill from Sequoyah Fuels Corporation, Gore, Oklahoma

Energy Fuels Resources (USA) Inc. (EFRI)

(formerly known as

Denison Mines [USA] Corp)

White Mesa Uranium Mill

San Juan County, Utah

In Consideration of an Amendment to

Radioactive Materials License No. UT1900479

to Authorize Receipt and Processing of the SFC Uranium Material as an Alternate Feed Material Primarily for the Recovery of Uranium and Disposal of the Resulting Residuals in the Mill's Uranium Tailings Impoundments as lle.(2) Byproduct Material

PREPARED BY:

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for

Utah Department of Environmental Quality

Division of Radiation Control

May 1, 2015

Table of Contents

List of Tables

ABBREVIATIONS AND ACRONYMS

11e.(2)	Section 11e.(2) of the Atomic Energy Act of 1954, as amended
µ	Micro
ALARA	As Low as Reasonably Achievable
avg	Average
Ba	Barium
Be	Beryllium
Bq	Becquerel
CFR	Code of Federal Regulations
Ci	Curie
DAC	Derived Air Concentration
Director	Director of Utah Radiation Control Division
DUSA	Denison Mines (USA) Corp.
EFN	Energy Fuels Nuclear, Inc.
EFRI	Energy Fuels Resources (USA) Inc.
ELI	Energy Laboratory, Inc.
EPA	U.S. Environmental Protection Agency
FES	Final Environmental Statement
FMRI	Fansteel Metal Resources, Inc.
FS	Feasibility Study
GMP	Groundwater monitoring program
gpm	Gallons per minute
g/cm^3	Grams per cubic centimeter
GWDP	Ground Water Discharge Permit
HDPE	High-density polyethylene
K_d	Distribution coefficient
Kg	Kilogram
lb/ft^3	Pounds per cubic foot
LSA	Low Specific Activity
max	Maximum
MDL	Method Detection Limit
mg/kg	Milligrams per kilogram
ml	Milliliter
mrem	Millirem

MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NEA	Nuclear Energy Agency
NIOSH	National Institute for Occupational Safety and Health
NRC	U.S. Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
pCi/g	Picocuries per gram
PEL	Permissible Exposure Limit
PPE	Personal Protective Equipment
ppm	Parts per million
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RfC	Reference concentration
RID	Reference dose
RML	Radioactive Materials License
RMPR	Radioactive Material Profile Record
RSL	Risk Screening Level
SER	Safety Evaluation Report
SFC	Sequoyah Fuels Corporation, Inc.
SOB	Statement of Basis
SSL	Soil Screening Level
Sv	Sievert
SX	Solvent Extraction
TCE	Trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TEDE	Total Effective Dose Equivalent
U-nat	Natural uranium
U	Uranium
U_3O_8	Triuranium octoxide; yellowcake
UAC	Utah Administrative Code
UCC	Union Carbide Corporation
UDRC	Utah Division of Radiation Control
UV	Ultraviolet (radiation)

1.0 INTRODUCTION

1.1 Background and Need for Proposed Action

This Safety Evaluation Report (SER) has been prepared to evaluate the environmental impacts of the proposal for the White Mesa Uranium Mill to receive and process alternate feed material from the Sequoyah Fuels Corporation, Inc. (SFC) Facility Conversion Plant located near Gore, Oklahoma (the “Gore Facility”). The alternate feed material shall hereafter (“SFC Uranium Material”). The White Mesa mill site is located in San Juan County, approximately 5 miles south of Blanding. Denison Mines (USA) Corp (DUSA), now Energy Fuels Resources (USA) Inc. (EFRI), submitted a license amendment application by letter dated December 15, 2012 to the Utah Division of Radiation Control (UDRC) to amend its State of Utah Radioactive Source Materials License No. UT1900479. The proposed amendment would allow EFRI to receive and process up to 16,700 tons gross weight (7,520 tons dry weight) of Uranium Material from the Gore Facility. The Uranium Material would have an average moisture content of approximately 45%.

The Gore Facility is being remediated and decommissioned under its Nuclear Regulatory Commission (NRC) License. The Uranium Material consists of dewatered raffinate sludges resulting from purification and conversion of natural uranium concentrates (yellowcake) at the former Gore Facility. The Uranium Material is the byproduct of the former yellowcake purification and conversion operations at the Gore Facility. The materials consist of finely graded dewatered slurry solids with no free liquid. The materials contain residual amounts of thorium, uranium, certain non-radioactive metals (arsenic, beryllium, and lead), and barium at concentrations that are higher than present in typical uranium mill tailings and typical uranium ores processed at the White Mesa Mill.

EFRI is requesting that the material be received and processed for its source material content. Byproducts from the extraction of source material will be disposed within one or both of the mill’s active double-lined tailings cells (Cells 4A and/or 4B). There is an existing groundwater detection monitoring program in place for the tailings management cell area that includes Cells 1, 2, 3, 4A, and 4B. Before the State of Utah’s Agreement State status was formalized, the NRC approved similar amendment requests in the past for separate alternate feed materials under this license.

The mill site is licensed by the Utah Department of Environmental Quality, UDRC, under State of Utah Radioactive Materials License (RML) No UT1900479 to receive and process natural uranium-bearing ores and certain specified alternate feed materials, and to possess byproduct material in the form of uranium waste tailings and other uranium byproduct waste generated by the licensee’s milling operations.

Groundwater quality at the White Mesa Mill site is also regulated by State Groundwater Permit Number UGW370004 (hereafter referred to “Permit”). After review of the proposal, the Director determined it is not necessary to modify the Permit in order to monitor and protect local ground water quality from possible effects of disposal of the proposed alternate feed material.

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1.2 Classification of the SFC Uranium Material as Alternate Feed Material

In the Final Application for Uranium Mills and Mill Tailings made by the State of Utah to the NRC Office of State and Tribal Affairs, the following commitment was made by the State of Utah:

> "The State of Utah recognizes the importance of and supports the uranium mining and milling industry. The State recognizes that to remain viable at this time, uranium mills must be able to engage in activities other than milling conventional mined uranium such as processing alternate feed materials for the recovery of uranium alone or together with other minerals."

The State of Utah also agreed to use the most recent NRC guidance (SECY 95-211, SECY-99-012, and NRC Regulatory Issue Summary 2000-23) for review and decision of receipt of alternate feed materials and that each amendment would be considered a major amendment for the purposes of licensing. These three criteria for decision making regarding the acceptance of alternate feed material are:

1. Determination of whether the feed material is an ore.

    For the tailings and wastes from the proposed processing to qualify as 11e.(2) byproduct material, the feed material must qualify as "ore." In determining whether the feed material is ore, the following definition of ore will be used: Ore is a natural or native matter that may be mined and treated for the extraction of any of its constituents or any other matter from which source material is extracted in a licensed uranium or thorium mill.

    The production method used at the Gore Facility involved: (1) feed preparation, (2) dissolution of the ore concentrate (yellowcake) in nitric acid, (3) purification of the uranium solution by solvent extraction, (4) thermal denitration of the uranyl nitrate to prepare uranium trioxide, (5) hydrogen reduction of the uranium trioxide to uranium dioxide, (6) conversion of the uranium dioxide to uranium tetrafluoride by reaction with anhydrous hydrogen. The SFC raffinate material was produced as a result of step (3) in what has been considered by Nuclear Regulatory Commission (NRC) to be the "front end" of the process, including the purification of the uranium solution by solvent extraction. The NRC declared this "front end waste" to be 11e.(2) byproduct material (See SECY-02-0095, July 25, 2002). See URL: http://www.nrc.gov/reading-rm/doccollections/commission/secys/2002/secy2002-0095/2002-0095scy.pdf#pagemode=bookmarks. Based on the above considerations, the UDRC has determined that the SFC Uranium Material meets this criterion.

2. Determination of whether the feed material contains hazardous waste.

    If the proposed feed material contains hazardous wastes, listed under subpart D Sections 261.30-33 of 40 CFR (or comparable Resource Conservation and Recovery Act (RCRA) authorized State regulations), it would be subject to the U.S. Environmental Protection Agency (EPA) or State regulation under RCRA. If the licensee can show that the proposed feed material does not contain a listed hazardous waste, this issue is resolved.

    Feed material exhibiting only a characteristic of hazardous waste (ignitable, corrosive, reactive, toxic) would not be regulated as hazardous waste and could therefore be *approved for recycling and extraction of source material. However, this does not apply to residues from water treatment, so determination that such residues are not subject to regulation under RCRA will depend on their not containing any characteristic hazardous waste. Staff may consult with EPA (or the State) before making a determination of whether the feed material contains hazardous waste.*

If the feed material contains hazardous waste, the licensee can process it only if it obtains EPA (or State) approval and provides the necessary documentation to that effect. Additionally, for feed material containing hazardous waste, the staff will review documentation from the licensee that provides a commitment from the U.S. Department of Energy or the State to take title to the tailings impoundment after closure.

The NRC (2002) classified the SFC Uranium Material as 11e.(2) byproduct material. Under 40 CFR 261.4(b)(7), solid wastes from the extraction, beneficiation, and processing of ores and minerals are not hazardous wastes. Even if this were not the case, information provided in the SFC Uranium Material alternate feed material license amendment request indicates that the SFC Uranium Material contains no known listed wastes under subpart D Sections 261.30-33 of 40 CFR. Therefore, this condition is satisfied.

3. Determination of whether the ore is being processed primarily for its source-material content.

   For the tailings and waste from the proposed processing to qualify as 11e.(2) byproduct material, the ore must be processed primarily for its source-material content. If the only product produced in the processing of the alternate feed is uranium product, this determination is satisfied. If, in addition to uranium product, another material is also produced in the processing of the ore, the licensee must provide documentation showing that the uranium product is the primary product produced.

   The SFC Uranium Material alternate feed material license amendment request and associated documents indicate that the SFC Uranium Material would only be milled for its uranium content. This condition is therefore satisfied.

Currently, EFRI has received UDRC approval of a total of two license amendments authorizing the mill to receive and process alternate feed materials from: (1) the Fansteel Metal Resources, Inc. (FMRI) site in Muskogee, Oklahoma, described in RML License Condition 10.19, and (2) a Dawn Mining Company facility in Washington State, described in RML License Condition 10.20, signed into effect in July 2014.

1.3 Uranium Material Generation Process Description

The SFC Uranium Material consists of filter press-dewatered raffinate sludge. The raffinate sludge was generated as a result of past processing (conversion and purification) of uranium ore concentrates at the Gore Facility, Oklahoma. The facility was formerly operated as a uranium conversion facility but has not operated since 1993. The chemical conversion process used at the Gore Facility converted uranium ore concentrates to uranium hexafluoride. The process included two primary purification steps: digestion followed by solvent extraction. Digestion occurred by dissolving the uranium in *nitric acid*. The resulting slurry was subjected to solvent extraction using *tributyl phosphate diluted with n-hexane*. Process conditions were controlled to extract uranium into the organic phase. The milling impurities remained in the aqueous phase, a dilute nitric acid mixture (raffinate).

The aqueous raffinate stream consisted primarily of a solution of nitric acid, metallic salts, and residual quantities of uranium and radioactive transformation products of natural uranium, primarily Th-230 and Ra-226. The raffinate sludge contains various metals in addition to uranium, thorium, and radium. The aqueous raffinate stream was combined with spent sodium hydroxide from nitrous oxide scrubber systems and waste sodium carbonate solutions. The untreated raffinate stream from solvent extraction was pumped to an impoundment and allowed to cool. Anhydrous ammonia was added to the raffinate solution to convert the dilute nitric acid to ammonium nitrate. The addition of the anhydrous ammonia also increased the pH of the raffinate solution causing the metallic salts and trace quantities of uranium, thorium, and radium to precipitate and settle out in the impoundments as raffinate sludge. Ammonia was also added at controlled rates sufficient to react and convert the dilute nitric acid to a marketable ammonium nitrate fertilizer product.

The treated raffinate solution was decanted to another impoundment for further treatment with barium chloride to remove trace levels of radium through co-precipitation. This precipitate was periodically combined with the raffinate sludge in the other impoundments.

The raffinate sludge (approximately 1,000,000 cubic feet) was accumulated and stored in several lined impoundments on site, including Clarifier A basins and Pond 4. No other materials were combined with the stored sludge. The raffinate sludge was eventually consolidated to Clarifier A basins between 1993 and 1995 to support decommissioning Pond 4 and subsequent dewatering of the raffinate sludge. This sludge was dewatered using a pressurized filter plate press system and is now being stored (NRC 2009) in polypropylene bags (“SuperSaks”), each approximately 3 feet by 3 feet by 4 feet high, with a 2,200-pound capacity, on the South Yellowcake Pad at the Gore Facility.

SFC submitted decommissioning plans to the NRC for the site in 1998 and 1999 in accordance with subpart E of 10 CFR 20 (the license termination rule). In July 2002, the Commission determined that most of the waste material at the site, including the raw raffinate sludge material, could be classified as 11e.(2) byproduct material. 11e.(2) byproduct material is material that meets the definition in section 11e.(2) of the Atomic Energy Act of 1954, as amended. It is “tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.”

1.4 Characterization of the SFC Uranium Material

Raffinate sludge materials at the Gore, Oklahoma Facility and samples of the uranium material (from bulk samples of the SFC Uranium Material now contained in the SuperSak bags stored at the facility) have been analyzed for radiological and non-radiological constituents. Results of these analyses are presented in this section, in roughly chronological order.

A single sample of raffinate sludge was collected from Basin 1 of Clarifier A in January 1995 to determine the concentration of volatile and semi-volatile organic compounds. The analytical results of this sample are that are greater than respective method detection limit are presented in Table 1. The results presented in Table 1 are for sludge that had not yet been subjected to dewatering.

Table 1. Analytical Results of Raw Raffinate Sludge for Mercury and Organic Compounds[a]

Parameter	Value	Remarks
Mercury (total)[b]	0.34 mg/kg	Practical quantitation limit 0.01 mg/kg
VOCs [c]	2-Butanone, 0.3 mg/kg 2-Hexanone, 0.08 mg/kg	Practical quantitation limit 0.1 mg/kg Practical quantitation limit 0.05 mg/kg
SVOCs [d]	None	NA

[a] Sample ID SDO14, January 1995 CoC E-0131-95] –- sample was tested prior to sludge dewatering.

[b] EPA SW7471

[c] Volatile Organic Compounds by EPA SW8240

[d] Semi-Volatile Organic Compounds by EPA SW8270

NA -= Not applicable

Raffinate sludge samples were collected in May 2003 from Basin 1 of Clarifier A for the purpose of testing feasibility of dewatering the raffinate sludge using a pressurized plate filter press. After dewatering by the filter press, three samples were developed and analyzed for metals and radionuclides. The three samples included the dewatered sludge, the water expelled from the sludge as a result of dewatering (filtrate), and a leachate derived from the dewatered sludge. The analytical results of these samples are presented in the second column of Table 2 as *Dewatered Sludge: May 2003- Total Metals, and in as Dewatering Filtrate*, respectively.

A sample of the SFC Uranium Material collected in December 2012 was submitted for total metals analysis for eight RCRA metals (EFRI 2013a, p. 37). A Toxicity Characteristic Leaching Procedure (TCLP) Method 1311 leachate test of the dewatered raffinate sludge was also performed in December 2012 (EFRI 2013a, p. 36). The analytical suite of metals tested is based on 40 CFR 261.24 Table 1, Maximum Concentration of Contaminants for the Toxicity Characteristic. Results of the analyses are presented in Table 1 of Attachment 2 of EFRI 2013b. The analytical results of these samples are presented in the third and fourth columns of Table 2 as *Dewatered Raffinate Sludge*, and *Dewatered Sludge TCLP Leachate*, respectively.

Of the eight metals analyzed, three were detected at a concentration above the Method Detection Limit (MDL). The three metals detections are orders of magnitude below the TCLP regulatory limit. Because the detections are significantly below the TCLP regulatory limit, there is no effect on the 10 CFR 40, Appendix A, Criterion 6(7) requirements relating to non-radiological constituents present in the dewatered raffinate sludge. With respect to metals, the SFC Uranium Material is physically and chemically comparable to previously-approved alternate feed materials that the Mill has processed (EFRI 2013a, p.35; EFRI 2013b, Section 4.5).

Table 2. Analytical Results of Dewatered Raffinate Sludge and Related TCLP Leachate (Liquid Extract) Samples

Parameter[a]		Dewatered Sludge[b] May 2003 – Total Metals	Dewatered Raffinate Sludge December 2012 – Total Metals[c]	Dewatered Sludge TCLP Leachate[c] December 2012[c]	Utah MCL[d]	TCLP Regulatory Level[e]
Ag		<90.8 mg/kg	<1.00 mg/kg	0.238 mg/L	0.1 mg/L	5 mg/L
Al		160000 mg/kg	NA	NA		- -
As		3030 mg/kg	1280 mg/kg	0.097 mg/L	0.05 mg/L	5 mgL/
Ba		4150 mg/kg	1530 mg/kg	<0.098 mg/L	2 mg/L	100 mg/L
Be		18.7 mg/kg	NA	NA	0.004 mg/L	--
Bo		NA	NA	NA	0.6 mg/L	
Ca		114000 mg/kg	NA	NA		--
Cd		<267 mg/kg	1.03 mg/kg	<0.100 mg/L	0.005 mg/L	1 mg/L
Co		133 mg/kg	NA	NA	0.73 mg/L	--
Cr		605 mg/kg	251 mg/kg	0.202 mg/L	0.1 mg/L	5 mg/L
Cu		2360 mg/kg	NA	NA	1.3 mg/L	--
Fe		164000 mg/kg	NA	NA	11 mg/L	--
Hg		*	1.76 mg/kg	0.00003 mg/L	0.002 mg/L	--
K		7740 mg/kg	NA	NA		--
Li		<2.67 mg/kg	NA	NA	0.73 mg/L	--
Mg		7190 mg/kg	NA	NA		--
Mn		1930 mg/kg	NA	NA	0.8 mg/L	--
Mo		10700 mg/kg	NA	NA	0.04 mg/L	--
Na		7480 mg/kg	NA	NA		--
Ni		1660 mg/kg	NA	NA	0.1 mg/L	--
P		19600 mg/kg	NA	NA		--
Pb		1010 mg/kg	361 mg/kg	<0.100 mg/L	0.015 mg/L	5 mg/L
Sb		78.4 mg/kg	NA	NA	0.006 mg/L	--
Se		348 mg/kg	97.9 mg/kg	<0.140 mg/L	0.05 mg/L	1 mg/L
Sn		NA	NA	NA	17 mg/L	
Sr		1210 mg/kg	NA	NA	4 mg/L	--

Table 2. Analytical Results of Dewatered Raffinate Sludge and Related TCLP Leachate (Liquid Extract) Samples

Parameter[a]		Dewatered Sludge[b] May 2003 – Total Metals	Dewatered Raffinate Sludge December 2012 – Total Metals[c]	Dewatered Sludge TCLP Leachate[c] December 2012[c]	Utah MCL[d]	TCLP Regulatory Level[e]
Tl		5860 mg/kg	NA	NA	0.002 mg/L	--
Ti		NA	NA	NA	150 mg/L	
V		<751 mg/kg	NA	NA	0.06 mg/L	--
Zn		<751 mg/kg	NA	NA	5 mg/L	--
F		NA	44100 mg/kg	NA	4 mg/L	--
NO_3(N)		NA	4580 mg/kg	NA	10 mg/L	--
NH_3(N)		NA	5210 mg/kg	NA	25 mg/L	--
U-total		19400 pCi/g	NA	NA	0.03 mg/L	--
Th-230		16200 pCi/g	NA	NA	18 mg/L	--
Th-232		NA	NA	NA	16 mg/L	
Ra-226		219 pCi/g	NA	NA	5 mg/L (combined Ra-226 plus Ra-228	--
Ra-228		NA	NA	NA	5 mg/L (combined Ra-226 plus Ra-228	

[a] Metals by EPA Method 6010

[b] Sample ID MISC raff-filter press only, May 2003 [CoC SF03-278]

[c] Sample ID SD-282, December 2012 – reported on a dry-weight basis

[d] Utah Maximum Contaminant Level (MCL) for Drinking Water (provided for general information purposes) .

e Toxicity Characteristic Leaching Procedure Threshold Level, based on 40 CFR 261.24, Table 1 - Maximum Concentration of Contaminants for the Toxicity Characteristic

* Data from this analysis will not be considered due to exceedance of the EPA holding time. Data from the Total Metals analysis conducted in December 2012 will be used for assessment purposes.

NA -= Not analyzed

Analytical results of SFC Uranium Material submitted to the UDRC in 2011 (comprised of analytical results of previous testing of the material conducted by SFC) for uranium (total) and thorium isotopes are summarized in Table 3 below.

Table 3. Analytical Results of Testing of SFC Uranium Material by SFC (Bulk Sample Collected on May 2003 and Composite Samples Collected on November 14, 2005)

Analyte	Concentrations (Results reported on *dry* weight basis)
Uranium (Total)	7,080 -19,400 µg/g
Th-228 (dry-weight basis)	449 -1,110 pCi/g
Th-230 (dry-weight basis)	16,200 -74,400 pCi/g
Th-232 (dry-weight basis)	1,060 – 4,990 pCi/g

Energy Laboratory, Inc. (ELI), in support of a previous initiative involving this dewatered sludge material, independently analyzed two samples of the Uranium Material in July 2005 (ELI 2005). The samples tested had an average moisture content of approximately 50%; whereas the analytical results reported by ELI for this testing were provided on a *dry* weight basis). Analytical results of those samples for uranium (total) and thorium isotopes are summarized in Table 4 below.

Table 4. Analytical Results of Two Samples of SFC Uranium Material Collected on July 19, 2005 (ELI 2005)

Analyte	Concentrations (Results reported on *dry* weight basis)
Uranium (Total)	7,120 µg/g and 7,350 µg/g
Th-228 ("Digested, dry")[1]	256 pCi/g and 391 pCi/g)
Th-230 ("Digested, dry") [1]	30,900 pCi/g and 60,500 pCi/g)
Th-232 ("Total, dry")	3,380 pCi/g and 4,540 pCi/g)
Th-232 ("Digested, dry") [1]	454 pCi/g and 679 pCi/g)

[1] No details were provided regarding processes that were used as part of the laboratory analyses performed for the samples corresponding to the "digested, dry" analytical results.

The NRC (2005), based on measurements obtained by SFC during the test phase of the raffinate sludge dewatering project, estimated the average concentrations of natural uranium and Thorium-230 in the dewatered raffinate sludge (Uranium Material) at 19,400 µg/g, and 16,200 pCi/g, respectively. They further estimated (NRC 2008) that the dewatered raffinate sludge (the SFC Uranium Material) contains approximately 43,200 kilogram (kg) (95,232 lb) of natural uranium.

Section 4.1 of this SER provides additional characterization information (e.g., radioactive isotopic levels) for the SFC Uranium Material. That section also compares the SFC Uranium Material to typical Colorado Plateau-derived uranium ores, Arizona strip uranium ores, and other alternate feed materials previously proposed and/or previously processed at the Mill.

Review Scope: Environmental Analysis

In accordance with UAC R313-22-38 and R313-24-3, this SER has been prepared to:

1. Assess the radiological and non-radiological impacts to the public health.
2. Assess any impact on waterways and groundwater.
3. Consider alternatives, including alternative sites and engineering methods.
4. Consider long-term impacts including decommissioning, decontamination, and reclamation impacts.
5. Present information and analysis for supporting UDRC findings and conclusions with respect to approval of the proposed license amendment.

In addition to the above criteria, the UDRC's evaluation included consideration of the following additional items:

- Evaluating the ability of current mill operational and radiological protection practices to safely accommodate the temporary storage, and processing of the SFC Uranium Material alternative feed material, and disposal of the process residuals in the designated tailings cells without increasing potential impacts to the environment, and/or increasing potential exposure to workers or the public; and
- Assessing the need for, and adequacy of proposed additional protective measures to be implemented to mitigate against such potential increased environmental impacts or exposures.

2.0 CHARACTERISTICS OF THE WHITE MESA MILL SITE AND VICINITY

The climate at and surrounding the White Mesa facility is characterized as semi-arid with an annual average precipitation of approximately 12 inches and a mean annual temperature of about 50° F. Runoff in the project area is directed by the general surface topography either westward into Westwater Canyon, eastward into Corral Creek, or to the south into an unnamed branch of Cottonwood Wash. The San Juan River, a major tributary to the Colorado River, is located approximately 18 miles south of the site.

The population density of San Juan County is approximately 1.7 persons per square mile. The Town of Blanding is the largest population center near the facility with a population of 3,600. Approximately 3.5 miles southeast of the site is the White Mesa Reservation, a community of approximately 350 Ute Mountain Ute Indians. The nearest resident to the mill is located approximately 1.4 miles to the northeast of the mill, which is in the prevailing wind direction from the Mill site (DUSA 2008).

Approximately 60% of San Juan County is federally-owned land administered by the U.S. Bureau of Land Management, the U.S. National Park Service, and the U.S. Forest Service. Primary land uses include livestock grazing, wildlife range, recreation, and exploration for minerals, oil, and gas. A quarter of the county is Native American land owned by either the Navajo Nation or the Ute Mountain Ute Tribe. The land within 5 miles of the site is predominantly owned by residents of Blanding. EFRI owns or has claims or leases on approximately 5,500 contiguous acres, of which the White Mesa mill site encompasses approximately 500 acres.

Groundwater beneath the site mainly occurs in two aquifers: a shallow unconfined aquifer hosted by the Dakota Sandstone and the Burro Canyon formations; and the deep confined aquifer in the Entrada/Navajo Sandstone. Near the tailings cells the shallow aquifer is found at a depth of about 80 to 100 feet below ground surface and consists of groundwater perched over the Brushy Basin Member of the Morrison formation. The deep Entrada/Navajo Sandstones form one of the most permeable aquifers in the region. It is found at a depth of over 1,000 feet below ground and is separated from the shallow aquifer by hundreds of feet of low permeability shales and mudstones (e.g., Brushy Basin and Recapture Members of the Morrison Formation, the Summerville Formation, etc.). Recharge to the aquifers occurs by infiltration along the flanks of the Abajo, Henry, and La Sal Mountains, and along the flanks of the structural folds in the terrain.

Groundwater in the shallow perched water-bearing zone (Dakota Sandstone and Burro Canyon Formation) is monitored by EFRI l in the groundwater detection monitoring program. Water in this zone generally flows southward to southwestward.

Approximately 95 groundwater applications for wells located within a 5 mile radius of the site are on file with the Utah State Engineer’s Office. The majority of applications are by private individuals and for wells drawing small, intermittent quantities of water (flow rates less than 8 gpm) from the Burro Canyon formation. For the most part, these wells are located upgradient (north) of the facility. Stockwatering and irrigation are listed as the primary uses. Two deep water supply wells are completed in the Entrada/Navajo Sandstone located approximately 4.5 miles southeast of the site on the Ute Mountain Ute Tribe Reservation. The well casings for these deep water supply wells are perforated at a depth of approximately 1,200 feet below the ground surface.

3.0 MILL OPERATIONS

The White Mesa uranium mill was built in the late 1970s by Energy Fuels Nuclear, Inc. (EFN) as an outlet for the many small mines that are located in the Colorado Plateau. After about two and one-half years, the mill ceased ore processing and entered a total shutdown phase. In 1984, a majority ownership interest was acquired by Union Carbide Corporation's (UCC) Metals Division, which later became Umetco Minerals Corporation (UMETCO), a wholly-owned subsidiary of UCC. The partnership between UMETCO and EFN continued until May 26, 1994, when EFN reassumed complete ownership of the mill. In May of 1997, IUSA purchased the assets of EFN and operated the facility until December 2006. Denison Mines (USA) Corp. operated the facility between December 2006 and August 2012, when EFRI took ownership of the Mill. The mill has gone through several operational and shut down periods from 1980 to date.

EFRI currently operates the Mill. Current License Condition 10.1 specifies a maximum yellowcake production rate of 4,380 tons of yellowcake per year. License Condition 10.1.D. limits the quantities of feed material stored at the White Mesa site, including alternate feed materials or other ores, to the total material storage quantity found in the currently approved mill surety pursuant to License Condition 9.5, unless prior approval for additional storage is first obtained from the Director of the UDRC. The maximum mill throughput is limited in part by annual freeboard limits established for the tailings disposal cells. Freeboard calculations are required to be submitted to the UDRC annually, in accordance with License Condition 10.3.

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4.0 ASSESSMENT OF POTENTIAL ENVIRONMENTAL EFFECTS

4.1 Radiological and Non-Radiological Impacts

4.1.1 Radiological Impacts

According to the December 2011 License Amendment Request submittal, EFRI's August 2013 (Revised) License Amendment Request (EFRI 2013b) and other available analytical data, the following radionuclides are known to exist in the SFC Uranium Material alternate feed material: Th-230, Ra-226, Th-232, Ra-228, Th-228, Ra-224, U-234, U-235, and U-238. Reported ranges of concentrations of radionuclides detected in samples of the (dewatered) SFC Uranium Material are shown in Table 5 and Table 6 below. The radionuclides present in the SFC Uranium Material are associated with the uranium decay series and natural thorium decay series.

Table 5. Minimum and Maximum Radionuclide Concentrations in SFC Uranium Material (Based on Samples Collected by SFC in May 2003 and November 2005 and in July 2005 [ELI Analyses])

Result (dry weight basis)	Uranium-Total (µg/g)[1]	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)	Ra-228 (pCi/g)	Ra-226 (pCi/g)
Min	7,080	3,290	5.3	170	256	16,200	1,060	8.7	135
Max	19,400	4,020	29	580	391	74,400	4,990	22.2	367

NA = Not Analyzed or Not Applicable

Table 6. Radionuclide Analytical Results for Composite of Grab Samples of SFC Dewatered Raffinate Sludge Material (Samples Collected by SFC on 11/14/2005)

Result (dry weight basis)	Gross Alpha	Gross Beta	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	U-natural (pCi/g)	Th-228 (pCi/g)	Th-230 (pCi/g)	Th-232 (pCi/g)	Ra-228 (pCi/g)	Ra-226 (pCi/g)
Min	NA	NA	NA	NA	NA	4,793	449	43,900	1,060	NA	135
Max	NA	NA	NA	NA	NA	7,041	1,110	74,400	4,990	NA	367
Weighted Ave.	NA	NA	NA	NA	NA	5,777	699	55,685	2,385	NA	236

NA = Not Analyzed or Not Applicable

The data indicate that the SFC Uranium Material has higher average concentrations of uranium, Th-230 and Th-232 (and its radioactive decay daughter products) than do typical (e.g., Colorado Plateau-derived) uranium ores previously processed at the Mill (see Table 7 below). With respect to its uranium content, the SFC Uranium Material is radiologically similar to Arizona Strip uranium ores that are licensed for processing at the Mill (Table 7). The range of Th-232 concentrations detected in samples of the SFC Uranium Material falls within the range of other alternate feeds that have been previously approved for processing at the Mill (Table 8 below).

On the other hand, available data indicate that Ra-226 levels in the SRC Uranium Material are lower than in typical uranium ores and associated mill tailings (e.g., Colorado Plateau-derived, Utah area acid-leach ore-derived uranium mill tailings).

The higher Th-230 and Th-232 concentrations present in the SFC Uranium indicate that this material has an incrementally higher radiological risk than do typical Colorado Plateau-derived ores and associated mill tailings (e.g., see NRC 2002a, Attachment 9, p. 5).

Table 7. Concentrations of Uranium, Th-230, and Th-232, and Ra-226 in SFC Uranium Material vs. Typical Uranium Ores

Radionuclide	SFC Uranium Material[1]	Typical Sandstone-Hosted Uranium Ores (e.g., Colorado Plateau Ores)	Arizona Strip Breccia Pipe Uranium Ores
Th-230	30,900 – 74,400 pCi/g (dry weight basis)	875 pCi/g [2]	--
Th-232	1,060 to 4,990 pCi/g (0.106% – 0.499%) (dry weight %)	~ 0.2 to 2.2 pCi/g [3] (~0.002% to 0.002%)[3]	--
Uranium (Total)	7,080 -19,400 µg/g	531 µg/g [2]	--
% U_3O_8	0.8% – 1.2% (dry weight %)	0.15% to 0.30%[4]	0.40% to > 1%[4]
Ra-226	80 – 367 pCi/g (dry weight basis)	710 pCi/g [2]	1,838 pCi/g [4]

[1] Based on information provided by DUSA in its December 15, 2011 License Amendment Request, including composite samples of the same material analyzed by Outreach Laboratory, OK on March 7, 2006, and analysis of two samples of the SFC dewatered sludge material by ELI Laboratory in July 2005.

[2] Data from Abdelouas 2006

[3] Based on NCRP Report 188 (1993) and Cardarelli 1999

[4] Mined ores range from 0.1% to higher than 1% U_3O_8. Some Arizona strip ores have ranged as high as 2% U_3O_8 (1.7% U-nat). Concentration ranges for Ra-228, Th-228, Ra-224, and Ra-220 in uranium ores are assumed to be approximately equivalent to the range of Th-232 concentrations (assumes approximate secular equilibrium in ores). Ra-226 determined assuming an average ore grade of 0.65% U_3O_8.

Table 8 compares the ranges of concentrations of radionuclides present in the SFC Uranium Material to concentrations of radionuclides present in other alternate feed materials previously approved for processing and/or that were processed at the White Mesa Mill. The range of concentrations of, and the weighted average concentration of Th-230 in the SFC Uranium Material are higher than in other alternate feed materials previously approved for processing at the Mill with the exception of the Nevada Test Site Cotter Concentrate processed at the Mill for its uranium content between September 1997 and January 1998 (approximately 400 tons of material processed). The range of concentrations of, and the weighted average concentration of, Th-232 in the SFC Uranium Material exceed concentrations of Th-232 detected in other alternate feed materials previously considered for processing at the Mill with the exception of the W.R. Grace alternate feed materials (Table 8).

Table 8. Comparison of Radionuclide Activity Concentrations in SFC Uranium Material and Previously Approved Alternate Feed Materials

Radionuclide	Range of Radionuclide Activity Concentration in SFC Uranium Material[1] (pCi/g dry)[2]	Range of activity Concentrations in Previously Approved Alternate Feed 3,4 (pCi/g dry)[2]	Source for Alternate Feed Information
Ra-226	135 to 367 Weighted avg. 236	138 to 400; 0 to 10,200 max. (weighted avg. 2,000)	Fansteel Application 2005; W.R. Grace Application April 2000
Ra-228	8.7 to 22.2	94 to 680; 0 to 10,400 (weighted avg. 8,000)	Fansteel Application 2005; W.R. Grace Application April 2000
Th-228	449 to 1,110 Weighted avg. 699	94 to 680; 170 to 186; 2,000 avg; 3,222 max.	Fansteel Application 2005; Heritage RMPR 2000; W.R. Grace Application April 2000
Th-230[4]	43,900 to 74,400 Weighted avg. 55,685	2 to 1,200	Molycorp Application 2000; Fansteel Application 2005; Heritage RMPR 2000
		2,000 avg.; 10,400 max.	W.R. Grace Application April 2000
		75.5 mg/kg (1,555,000 pCi/g) avg., 143 mg/kg (2,330,000 pCi/g) max.[5]	Nevada Test Site Cotter Concentrate Application March 1997
Th-232	1,060 to 4,990 Weighted avg. 2,385	6 to 135	Molycorp Application 2000
		1,190 avg [6]	Heritage RMPR 2000 [6]
		Non-detectable to 3,800 (970 average); 94 to 680	Maywood Application 2002; Fansteel Application 2005
		Weighted avg. 8,000; 31,500 max.	W.R. Grace Application April 2000
U-nat	7,080 to 10,100 mg/kg	500 mg/kg (average)	Heritage RMPR 2000
		7,400 mg/kg avg.	W.R. Grace Application April 2000
		686,000 mg/kg U-nat max[7]	Nevada Test Site Cotter Concentrate Application 1997
		75.5 mg/kg (1,555,000 pCi/g ave.; 143 mg.kg	Mill lab monthly assays Cameco UF_4

Table 8. Comparison of Radionuclide Activity Concentrations in SFC Uranium Material and Previously Approved Alternate Feed Materials

Radionuclide	Range of Radionuclide Activity Concentration in SFC Uranium Material[1] (pCi/g dry)[2]	Range of activity Concentrations in Previously Approved Alternate Feed 3,4 (pCi/g dry)[2]	Source for Alternate Feed Information
		(2,330,000 pCi/g max.)	

[1] Attachment 2 of the December 2011 License Amendment Request (Radioactive Material Profile Record, and associated tables); ELI July 2005 analytical data; and the August 2013 Revised License Amendment Request.

[2] Units are pCi/g unless otherwise noted.

[3] Selected concentrations for constituents found in characterization data for other alternate feed materials licensed for processing at the Mill, for comparison purposes only.

[4] Th-230 is not a significant contributor to gamma emissions, but is included because it is considered in the generation of Derived Air Concentrations (DACs) for each ore or alternate feed material.

[5] Based on Th-230 conversion of 20,600 pCi/g per mg/kg.

[6] Heritage alternate feed material was stored on the ore pad in bulk and managed under a high thorium SOP

[7] Monthly average grade assays of Cameco UF_4 have periodically been as high as 80.7% U_3O_8 (68.6% U).

The SFC Uranium Material may be approximately 20 years old or older. Therefore, the concentration of Th-228 (half-life of 1.91 yrs) should currently be near to equilibrium (i.e., calculated to be approximately 90% of the Th-232 concentration) with Th-232. However, the radionuc1ide concentrations reported in the available data show that Th-228 is not equilibrium with Th-232, as the weighted average Th-228 concentration is a factor of 3.4 lower than Th-232. Uncertainties associated with laboratory-reported values of the isotopic abundances might be a contributing factor for the differences in isotopic compositions. Such differences notwithstanding, the average Th-228 and Th-232 concentrations in the SFC Uranium Material are within one order of magnitude of each other (Table 8).

4.1.1.1 Gamma and Radon Emissions

Ra-226 concentrations in the SFC Uranium Material are in disequilibrium and much lower than typical low-grade Colorado Plateau-derived uranium ores. The weighted average concentration of Ra-226 in the SFC Uranium Material is reported to be 236 pCi/g. For comparison, the Ra-226 concentration from typical Colorado Plateau ores (assuming an average of 0.25% U_30_8) is 707 pCi/g. The average Ra-226 concentration in typicalArizona Strip ore (assumed average 0.65% U_30_8) is 1,838 pCi/g). Given the lower average Ra-226 concentrations in the SFC Uranium Material than in uranium ores typically processed at the mill (Table 7), Rn-222 emissions (from the uranium decay series) in the SFC Uranium Material are expected to be lower than those for the uranium ores processed at the mill.

Gamma radiation fields arising from the U-nat radionuclide decay chain associated with the SFC Uranium Material are derived primarily from decay of Ra-226. Therefore, the gamma derived from the U-nat chain is expected to be lower than for typical uranium ores processed at the mill. The lower gamma field emanating from the U-nat chain decay in the SFC Uranium Material will be offset to a degree by higher gamma fields derived from the Th-232 chain decay associated with the SFC Uranium Material. However, this gamma radiation is derived primarily from the

Th-228 in the SFC Uranium Material (1.91 yr half-life), which is currently present in relatively lower concentrations in the SFC Uranium Material compared to its parent Th-232 (Table 8). Calculations (described in the following paragraphs) indicate that the combined gamma radiation derived from the uranium and thorium decay series in the SFC Uranium Material is expected to be less than twice the gamma radiation emitted from Arizona Strip uranium ores typically processed at the Mill. .

The half-life of the longest lived radionuclide in the Th-232 decay chain is 5.8 years (Ra- 228). Thus, the Th-232 series, and specifically Th-228 (average concentration of approximately 699 pCi/g), would be expected to come (close to) equilibrium with Th-232 (average concentration of approximately 2,385 pCi/g) within a few decades. Considering several gamma emitters in the Th-232 decay chain below Th-228, the gamma radiation dose from the Th-232 decay chain would be projected to increase when Th-228 grows toward equilibrium with its parent Th-232. Assuming the weighted average concentration of Th-232 of 2,385 pCi/g, the gamma radiation dose from the Th-232 decay series when Th-228 will have grown into equilibrium is estimated at approximately 37 micro Sieverts per hour [µSv/hr] (3.7 millirems per hour [mR/hr]) on the surface of a large uncovered area of the SFC Uranium Material. Based on this analysis, these dose rates could be expected to increase to approximately 3.7 mR/hr adjacent to a large source, i.e. a large number of SuperSaks, over a few decades.

The gamma radiation field from decay of Ra-226 in the SFC Uranium Material (using weighted average concentration of Ra-226 (236 pCi/g) is approximately 3 µSv/hr (0.3 mrem/hr). The gamma radiation dose from the Th-232 decay series in equilibrium in the SFC Uranium Material is therefore about a factor of about 14 higher than that from Ra-226 decay in the same material; however, even when combined with the gamma field from Ra-226 decay in the Uranium Material, the gamma field is a factor of about 1.7 times that from Ra-226 decay in Arizona Strip ores (about 23.4 µSv/hr or 2.34 mrem/hr). Such increased gamma emission represents a proportionally very small gamma contribution to the tailings given the total volume of Uranium Material (7,520 dry tons) compared to the total volume of tailings in the tailings cells (e.g., 1,856,000 dry tons tailings capacity in Cell 4A).

In 2003, SFC measured radon emanation rates (at the Gore, Oklahoma facility) from the polypropylene storage bags filled with raffinate sludge dewatered during pilot testing conducted prior to full-scale dewatering of the raffinate sludge material and found the concentrations to be acceptable for the work area (SFC 2003). Radon flux measurements made on the surface of unlined sacks of dewatered raffinate sludge indicated an average flux rate of 5 $pCi/m^2/sec$. Based on an assumed total volume of 485,000 cubic feet of dewatered sludge stored in SuperSak bags, stacked two rows high, on a temporary storage pad over a 87,700 square foot area, and covered with a high density polyethylene geomembrane cover, SFC calculated (SFC 2003, Attachment 1) a total estimated emission (fluence) rate of 0.01 uCi/sec from the covered and bagged dewatered sludge mass on the storage pad. Simplified Gaussian plume dispersion calculations provided by SFC (SFC 2003, Attachment 1) indicated that the worst-case radon (Rn-222) concentration at a location approximately 350 feet downwind from the center of the dewatered sludge storage pad, and assuming the wind would always blow in the downwind direction) would be approximately 3×10^{-11} uCi/ml, which is within the applicable effluent concentration (EC) limits of 10 CFR 20, Appendix B, Table 2, Column 1.

Data provided by EFRI (Appendix B to EFRI 2013a) also indicate that, despite the elevated levels of thorium isotope concentrations measured in a finite number of samples of the SFC Uranium Material, actual gamma radiation rates from the inventory of stored stacked SuperSaks at the Gore, Oklahoma facility, measured at a distance of 12 inches away from the surface of the SuperSaks, were less than or equal to 1.6 mR/hr (measurements made by SFC personnel on February 11, 2013).

4.1.1.2 Radiation Monitoring During Storage and Processing of SFC Uranium Material

The SFC Uranium Material-specific SOP describes procedures for performing radiological monitoring throughout the duration of the handling, storage and processing and disposal of the SFC Uranium Material and the disposal of the residuals following processing the material. Elements of the radiation monitoring program are summarized below.

Area Airborne Monitoring

EFRI proposes that weekly area airborne sampling be conducted in the areas of the mill listed below (Section 4.1 of the SOP in Attachment 7, Standard Operating Procedure (SOP) - SFC Alternate Feed Management, to the Revised August 2013 LAR [EFRI 2013b]):

- Ore Storage area
- Leaching area
- Central Control Room
- Solvent Extraction (SX) Building
- Precipitation area
- Yellowcake drying area
- Yellowcake packaging area

EFRI proposes to collect an eight-hour air sample at a flow rate of 40 liters per minute or greater and that, after sufficient data have been collected and reviewed by the Radiation Safety Officer (RSO) and ALARA (As Low As Reasonably Achievable) Committee, area airborne sampling frequency may be reduced to once every two weeks during the receiving of Uranium Material. EFRI also proposes to analyze these air samples for gross alpha, beryllium, arsenic and lead.

Derived Air Concentrations

As is the practice for other alternate feed materials processed at the mill, in order to monitor, document, and address the specific radionuclide make-up of the SFC Uranium Material, EFRI proposes to establish appropriate derived air concentrations (DACs) for the SFC Uranium Material for the different areas of the mill site described above for use in analyzing potential airborne particulate exposure to workers, based on applicable regulations and mill procedures. As defined in UAC R313-15, Definitions, Derived Air Concentration (DAC) means the concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work, results in an intake of one Annual Limit of Intake (ALI). For purposes of these rules, the condition of light work is an inhalation rate of 1.2 cubic meters of air per hour for 2,000 hours in a year. DAC values are given in Table I, Column 3, of Appendix B of 10 CFR 20.1001 to 20.2402.

EFRI proposes to use analysis results from a composite sample of a (solid) feed sample of the alternate Feed Material for radioscopic composition for U-nat and Th-nat and from a composite of two air samples from each of these locations for U-nat and Th-nat (Section 4.2 of the proposed SOP (Attachment 7, Standard Operating Procedure (SOP) - SFC Alternate Feed Management, to the Revised August 2013 LAR). This information will be used to derive the U-nat/Th-nat ratio for analysis using gross alpha counting. If gross alpha counting of air samples using the U-nat/Th-nat ratios indicate an airborne radioactive dust concentrations of 25% or greater of the derived DAC or the geometric mean of the mixed ratio DA, in any of the mill buildings/areas listed above, the air sampling frequency would be increased to weekly in those areas only (Section 4.2 of the SOP).

Breathing Zone Sampling

EFRI would collect breathing zone air samples once per month on select individuals who perform routine work tasks associated with processing operations. Breathing zone air samples would be collected from individuals who perform work tasks under a Radiation Work Permit ("RWP"). In addition to the above sampling, further breathing zone samples may be collected from individuals at the discretion of the RSO. Samples would be analyzed for gross alpha, beryllium, arsenic and lead.

Environmental Sampling

Continuous air samples will be collected on a weekly basis in the following areas during processing of SFC Uranium Material:

- Ore Storage area; and
- Tailings area

Surveys for External Radiation

Employees working with SFC Uranium Material would be required to wear a personal radiation monitoring device. The devices would be collected quarterly and the results entered on individual exposure forms. Beta/gamma dose rate measurements would be performed weekly in all areas of the Mill operations. These data would be used in monthly dose rate calculations.

In addition to the above, monthly personal radiation monitoring devices would be worn by individuals who perform work tasks that are anticipated to exhibit the highest potential dose rate exposures, such as those assigned to RWP tasks and workers performing initial receipt and handling of the SFC Uranium Material, prior to establishment of material-specific DAC values.

<u>Environmental Surveys for Rn-222, Radon-220, and Their Daughter Products</u>

Monthly measurements would be conducted to determine of radon daughter concentrations for both Rn-222 and Rn- 220 in those areas of the Mill listed above under *Aerial Airborne Monitoring* in Section 4.1.1.2 of this SOP. If radon daughter concentrations from either the uranium or thorium parent are greater than 25% of the limit (0.08 working level for Rn-222 or 0.25 working level for Rn-220) the sampling frequency will be increased to weekly in areas where these levels are routinely encountered. All ventilation systems in the Mill would be checked daily by the radiation safety staff.

4.1.1.3 Packaging, Transportation, and Handling Procedures

Packaging of SFC Uranium Material for Shipment

The SFC Uranium Material would be transported to the Mill Site in B.A.G. Corporation Specification Number G6798-1, 35 cubic-foot, 1,000-kg capacity SuperSaks. Product data for the B.A.G. Corp SuperSaks, along with test results data for these SuperSaks, were submitted in Appendix E to EFRI 2013c.

The SuperSaks meet U.S. DOT and UN packing Group II and III test standards, by passing the required Top Lift, Stack, Drop, Topple, Righting, and Tear tests as identified in attached Test Report #: 04-4711. The SuperSaks passed a load stacking test at full load weight (1,002.7 kg) with a safety factor greater than 5. That is, the test data indicate that the SuperSaks would be expected to retain their integrity up to a top load of 5,443.2 kg, or could be stacked 5 high with no loss of integrity.

Transportation of SFC Uranium Material

The SFC Uranium Material would be shipped via truck from the SFC Facility in Gore, Oklahoma in SuperSaks weighing approximately 0.95 tons each. Approximately 21 bags would be hauled per truckload. The bags would be shipped in truck trailers with poly-lined bottoms and sides, either box-style trailers, or flatbed style trailers with sidewalls and tarp covers. The SFC Uranium Material would be classified as Radioactive LSA I (low specific activity) Hazardous Material as defined by DOT regulations. SFC would arrange with a materials handling contractor for the proper marking, labeling, placarding, manifesting and transport of each shipment of the SFC Uranium Material. Shipments would be tracked by the shipping company from the Gore Facility until they reach the Mill. Each shipment would be "exclusive use" (i.e., the only material on each vehicle would be the SFC Uranium Material). SFC would ship a total of approximately 555 to 835 trucks over a period of 22 to 33 weeks, or an average of twenty five trucks per week for 22 to 33 weeks, equivalent to an average of about 5 trucks per day based on 5 days of shipping per week.

The SFC Uranium Material will be relatively moist, with an expected moisture content range between approximately 22 and 77% and an average moisture content of approximately 55 %, as noted in the Revised August 2013 LAR.

The trucks involved in transporting the SFC Uranium Material to the Mill site would be surveyed and decontaminated, as necessary, prior to leaving the Gore Facility for the Mill and again prior to leaving the Mill site.

<u>Projected Additional Traffic Volumes</u>

Comparison to Licensed Mill Operations

Section 4.8.5 of the 1979 FES for the Mill noted that during the operations period, when uranium ore mining in the region surrounding the Mill site was at expected peak levels, approximately 68 round trips on local highways would be made by 30-ton ore trucks to the Mill per day (see the 1978 Dames and Moore Environmental Report for the Mill, p. 5-34). In contrast, approximately

25 truckloads per week (5 per day) will be transported from the Facility to the Mill for a total period of approximately 22 to 33 weeks. In addition, based on a licensed yellowcake capacity of 4,380 tons U_30_8 per year (Mill license condition 10.1) a maximum of approximately 8,760,000 pounds of yellowcake would require shipment from the Mill to conversion facilities. This would require approximately 183-275 truck shipments from the Mill per year (based on 40 to 60 drums per truck, and 800 lbs per drum), or one truck every one to two days based on a seven day work week (one truck every day or so, based on a five-day work week). In contrast, the entire volume of yellowcake to be produced from processing the SFC Uranium Material is expected to be transported in a total of less than 8 truckloads. This frequency is minimal in comparison to the estimated yellowcake transport frequency at licensed capacity. Moreover, during the period of transportation of the SFC Uranium Material to the Mill, EFRI indicated (EFRI 2013b, p. 12) that it does not expect that ore deliveries from all other sources would, in total, exceed a small fraction of the truck transportation associated with licensed capacity.

After leaving Gore, Oklahoma, the shipments will travel west via Interstate Highway 40, followed by US and State Highways to the Four Corners area, to Utah State Highway (SH) 191 south of Blanding and north on SH 191 to the Mill. The shipments will likely enter Utah via SH 262.

Comparison to *Existing Truck Traffic on Utah State Highway 262*

Based on information from the State of Utah Department of Transportation ("UDOT") traffic analysis reports *Traffic on Utah Highways 2009* and *Truck Traffic on Utah Highways 2009*, accessed at the UDOT web page on October 30, 2010, on average during 2009, 103 multi-unit trucks traveled west daily on SH 262 to SH191. Based on the 2009 UDOT truck traffic information, an average of five additional trucks per day traveling this route to the Mill during the limited period anticipated for shipment of the SFC Uranium Material represents an increased traffic load of approximately five percent for that period. On the basis of this information EFRI concluded (EFRI 2013b, p. 12) that the truck traffic to the Mill resulting from accepting the SFC Uranium Material at the Mill site for processing is expected to be an insignificant portion of existing truck traffic on SH 262 and well within the level of truck traffic expected from normal Mill operations.

Comparison to *Existing Truck Traffic on Utah State Highway 191*

Based on information from the UDOT traffic analysis data, accessed at the UDOT web page on October 30, 2010, on average during 2009, 292 multi-unit trucks traveled daily on SR 191 from the Four Corners area to the Mill area south of Blanding. Based on the 2009 UDOT truck traffic information, an average of 5 additional trucks per day traveling this route to the Mill during the limited period anticipated for shipment of the SFC Uranium Material represents an increased traffic load of less than two percent for that period. On the basis of this information EFRI concluded (EFRI 2013b, p. 12) that the truck traffic to the Mill from this project is expected to be an insignificant portion of existing truck traffic on SH 191, and well within the level of truck traffic expected from normal Mill operations.

Radiological Transport Considerations

The transport of radioactive materials is subject to limits on radiation dose rate measured at the transport vehicle as specified in the US CFR. The external radiation standards are specified in

10 CFR 71.47 sections (2) and (3) and are less than 200 mrem/hr at any point on the outer surface of the vehicle, and less than10 mrem/hr at any point two meters from the outer lateral surfaces of the vehicle. To prevent migration of ore dust during transportation, all trucks transporting the SFC Uranium Material to the Mill Site would be covered by tarpaulins or similar cover. From a radiologic standpoint, the SFC Uranium Material is within the bounds of other ores and alternate feed materials transported for processing at the Mill. No significant incremental radiological impacts are expected to occur with transportation of the SFC Uranium Material to the Mill over and above those for other previously approved ores and alternate feed materials at the Mill or from licensed activities at other facilities in the State of Utah. All applicable requirements of 49 CFR Part 172 and Part 173 would be required to be met, and the selected transport company would be required to have all the mandatory training and emergency response programs and certifications in place.

Unloading, Handling, and Storage of SFC Uranium Material

Trucks arriving at the Mill site would be received according to existing Mill procedures (EFRI 2013b, p. 13). During storage on the Mill's ore pad, the SFC Uranium Material would remain sealed inside the polypropylene SuperSaks in which the material would be delivered to the Mill.

The manufacturer's test performance data for the SuperSaks notwithstanding (see "*Packaging of SFCUranium Material for Shipment"* above), some SuperSaks might tear or rupture either in shipping or during unloading, and a small number of bags might be expected to rupture during the tipping and subsequent movement by dozer to the storage location on the ore pad.

The Mill plans to stack the SuperSaks 3 to 4 high. It is not expected that long-term UV damage to has occurred to the SuperSaks of the SFC Uranium Material in storage at the Gore Facility because they have been stored under a UV protective polymer cover at that facility. Additionally, as described in the following section, the SuperSaks containing the SFC Uranium are proposed to be stored beneath a layer of soil on the storage pad at the Mill (EFRI 2013c).

Additional Required Personnel Protection Measures

In its August 30, 2013 (EFRI 2013a; b) and October 21, 2013 (EFRI 2013c) submittals, EFRI indicated that the Mill would implement additional worker protective measures during unloading, handling, and storage of the SFC Uranium Material. These procedures are provided in a SOP specifically prepared for managing the risks related to the higher thorium levels associated with the SFC Uranium Material. The October 21, 2013 submittal includes an updated, revised version of this SOP (Appendix D). Measures discussed in this SOP include the following types of additional general radiological protections:

- Measures to minimize dusting and airborne transport;
- Additional Personal Protective Equipment (PPE) and personnel hygiene required;
- Additional area and breathing zone monitoring; and
- Maintenance of resulting process residuals in the designated tailings disposal cells under cover.

The protective measures identified in the SOP were designed to minimize exposures to workers via inhalation, ingestion, and dermal exposure. The additional measures for minimizing exposure to radionuclides through these routes will also minimize exposure to non-radiological constituents of concern (e.g., toxic metals) through these routes. Because the SFC Uranium Material, like other ores and alternate feeds, will be processed in aqueous solutions from the time it enters the leach circuit, the primary areas for potential worker exposure are the unloading process, the ore pad, and the tailings area. The SOP incorporates the following additional specific protective measures for reduction of thorium exposures, which will also minimize exposure to metals in the SFC Uranium Material:

Ore Storage Pad Area

- Requirement of a RWP with additional personnel protective;
- Requiring that all personnel be no closer than 50 feet from all areas where trucks carrying SFC Uranium Material are moving and entering the ore pad area;
- Cessation of all dumping activities when wind speeds exceed 20 mph; and
- Daily application of water spray on stockpiled SFC Uranium Material on the ore pad until it is covered with soil or other suitable material.

Tailings Management Cells Area

- Residuals resulting from processing of the SFC Uranium Material would be deposited to the tailings Cell 4A or 4B (or a future, equivalently designed and constructed tailings management cell) in an area of the tailings system that will ensure that the material is fully submerged beneath pond liquid and/or tailings slurry from non-SFC alternate feed materials or tailings until such time as the first layer of interim cover or random fill is placed on the disposed tailings and alternate feed material process residuals;
- Management personnel at the Mill and the RSO would coordinate efforts to ensure that operations personnel are provided direction regarding placement of SFC Uranium Material process residuals;
- Following placement, the tailings cells would be inspected daily for conditions of potential concern, in accordance with the requirements in the latest version of the White Mesa Mill Tailings Management Systems and Discharge Minimization Technology (DMT) Monitoring Plan (e.g., DUSA 2007); and
- Weekly tailings inspections reports would document the placement of the SFC Uranium Material process residuals during the preceding week.

EFRI indicated that, based upon experience with receipt of other alternate feeds in SuperSaks and bulk bags, the Mill expects that the SuperSaks on the flatbed trailers or lined end-dump trucks would be unloaded by tipping and dumping (EFRI 2013a, p. 16). The procedures in the SOP for SFC Uranium Material storage were developed based on the assumption that one or more SuperSaks in storage might possess one or more tears or otherwise might be in disrepair and for that reason would be wetted daily until they are covered, as described below.

If during transportation from the Gore Facility, any SuperSak were to become damaged and/or leak, the Shipper and Transporter would have the responsibility under their Emergency Response Plans to have the material contained, cleaned up, and the shipping conveyance repaired. Any spillage of material that requires the notification to the U.S. Department of Transportation (DOT) cleanup crews, would be the responsibility of the Shipper or Transporter.

Once the material arrives at the Mill site, the local Radiation Staff would perform an inspection of each load to observe whether there is any damage or leaking material, prior to the loads being received on site. If any load is found to be damaged or leaking, the loads will be photographed and documented prior to entering the Restricted Area and the Shipper and Transporter will be notified. If leaking material is found, the Radiation Staff would inspect the roadway to see if the spillage has come in contact with the roadway. If so, the roadway will be decontaminated to achieve average background gamma levels. The leaking load would be secured in the conveyance and taken into the Restricted Area. Once in the Restricted Area, the conveyance will be unloaded following procedures of the SOP. The conveyance will then be decontaminated to meet Unrestricted Release requirements.

EFRI also indicated (EFRI 2013c) that if leaking materials are found, all on-site handling activities for the SFC Uranium Material would cease until employees are confirmed to be wearing the proper PPE and respiratory protection. No additional PPE would be required during the initial inspection/observation on an inbound delivery.

If bags arrive in damaged condition, whether or not the damage results in leakage into or outside the conveyance, Radiation Staff may, if needed, cover or patch damaged SuperSaks by taping polymer sheets or tarp material over the damaged areas, and maintain the SuperSaks and any exposed material in wet condition during transfer to storage, to minimize dusting and dispersion. It is expected that the SFC Uranium Material would be a very moist solid and, once placed in storage, the SuperSaks and any exposed material resulting from damaged SuperSaks would be maintained in a moist condition by daily water sprays until they are covered by a minimum 6-inch-thick layer of native soils within 3 days after their placement on the storage pad, and in accordance with requirements specified in the SOP, Section 3.0 Item 10. The Mill has placed a similar cover of soils on alternate feed bulk material previously received from Cabot and bagged alternate feed material previously received from FMRI. The soil cover would be monitored daily for apparent dust emissions and sprayed with water when the cover soil, or the ore pad conditions in general, indicate the potential for dust emissions to occur (EFRI 2013c, p. 7), e.g., at levels that would cause an exceedance of limits prescribed in the facility’s Air Approval Order (Utah Division of Air Quality 2011). The SOP requires placement of a cover of soil or other material for providing shielding for gamma radiation emanating from the SFC Uranium Material, regardless of the condition of the SuperSaks; that is, even if they remain intact during their shipping, unloading, and storage life on the Mill's ore pad. Based on these considerations, a new License Condition is proposed (see Section 5.0) that includes the above-described provisions and monitoring and engineering measures as license requirements. Once the soil or cover material is removed from the SuperSaks prior to transfer of the SuperSaks to the Mill circuit, the bags would be maintained in a moist condition by spraying until the SFC Uranium Material has been loaded into the grizzly or other appropriate feed equipment. As discussed above, additional respiratory protection measures would apply to all SuperSak handling steps as specified in Section 6.1, Item 4 of the SOP.

URS

4.1.2 Non-Radiological Impacts

Based on information provided in the December 15, 2011 DUSA submittal (the Radioactive Material Profile Record attached in Attachment 2), the known and possible chemical components or hazardous waste characteristics of the SFC Uranium Material are summarized in Table 9 below.

Table 9. Chemical Characteristics of the SFC Uranium Material

		(Y)	(N)			(Y)	(N)			(Y)	(N)
a.	Listed HW		X	b.	Derived-From HW		X	c.	Toxic		X
d.	Cyanides		X	e.	Sulfides		X	f.	Dioxins		X
g.	Pesticides		X	h.	Herbicides		X	i.	PCBs		X
j.	Explosives		X	k.	Pyrophorics		X	l.	Solvents		X
m.	Organics		X	n.	Phenolics		X	o.	Infectious		X
p.	Ignitable		X	q.	Corrosive		X	r.	Reactive		X
s.	Antimony	X		t.	Beryllium	X		u.	Copper		X
v.	Nickel	X		w.	Thallium	X		x.	Vanadium		X
y.	Alcohols		X	z.	Arsenic	X		aa.	Barium	X	
bb.	Cadmium		X	cc.	Chromium	X		dd.	Lead	X	
ee.	Mercury	X		ff.	Selenium	X		gg.	Silver		X
hh.	Benzene		X	ii.	Nitrate	X		jj.	Nitrite		X
kk.	Fluoride	X		ll.	Oil		X	mm.	Fuel		X
nn.	Chelating Agents		X	oo.	Residue from Water Treatment						X
pp.	Other Known or Possible Materials or Chemicals										X

For a detailed list of all the non-radiological chemical and their concentrations found in the SFC Uranium Material, refer to Table 5 and Table 6 of Appendix 2 of the December 15, 2011 DUSA submittal and the ELI July 2005 analytical results for the SFC Uranium Material. Key results of prior testing samples of the SFC Uranium Material are further summarized below.

RCRA-Listed Materials Analysis

As stated in Section 1.3, the SFC Uranium Material is considered to be the result of natural ore processing, therefore no listed RCRA material is presented because it is exempt under 40 CFR 261.4(b)(7).

RCRA Characteristic Materials Analysis

The following metals and inorganic chemicals in Table 10 can be found in the SFC Uranium Material (DUSA 2011, Attachment 2; ELI 2005, Attachment C).

Table 10. Metals and Inorganic Chemicals Present in SFC Uranium Material

Class	Component of SFC Uranium*
Alkali Metals	Sodium, potassium, **rubidium, cesium**
Alkaline Earths	Barium, beryllium, calcium, magnesium, strontium, radium
Transition Metals, Lanthanides, and Actinides	Antimony, cadmium, **cerium**, chromium, cobalt, **disprosium, erbium, europium, gadolinium**, **hafnium**, **holmium**, **iodine,** iron, **lanthanum**, **lutetium,** manganese, mercury, molybdenum, **neodymium**, nickel, **niobium**, **osmium, palladium, praseodymium**, **samarium,** silver, **terbium,** thallium, thorium, titanium, **tungsten**, vanadium, zinc, zirconium
Other Metals	Aluminum, gallium, lead, thallium, tin
Metalloids	Antimony, arsenic, boron, silicon
Non-Metal Ions Halogens	Ammonia, fluoride, nitrate, phosphate, phosphorous, selenium Bromine, fluoride,
Volatile Organic Compounds	2-Butanone (methyl ethyl ketone), **2-Hexanone**
Semi-Volatile Organic Compounds	N.A.

*Bold Type = elements or compounds in the SFC Uranium Material, that have not been quantified in the mill's tailings cells to date. Some of these elements, such as tantalum, niobium and scandium are known to exist in the mill's tailings from other alternate feed materials, but have never been quantified. Others, such as cerium, hafnium, lanthanum, praseodymium, tungsten, and yttrium are expected by DUSA to exist in the mill's tailings cells, due to their natural abundance with other elements found in the tailings cells, but have never been quantified.

N.A. = Not applicable

Other Constituents in the SFC Uranium Material

Attachment 5 to the December 15, 2011 submittal, and Appendix A to the August 2013 submittal (EFRI 2013b) indicate that the SFC Uranium Material contains residual tributyl phosphate and/or n-hexane. These compounds were used as part of the solvent extraction process on the slurry following digestion of the uranium ores using nitric acid. Phosphorus, expected to be present as a residual in the phosphate form, was detected at a concentration of 19,600 mg/kg in a sample of the dewatered sludge (that comprises the SFC Uranium Material). This level is within the range of phosphorous/phosphates present in other alternate feed materials previously approved and processed at the Mill, which ranged as high as 262,000 mg/kg of phosphorus in the phosphate form, such as the Cameco Calcined Product alternate feed material (Attachment 5 to EFRI 2013b).

Attachment 5 of the December 15, 2011 submittal and EFRI 2013b also indicate the following:

1. Barium is present as a result of the barium chloride added to the raffinate solution for coprecipitation of radium prior to discharge at the Gore Facility. Barium was used to form inert non-reactive precipitates with radium;
2. The fluoride level detected analyzed in a sample of the dewatered raffinate sludge analyzed in 2013 was 44,100 mg/kg. This level is well within the range of fluoride levels present in other alternate feeds already processed at the Mill, such as the FMRI alternate feed material, which contained concentrations ranging up to 396,000 mg/kg (EFRI 2013b);

URS

3. Nitrate plus nitrite as N was detected in a sample of dewatered raffinate sludge in 2013 at 4,580 mg/kg. This level is well below the level present in other alternate feed materials previously processed at the Mill, such as the Cameco Regen Product alternate feed material, which contained concentrations ranging up to 350,000 mg/kg; and
4. Ammonia was detected in a sample of dewatered raffinate sludge in 2013 at 5,210 mg/kg.

Nitrate/nitrite compounds entered the Gore Facility process due to the use of nitric acid in the uranium digestion step. The Mill has previously handled nitrate compounds in the Mill circuit and tailings system with no adverse process, environmental, or safety issues (EFRI 2013b).

Anhydrous ammonia gas or high concentrations of ammonium hydroxide solutions are incompatible with strong oxidizers, halogen gases, acids, and salts of silver and zinc. If ammonia is present, it will not be present as anhydrous ammonia gas or high concentration ammonium hydroxide and will not contact halogen gases at any time in the Mill process. Ammonia entering the leach circuit would not be present in the reactive hydroxide form, that is, ammonium hydroxide, and would not be available to react with the silver and zinc already present in the Mill tailings, or with the moderate oxidizer that may be added in the Mill acid leach circuit.

The Mill regularly handles 100% anhydrous ammonia which is used to prepare concentrated ammonia solutions introduced into the yellowcake precipitation area. The presence of ammonia in the SFC Uranium Material is within the envelope of conditions normally encountered at the Mill and anticipated in environmental assessments that have previously been completed to support the Mill's RML.

Information provided in EFRI 2013b indicates that the Mill manages hazards related to fluoride presence in alternate feed material by one or a combination of process variations, including blending of bulk feed with conventional ores, alkaline or carbonate leaching, and/or conducts additional area monitoring in the leach circuit and subsequent process steps. The Mill has previously managed alternate feed materials with fluoride levels approximately an order of magnitude higher than detected in the SFC Uranium Material and has established worker protection SOPs, PPE, and monitoring programs in place for fluoride-bearing alternate feed materials.

The compounds 2-Butanone (methyl ethyl ketone) and 2-Hexanone were detected at levels very near their respective Practical Quantitation Limits (PQLs) - 0.3 mg/kg versus a PQL of 0.1 mg/kg for 2-butanone, and 0.08 mg/kg versus a PQL of 0.05 mg/kg for 2- hexanone (Attachment 5). Both of these compounds are common laboratory solvents and are also present in adhesives, marker pens, and inks associated with the sampling process. EFRI concluded that the detection of both of these compounds should be considered as anomalous or as due to laboratory or sampling influences. EFRI indicated that, based on its knowledge of the processes used by SFC, no organic hazardous constituents were produced, used, or stored at the Gore Facility (Attachment 5 to EFRI 2013b).

Table 11 summarizes the anticipated changes (e.g., percentage increase) in concentrations of metal and non-metal constituents in the tailings disposal area following disposal of the process residuals from processing of the SFC Uranium Material.

URS

Table 11. Projected Changes in Tailings Inventories and Concentrations From SFC Uranium Material and Comparison to Other Alternate Feed Materials

Component	A Estimated Average Conc. In SFC Uranium Material (mg/kg or ppm)[1]	B Estimated Mass in SFC Uranium Material (tons)[2]	C Conc. Range in Mill Tailings before Processing SFC Uranium Material (mg/L or ppm)[3A]	D Estimated Average Conc. In Mill Tailings before Processing SFC Uranium Material (mg/L or ppm)[3A,3B]	E Estimated Current Mass in Mill Tailings (tons)[4]	F Mass in Mill Tailings after SFC Uranium Material Processing (tons)[5]	G Conc. In Mill Tailings after SFC Uranium Material Processing (ppm)[6]	H Difference between Column G and D (Incremental increase in Mill Tailings Conc. After SFC Uranium Material Processing) (ppm)[7]	I Increase in Mill Tailings Conc. After SFC Uranium Material Processing (%)[8]	J Conc. In Ores and Other Alternate Feed Materials (mg/L or ppm)[9,10,11]
Ammonia as N	5210	39.18	3-13,900	3,131	5,639	5,678.1	3,140	8.6	0.3	100-730
Aluminum (Al)	160,000	1,203.20	330-2,530	3,154	5,680	6,883.6	3,806	652.2	20.7	2,000-133,000
Antimony (Sb)	78.4	0.59	<20	20	36	36.6	20	0.2	1.2	0.01-120
Arsenic (As)	3,030	22.79	0.3-440	149	269	291.3	161	12.0	8.0	3.5-16,130
Barium (Ba)	4,150	31.21	0.021-0.1	28	50	81.6	45	17.1	81.2	21-43,000
Beryllium (Be)	18.7	0.14	0.347-0.78	1.00	2	1.9	1	0.1	7.4	1-105
Cadmium (Cd)	267	2.01	1.64-6.6	1.0	2	3.8	2	1.1	1-10.6	0.004-59,000
Calcium (Ca)	114,000	857.28	90-630	1,052	1,895	2,751.9	1,522	469.6	44.6	up to 217,000
Cobalt (Co)	133	1.00	14-120	83.0	149	150.5	83	0.2	0.3	9-350,400
Chromium (Cr)	605	4.55	1.0-13	24.0	43	47.8	26	2.4	10.1	8-16,000
Copper (Cu)	2,360	17.75	2,110-8.000	230	415	432.4	239	8.9	3.8	8-296.000
Fluoride	44,100	331.63	0.02-4,440	1,695	3,053	3,384.3	1,871	176.3	10.4	3-460.000
Iron (Fe)	164,000	1,233.28	1,080-3,400	2,608	4,697	5,930.3	3,279	871.1	25.7	up to 54,000
Lithium (Li)	2.67	0.02	1,080-3,401	17.2	31	31.0	17	-0.1	-0.4	up to 810
Lead (Pb)	1,010	7.60	0.21-6.0	4	7	14.8	8	4.2	104.6	9-236,000
Magnesium (Mg)	7,190	54.07	1,800-7,900	4,938.00	8,893	8,947.4	4,947	9.4	0.2	1,020-43,400
Manganese (Mn)	1,930	14.51	74-222	444	800	814.2	450	6.2	1.4	172-3,070

Table 11. Projected Changes in Tailings Inventories and Concentrations From SFC Uranium Material and Comparison to Other Alternate Feed Materials

Component	A Estimated Average Conc. In SFC Uranium Material (mg/kg or ppm)[1]	B Estimated Mass in SFC Uranium Material (tons)[2]	C Conc. Range in Mill Tailings before Processing SFC Uranium Material (mg/L or ppm)[3A]	D Estimated Average Conc. In Mill Tailings before Processing SFC Uranium Material (mg/L or ppm)[3A,3B]	E Estimated Current Mass in Mill Tailings (tons)[4]	F Mass in Mill Tailings after SFC Uranium Material Processing (tons)[5]	G Conc. In Mill Tailings after SFC Uranium Material Processing (ppm)[6]	H Difference between Column G and D (Incremental increase in Mill Tailings Conc. After SFC Uranium Material Processing) (ppm)[7]	I Increase in Mill Tailings Conc. After SFC Uranium Material Processing (%)[8]	J Conc. In Ores and Other Alternate Feed Materials (mg/L or ppm)[9,10,11]
Mercury (Hg)	1.41	0.01	0.0008-17.6	3.0	5	5.4	3	0.0	-0.2	0.0004-14
Molybdenum (Mo)	10,700	80.46	0.44-240	143.0	258	338.0	187	43.9	30.7	12-17,000
Nickel (Ni)	1,660	12.48	7.2-370	67	157	169.2	94	6.5	7.5	7-450,000
Nitrate – Nitrite as N	4,580	34.44	24.00	24	43	77.7	43	18.9	78.9	0.6-350,000
Phosphorus (P)	19,600	147.39	88.1-620	90.1	162	309.7	171	81.1	90.0	11,900-86,500
Potassium (K)	7,740	58.20	219-828	458.0	825	883.1	488	30.3	6.6	17-1,440
Selenium (Se)	348	2.62	0.18-2.4	1.0	2	4.4	2	1.4	144.3	0.02-710
Silver (Ag)	90.8	0.68	0.005-0.14	1.0	2	2.5	1	0.4	37.3	0.007-80
Sodium (Na)	7,480	56.25	1,400-10,000	5.828	10,496	10,552.5	5,835	6.9	0.1	up to 28,800
Strontium (Sr)	1,210	9.10	28,900-190,000	7	12	21.5	12	5.0	72.8	Detected in tailings, so known to originate with ores or other alternate feed materials
Thallium (Tl)	5,880	44.07	0.7-45	16	29	72.9	40	24.3	151.9	0.02-960
Vanadium (V)	1.6	0.01	136-510	284	475	475.5	263	-1.1	-0.4	10-25,000
Zinc (Zn)	751	5.65	50-1,300	637	1,147	1,152.9	637	0.5	0.1	8-14,500

[1] The concentration in the Uranium Material is based on Section D.1 of the RMPR. Ranges were not provided. Values reported as less than (<) were used as reported.

[2] Estimated mass in the Uranium Material is calculated by multiplying Column B by an assumed 7,520 dry tons of Uranium Material.

[3A, 3B] Mill tailings range and average concentrations were taking from Mill tailings samples to date, as summarized in Table 5 of the draft Statement of Basis (SOB) for the Utah Groundwater Discharge Permit (GWDP) for the Mill (November 29, 2004).

All constituents in SFC Uranium Material have been analyzed in Mill tailings. Table 5 of SOB and Column C, above, summarize range of measured values. Values reported as less than (<) were used as whole values.

Column D is theoretical average from Cell 3 plus processing of Fansteel alternate feed material. Copper, lithium, and strontium were not present in FMRI alternate feed and were not adjusted from GWDP SOB Table 5 in Column D.

Phosphate (PO_4*) reported in FMRI was adjusted to phosphorus (P) for consistency with SOB Table 5.

[4] Estimated current mass in Mill tailings C ell 3 is 1,801,000 dry tons.

[5] Mass in Mill tailings after SFC Uranium Material processing is calculated by adding Columns B and E.

[6] The concentration in Mill tailings after SFC Uranium Material processing is calculated by dividing Column F by 1,808,520, being the existing volume of tailings in Cell No. 3 of 1,801,000 dry tons plus the assumed 7,520 dry tons of Uranium Material.

[7] The increase in Mill tailings concentration after SFC Uranium Material processing (ppm) shows the increase (decrease) in concentration of each constituent in the Mill's tailings, stated in ppm of the total mass of tailings in Cell No. 3, which is calculated as the difference between Column G and Column D.

[8] The increase in Mill tailings concentration after SFC Uranium Material processing is the ratio of Column D to Column H expressed in percent.

[9] The concentration in other alternate feeds represents some selected concentrations for constituents found in characterization data for other alternate feed materials licensed for processing at the Mill, for comparison purposes.

[10] Phosphorus value approximated from reported phosphate values times 0.33. Actual value will be higher if phosphorus is present in forms other than phosphate.

[11] Sodium and lithium values are wet basis from Maywood, New Jersey alternate feed material previously proposed and approved by the U.S. NRC (NRC 2002b) for acceptance/processing at the Mill. Dry basis value would be higher.

[12] Column D includes constituents added via FMRI processing. As, Ba, Cr, Ni, and Sb were not analyzed for in FMRI ponds but were detected in perimeter soils present and assumed to be in ponds as well.

* Results are reported on a dry weight basis.

Based on readily available HDPE geomembrane manufacturer's information, the presence of the additional trace constituents listed in Table 10 in the SFC Uranium Material will not result in any additional detrimental impacts to the HDPE geomembrane liners in Cells 4A and 4B.

EFRI also evaluated (Attachment 5 to EFRI 2013b) the chemical compatibility of the elements and compounds reported detected in the SFC Uranium Material with the double High Density Polyethylene (HDPE) liners in tailings cells 4A and 4B and with the tailings present in tailings disposal cells 4A and 4B for constituents that have not been quantified to date in the tailings ponds. These compounds include: 2-Butanone (methyl ethyl ketone) and 2-Hexanone, rubidium, cesium, disprosium, erbium, gadolinium, holmium, iodine, iridium, lanthanum, lutetium, neodymium, niobium, osmium, palladium, platinum, praseodymium, rhenium, rhodium, ruthenium, samarium, tantalum, technetium, tellurium, terbium, and tungsten. Attachment 5 discussed the following findings:

1. "Every metal and non-metal cation and anion component in the SFC Uranium Material already exists in the Mill tailings system and/or is analyzed under the Mill's groundwater monitoring program.
2. Every component detected in the SFC Uranium Material has been:
    a. Detected in analyses of the tailings cells liquids;
    b. Detected in analyses of tailings cells solids;
    c. Detected in analyses of alternate feed materials licensed for processing at the Mill; or
    d. Detected in process streams or intermediate products when previous alternate feeds were processed at the Mill; or at concentrations that are generally comparable to the concentrations in the SFC Uranium Material;
3. A summary of the potential tailings composition before and after processing the SFC Uranium Material is presented in Table 4 [to Attachment 5] - reproduced in Table 11 of this SER;
4. Table 4 indicates that none of the constituents considered in the SFC Uranium Material is estimated to raise the current concentration of the tailings system more than one tenth of one percent, and in some cases, due to the low levels in the SFC Uranium Material, the resulting concentration in tailings is expected to go down;
5. According to a study by Gulec et al. (2005), in a study on the degradation of HDPE liners under acidic conditions (synthetic acid mine drainage), HDPE was found to be chemically resistant to solutions similar to the tailings solutions at the Mill. Mitchell (1985) also studied the chemical resistivity of HDPE and PVC at a pH range of 1.5 to 2.5 standard units using sulfuric acid, and study concluded that PVC performed satisfactorily under these conditions and HDPE performed better and was overall more stable under these acidic conditions; and
6. The constituents in the SFC Uranium Material are expected to produce no incremental additional environmental, health, or safety impacts in the Mill's tailings system beyond those produced by the Mill's processing of natural ores or previously approved alternate feeds.

Although certain constituents have been detected in the SFC Uranium Material that have not been detected/reported in uranium mill tailings solutions previously tested at the Mill (e.g., Cells 3 and 4A), in the majority of these instances, the reason is that that analyte was not included in the list of parameters tested in the tailings solutions. In each case, the reported concentrations of these constituents in the SFC Uranium Material are low and are considered to represent concentrations of naturally-occurring trace elements associated with the original (source) ore materials.

Miesch (1963; Tables 2 and 3) and Abdelouas (2006), based on data from Morrison and Cahn (1991), allows the following comparison (see Table 12) between the SFC Uranium Material and: (1) chemical compositions of uranium ore from a uranium mine deposit and mill pulp samples from over 200 mine sites on the Colorado Plateau; and (2) the average chemical composition of uranium mill tailings from different locations in Utah (for acid-leached uranium ores):

Table 12. Concentrations of Selected Inorganics in SFC Uranium Material Compared to Typical Colorado Plateau Uranium Mill Tailings and Uranium Ores

Analyte	Average Concentration in Colorado Plateau –Derived Uranium Ores and Mill Pulp Samples	Average Concentration in Utah Area Uranium Mill Tailings	Analytical Results of Dewatered Raffinate Sludge (SFC Uranium Material)
As	120 µg/g	74 µg/g	3,030 µg/g
Pb	31 – 90 µg/g	158 µg/g	1,010 µg/g
Ba	550 - 750 µg/g	1,010 µg/g	4,150 µg/g;1,530 µg/g
Be	~ 0.3 0- 0.4 µg/g	Not Reported	18.7 µg/g

ELI (2005) also reported the following analytical results for two samples obtained from the SFC dewatered sludge material stored at the SFC Gore Facility in July 2005:

Table 13. Concentrations of Selected Inorganics in SFC Uranium Material (ELI 2005)

Analyte	Concentrations (Results reported on *dry* weight basis; Received samples had ~50% moisture content))
As	1,370 µg/g and 1,470 µg/g
Pb	101 µg/g and 165 µg/g [1]
Ba	190 µg/g and 454 µg/g [2]
Be	2.3 µg/g and 2.9 µg/g

1 Note: The reported values compare to a value of 1,010 µg/g Pb for a sample of the dewatered sludge reported in Table 1 in Attachment 2 furnished by DUSA (Table 11).

2 Note: The reported values compare to a maximum value of 4,150 µg/g Ba for a sample of the dewatered sludge reported in Table 1 in Attachment 2 furnished by DUSA (Table 11).

A sample of the raw raffinate sludge collected from Basin 1 of Clarifier A at the Gore, Facility in the RCRA Facility Investigation (RFI) contained 1,350 μg/g arsenic, 515 μg/g lead, 2,750 μg/g barium, and 4.12 μg/g beryllium (NRC 1995, Attachment 4, Table 2 and SFC 1996). A sample of the dewatered raffinate sludge tested in December 2012 had a reported barium concentration of 1,530 μg/g (Tables 2, 12 and 14).

A total metals analysis for 8 RCRA metals was performed on the SFC Uranium Material in December 2012. Results of the analysis are summarized in Table 1 of Attachment D1 to Attachment 2 to EFRI 2013b and are presented in Table 2 of this SER.

A TCLP Method 1311 leachate test of the dewatered raffinate sludge was also performed in December 2012 (EFRI 2013a, p. 36). The analytical suite of metals tested is based on 40 CFR 261.24 Table 1 Maximum Concentration of Contaminants for the Toxicity Characteristic. Results of the analyses are presented in Table 1 of Attachment 2 of EFRI 2013b. Of the eight metals analyzed, three (silver, arsenic, and mercury) were detected at a concentration above their respective MDLs. Concentrations of these metal constituents in the liquid extract samples are orders of magnitude below their respective TCLP regulatory limits. Because the detections are significantly below the TCLP regulatory limit in each case, there is no effect on the 10 CFR 40, Appendix A, Criterion 6(7) requirements relating to non-radiological constituents present in the dewatered raffinate sludge. With respect to metals, the SFC Uranium Material is physically and chemically comparable to previously-approved alternate feed materials that the Mill has processed (EFRI 2013a, p.35; EFRI 2013b, Section 4.5).

Information provided by EFRI indicates that none of the operations or processes associated with RCRA F or K listings for arsenic was ever conducted at the Gore Facility, and therefore none of the F or K listings is applicable to the SFC Uranium Material. EFRI also provided information indicating that there is no reason this any of the arsenic compounds associated with RCRA listings U136, P011, or P012 would be present as chemical products, off-spec products or manufacturing byproducts on the Gore Facility. Arsenic is a natural constituent in tantalum and tin ores processed at the Gore Facility. It is a natural constituent in some uranium ores and would be present in trace levels in precipitates from the conversion process at the Gore Facility.

No RCRA F or K listing operations or processes for lead were known to have been conducted at the Gore Facility, and therefore none of the F or K listings are applicable to the SFC Uranium Material. EFRI also indicated that there is no reason lead compounds related to RCRA listings U144, U145, U146 or P110 would be present as chemical product, off-spec product, or manufacturing byproduct at the Gore Facility site. Instead, lead is a natural constituent in some uranium ores and would be present in trace levels in precipitates from the conversion process at the Gore facility.

Barium may be associated with one RCRA listing, P013, if it resulted from the disposal of barium cyanide commercial chemical products, off-spec commercial chemical products, or manufacturing chemical intermediates. As described above, residual barium is present as a byproduct of the raffinate solution treatment (as result of the addition of barium chloride to one of the SFC Gore water treatment impoundments to coprecipitate radium from the decanted raffinate solution. Based on information provided by EFRI, there is no reason to suspect that barium would be present in any of the forms mentioned in the RCRA listing P013. Therefore the P013 RCRA listing does not apply to the SFC Uranium Material.

Beryllium may be associated with one RCRA listing, P015, if it resulted from the disposal of commercial chemical beryllium powdered products, off-spec commercial chemical products, or manufacturing chemical intermediates. Information provided by EFRI indicates that there is no reason beryllium would be present as a chemical product, off-spec product or manufacturing byproduct on the Gore Facility.

While arsenic (As), lead (Pb), barium (Ba), and beryllium (Be) are present in the SFC Uranium Material at levels above those in typical Colorado Plateau-derived uranium ores (Table 12), As, Pb, and Be concentrations in alternate feed materials previously already approved and processed at the Mill have been higher than those measured in the SFC Uranium Material. For example, Be concentrations in the FMRI alternate feed materials have ranged as high as 33 mg/kg (ppm) or nearly twice the highest measured Be concentration in the SFC Uranium Material of approximately 18.7 mg/kg (Table 14).

Similarly, alternate feed materials previously approved and processed at the Mill have had As concentrations up to 7,800 mg/kg (Table 14), more than twice the measured As concentration in the SFC Uranium Material (3,030 mg/kg). Other alternate feed materials approved for processing at the mill (Table 14) have had Pb concentrations higher than the highest measured Pb concentration of 1,010 mg/kg (ppm) in the SFC Uranium Material.

Two alternate feed materials previously approved and processed at the Mill, and other alternate previous alternate feed materials have had Ba concentrations exceeding or of the same order of magnitude as the maximum concentration of barium reported in the SFC Uranium Material (4,150 mg/kg), as indicated in Table 14. The 4,150 mg/kg concentration of barium in the SFC Uranium Material is less than one order of magnitude greater than (approximately 4 to 7 ½ times) the range of barium concentrations reported for typical Colorado- Plateau-derived uranium ores and mill pulp samples and Utah area uranium mill tailings (Table 12).

Table 14 below summarizes the range of concentrations of four specific constituents present in alternate feed materials previously approved and processed through the Mill.

Table 14. Comparison of Concentrations of Inorganic Constituents in SFC Uranium Material and Alternate Feed Materials Previously Approved and Processed at Mill

Constituent	Reported Concentrations in SFC Uranium Material[1] (mg/kg)	Range of Concentrations in Previous Alternate Feed Materials[2] (mg/kg dry)	Source for Alternate Feed Material Information
Arsenic	3,030	3,300 to 7,800 (ave. 4,500)	Cameco calcined product – customer supplied data
		1,640 to 3,280	Cameco fluoride product MSDS
Barium	4,150; 1,530	10 to 3,000 (ave. 1,550)	FMRI Application, March 2005
		6,629 oxidized residues 6,884 unoxidized residues	Molycorp Application, December 2000

Table 14. Comparison of Concentrations of Inorganic Constituents in SFC Uranium Material and Alternate Feed Materials Previously Approved and Processed at Mill

Constituent	Reported Concentrations in SFC Uranium Material[1] (mg/kg)	Range of Concentrations in Previous Alternate Feed Materials[2] (mg/kg dry)	Source for Alternate Feed Material Information
Beryllium	18.7	8.5 to 33 (ave. 21)	FMRI Application, March 2005
Lead	101 - 1,010	<10 to 2,040 (ave. 78)	FMRI Application, March 2005
		52,000 to 100,000 (drums) 1,544 to 262,410 (drums)	Molycorp Application, December 2000

[1] Attachment 2 of the December 2011 Amendment Request (Radioactive Material Profile Record, and associated tables) and EFRI, 2013b.

[2] Selected concentrations for constituents found in characterization data for other alternate feed materials licensed for processing at the Mill, for comparison purposes only.

Arsenic Toxicity

Inorganic As is toxic metal and a known human carcinogen by both inhalation and oral exposure routes. In addition to dermal, cardiovascular, and respiratory effects, oral exposure to inorganic arsenic may result in effects on other organ systems. The differences in toxic potency among different inorganic chemical forms of As are usually minor. At elevated exposure levels, inorganic As toxicity manifests as skin lesions, gastrointestinal effects, encephalopathy, or peripheral vascular effects including cyanosis and gangrene. At lower exposure levels, oral exposure is associated with hypertension, circulatory problems, and peripheral neuropathy including numbness or pain (CDC 2007).

Beryllium Toxicity

Be is a toxic metal and a known carcinogen. The principal exposure pathways for Be from the SFC Uranium Material are inhalation, ingestion and dermal contact. Inhalation can cause irritation to the nose, throat, lungs and mucous membranes. In some individuals, possibly due to genetic factors, Be may cause chronic beryllium disease ("eBD"), a hypersensitivity or allergic conditions causing inflammation and fibrosis resulting in a restriction of the exchange of oxygen between the lungs and the bloodstream (Materion 2011). Be can also be taken into the body by ingestion of water and food or through the skin. Although skin absorption does not appear to be a major pathway, skin contact can cause an allergic dermal response in sensitive individuals and skin contact with Be dusts can result in sensitization (CDC 2013a). The solubility of the Be compound affects the toxicity. The more soluble Be salts can cause irritant and allergic contact dermatitis. Delayed hypersensitivity dermal granulomas may be caused by the less soluble forms of Be in contaminated wounds (Wambach and Laul 2008).

Occupational exposures to beryllium might include skin, inhalation, and inadvertent ingestion of beryllium. The concentration of beryllium detected in the SFC Uranium Material and the average concentration of Be in the existing tailings cells are 18.7 mg/kg and less than 1 ppm (Table 11), respectively. The New Hampshire Department of Environmental Services (NHDES) Beryllium

Health Information Summary notes that skin exposure to concentrated beryllium can result in allergic skin response (NHDES 2010). Because of the very low concentrations in the SFC Uranium Material and tailings, beryllium is not likely to cause an allergic response from skin contact. The reported adverse effects on skin are generally for the pure beryllium compounds or metal. In any case, the normally required personal protective equipment and safe work practices at the Mill facility are expected to protect workers from direct contact with the beryllium in the SFC Uranium Material, tailings, and mill process solutions.

The Mill is subject to regulation and enforcement by the Mine Safety and Health Administration (MSHA), as a result of a tripartite agreement between the NRC, MSHA, and OSHA. MSHA requirements address potential worker exposure to beryllium (MSHA 2013).

Lead Toxicity

Pb is a toxic metal and classified by EPA as a probable human carcinogen. The principal exposure pathways for Pb from the SFC Uranium Material are inhalation, ingestion, and dermal (skin or eye) contact.

Inhalation can cause irritation to the nose, throat, lungs, and mucous membranes. Pb can also be taken into the body by ingestion of water and food or through the skin. The solubility of the Pb compound affects its toxicity. Symptoms of acute Pb poisoning via ingestion or inhalation include weakness/exhaustion, insomnia, weight loss, abdominal pain, tremors, paralysis of wrist or ankles, encephalopathy, gingival deposition, kidney disease and hypertension. Eye contact is associated with short term eye irritation.

Occupational exposures to As, Be, or Pb might include dermal, inhalation and inadvertent ingestion. Mill procedures for personnel protection from each pathway are discussed below.

The primary opportunities for personnel dermal or inhalation exposure occur material unloading and storage. EFRI’s October 21, 2013 submittal provided the SFC Uranium Material-Specific SOP which includes additional procedures to mitigate risks associated with elevated thorium levels in the SFC Uranium Material, tailored to the specific radiological characteristics of the SFC Uranium Material, to minimize the potential for additional exposures to workers or additional radiological effects on the environment. The requirements of the SOP, designed to control and limit the dermal and inhalation exposure of personnel to thorium in this material, will also control and limit exposure to inorganic constituents, including As, Be and Pb, also present in the SFC Uranium Material.

Information provided by EFRI and the SOP describe additional radiation monitoring requirements, discuss requirements for covering of the SFC Uranium Material while in temporary storage on the storage pad, other dust control measures, prescribe use of radiation-related PPE, prescribe additional tailings area management requirements for disposing and covering of process residuals from the SFC Uranium Material processing, and describe additional air monitoring and respiratory protection requirements for As, Be, and Pb that will be implemented throughout the duration of handling, storage, and processing of the SFC Uranium Material and during disposal of its residuals. The SOP includes specific provisions for continuous monitoring of area and breathing zone levels of these inorganic constituents by requiring that samples collected and analyzed on site for assessment of area and breathing zone levels of radionuclides also be analyzed for these three metals. In accordance with the SOP provisions, these data will be used to determine appropriate levels of respiratory protection for these inorganic constituents, in addition to radionuclides, during material unloading, storage and processing activities.

Full face respirator devices used when required for elevated levels of radionuclides or inorganic constituents would also provide protection from eye-related exposure to these inorganic constituents.

With respect to inadvertent ingestion, normal uranium mill work rules and existing controls, designed to prevent ingestion of radionuclides, would provide a reasonable assurance that these inorganic constituents would not be inadvertently ingested at levels likely to cause significant occupational risk. It is therefore expected that adherence to the provisions in the SFC Uranium Material-specific SOP would minimize the potential for a new or incremental increase in personnel exposure risk from these inorganic constituents.

Tributyl Phosphate

Tributyl phosphate may cause irritation of the eyes, nose, and throat. It may also cause nausea and headache. Workers exposed to 15 mg/m^3 of tributyl phosphate have complained of nausea and headache (TOXNET 2012).

The UDRC recommends that EFRI evaluate potential tributyl phosphate levels in air that Mill workers could experience during processing of the SFC Uranium Material and compare those levels to potentially relevant risk or health-based criteria (e.g., ACGIH 8-hr average TLVs or BEIs [Biological Exposure Indices] to the extent applicable, and incorporate worker protection measures, if warranted, into Mill operations associated with processing of the SFC Uranium Material.

4.2 Surface Water and Groundwater Effects

4.2.1 Surface Water Effects

As stated above, during storage on the ore pad, the SFC Uranium Material will be sealed in polyethylene bags, each of which contains a plastic inner liner. The SFC Uranium Material is expected to have an average moisture content of approximately 55% (EFRI 2013b, p. 17). There will be no free liquid inside the bags. Therefore it is unlikely that material or liquids will penetrate the bag and become exposed to stormwater. In the event that the SFC Uranium Material were to become exposed to stormwater, EFRI has an approved spill management plan and stormwater management plan, and the Specific SOP contains additional protective measures for managing and repairing any damaged SuperSaks. All storm water runoff from the ore pad is routed to Cell 1.

4.2.2 Groundwater Effects

The design of the existing tailings management cells (Cells 4A and 4B) that would be used for disposal of the process residuals from processing of the SFC Uranium Material has been approved by the UDRC. EFRI is required to conduct regular monitoring of the leak detection systems in Cells 4A and 4B and monitoring of groundwater conditions in the vicinity of these disposal cells to detect leakage should it occur.

The receipt and processing of the SFC Uranium Material at the Mill is not expected to pose incremental additional impacts on groundwater compared to the current uranium mill tailings and alternate feed material residual inventories.

EFRI currently conducts an ongoing groundwater monitoring program at the Mill. With the exception of aluminum, antimony, barium, lithium, magnesium, potassium, sodium, and phosphorus, all inorganic non-radiological constituents detected in the SFC Uranium Material listed in Tables 1 and 2 are included in the current facility groundwater monitoring program.

Barium will be introduced into either disposal Cell 4A or 4B with the disposal of the process residuals resulting from the processing of the SFC Uranium Material. The concentration of barium present in the SFC Uranium Material exceeds that in uranium ores and other alternate feed materials previously approved for processing and/or processed at the Mill, with the exception of certain Molycorp alternate feed materials previously approved and processed at the Mill (Table 14), which contained somewhat higher concentrations of barium than the SFC Uranium Material. Excluding barium (in general, subject to this one exception noted), and excluding certain thorium isotopes (see Section 4.3 below), the chemical and radiological concentrations and makeup of the SFC Uranium Material are similar to uranium ores and other alternate feed materials previously approved for processing and/or processed at the Mill, and the resulting residual materials disposed in the tailings cells will have the chemical composition of typical uranium process tailings, for which the Mill's tailings management cells 4A and 4B were designed. Based on the expected mobility of barium in the tailings environment at the site , as described in the following section of this SER, and the considerations discussed above, the existing groundwater monitoring program at the Mill is expected to be adequate to detect potential future impacts to groundwater resulting from processing of the SFC Uranium Material and disposal of its residuals in the designated tailings cells.

As stated above, during storage on the ore pad, the SFC Uranium Material will remain sealed in fabric SuperSak bags having a plastic inner liner. The material is expected to have a moisture content of about 45% to 50%. There will be no free liquid inside the polyethylene bags. In addition, the highly compacted ore pad surface and the limited duration of storage will further reduce the potential for seepage to occur while the SFC Uranium Material is on the ore paid. Therefore, seepage of the material into the groundwater at the ore pad site is not anticipated. The SFC Uranium Material has similar chemical and radiological properties to natural uranium ore and/or alternate feed materials previously stored on the ore storage pad prior to processing through the Mill following which residuals of the processing were routed to the tailings cells for disposal. Therefore, it is not anticipated that ore pad storage of the SFC Uranium Material would pose any additional risk to the groundwater compared to ore pad storage of conventional uranium ores or previous alternate feed materials managed at the Mill.

A groundwater detection monitoring program is already in place, in accordance with the State issued groundwater permit, to determine if any leakage from the tailings cells has occurred. Additionally, if groundwater contamination were to occur, the UDRC would require that EFRI conduct a corrective action to restore groundwater to the groundwater standards detailed in the state groundwater permit.

4.3 Evaluation of Need for Additional Groundwater Monitoring Compliance Parameters

With the introduction of the SFC Uranium Material into the mill process, each contaminant found in these materials needs to be considered in order to determine if additional groundwater monitoring compliance parameters should be added to the Ground Water Discharge Permit.

In Table 4 in Attachment 5 to EFRI 2013b ("Comparison of Uranium Material to Tailings and Alternate Feeds"), information is summarized for 30 constituents found in the SFC Uranium Material in relation to concentrations of these constituents present in the existing tailings and the ranges of concentrations of these constituents present in other alternate feed materials previously proposed and/or processed at the White Mesa Mill. Additional comparisons of constituent concentrations found in the SFC Uranium Material to uranium ores and selected other alternate feed materials are presented above in this SER.

In determining if additional groundwater compliance monitoring parameters are needed for the Permit, the following criteria were considered for the constituents reported detected in the SFC Uranium Material (Tables 1 through 6 and Table 15 of this SER):

1. Is the constituent already included as a groundwater monitoring compliance parameter in the Permit?
2. Are concentrations reported for the constituent in the SFC Uranium Material clearly higher than in uranium ores typically processed at the Mill and/or than present in other Alternate Feed Materials previously licensed for processing at the Mill?
3. Will there be a significant increase in concentration in the tailings inventory?
4. Does available information indicate that the contaminant could be mobile in the tailings or groundwater environment (i.e., have a relatively low soil-water partitioning coefficient (Kd) or have a Kd value that is equal to or less than that of a chemically similar constituent already included as a groundwater monitoring compliance parameter in the Permit, or does it exhibit high solubility)?
5. Does the contaminant represent a known human toxicity hazard?
6. Is there an existing and reputable groundwater quality compliance standard for the constituent?
7. Are there EPA-approved analytical methods for the constituent and do the approved methods have a detection limit low enough to readily allow determination of whether the constituent concentration exceeds the applicable groundwater quality compliance standard?

As described in Section 4.1.2 above, the UDRC observed that several of the trace, naturally-occurring constituents identified in the SFC Uranium Material have never been quantified in the mills tailings cells and, as a result, have not been considered to date for inclusion in the Permit. However, these constituents are expected to be present at roughly similar concentrations in the uranium mill tailings and in other alternate feed materials previously processed at the Mill. For this reason, the overall concentrations of these newly-quantified constituents in the tailings cells following processing of the SFC Uranium Material and disposal of the residuals in the tailings cells are not expected to change significantly as a result of handling the SFC Uranium Material at the Mill. According to Table 4, in Attachment 5 to EFRI 2013b, for those constituents detected in the Uranium Material that are already included in the Mill's ongoing groundwater detection monitoring program, constituent inventories are projected to increase by less than 1%, in all cases, as a result of processing of the SFC Uranium Material.

A total of 24 of the constituents detected in the SFC Uranium Material (Tables 1 through 6 and table 15 of this SER) are already required as groundwater monitoring parameters in the Permit.

EFRI (2013b) indicated that barium concentrations as high as 43,000 ppm (mg/kg) (see Table 11) have been processed at the mill (with no adverse process effects or safety issues).

Barium is not a currently required groundwater monitoring parameter in the Mill's existing Ground Water Discharge Permit, and was omitted from the original Permit because concentrations of barium in tailings wastewater samples were found to be less than or equal to the Utah-prescribed groundwater quality standard for barium (see 12/01/04 UDRC Statement of Basis [SOB], Table 5). The State of Utah Department of Environmental Quality has adopted a groundwater quality standard for barium of 2 mg/L (UAC R317-6-2, Table 1).

It is stated in Section 4.6 of the April 2011 Amendment Request and in Section 9.2 of Attachment 5 ("Review of Chemical Contaminants in the Dawn Mining Company Uranium Material to Determine Worker Safety and Environmental Issues and Chemical Compatibility at the Denison Mines White Mesa Mill") included in the April 27, 2011 submittal that the distribution coefficient (K_d) for barium is 100 to 150,000 L/kg for sandy to clayey soil types. DUSA (2011) also indicated that the UDRC SOB for the GWDP (UDRC 2004) assumes K_d values for calcium ranging from 5 to 100 L/kg. On this basis, the licensee concluded that barium would be less mobile in groundwater than calcium, and that calcium therefore would serve as an effective analogue for barium.

EFRI (2013a;b) submitted additional information indicating that the chemistry of the tailings cells would likely limit the mobility of barium due to the existing abundance of sulfate in the tailings cells. As described above, barium chloride was added to the raffinate solution for coprecipitation of radium prior to discharge at the Gore Facility. Ba is present in the SFC Uranium Material at concentrations of approximately 4,150 mg/kg with Ba present primarily as barium sulfate ($BaS0_4$). In waters where sulfate is present, radium is easily removed by addition of barium chloride: barium chloride dissolves and in the presence of sulfate, the dissolved barium rapidly re-precipitates as barium sulfate due to its very low solubility. Dissolved radium co-precipitates with the barium sulfate (NEA & IAEA 2002). Barium sulfate is one of the most insoluble sulfate salts: the solubility of barium sulfate in cold water is 0.022 mg/L in cold water (Weast 1987) and in concentrated sulfuric acid only increases to 0.025 mg/L (Handbook of Chemistry and Physics, 68th Edition).

Geochemical modeling with the PHREEQC® modeling tools using the above solubility data and the geochemical conditions present in the Mill tailings (average tailings sulfate concentration of 65 g/L) predicts that Ba from the SFC Uranium Material would be expected to remain stable in the tailings impoundment as the solid phase barium sulfate, and would not be expected to dissolve.

Once in the EFRI Mill circuit, barium sulfate would be expected to remain as barium sulfate due to its very low solubility in concentrated sulfuric acid (0.025 mg/L). At the listed concentrations of sulfate in the tailings solutions (67,600 mg/L to 87,100 mg/L in Cell 4A), a change in the ambient barium concentration in the tailings solutions (0.02 mg/L) due to placement of the SFC Uranium Material process residues to the tailings would be expected to be very small to negligible. Therefore, given the strong tendency of barium to partition to solids, especially in the presence of sulfate, the potential for barium to migrate to groundwater from the tailings cells at the Mill in the event of a release from the tailings cells is considered to be low. Given the conditions present in the tailings cells, it is likely that mobilization of barium in water would therefore be limited primarily due to solubility considerations.

The above findings support EFRI's contention that barium would be expected to be less mobile than calcium, if it were to be solubilized within the tailings environment. For this reason, barium will not be added to the Permit as an additional groundwater monitoring compliance parameter. Should new information become available at a future date that would suggest that the degree of mobilization of dissolved barium in the tailings pore-water environment might be higher than currently predicted, or in the event that any change (reduction) occurs to the current Utah-established MCL for barium in drinking water, UDRC may consider whether barium should be added to the Mill's groundwater compliance monitoring program.

$Be(OH)_2$ is insoluble in water but dissolves in sulfuric acid (NTP 2011) forming beryllium sulfate, $BeS0_4$ (Wiberg et al. 2001). Therefore, once in the EFRI Mill circuit, beryllium will be present as BeS04. $BeS0_4$ is readily soluble in water (37 to 42.5 g/l00 mL) and has low solubility in concentrated sulfuric acid (solubility does not exceed 2.5% in the range of 88 to 98 wt% sulfuric acid) (Walsh 2009).

Analysis of tailings pore water in the Cell 2 slimes drain (MWH 2010) indicates high sulfate concentrations (60,600-74,000 mg/L) and low pH (3.11-3.28) conditions, indicating that $BeS0_4$ solubility in the tailings will be more comparable to the above-reported solubility in sulfuric acid.

Groundwater at the Mill site is currently monitored for a number of other dissolved constituents, such as chloride, fluoride, and sulfate, each of which is an anion that is expected to have a higher mobility in groundwater than a cation such as barium. These anions can be used as indicators of potential tailings cell seepage, and because of their mobility, as 'early warning' indicators for less-mobile constituents such as barium. Chloride, in particular, is a conservative solute that is not retarded with respect to groundwater flow. Chloride salts are highly soluble, so chloride is rarely removed from water by precipitation except under the influence of freezing or evaporation (Davis and DeWiest 1966). Chloride is also relatively free from effects of exchange, adsorption, and biological activity.

The ranges of Th-228 and Th-232 concentrations detected in the SFC Uranium Material include concentrations that exceed those present in typical ores and other alternate feed materials previously reviewed for processing and/or processed at the mill except for the W.R. Grace alternate feed materials, which were previously reviewed by the U.S. NRC for acceptance for processing at the Mill, which exhibited up to 3,222 pCi/g Th-228 and up to 31,500 pCi/g Th-232.

With the exception of Th-230 (other than for a relatively small amount of one alternate feed material previously processed at the Mill between 1997 and 1998 – described below), and Th-228 and Th-232 (excepting the W.R. Grace alternate feed materials as described above) the chemical and radiological concentrations and makeup of the SFC Uranium Material is similar to uranium ores or other alternate feed materials previously approved and/or processed at the Mill, and it is expected that the resulting residuals left after processing of this material would have a chemical composition similar to that of typical uranium process tailings, for which the Mill's tailings containment systems were designed, or that of other alternate feed materials previously processed at the mill. The Mill's tailings containment systems in Cells 4A, 4B and future similarly-designed tailings management cells are considered adequate for disposal of the process residuals (tailings) associated with the SFC Uranium Material.

Based on the above considerations, the existing groundwater monitoring program at the Mill is adequate to detect potential future impacts to groundwater from potential releases from the tailings cells where the SFC Uranium Material process residuals would be disposed. Rationale for not adding other remaining constituents found in the SFC Uranium Material to the current groundwater monitoring program is discussed below.

Additional Constituents Omitted from Consideration for Inclusion in Mill Groundwater Monitoring Program

The suite of 32 nutrients, inorganics and metals, and organic constituents or groups of constituents detected in the SFC Uranium Material listed in Table 15 below were not added to the Mill’s groundwater monitoring program because they: (1) are already required as groundwater monitoring compliance parameters in the Permit; (2) are considered common laboratory contaminants; (3) are already addressed by surrogate radiologic monitoring parameters (e.g., gross alpha serves as a surrogate for Ra-226, Th-232, U-238, etc…) in the existing groundwater monitoring program; and/or (4) inventories are not expected to increase significantly in the tailings cells as a result of disposal of the process residuals from the proposed processing of the SFC Uranium Material.

Table 15. Nutrients, Inorganics and Metals, and Organic Constituents Present in SFC Uranium Material and Not Added as Groundwater Monitoring Parameters

Nutrients (2)	Ammonia and nitrate
Inorganics and Metals (28)	Arsenic, beryllium, calcium, cadmium, chloride, chromium, cobalt, fluoride, gross alpha, radium-226, thorium isotopes, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, sodium, sulfate, thallium, tin, total uranium and uranium isotopes, vanadium, and zinc
Organics (2)	2-Butanone, 2-hexanone

The remaining constituents detected in the SFC Uranium Material that are not proposed as additional groundwater monitoring parameters include the following constituents, categorized into four groups with their corresponding UDRC findings:

Inorganics: cyanide and phosphate/phosphorous

Although no data were provided on cyanide concentrations in the SFC Uranium Material, if cyanide were to be present in this material, it would be expected to off-gas in the high acid environment of the White Mesa Mill process. Therefore, cyanide was omitted from consideration

Should cyanide be found in future tailings wastewater sampling under Part 1.H.5, the UDRC may consider whether it should be added as a compliance monitoring parameter at a future date.

As described above, phosphorus is present as a residual of the tributyl phosphate used in the uranium hexafluoride extraction step at the Gore Facility. However, phosphate was not added as a required groundwater monitoring parameter in the Permit, because, although an increase in the inventory of phosphate in the uranium mill tailings is projected to occur as a result of processing of the SFC Uranium Material (Table 11), there is not insufficient information to conclude that this constituent poses a human health risk through the ingestion of water pathway (TOXNET 2012).

<u>Metals, Metalloids, Lanthanides, and Actinides: aluminum, antimony, cerium, hafnium, lanthanum, neodymium, niobium, praseodymium, scandium, silicon, tantalum, thorium, titanium, tungsten, yttrium, and zirconium</u>

Cerium, hafnium, lanthanum, neodymium, niobium, praseodymium, scandium, tantalum, thorium, tungsten, yttrium, and zirconium are not required as groundwater monitoring parameter in the Permit. Although these constituents are present in the SFC Uranium Material, most of these constituents have not been quantified in the mill's uranium mill tailings to date. All were eliminated for monitoring consideration because of high Kds ranging from 40 to 1,500 L/kg (Colsman 2005). Other metals are already used as compliance monitoring parameters that have much lower Kd values, and would be expected to be detected in a downgradient groundwater monitoring well before the arrival of the above eliminated metals.

Although an increase in aluminum concentrations in the tailings inventory (by approximately 20 percent; See Table 11) is expected following disposal of the residuals from processing of the SFC Uranium Material, aluminum was also omitted as a groundwater monitoring parameter in the Permit. This omission is based on the following considerations: 1) Aluminum and iron have similar geochemical behavior in groundwater environments[1]; 2) iron is already a required groundwater monitoring parameter in the Permit; 3) it is estimated that the average concentrations of aluminum and iron in the Mill's tailings inventory after disposal of the residues from processing the SFC Uranium Material will be similar (see Table 11); and 4) iron has an estimated lower Kd than aluminum (iron estimated Kd of 1.4 L/kg [UDRC 2004] and aluminum having an estimated Kd range from about 2.2 to 2.2 x 10^6 [geometric mean of about 34,000] L/kg [Sheppard et al. 2007]). Consequently, iron should be detected at downgradient monitoring wells before the arrival of aluminum and therefore is an acceptable analog for aluminum.

[1] In sulfate solution concentrations greater than 10,000 mg/L, as in the wastewater in the tailings cells, iron and aluminum values greater than 1000 mg/L are common. The mobility of these constituents away from the source of acidity is primarily a function of the total acidity of the solution and the acid-neutralizing capacity of the material the solution contacts. The acidity of the solution is partly due to the activity of hydrogen; however, a much greater component is generally due to dissolved iron and aluminum. As the pH of the solution is raised by reactions with the solid phase iron and aluminum minerals become less soluble and precipitate producing hydrogen. This reaction produces a much greater acidity provided by the solution concentration of hydrogen. As a consequence the pH plume and its dissolved constituents will be more mobile in an acidic solution with high concentrations of iron and aluminum than a plume without these metals (Deutsch 1997).

Antimony is also not considered as a required groundwater monitoring parameter in the Permit, in part because there is no expected significant increase in the tailings inventory from the proposed action (Table 4 of Attachment 5 of the December 2011 submittal). Further, antimony and arsenic could be expected to behave similar geochemically, and arsenic is already a required groundwater monitoring parameter in the Permit. The estimated mass of antimony in the mill's tailings after processing the SFC Uranium Material will be significantly less than the estimated mass of arsenic in the mill tailings (Table 4 of Attachment 5). Antimony has an estimated Kd range of about 2.0 to 14,200 L/kg (UDRC SOB for Permit 2004; Sheppard et al. 2007). Sheppard et al. 2007 reported a geometric mean Kd value of 730 L/kg for antimony in soil based on 100 measurements. The 2004 UDRC SOB listed estimated Kd values for antimony of about 2.0 to 16 L/kg. Arsenic has an estimated Kd range of between about 6 and 16,000 L/kg (UDRC SOB 2004; Sheppard, et al. 2007). Sheppard et al. 2007 reported a geometric mean Kd value of 750 L/kg for arsenic in soil based on 80 measurements. The 2004 UDRC SOB listed estimated Kd values for arsenic of about 6 to 19 L/kg. EPA reported arsenic Kd values ranging from about 25 to 31 L/kg (for pH values ranging between 4.9 and 8.0 (EPA 2002, Exhibit C-4 and EPA 2011, Exhibit C-4). Consequently, based on consideration of their respective reported Kd values, antimony and arsenic could be expected to be detected at the compliance monitoring wells at roughly the same time based on the roughly comparable Kd values reported for these two constituents.

Titanium is not a required groundwater monitoring parameter in the Permit. Analytical results for two samples of the SFC Uranium Material tested by ELI in 2005 indicate that concentrations of titanium in the SFC Uranium Material (469 mg/kg and 552 mg/kg on a dry weight basis) are roughly comparable to the range of titanium concentrations reported for uranium ore from a uranium mine deposit and mill pulp samples from over 200 mine sites on the Colorado Plateau (approximately 550 to 950 mg/kg) as reported by Miesch (Miesch 1963, Table 2). There was no information found in the Hazardous Substance Data Bank (HSDB) regarding human health risks from exposure to titanium. Further, no Kd information was found in available technical literature. Since this information was not available and concentrations of titanium in the SFC Uranium Material appear to be comparable to titanium concentrations in uranium ore and mine sites on the Colorado Plateau, titanium was eliminated from consideration as a groundwater monitoring parameter. If in the future, additional information pertaining to titanium health effects and/or partition (distribution) coefficients for titanium should become available; the UDRC Director may consider at that time whether titanium should be added as a monitoring parameter, pursuant to Part IV.N of the Permit.

<u>Volatile Organic Compounds (VOCs): 2-Butanone and 2- Hexanone</u>

2-Butanone (MEK) is already a required groundwater monitoring parameter in the Permit. 2-Hexanone (n-Butyl methyl ketone (]MBK]) is not a required groundwater monitoring parameter in the Permit, in part because there is not expected to be a significant increase in MBK in the tailings inventory following processing of the SFC Uranium Material. Further, the MBK reported detected at a trace concentration in the SFC Uranium Material is suspected to have been caused by introduced laboratory contamination. Also MBK and MEK are members of the same chemical class (ketones). MEK can therefore serve as an analog for MBK.

Conclusions

The inventory for the SFC Uranium Material included 61 detected different inorganic constituents and two organic constituents for groundwater monitoring compliance consideration. Of these 63 constituents, 24 were already required as groundwater monitoring compliance parameters in the Permit. With the exception of aluminum, antimony, barium, lithium, magnesium, potassium, sodium, and phosphorus, all inorganic non-radiological constituents detected in the SFC Uranium Material listed in Tables 1 and 2 are included in the current facility groundwater monitoring program. None of the remaining 39 detected constituents in the SFC Uranium Material but not included in the monitoring program would be added as a new groundwater monitoring compliance parameter in the Permit.

4.4 Alternatives

The action the UDRC is considering is approval of an amendment request to Radioactive Source Materials License issued pursuant to UAC R313-24 Uranium Mills and Source Material Mill Tailings Disposal Facility Requirements. Subparagraph UAC R313-24-3(1)(c) requires that alternate sites and engineering methods be considered in the analysis of the license amendment request.

There are a limited number of facilities in the U.S. that are suitably licensed to receive, store, process or dispose of the SFC Uranium Material. Sequoyah Fuels Corporation previously considered shipping the SFC Uranium Material to the former Cotter Corporation (Cotter) uranium mill facility in Canon City, Colorado for processing to extract recoverable uranium, with disposal of the resulting tailings proposed to occur in the facility’s Primary Impoundment. However, the request to transport and process the material at the mill was subsequently withdrawn based in part on the State’s concern regarding the integrity of the (single) synthetic liner underlying the Primary Impoundment.

For this License Amendment Request, the UDRC considered alternative engineering methods for mitigating potential impacts associated the offloading and temporary storage of the SFC Uranium Materials on the site. The UDRC identified specific engineering controls to be implemented and imposed these measures in new License Condition 10.21 (see Section 5.0).

The licensee has provided an adequate description of the alternate feed material to be processed at the Mill and tailings disposed in the tailings embankment, including the physical and chemical properties important to risk evaluation, and the procedures to be implemented to mitigate potential radiological exposures to workers and minimize potential doses to individual members of the public. In reviewing the License Amendment Request, the UDRC considered current Mill operating practices, assumed that the additional monitoring and the engineering practices/methods outlined in the SFC Uranium Material-specific SOP would be established and implemented, and incorporated additional requirements in the proposed new License Condition to reduce risks associated with elevated thorium concentrations in the SFC Uranium Material. Assuming that these additional monitoring and engineering methods are implemented, the UDRC concludes that the environmental impacts associated with the proposed action can be acceptably mitigated and therefore that there is no basis for denying the License Amendment Request.

Other alternatives need not be evaluated.

4.5 Long-Term Impacts

On the basis of the information submitted by EFRI, the UDRC does not anticipate significant impacts on public health and safety or the environment resulting from the acceptance, temporary storage, and processing of the SFC Uranium Material and disposal of the process residuals at the Mill site. In general, with the exception of its elevated Th-230, Th-228, and Th-232 levels, other than for the cases of the Nevada Test Site Cotter Concentrate alternate feed material (400 tons) processed between 1997 and 1998), and the W.R. Grace alternate feed materials (reviewed by the NRC in 2000 for acceptance for processing at the Mill), the SFC Uranium Material has similar radiological and metal constituent concentrations as other alternate feed materials and natural uranium ores already reviewed and approved for processing and/or been processed at the Mill. EFRI developed a specific SOP for addressing these elevated thorium levels in the SFC Uranium Material. The SOP prescribes additional personnel monitoring and additional radiological monitoring and protective measures that would be implemented during unloading, temporary storage, and processing of the SCF Uranium Material and during placement/covering of the process residuals in the designated tailings disposal cells.

Previously processed alternate feed materials also contained higher levels of non-metals, such as nitrate, phosphorous, and fluoride, than are present in the SFC Uranium Material. Although the SFC Uranium Material may contain ammonia at levels higher than introduced in other alternate feed materials, ammonia is currently used in the Mill’s precipitation circuit, and the concentrations of ammonia present in the SFC Uranium Material are within the envelope of conditions normally encountered at the Mill and anticipated in environmental assessments that have previously been completed to support the Mill's RML.

Additionally, the tailings containment systems present in the tailings cells that would receive process residuals from processing of the SFC Uranium Material were designed to accommodate elevated concentrations of residual ammonia. Due to the appreciable concentration of ammonia already present in the tailings system, the projected effect of the SFC Uranium Material on the concentration in ammonia in tailings, an increase of 0.3 percent (see Table 11), is considered minimal.

The UDRC does not anticipate any significant impacts on the reclamation, decommissioning, and decontamination of the White Mesa facility, if the SFC Uranium Material is processed as an alternate feed material.

. In the unlikely event that EFRI were to close prior to processing the SFC Uranium Material, the surety funds would be issued to the Director of the UDRC and the material on site at the time would be hauled to one of the two active disposal cells (Cells 4A or 4B) and disposed of directly into one of those the cells. The financial surety does not need to be increased or modified for the acceptance of the Uranium Material, because the Mill cannot possess at any one time, more feed material than can be placed in the cells. Therefore, there is a limit as to how much ore and alternate feed that can be on site for processing at any given time. Surety reviews and adjustments are performed annually by the UDRC. No changes to the surety are necessary for receipt and processing of the Uranium Material.

4.6 Report Findings

Based on the foregoing evaluation of the environmental impacts of the SFC Uranium Material alternate feed material license amendment request, the UDRC has determined that there will not be a significant adverse effect on public health on the environment resulting from the proposal. The following statements support and summarize this conclusion:

1. An acceptable environmental and effluent monitoring program is in place to monitor effluent releases and to detect whether applicable regulatory limits are exceeded. Radiological and non-radiological effluents from site operations have been and are expected to continue to remain below the regulatory limits. A groundwater monitoring program for the shallow perched aquifer is in place to detect potential seepage of contaminants from the tailings cells. The deep, confined Entrada/Navajo Sandstone Aquifer is separated by low permeability formations from the tailings cells further decreasing a potential impact to deep groundwater resources. The potential for seepage to occur while the material is temporarily stored on the ore pad is minimal due to triple layer packaging, dry climate and highly compacted ore pad surface, and the limited duration of storage. Further, decommissioning and reclamation activities at the storage pad can remove any such contamination, should it occur, to the tailings cells for long-term control. An existing dust suppression program is in place and will be implemented at the mill to reduce the potential for airborne contamination.

2. An approved radiation safety program is in place at the mill. Site perimeter postings required by License Condition 9.9 are in place at entrances to the mill. In the past, all worker Total Effective Dose Equivalents (TEDEs) have been found to be well below the 0.05 Sv (5 rem) annual limit specified in UAC R313-15-201 (10 CFR 20.1201). The licensee has also implemented a bioassay program as consistent with NRC Regulatory Guide 8.22, "Bioassay at Uranium Mills."

3. A specific SOP has been developed that will be implemented during the handling, temporary storage, and processing of the SFC Uranium Material and disposal of the process residuals which is designed to mitigate against potential human health and environmental impacts associated with exposure to the higher thorium levels present in the SFC Uranium Material and in the process residuals.

4. Present and potential environmental impacts from the receipt and processing of the SFC Uranium Material and disposal of the process residuals in designated tailings cells were assessed. With the implementation of the additional personnel monitoring, and additional protective measures contained in the SOP, which include, among other practices, daily spraying and subsequent covering the stored SuperSaks of the SFC Uranium Material while in temporary storage on the ore storage pad, and ensuring that disposal of the residuals occur under water and/or covering of the emplaced residuals following emplacement in the designated tailings cells, the potential for significant impacts from processing of the SFC Uranium Material and disposal of the process residuals should be adequately mitigated. The UDRC has determined that the potential for increased risks to public health and environmental hazards can be adequately mitigated if the proposed action and proposed additional monitoring and engineering practices included in the licensee's proposed SFC

Uranium Material-specific SOP and specified in the proposed new License Condition are implemented.

5.0 PROPOSED LICENSE AMENDMENTS AND PERMIT MODIFICATIONS

5.1 License Amendments Proposed

The following license condition changes would result from this license amendment:

10.21 "The licensee is authorized to receive and alternative feed material (the SFC Uranium Material) from the Sequoyah Fuels Corporation Facility located near Gore, Oklahoma, in accordance with statements, representations, and commitments contained in the Amendment Request submitted to the Executive Secretary dated December 15, 2011 and supplemented by a Letter Report (with attachment) submitted to the Director of the Utah Division of Radiation Control (Director) on August 30, 2013, and a Letter Report (with attachments) submitted to the Director on October 21, 2013. The total amount of material stored and processed shall not exceed the following parameters:

(1) Alternate feed material stockpiled in bulk form shall not exceed 16,700 tons gross weight (approximately 7,520 tons dry weight) , without prior approval of the UDRC Director; and

(2) The number of bags of the SFC Uranium Material stored on the ore storage pad is not to exceed 11,500 SuperSaks, without prior approval of the UDRC Director, and the weight of any SuperSak contain the SFC Uranium Material shall not exceed approximately 2,200 pounds.

[Applicable UDRC Amendment: 1

10.21A "The following specific provisions apply to off-loading and on-site storage of the SFC Uranium Material: (1) SuperSaks of the SFC Uranium Material stored (stockpiled) at the Mill Site shall be kept in a moist condition by daily water sprays until such time as they are covered with a minimum 6-inch-thick layer of soil to provide resistance to damage of the fabric bags containing the SFC Uranium Material by ultraviolet (UV) radiation and provide shielding of the gamma radiation field emanating from the bagged alternate feed material; (2) Such soil cover shall be applied over SuperSaks within 3 days following placement of the SuperSaks on the ore storage pad; (3) Soil cover shall be monitored daily for apparent dusting and will be sprayed with water when the cover soil, or the ore pad conditions in general, indicate the potential for dust generation; (4) If at any time, visible dust is observed to be originating from SFC Uranium Material stored on site or from the cover placed over this material, the EFRI RSO or his or her authorized representative shall take actions within 30 minutes to stop the generation of visible dust; and (5) All offloading of SuperSaks onto the storage pad shall cease when wind speeds exceed 20 mph."

[Applicable UDRC Amendment: 1]

5.2 Permit Modifications Proposed

No Groundwater Discharge Permit modifications are required as a result of acceptance of the SFC Uranium Material for processing at the Mill.

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