OPERATIONAL MONITORING PLAN

PIÑON RIDGE MILL FACILITY
MONTROSE COUNTY, COLORADO

Submitted to

Colorado Department of Public Health and Environment
Radiation Management Program
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Denver, Colorado 80246-1530

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November 11, 2009

Preface

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Units of Measure and Abbreviations

Act	Colorado Radiation Control Act
ALARA	As low as reasonably achievable
APCD	Air Pollution Control Division of CDPHE
BLM	U.S. Department of Interior, Bureau of Land Management
BMP	Best Management Practice
CCD	Counter Current Decantation
CCR	Code of Colorado Regulations
CDOW	Colorado Division of Wildlife
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CH2M HILL	CH2M HILL Engineers, Inc.
cm	centimeter
Company	Energy Fuels Resources Corporation
CRS	Colorado Revised Statutes
DAC	Derived air concentration
DCS	Data Collection System
DOE	U.S. Department of Energy
Energy Fuels	Energy Fuels Resources Corporation
EPA	U.S. Environmental Protection Agency
ERG	Environmental Restoration Group, Inc.
Facility	Piñon Ridge Mill Facility
ft	feet or foot
g	gram
Golder	Golder Associates, Inc.
gpm	Gallons per minute
HDPE	High density polyethylene
hr	hour
kg	kilogram

Units of Measure and Abbreviations (continued)

Kleinfelder	Kleinfelder West, Inc.
LCRS	Leak collection and recovery system
mg	milligram
µm	micrometer (or micron)
µR	microroentgen
Mill License	Radioactive Source Material License
MMGRMA	Meteorological Monitoring Guidance for Regulatory Modeling Applications
mrem	Millirem
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NUREG	U.S. Nuclear Regulatory Commission Regulation
NVLAP	National Voluntary Laboratory Accreditation Program
OSL	Optically stimulated luminescence
PARCC	precision, accuracy, representativeness, completeness, and comparability
Pb-210	Lead-210
pCi	picocurie
pH	Hydrogen (ion) concentration
Plan	Operational Monitoring Plan
PM-10	Particulate matter with a diameter of 10 micrometers or less
Po-210	Polonium-210
Project	Piñon Ridge Mill Facility
Property	Piñon Ridge Property
PVC	Polyvinyl chloride
QA/QC	Quality assurance and quality control
Ra-226	Radium-226
RMP	Radiation Management Program of CDPHE

Units of Measure and Abbreviations (continued)

Rn-222	Radon-222
RSO	Radiation Safety Officer
s	second(s)
SOP	Standard Operating Procedure
SPCC	Spill Prevention Control and Countermeasure
SWMP	Stormwater Management Plan
TDS	Total dissolved solids
TES	Threatened, Endangered and Sensitive
Th-230	Thorium-230
Th-232	Thorium-232
TLD	Thermoluminescence Dosimetry or Thermoluminescence Dosimeter
TOC	Total organic carbon
tpd	Tons per day
TPH	Total petroleum hydrocarbons
TSP	Total suspended particles (air)
TSS	Total suspended solids (water)
U-nat	Natural Uranium
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USFWS	U.S. Fish and Wildlife Service
Visus	Visus Consulting Group, Inc.
WWE	WestWater Engineering
yr	year

1.0 Introduction

Energy Fuels Resources Corporation ("Energy Fuels" or "the Company") proposes to license, construct, and operate a conventional acid leach uranium and vanadium mill at the Piñon Ridge Property (the "Property") in western Montrose County, Colorado. Refer to Figure 1-1, Site Location Map, for the general location of the Property, and Figure 1-2, Property Map, for the Property boundary.

The Piñon Ridge Mill Facility (the "Project" or the "Facility") includes an administration building, a 17-acre mill complex, tailings ponds totaling approximately 30 acres (expansion capacity to 90 acres), a 40-acre evaporation pond (expansion capacity to 80 acres), a 6-acre ore storage pad, access roads and maintenance and warehouse buildings. Figure 1-3, Site Plan, shows the locations of the Project facilities. The mill is designed to process ore produced from mines on the Colorado Plateau located within a reasonable truck-haul distance. The mill will initially process 500 tons of ore per day and is designed for future expansion capable of accommodating a production capacity of 1,000 tons per day ("tpd"). The projected operating life of the Facility is 40 years, operating 24 hours per day, 350 days per year at 500 tpd. The Facility is expected to employ 85 people directly.

Energy Fuels has prepared this Operational Monitoring Plan ("Plan") for submittal to the Radiation Management Program ("RMP") of the Colorado Department of Public Health and Environment ("CDPHE") as one component of its Radioactive Source Material License ("Mill License") Application. The Colorado Radiation Control Act (the "Act") provides for the regulation of radioactive materials by the CDPHE in Colorado Revised Statutes ("CRS") 25-11-101, et seq. Through the Act and an agreement between the Governor and the U.S. Nuclear Regulatory Commission ("NRC"), the CDPHE is empowered to be the sole regulator of radioactive material in the state. The Rules and Regulations Pertaining to Radiation Control [6 Code of Colorado Regulations ("CCR") 1007-1] provides the details of how radioactive materials are regulated. The process for licensing uranium-recovery facilities is specifically addressed in the Act (CRS 25-11-203). The regulatory process requires that a Mill License Application be submitted to CDPHE, which includes amongst other items, an Environmental Report, design plans, and operating and decommissioning procedures.

1.1 Facility Location

The proposed Facility is situated on an 880-acre private parcel owned by Energy Fuels and located in the southeastern portion of Paradox Valley, approximately 12 miles west of Naturita and approximately seven miles east of Bedrock, along the northeastern edge of Davis Mesa. More specifically, the Property is situated in portions of Section 5 and Section 17, and all of Section 8 in Township 46 North, Range 17 West of the New Mexico Prime Meridian. The Property boundary lies primarily southwest of State Highway 90 and is shown on the U.S. Geological Survey, Bull Canyon and Davis Mesa 7.5-minute topographic quadrangles. Access to the Project site is via State Highway 90 to milepost 23. The Property address is 16910 Highway 90, Bedrock, Colorado 81411.

The Property has been and is currently being used for seasonal cattle grazing. Energy Fuels has also installed geotechnical borings, groundwater monitoring wells, surface water monitoring systems, air monitoring devices, and meteorological stations on the Project site to establish

baseline environmental conditions for permitting purposes. The surrounding property consists of rangeland, uranium mines, and undeveloped land. The uranium mines include an open pit operation immediately southeast of the Property and underground mines along the top of the mesa south of the Property. Energy Fuels does not own or operate these mines, which are currently inactive. The closest residences to the Property are located 1.8 miles southwest, 3.2 miles northwest, and 3.1 miles southeast of the Property boundary. More specifically, these residences are located 2.3 miles west-southwest, 3.4 miles northwest, and 3.5 miles southeast of the Mill License Boundary, which is positioned within the Property boundary.

1.2 Facility Overview

The Facility is designed to process run-of-mine (uncrushed) uranium and vanadium ore at the nameplate capacity of 1,000 tpd; however, as mentioned above, it will initially be constructed and operated to process 500 tpd. Ore will be delivered to the site in highway trucks via State Highway 90 at the estimated rate of 21 loads per day, predominately during daylight hours. The milling operation involves grinding the ore into a fine slurry and then leaching it with sulfuric acid to separate the uranium and vanadium from the remaining rock. Uranium and vanadium are then recovered from solution and precipitated as concentrates (i.e., uranium oxide and vanadium oxide), which are sealed in 55-gallon, steel drums and transported off site. Construction of the mill and ancillary facilities will commence following full regulatory approval, which is anticipated in early 2011, with milling operations following through approximately 2051. The operating life could be extended by an additional 10 years or more if economic conditions warrant.

Energy Fuels will commence closure and reclamation activities following the productive life of the mill. The objectives of the closure and reclamation plan are to establish a long-term stable land configuration with a self-sustaining ecosystem, and to provide for environmental protection and public safety. The majority of the site will be returned to rangeland use, with the exception of the tailings cells, which will be capped with an engineered soil cover and transferred to the U.S. Department of Energy ("DOE") or the State of Colorado for long-term monitoring and maintenance.

Please refer to the Facility Operating Plan (Energy Fuels and Visus 2009) for a comprehensive description of the Facility design and operation. The Facility Operating Plan provides detailed descriptions of the operational components, including ore delivery and storage, the mill facility, waste management facilities, and ancillary facilities and infrastructure, and discusses the operating procedures, system controls and maintenance procedures specific to each process area.

1.3 Purpose and Need

Energy Fuels has developed this Operational Monitoring Plan to present the protocols for ongoing monitoring of environmental resources, process waste attributes and controls, and Health and Safety aspects during operation of the Facility. Specifically, this Plan provides monitoring schedules and procedures to assess radiation doses and the radionuclides in the mill effluents and environment during operations. In addition to radiation dose monitoring and the monitoring of certain process controls, monitoring programs are provided for the following environmental resources:

- Soils;
- Biota (flora and fauna);
- Surface Water;
- Groundwater; and
- Air.

Uranium mill operators are required by NRC regulations and license conditions to conduct radiological effluent and environmental monitoring programs. Regulations applicable to uranium milling are contained in 10 Code of Federal Regulations ("CFR") Part 20, "Standards for Protection Against Radiation," and Part 40 "Domestic Licensing of Source Material." As mentioned above, through the Act, CDPHE is the sole regulator of radioactive material in Colorado. In accordance with these applicable regulations, the monitoring programs provided in this Plan, are designed to provide accurate information on the specific radionuclides in effluents from the Piñon Ridge Mill, its ore piles, its tailings retention systems, its evaporation ponds and in the surrounding environment.

NRC Regulatory Guides are issued to describe, and make available to the public, acceptable methods of implementing specific parts of the applicable regulations, to delineate techniques used by the regulatory staff in evaluating specific problems or postulated accidents, or to provide guidance to applicants. This Plan incorporates the relevant NRC Regulatory Guides into the specific monitoring programs and procedures, including:

- Regulatory Guide 3.63 – Onsite Meteorological Measurement Program for Uranium Recovery Facilities - Data Acquisition and Reporting;
- Regulatory Guide 4.13 – Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry; Environmental Applications;
- Regulatory Guide 4.14 – Radiological Effluent and Environmental Monitoring at Uranium Mills; and
- Regulatory Guide 4.15 – Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment.

Regulatory Guide 3.63 provides guidance regarding the meteorological parameters that should be measured, the siting of meteorological instruments, system accuracies, instrument maintenance and servicing schedules, and the recovery, reduction and compilation of data. Regulatory Guide 4.13 provides minimum acceptable performance criteria for Thermoluminescence dosimetry ("TLD") systems and procedures for calibration, field application, and reporting. Regulatory Guide 4.14 describes programs acceptable to regulatory staff for measuring and reporting releases of radioactive materials to the environment from typical uranium mills. The guide provides programs for both preoperational sampling and operational monitoring. According to the guide, acceptable monitoring programs should be conducted during construction and after the beginning of milling operations, with results summarized quarterly and submitted (to CDPHE) semiannually or annually, depending on the media being monitored. Regulatory Guide 4.15 describes an acceptable Quality Assurance

method for use in designing and implementing programs to ensure the quality of the results of measurements of radioactive materials in the effluents from, and environment outside of, facilities that process, use, or store radioactive materials during all phases of the facility's life cycle.

Table 1-1, Operational Radiological Monitoring Summary for Uranium Mills, provides a summary of the monitoring requirements to be conducted during construction and after the beginning of operations of a typical uranium mill according to Regulatory Guide 4.14. Please note that the actual sample parameters for various media at the Piñon Ridge Mill Facility may differ from those listed in Table 1-1 due to site-specific characteristics (e.g., the ore to be processed does not contain detectable amounts of Thorium-232; therefore, that particular radionuclide may not be analyzed during operations). Each monitoring program provided in this Plan contains an individual table summarizing the specific monitoring conducted for that particular environmental resource and/or Facility component. The results of this operational monitoring program are compiled quarterly and submitted to CDPHE semiannually, annually, and at times of license renewal as required by specific license conditions. Reporting formats are in accordance with Regulatory Guide 4.14.

1.4 Document Organization and Format

This Operational Monitoring Plan is a dynamic (working) document, designed to incorporate and reflect changes to the Facility as they occur. Therefore, to facilitate future revisions and improve the readability of this initial version, which has been created prior to construction and operation of the Facility, the narrative describing the monitoring programs is written in the present tense (i.e., as if the Facility is currently under construction and/or in operation).

The figures (drawings) prepared for this Plan are located together, in a tabbed section near the end of the document. The appendices to this document contain supporting information. Appendix A, Environmental Procedures, provides the Standard Operating Procedures ("SOPs") for environmental monitoring work tasks. Appendix B, Mitigation Plan for Pumping Production Wells, provides the proposed plan for monitoring offsite wells. The Ambient Air Monitoring Plan (Kleinfelder 2008b) provides the detailed protocol for monitoring air quality and meteorological parameters.

Table 1-1
Operational Radiological Monitoring Summary for Uranium Mills
(Source: NRC Regulatory Guide 4.14)

Type of Sample		Sample Collection				Sample Analysis		Applies to Piñon Ridge Mill
		Number	Location	Method	Frequency	Frequency	Type of Analysis	Yes/No
Soil and Sediment	Soil	Five or more	Same as for air particulate samples(1)	Grab	Annually	Annually	U-nat, Ra-226 and Pb-210	Yes
	Sediment	One or two from each water body	Same as surface water samples(2)	Grab	Annually	Annually	U-nat, Ra-226 and Pb-210	Yes
Biota (Vegetation, Food, and Fish)	Vegetation or Forage(3)	Three or more	From animal grazing areas near the mill site in the direction of the highest predicted airborne radionuclide concentrations	Grab	Three times during grazing season	Each sample	Ra-226 and Pb-210	Yes
	Food	Three of each type	Crops, livestock, etc. raised within three km of mill site	Grab	Time of harvest or slaughter	Once	Ra-226 and Pb-210	Yes (see Section 3.0)
	Fish	Each body of water	Collection of fish (if any) from lakes, rivers, and streams in the site environs that may be subject to seepage or direct surface runoff from potentially contaminated areas or that could be affected by a tailings impoundment failure	Grab	Semi-annually	Twice	Ra-226 and Pb-210	No
Water	Surface Water	Two from each water body	Surface waters passing through the mill site or offsite surface waters that are sufficiently close to the site to be subject to surface drainage from potentially contaminated areas or that could be influenced by seepage from the tailings disposal area.(4) One sample collected upstream of mill site and one sample collected at the downstream site boundary or at a location immediately downstream of location of potential influence	Grab	Quarterly	Quarterly	Dissolved and suspended U-nat, Ra-226, Th-230, Pb-210, and Po-210	Yes (see Section 4.0 for sampling schedule)
		One from each water body	Large water impoundments (i.e., lakes, reservoirs) near the mill site that are sufficiently close to the site to be subject to drainage from potentially contaminated areas or that could be influenced by seepage from the tailings disposal area.	Grab	Quarterly	Quarterly	Dissolved and suspended U-nat, Ra-226, Th-230, Pb-210, and Po-210	Yes (storm-water detention pond)

Table 1-1 (continued)
Operational Radiological Monitoring Summary for Uranium Mills
(Source: NRC Regulatory Guide 4.14)

Type of Sample		Sample Collection				Sample Analysis		Applies to Piñon Ridge Mill
		Number	Location	Method	Frequency	Frequency	Type of Analysis	Yes/No
Water (continued)	Groundwater	Three or more	Hydrologically downgradient and relatively close to the tailings impoundment(5)	Grab	Monthly (first year) and Quarterly (after first year)	Monthly (first year) and Quarterly (after first year)	Dissolved U-nat, Ra-226, Th-230, Pb-210, and Po-210(6)	Yes
		At least one control sample	Hydrologically upgradient (i.e., not influenced by seepage from tailings)	Grab	Quarterly	Quarterly	Dissolved U-nat, Ra-226, Th-230, Pb-210, and Po-210	Yes
		One from each well	Each well used for drinking water or watering of livestock or crops within two km of the tailings cells	Grab	Quarterly	Quarterly	Dissolved and suspended U-nat, Ra-226, Th-230, Pb-210, and Po-210(7)	Yes
Point Source Emissions (Stacks)	Particulates	One for each stack	Yellowcake dryer and packaging stack(s)	Isokinetic	Quarterly	Each sample	U-nat, Th-230, Ra-226, and Pb-210 if not available from other sources. Measure stack flow rate semi-annually.	Yes (packag-ing stack only)
	Particulates	One for each stack	Other stacks	Represent-ative grab	Semi-annually	Each sample	U-nat, Th-230, Ra-226, and Pb-210. Measure stack flow.	Yes
Air	Particulates	Three	Locations at or near the site boundaries and in different sectors that have the highest predicted concentrations of airborne particulates(8)	Continuous(9)	Weekly filter change, or more frequently as required by dust loading	Quarterly composite (by location) of weekly samples	U-nat, Ra-226, Th-230, and Pb-210	Yes

Table 1-1 (continued)
Operational Radiological Monitoring Summary for Uranium Mills
(Source: NRC Regulatory Guide 4.14)

Type of Sample		Sample Collection				Sample Analysis		Applies to Piñon Ridge Mill
		Number	Location	Method	Frequency	Frequency	Type of Analysis	Yes/No
Air (continued)	Particulates (continued)	One or more	At the nearest residence(s) or occupiable structure(s)	Continuous	Weekly filter change, or more frequently as required by dust loading	Quarterly composite (by location) of weekly samples	U-nat, Ra-226, Th-230, and Pb-210	Yes
		One	Control Location(s)(10)	Continuous	Weekly filter change, or more frequently as required by dust loading	Quarterly composite (by location) of weekly samples	U-nat, Ra-226, Th-230, and Pb-210	Yes
	Radon Gas	Five or more	Same locations as for air particulates	Continuous or at least one week per month(11)	At least one week per calendar month representing approx. the same period each month	Monthly	Rn-222	Yes
Direct Radiation	Gamma Dose Rates	Five or more	Same as for air particulate samples	Continuous passive integrating device	Quarterly change of passive dosimeters	Quarterly	Gamma exposure rate	Yes

Footnotes:

(1) Surface soil samples should be collected using a consistent technique to a depth of 5 cm.

(2) Several samples should be collected at each location and composited for a representative sample.

(3) Vegetation or forage sampling need be carried out only if dose calculations indicate that the ingestion pathway from grazing animals is a potentially significant exposure pathway (an exposure pathway should be considered important if the predicted dose to an individual would exceed 5% of the applicable radiation protection standard).

(4) Natural drainage systems (dry washes) that carry surface runoff from the site following a precipitation event should be sampled following the event but at a frequency not greater than monthly.

(5) The location of the groundwater sampling wells should be determined by a hydrological analysis of the potential movement of seepage from the tailings disposal area. In general, the objective is to place monitor wells in all directions around the tailings area with the emphasis on the down gradient locations.

(6) If the sample contains appreciable suspended material, it should be filtered as soon as possible following collection through a membrane filter and the filtrate acidified to 1% hydrochloric acid.

(7) Surface-water samples to be analyzed for dissolved and suspended fractions should be filtered as soon as possible following collection through a membrane filter and the filtrate acidified to 1% hydrochloric acid.

(8) The term “nearest” as used here means the location with the highest predicted airborne radionuclide concentrations during milling operations.

(9) Continuous collection means continuous sampler operation with filter change weekly or as required by dust loading, whichever is more frequent.

(10) Care should be taken in selection of the control sampling location so that it is representative of the site conditions. In general, a location in the least prevalent wind direction from the site should provide a suitable location for a control sampling site.

(11) Various methods are acceptable; for example: (1) Continuous collection of a gaseous air sample with samples being changed about every 48 hours for a one-week period, or (2) continuous sampling.

2.0 Soil Sampling

Field investigations were conducted during fall 2007 to collect baseline radiological data for surface soil (0-5 and 0-15 centimeters) and subsurface soils (to a depth of one meter) representative of the Piñon Ridge site (ERG 2009). Results demonstrate that the majority of the site is characterized by surface soil with Radium-226 ("Ra-226") concentrations less than 2.6 picocuries per gram ("pCi/g"), with a central tendency of one pCi/g. Areas in the southern portion of the site exhibit higher levels of radioactivity in drainage areas (reaching 44 uR/hr [interpolated] compared to 11 uR/hr at the north end of the site) due to natural processes and possibly anthropogenic sources from nearby mines. Additionally, slightly elevated levels of surface soil Ra-226 concentrations are apparent in all three major drainages (i.e., the western, central, and eastern drainages). These survey results represent a preoperational baseline to compare soil samples collected at the same locations and depths during the operational phase of the mill.

The Soil Sampling Procedure (Procedure No. EV-010) provides the methods for the collection, analysis, and reporting of soil samples in and around the mill site for annual routine soil sampling during operation of the Facility (see Appendix A). The soil sampling procedure and the number and types of analytes for the surface and sub-surface soil samples, are based on requirements provided by NRC Regulatory Guide 4.14 (NRC 1980). The program consists of sampling soils at:

- four locations; randomly collocated with baseline soil sample locations (see Figure 1, ERG 2007), representative of the site and outside of the windblown sample areas;
- five locations; at each of the air monitoring station locations (three onsite and two offsite); and
- four locations; collocated with the surface water samplers.

Additionally, one duplicate sample is collected per every twenty soil samples collected, with a minimum of one per sampling event. The Soil Sampling QA/QC Procedure (Procedure No. EV-011) specifies the methods for performing quality assurance and quality control ("QA/QC") reviews of analytical data for the soil samples collected and the types of QA/QC samples collected and methods for analyzing the sample results (see Appendix A).

The frequencies of soil sampling events are listed in Table 2-1, Soil Sampling Summary. Soil samples are analyzed for Ra-226. Additionally, an extended set of parameters, including natural Uranium ("U-nat"), Lead-210 ("Pb-210"), Thorium-230 ("Th-230"), and Thorium-232 ("Th-232") are analyzed for approximately 10 percent of the samples collected. Results and recommendations are included in the annual environmental monitoring report submitted to CDPHE. Refer to Figure 2-1, Soil Sampling Locations, for soil sampling areas.

2.1 Windblown Material

In addition to the standard annual sampling, surface sampling of windblown soils is conducted every five years (prior to license renewal with CDPHE) at locations downwind of the tailings cells, evaporation ponds, and ore pad. Shallow (surface to one-cm deep) samples will initially be collected at the predominantly downwind edge of these facilities, as shown on Figure 2-1.

Based on the analytical results of the initial soil samples, samples progressively further from these areas may be collected as specified by the Radiation Safety Officer ("RSO").

2.2 Sediment

The water quality swale, which is located at the downstream end of the haul road ditch at the road's intersection with State Highway 90, is designed to significantly reduce the flow velocity of runoff within the ditch in order to promote sediment settling. The design also incorporates vegetation in the channel to achieve minor pollutant removal prior to flows exiting the Property. Because this swale is not a water body, a sediment sample is not required to be collected. However, since a soil sample is collocated with surface water sampling location S-2 (i.e., in the water quality swale), a sample of the earth at this location will be collected.

The East and West Stormwater Ponds located on site (see Figure 2-1) are provided to intercept and store runoff originating predominately from the mill area and ore pad. These ponds are lined with geomembrane underlain by a geosynthetic clay liner on prepared subgrade; therefore, sediment collected in the ponds is not sampled.

There are no other onsite or offsite water impoundments that are subject to seepage from the tailings cells or evaporation ponds, or subject to drainage from potentially contaminated areas or a tailings impoundment failure. Accordingly, pre-operational (baseline) sediment samples were not collected.

2.3 Soil Remediation

Any spills or leaks of toxic or hazardous pollutants will be contained and cleaned immediately. A Materials Containment Plan and Spill Prevention, Control and Countermeasure ("SPCC") Plan (Energy Fuels 2009b and 2009a, respectively) have been prepared for the Facility. These plans outline measures taken to prevent spills and, in case of a spill, measures to be taken to contain, clean, and report the spill. Spill cleanup materials for small spills are located onsite and are inspected regularly. In addition, heavy equipment is available onsite to respond to larger spills.

Soil sampling is conducted around the mill facilities and tailings pipelines following spill cleanup activities on a per occurrence basis in order to confirm that contaminated soils within the spill area have been remediated. The sampling of soils in remediated spill areas is conducted in a similar manner as specified by Procedure No. EV-010.

Table 2-1
Soil Sampling Summary

Type of Sample	Sample Collection				Sample Analysis		Sampling Procedure
	Number	Location	Method	Frequency	Frequency	Type of Analysis	
Surface (0-5 cm)	Four	Randomly collocated with baseline soil sample locations (determined by RSO)	Grab	Annually	Annually	U-nat, Ra-226 and Pb-210	EV-010
	Five	Five air monitoring stations					
	Four	Collocated with surface water samplers in onsite drainages					
Windblown (0-1 cm)	Five (or more)	Downwind of tailings cells, evaporation ponds and ore pad	Grab	Every five years (prior to license renewal)	Every five years	U-nat, Ra-226 and Pb-210	
Remediation	Per spill	Around mill facilities and tailings pipelines	Grab	Per spill	Each sample	U-nat, Ra-226 and Pb-210	

Note: Refer to Figure 2-1 for general locations of soil samples.

3.0 Biota Monitoring

The mill site is located in a semiarid area, which provides habit for various wildlife species and is historically grazed by cattle. The predominant vegetation is sagebrush and grass in the basin area, and piñon-juniper woodland along the southern boundary on the northeast-facing slope of Monogram Mesa. The dominant resident animals on the site include jack and cottontail rabbits, smaller mammals such as rodents, predators such as coyotes and foxes, and various reptilian and insect species. Mule deer, elk, and various bird species visit the site on a seasonal basis. Cattle are grazed in the area during winter and early spring. No fish habitat exists on or near the mill site, which potentially could be affected by site operations and there are no crops or vegetable gardens located within three kilometers of the site.

The following sections describe the programs for monitoring flora and fauna during operation of the Facility. Table 3-2, Biota Monitoring Summary, lists the monitoring conducted for each particular resource component.

3.1 Vegetation

Vegetation at and near the mill site is monitored for radiological content, noxious weeds, and revegetation progress. Radiological content of vegetation is compared to the baseline characterization. Noxious weed monitoring includes surveys on the mill site property and pesticide application when necessary. Revegetation monitoring includes surveys of revegetation areas to document progress and identify additional reclamation measures that may be required.

3.1.1 Radiological

Field investigations were conducted for baseline radiological characterization during fall of 2007, and spring and summer of 2008, which are representative of the typical growing seasons at the site (ERG 2009). Results showed baseline radionuclide concentrations in the vegetation samples ranging as follows:

- Ra-226: 0.03 to 0.6 pCi/g;
- Th-230: –0.2 to 1.2 pCi/g;
- U-Nat: 0.08 to 2.41 milligram/kilogram ("mg/kg") (equivalent to 0.05 to 1.6 pCi/g);
- Pb-210: 1.4 to 6.6 pCi/g; and
- Polonium-210 ("Po-210"): 0.2 to 4.3 pCi/g.

The maximum concentrations of Pb-210 and Po-210 were measured at onsite Air Monitoring Station No. 2 and offsite Air Monitoring Station No. 4, respectively. Comparison with corresponding soil sample results yields no apparent relationship. Radionuclide concentrations were highest in the onsite soil sample collected at Air Monitoring Station No. 2, located in the southeastern portion of the site, and the corresponding vegetation sample collected at this location had the lowest radionuclide concentrations of the five samples collected.

The Vegetation Sampling Procedure (Procedure No. EV-020) describes the methods of collection, analysis, and reporting of vegetation, forage, and crop samples in and around the

mill site during the operational phase of the Facility (see Appendix A). Non-woody forbs, grasses, and/or shrubs are sampled once during the growing season at the five air monitoring stations and/or other locations determined by the RSO, and three times during the grazing season, typically at the Property boundary fence line along the east, west and south sides of the site as shown on Figure 3-1, Biota Sampling Locations. Sample locations are determined by the highest predicted contaminant concentrations as determined by the most recent offsite dose assessment information. The samples are shipped to the laboratory for analysis of radionuclides specified by the RSO. The RSO reviews the analysis from the laboratory and makes any necessary calculations needed for the annual report to the CDPHE.

The vegetation sampling procedure and the number of and types of analytes for the samples are based on requirements provided by NRC Regulatory Guide 4.14 (NRC 1980). Samples are collected using grass clippers or shears and placed in sealable plastic bags, labeled appropriately, and stored in a laboratory-supplied cooler until transfer to the laboratory. The samples are analyzed for Ra-226, Th-230, U-Nat, and Pb-210 using the methods identified in Table 3-1, Laboratory Analytical Methods for Vegetation Samples. Based on the ore types that will be processed at the mill, Po-210 levels are not expected to be measurably affected in vegetation due to the short half-life of Po-210 (138.4 days); therefore, Po-210 is not included in the analytical suite.

Table 3-1
Laboratory Analytical Methods for Vegetation Samples

Analyte	Method	Comments
Ra-226	M903.1	Digestion method is EPA method 3050B
Th-230	ESM 4506	Th-228 and Th-232 are also measured using this method; results are provided in the laboratory reports.
U-nat	M6020 ICP-MS	No comments
Pb-210	EPA 901.1	No comments

To the extent practicable, each composite sample collected will be representative of the surrounding vegetation. Photographs are taken of each sample and its location. The vegetation types (common species names) are recorded at each sampling location along with their relative percentage of the composite sample.

Adjoining property is used for winter grazing; therefore, the grazing season is typically from late fall through early spring. The regulations require that only vegetation available to and likely eaten by locally grazed livestock be collected. Since none of the plant species within the sagebrush areas are particularly palatable to livestock, the vegetation sampling program conducted during grazing season focuses on sampling grasses within mixed grassland areas adjacent to the Property where the highest contaminant concentrations are predicted to occur. The most recent offsite dose assessment information will be used to determine the highest predicted contaminant concentrations. If possible, the same fence-line sampling stations will be used for multiple sampling events to allow for evaluation of concentrations over time, as well as on a seasonal basis.

3.1.2 Noxious Weeds

Weed control will be practiced throughout the life of the milling operation as well as during reclamation. During operations, weed surveys and weed control measures will be implemented at the mill site, especially along the main access and secondary roads. Measures that will be employed to minimize the occurrence and spread of noxious weed species during operations include:

- conducting a weed survey of the site in the spring and in the fall;
- spraying noxious weeds if they are identified (the herbicides used will be appropriate for the types of weeds observed);
- providing special attention to infestations of State List A and B species;
- reporting weed survey results to CDPHE in the annual reporting along with measures and practices employed for weed control, which include Pesticide Application Records; and
- using a non-ionic surfactant for all applications according to the manufacturer's specifications.

Experience shows that some initial weed cover in the first year following placement of topsoil and seeding is beneficial to the reclamation effort at dry range sites. Weeds tend to provide shade for new grasses and serve to hold snow on the seedbed longer, which protects it from wind and water erosion while the planted species are taking hold. Therefore, weed control measures do not include total weed removal in areas that will be reclaimed concurrently with mill operations.

3.1.3 Revegetation

Revegetation monitoring of disturbed areas will be conducted following seeding of disturbed areas. This includes reclamation concurrent with operations when practical. Species used for revegetation will include native grasses and forbs as specified in the Specifications for Closure and Reclamation of Mill Facilities report (Golder 2009c). The primary goal of revegetation is to prevent erosion of reclaimed areas, especially steeper areas such as embankments. In addition, the revegetation program will emphasize grasses, forbs and shrubs that can be utilized by wildlife as forage in areas that will be accessible to wildlife.

Revegetated areas will be monitored to document the success of the seeding efforts and identify areas where further efforts (e.g. reseeding, installing temporary structural erosion controls, etc.) may need to be employed. Revegetation is a stormwater Best Management Practice ("BMP"); therefore, its progress will be evaluated on a monthly basis during BMP Inspections (see Section 4.2). Disturbed areas are considered satisfactorily revegetated when the vegetative cover is sufficient to minimize erosion.

3.2 Animal Tissue

A baseline survey of naturally occurring radionuclides in animals was performed in May 2008 (Whicker 2008). The survey was designed to allow comparison of baseline measurements with similar measurements made during and following the operational phase of the Facility and to facilitate an assessment of any radiological contamination of animals resulting from mill operations.

Every five years, prior to renewing its Mill License with CDPHE, Energy Fuels will collect representative samples of cottontail and jackrabbit bone tissue for analysis of naturally occurring radionuclides. Three samples of Cattle, which are grazed within three kilometers of the mill site, will be collected at the time of slaughter if the rabbit samples exhibit increasing levels of radiation. Rabbits (both jack and cottontail) are abundant, reside year round, and appear to represent the dominant herbivorous mammals on the site. Thus, this species provides a much better representation of the local radiological conditions than would large game such as deer or elk, which mainly use the site during seasonal migration periods and cattle, which graze on adjacent properties on a seasonal basis only. Another advantage of rabbits as indicators is that they are large enough to provide ample bone tissue for reasonably accurate radionuclide analysis. Smaller mammals would require pooling of tissues from several individuals in order to have sufficient tissue for a reliable analysis. Additionally, Ra-226 levels are readily measureable in bone with relatively small variability (Whicker 2008). Therefore, Ra-226 levels in this species (rabbits) are targeted as the most sensitive and useful indicator of any future changes in radiobiological conditions. During the baseline survey, cottontails were most numerous along the southern boundary of the site near the piñon-juniper woodland, while the jackrabbits appeared more numerous toward the northern and central portions of the site, which are dominated by sagebrush and grass.

The Animal Tissue Sampling Procedure (Procedure No. EV-030) describes the methods of collection, analysis, and reporting of naturally occurring radionuclides in rabbit species (and cattle if it becomes necessary) in and around the mill site during the operational phase of the Facility (see Appendix A). Bone tissues of the two rabbit species are collected and analyzed. These tissues are carefully dissected, cleaned, bagged, and frozen, and submitted to a laboratory for analysis of U-nat, Ra-226, and Pb-210. More precise tissue dissections are completed in the laboratory. The RSO reviews the analysis from the laboratory and makes any necessary calculations needed for reporting to the CDPHE. The baseline survey findings suggest that monitoring for Pb-210 in animals at the mill site will be more instructive than monitoring for Th-230 or Po-210, although for biological monitoring purposes, U-nat and especially Ra-226 should take precedence over the other radionuclides measured (Whicker 2008). Therefore, biota animal sampling and analysis will typically be limited to analyzing for U-nat, Ra-226, and Pb-210 in jackrabbit and cottontail rabbit bone tissue. The constituents, tissues, and species analyzed may be expanded at the discretion of the RSO.

3.3 TES Species Surveys

Biologists performed field surveys and assessments of wildlife, wildlife habitats, and ecological habitats on the Project site from August 2007 through May 2008 (Kleinfelder 2009) and in August 2009 (WWE 2009) to identify the wildlife and plant species that occupy the project area at varying periods of the year. Additionally, the field surveys and assessments were performed to identify any species, including Threatened, Endangered and Sensitive ("TES") species, that would potentially be impacted as a result of development and operation of the mill. Factors considered, include the absence or presence of wildlife and plant species including Gunnison's prairie dog, Burrowing Owl, Colorado hookless cactus, raptors, and migratory birds; and the existing natural vegetation community.

The categories of TES species considered are 1) Federal Threatened, Endangered, and Candidate Species; 2) Bureau of Land Management ("BLM") Sensitive Species; and 3) State of Colorado

Species of Special Concern. No threatened, endangered, or special status species were observed on site during the various baseline surveys. However, Gunnison's prairie dog, a candidate species, has inhabited areas near the well field (west of the site) in the past, as abandoned burrows were found in the vicinity of the well field. Western burrowing owls were also likely present at this location as late as 2008 (Kleinfelder 2009 and WWE 2009). The Western burrowing owl is a state species of concern (i.e., threatened in Colorado).

Every five years, prior to renewing its Mill License with CDPHE, Energy Fuels has a TES survey conducted for the Property and immediate surroundings. A qualified biologist consults with the U.S. Fish and Wildlife Service ("USFWS"), BLM, the Colorado Division of Wildlife ("CDOW"), and current TES listings to determine potential TES species that may be present. The biologist conducts pedestrian surveys to identify, locate and record wildlife species, wildlife signs (tracks, fecal droppings, and vegetation disturbance), vegetation communities, and wildlife habitats. A qualified biologist conducts pedestrian surveys within the Property boundary, and visual surveys (with the aid of binoculars) within a 200-ft buffer from the Property boundaries. Vegetation types are determined through field identification of plants (aided by using pertinent published field guides) and on-the-ground assessments of plant abundance. Visual searches for raptor nests and bird species focus on the woodlands, cliff habitat on the ridge to the south of the property, and the mixed grassland. Nest searches and bird identification are aided by the use of binoculars and song recognition where necessary. The RSO reviews the survey results and summarizes the findings for submittal to the CDPHE as part of the license renewal application.

Table 3-2
Biota Monitoring Summary

Type of Sample	Sample Collection				Sample Analysis		Sampling Procedure
	Number	Location	Method	Frequency	Frequency	Type of Analysis	
Vegetation (non-woody forbs, grasses and/or shrubs	Five (or more)	Five air monitoring stations and/or other locations determined by RSO	Grab	During growing season	Each sample	U-nat, Ra-226, Th-230, and Pb-210	EV-020
	Three	Along east, west, and south Property boundaries	Grab	Three times during grazing season	Each sample		
Animal Tissue	Three of each rabbit species	Representative cottontail and jackrabbit tissue collected onsite	Bone	Every five years	Every five years	U-nat, Ra-226, and Pb-210	EV-030
	Three (conditional upon rabbit results)	Representative cattle tissue (as necessary) within 3 km of site	Organs, muscle, bone	At time of slaughter	Each sample	U-nat, Ra-226, and Pb-210	
TES	Per observance	Pedestrian surveys within Property boundary and visual surveys within 200-ft buffer around Property	Visual	Every five years	Each observance	Locate, identify and record wildlife species	Qualified Biologist

4.0 Surface Water Monitoring

Baseline surface water sampling was conducted at the mill site from February 2008 to July 2009 and is summarized in a surface water monitoring summary report (Golder 2009d). The operational surface water sampling program has been developed to collect surface water on an event basis, rather than a fixed calendar schedule, given the intermittent nature of runoff events in the area. The intent is to characterize the chemistry of seasonal runoff from snowmelt, spring storms, and summer monsoon rain events. Quarterly surface water samples are scheduled, although the actual number of sampling events each year is dependent on precipitation during the sampling period. The type of runoff event, rain gauge recording, and presence or lack of runoff at each sampling location is documented for each event.

The surface water sampling program has been prepared in general accordance with Chapter 5 of the Mining Non-point Source Management Program of the CDPHE Water Quality Control Division and with NRC Regulatory Guide 4.14 (NRC 1980). It provides detailed descriptions of the sample collection procedures, analytical methods and schedule, and the data evaluation requirements necessary to characterize surface water quality conditions at the site.

The following sections describe the program for monitoring surface water during operation of the Facility. Table 4-1, Surface Water Monitoring Summary, summarizes the monitoring conducted for each particular component.

4.1 Surface Water Sampling Stations

Four onsite surface water samplers (labeled S-1 through S-4) were installed in February 2008 within selected drainages. These samplers were installed for purposes of baseline data collection and are used for operational monitoring purposes as well. The samplers are located:

- to minimize the possibility of damage as a result of construction or operational activities;
- within water courses where evidence of recent water flow exists; and
- at positions characteristic of the upstream and downstream conditions for water flow across the site.

A standard rain gauge is located adjacent to each sampling site to record storm intensity in the immediate area of the sampler. Refer to Figure 4-1, Surface Water Sampling Stations, for the surface water sampler locations and associated watershed boundaries.

Surface water sampling location S-2 will be replaced with the water quality swale, which is located at the downstream end of the haul road ditch at the road's intersection with State Highway 90. The swale is designed to significantly reduce the flow velocity of runoff within the ditch in order to promote sediment settling. Additionally, vegetation in the channel helps to remove pollutants prior to flows exiting the Property. Because this swale acts as a final stormwater and sediment control facility for minor stormwater flows exiting the site, the stilling basin at the swale inlet serves as a surface water monitoring location and samples are collected at this location under the surface water monitoring program.

The surface water samplers consist of a polyethylene catchment box, nested inside a Quazite® polymer concrete vault. Details of the samplers are shown in the Surface Water Sampling Work

Plan. The double-box arrangement is installed below grade and at sufficient depth to resist displacement during storm events. The top of the catchment is protected by a Quazite® lid, secured to the liner by screws, and punctured with holes over the inner liner to allow water collection and exclude large debris from dropping into the catchment. The inner liner is removable for sampling and decontaminating after the samples are collected. A series of three slotted, 4-inch diameter polyvinyl chloride ("PVC") tubes, threaded and capped on both ends, are situated within the liner to provide pre-filtration and reduce sediments in the water samples.

4.2 Sampling of Water Impoundments

The East and West Stormwater Ponds located on site (see Figure 1-3) are provided to intercept and store runoff originating predominately from the mill area and ore pad. These ponds are lined with geomembrane underlain by a geosynthetic clay liner on prepared subgrade; therefore, sediment collected in the ponds is not sampled. There are no other onsite or offsite water impoundments that are subject to seepage from the tailings cells or evaporation ponds, or subject to drainage from potentially contaminated areas or a tailings impoundment failure. Therefore, quarterly sampling of water from impoundments is not required. Additionally, there are no onsite or offsite streams or rivers that may be subject to drainage from potentially contaminated areas or a tailings impoundment failure. Therefore, monthly sampling of these types of surface waters is not required.

4.3 Stormwater Monitoring

Sediment and erosion control at the site is accomplished using diversion channels, ditches and berms designed to divert stormwater run-on from undisturbed areas around the onsite facilities. A southern diversion channel and berm are designed to divert run-on around the site facilities. Channels along the southern edge of the evaporation ponds are designed to divert stormwater run-on to the east and west into natural drainages, which discharge offsite. Soil stockpile areas also incorporate berms to divert run-on. Stormwater runoff from the haul road (i.e., the main access road into the site) is conveyed by a riprap-lined ditch along the west side of the road, which flows into a water quality swale before exiting the site.

The East and West Stormwater Ponds are provided to intercept and store runoff originating predominately from the mill area and ore pad. These lined ponds are designed to store the 100-year runoff volume from these site facilities. If these ponds receive additional runoff exceeding the 100-year storage capacity, the impounded water will be routed to the evaporation pond cells via a pipe system. The evaporation cells are designed with sufficient capacity to retain runoff volumes generated by the 1,000-year storm event.

Temporary and permanent structural BMPs include engineered measures designed to minimize pollution of stormwater runoff from the site. Temporary structural BMPs are implemented during construction activities within the site to mitigate erosion during construction and to prevent any generated sediment from entering a watercourse and exiting the site. Permanent structural BMPs are implemented for the life of the mill operations.

In accordance with the Stormwater Management Plan ("SWMP") prepared for the Facility (Golder 2009a), Energy Fuels inspects and monitors the stormwater facilities and discharges on a monthly, quarterly, and semiannual basis as follows:

- Monthly – inspections of structural stormwater management measures, erosion and sediment controls, and other structural BMPs;
- Quarterly – sampling of stormwater runoff according to the general surface water monitoring program; and
- Semiannually – comprehensive site compliance evaluations.

Monthly inspections include observations of evidence of, or the potential for, pollutants entering the drainage system and erosion and sediment controls. In addition to stormwater controls, the stockpiles and stormwater ponds are inspected for potential stability problems during the monthly BMP inspections. The comprehensive site compliance evaluations are designed to evaluate the effectiveness of the stormwater management system and the SWMP and are performed in the spring and fall. These semiannual facility inspections include the same equipment and areas with potential pollutant sources as the monthly BMP inspections. However, the semiannual comprehensive site compliance inspections evaluate if the structural stormwater management measures, erosion and sediment controls, and other structural pollution prevention measures are adequate, properly implemented and operating correctly.

4.4 Sampling and Analyses Methods

The Surface Water Sampling (Procedure No. EV-040) provides the methods for sampling surface water at the mill site during the operational phase and through the post-closure phase of the Facility. It specifies methods for the collection, handling, documentation, analysis, and reporting of surface water samples; and is based on the Surface Water Sampling Work Plan (Kleinfelder 2008c) used during the baseline data collection phase of the Project. The surface water sampling rationale is based on protection standards required by 6 CCR 1007-1, Part 18, State Board of Health Licensing Requirements for Uranium and Thorium Processing (Kleinfelder 2008c). Criterion 10 lists hazardous constituents reasonably expected to be associated with radiological material. In addition to metals, the list includes organic compounds, such as solvents, pesticides, and other industrial-use products that are not expected in conjunction with the historic use of the Piñon Ridge site or its anticipated use as a mill.

Samples collected during operation are analyzed for the constituents recognized as being specifically associated with uranium deposits by the methods listed in Table 4-2, Surface Water Monitoring Parameters, as specified by the United States Environmental Protection Agency ("EPA"). The Surface Water Sampling QA/QC Procedure (Procedure No. EV-041) specifies the methods for performing QA/QC reviews of analytical data for the surface water samples collected and the types of QA/QC samples collected and methods for analyzing the sample results. The data must meet the project standards for precision, accuracy, representativeness, completeness, and comparability ("PARCC"), and must be scientifically valid, defensible, and of a defined quality. Refer to Appendix A for the above-mentioned procedures.

4.5 Schedule

As previously discussed, the schedule for the collection and analysis of surface water samples is dependent on the frequency of storm events. Surface water sample collection is scheduled for one sample per each type of runoff event (rain and snowmelt) per quarter at each surface water

sampling location, with the total number of sampling events per year being dependent on actual precipitation events. If storms with sufficient runoff occur between sampling events, the sampling catchments are examined, cleaned, and reconditioned after such events in preparation for future sampling. Stormwater facilities and discharges are inspected and monitored according to the schedule outlined in Section 4.3 above.

Surface water monitoring data is submitted on an annual basis to the CDPHE. Reports include a summary of the monitoring activities, sampling data sheets and analytical reports, and contain an evaluation of data trends. The annual reports are submitted by July 1 of the following year.

Table 4-1
Surface Water Monitoring Summary

Type of Sample	Sample Collection				Sample Analysis		Sampling Procedure
	Number	Location	Method	Frequency	Frequency	Type of Analysis	
Surface runoff	Four per each type of runoff event	Four onsite surface water samplers (S-1 through S-4) within select drainages	Grab	Quarterly	Each sample	Table 4-2	EV-040
Stormwater Facilities	Various	Structural stormwater management measures, erosion and sediment controls, and other structural BMPs	Visual	Monthly	Quarterly	Facility inspection	SWMP
		Stormwater runoff according to the general surface water monitoring program	Refer to sampling of surface runoff (above)				
		Comprehensive site compliance evaluations	Visual	Semi-annually	Semi-annually	Facility inspection	SWMP

Table 4-2
Surface Water Monitoring Parameters

Parameter	Analytical Method	Reporting Limits
Dissolved Metals		
Aluminum	EPA 200.7	0.1 mg/L
Antimony	EPA 200.8	0.001 mg/L
Arsenic	EPA 200.8	0.001 mg/L
Barium	EPA 200.7	0.1 mg/L
Beryllium	EPA 200.7	0.01 mg/L
Cadmium	EPA 200.8	0.001 mg/L
Chromium (total)	EPA 200.7	0.04 mg/L
Copper	EPA 200.7	0.01 mg/L
Iron	EPA 200.7	0.1 mg/L
Lead	EPA 200.8	0.001 mg/L
Manganese	EPA 200.7	0.1 mg/L
Mercury (inorganic)	EPA 200.8	0.001 mg/L
Molybdenum	EPA 200.7	0.01 mg/L
Nickel	EPA 200.7	0.1 mg/L
Potassium	EPA 200.7	0.5 mg/L
Selenium	EPA 200.8	0.001 mg/L
Silver	EPA 200.7	0.05 mg/L
Thallium	EPA 200.8	0.001 mg/L
Uranium, Dissolved and Total	EPA 200.8/6020	0.0003 mg/L
Vanadium	EPA 200.7	0.01 mg/L
Zinc	EPA 200.7	0.01 mg/L
Dissolved and Total Radioactive Analytes		
Thorium-230	ESM 4108/4506 TOPO Extraction	1 pCi/L
Radium-226	EPA 903.0/9315	1.5 pCi/L
Radium-228	EPA 9320	1 pCi/L
Lead-210	Ei Chrom OTW01	4 pCi/L
General Water Quality (Total Concentrations Unless Otherwise Noted)		
Nitrate plus Nitrite (as N)	SM 4500-B	0.1 mg/L
Total Dissolved Solids (TDS)	SM 2540C	10 mg/L
Total Suspended Solids (TSS)	SM 2540 D	1 mg/L
pH	SM 4500-HB	0.01 Std. Units
Fluoride	SM 4500-FC	0.1 mg/L

Notes:

(1) L = liter; ml = milliliter; and SM = Standard Methods

(2) mg/L = milligram per liter; and pCi/L = picoCuries per liter

(3) The lower limit of detection (LLD) for radionuclide samples is highly sample specific and may be higher or lower than the reporting limit expressed in this table.

5.0 Groundwater Monitoring

Water quality within the project area and its immediate vicinity is based on the results of groundwater samples collected from 20 locations over the period of eight quarters from October 2007 to September 2009 (Golder 2009b). The baseline sampling locations include five onsite monitoring wells, three production wells (two onsite and one offsite), seven exploratory holes (four onsite and three offsite), and four domestic wells and one spring located within approximately five miles of the site.

This operational monitoring program is designed to detect potential impacts of operations on groundwater through quarterly monitoring, as Energy Fuels continues to monitor groundwater throughout pre-operational, operational, and post-operational phases of the mill. The program calls for collecting samples monthly through the first year of operation and quarterly thereafter. The effect caused by pumping the production wells will be assessed by monitoring water levels in the observation piezometers near the production wells and by monitoring water quality and flow at offsite wells and an offsite spring in the vicinity of the site. Energy Fuels will monitor the offsite wells and spring to evaluate if their water productivity and/or quality are impacted by operation of the production wells.

The monitoring efforts are grouped into four categories:

- Monitoring groundwater presence and quality in wells located hydraulically upgradient and downgradient of the project;
- Monitoring perched water and groundwater, if present, for potential leakage of the process water and raffinate in close proximity to the mill and tailings disposal cells;
- Monitoring groundwater observation piezometers to observe the water level response to pumping the production wells; and
- Monitoring pre-existing Chinle formation water wells and springs located within five miles of the site.

The locations and upgradient/downgradient designations of the monitoring wells in the groundwater monitoring network are shown on Figure 5-1, Groundwater Monitoring Locations. The locations of the observation piezometers proposed for water level monitoring near the production wells are shown on Figure 5-2, Groundwater Observation Piezometers. The vicinity wells and springs to be monitored are shown on Figure 5-3, Offsite Water Wells and Springs. The final locations and number of wells may be adjusted based on operational constraints and future findings regarding groundwater presence and quality.

The following sections describe the program for monitoring groundwater during operation of the Facility. Table 5-3, Groundwater Monitoring Summary, summarizes the monitoring conducted for each particular component.

5.1 Upgradient and Downgradient Wells

The upgradient portion of the aquifer, relative to the facilities, is situated between the edge of Davis Mesa and the southern boundary of the site and the aquifer terminates north of the location of Tailings Cell A (Golder 2009b). Therefore, the downgradient part of the aquifer is

west/northwest of the site. Locations of upgradient and downgradient areas of the aquifer are illustrated on Figure 5-1.

The upgradient monitoring wells, progressing from the south; include MW-7, MW-6, MW-5 and MW-8B. Well MW-1 (which is dry) is designated to monitor for leakage downgradient of the evaporation ponds. Upon completion of construction of Tailings Cell A and prior to commencement of mill operations, a downgradient monitoring well (MW-10) will be installed at the western edge of the tailings cell. Monitoring of proposed wells at four additional locations downgradient of the mill, tailings cells, and evaporation ponds will be conducted to provide warning of raffinate or process water leakage. Proposed wells MW-11S and MW-11D are sited downgradient of the mill and proposed wells MW-12S, MW-12D, MW-13S, MW-13D, and MW-14S are sited downgradient of the three tailings cells. Energy Fuels will use these wells to monitor the presence and quality of water perched at the bottom of the alluvium (shallow S-designated wells and MW-1) and at the bottom of the Chinle/Moenkopi formations or first groundwater (deep D-designated wells), where present.

Additionally, wells installed north of the aquifer limit are also monitored quarterly to provide continued documentation of the absence of groundwater at these locations. These wells, which include MW-1, MW-2, MW-3, and MW-4, are monitored for water levels and will be sampled if water levels and production are sufficient for sample collection.

For upgradient and downgradient monitoring wells (MW-5, MW-6, MW-7, MW-8B, MW-10, MW-11S/D, MW-12S/D, MW-13S/D, and MW-14S) samples will be collected monthly during the first year of operations and quarterly thereafter (if an adequate volume of water exists for sample collection). These monitoring wells are not used for drinking water or watering of livestock or crops. Groundwater samples are analyzed for the monthly/quarterly suite of parameters shown in Table 5-1, Groundwater Monitoring Parameters, which include U-nat, Ra-226, Ra-228, Th-230, and Pb-210. Once each year, the sampling suite is expanded to include the annual suite of parameters shown in the table.

5.2 Potential Leakage of Process Water

As discussed above, three well pairs and one single well are planned at the western side (downgradient) of the mill and tailings cells to monitor potential leakage of process water and raffinate. Four wells (one of each well pair and the single well) are designated as shallow (S) completions and will be screened at the bottom of the alluvium, near the contact with the underlying formation (either the Chinle or the Hermosa). The remaining three wells are designated as deep (D) completions and will be screened at the first groundwater occurrence, or if groundwater is not present, at the contact between the Chinle/Moenkopi formation and the Hermosa formation. These monitoring well locations are shown on Figure 5-1 and summarized below:

- Well MW-11S and MW-11D: located at the western side of the mill;
- Wells MW-12S and MW-12D: located at the western edge of Tailings Cell A;
- Wells MW-13S and MW-13D: located at the western edge of Tailings Cell B; and
- Well MW-14S: located at the western edge of Tailings Cell C (only shallow completion of monitoring well MW-14 is planned for this location due to anticipated absence of the Chinle and Moenkopi formations).

These wells will be installed upon completion of the mill and neighboring tailings cells to avoid interference with construction activities. Wells are located outside the reclamation footprint of the mill and tailings facilities and will remain operational during the post-operational phase of the project.

Monitoring well MW-1 (currently installed) is designated to monitor potential leakage from the evaporation pond area. The well is located near the northwestern side of the evaporation pond area and is screened in the alluvium, near the contact with the Hermosa formation. The well is similar in completion to the wells designated as shallow (S) completions for monitoring water perched at the bottom of the alluvium. To date, no water has been observed at well MW-1.

The wells close to the process facility (MW-11 through MW-14) are downgradient wells and are part of the upgradient/downgradient well system described above. Therefore, these wells are monitored on the same schedule and for the same suite of parameters as described in Section 5.2 above and listed in Table 5-1.

5.3 Observation Piezometers and Production Wells

Throughout operations, groundwater levels will be monitored to assess the response of the aquifer to groundwater withdrawal from pumping the production wells. Water levels will be monitored in six piezometers, to be installed in the vicinity of the production wells similar to those installed (and subsequently abandoned) as part of the long-term aquifer tests (Golder 2008a and 2008b). The locations of these wells and piezometers are shown on Figure 5-2. Monitoring of the piezometers will be initiated prior to the start of mill operations to establish baseline conditions and will continue during the life of the mill unless operation of the production well field is terminated or Montrose County approves otherwise.

The existing groundwater observation piezometers include:

- PW-1 OB-A;
- PW-1 OB-B;
- PW-2 OB-A;
- PW-2 OB-B;
- PW-3 OB-A; and
- PW-3 OB-B.

Additional production wells (including, but not limited to PW-4 and PW-5) are to be installed prior to commencement of mill operations. Each of the future production wells will be tested for aquifer properties using two observation piezometers at each production well. The approximate locations of PW-4 and PW-5 and the corresponding piezometers are shown on Figure 5-2. Following aquifer testing at the production wells, the piezometers will continue to function as water level monitoring systems.

While production wells are operating, water levels in the observation piezometers will be monitored twice each month during the aquifer's transient state induced by pumping. If the aquifer attains steady state (recharge balances the pumping rate[s]) as indicated by stable water

levels in the observation piezometers, the frequency of monitoring will be reduced to monthly readings. Should the saturated thickness of the aquifer at the location of the observation piezometers for a production well be reduced by pumping to 50 percent of its original thickness, the pumping rate at that production well will be adjusted (reduced) to prevent further groundwater drawdown. If adjusting the pumping rate proves ineffective, the production well will be shut down until the aquifer recovers sufficiently to resume pumping.

Water quality samples are not collected from the observation piezometers; however, samples will be collected from each of the production wells on a quarterly basis during the first year of operation and annually thereafter. The samples will be analyzed for the monthly/quarterly suite of parameters shown on Table 5-1, which include U-nat, Ra-226, Ra-228, Th-230, and Pb-210. Once each year, the sampling suite is expanded to include the annual suite of parameters shown in the table. With the exception of well PW-3, the production wells are not used for drinking water or watering of livestock or crops. Production well PW-3, which is located within two kilometers of the tailings cells, is used for watering of livestock in addition to providing a raw water supply to the mill. Therefore, this well will be analyzed for both dissolved and suspended radionuclides.

5.4 Pre-existing Offsite Water Wells and Springs

To assess the response of the aquifer to groundwater withdrawal from pumping the production wells, offsite wells and an offsite spring in the vicinity of the site will be monitored. Monitoring of the offsite wells and spring was initiated prior to the start of mill operations to establish baseline conditions and will continue during the life of the mill unless operation of the production well field is terminated. Appendix A of the Hydrogeologic Report for the Piñon Ridge Project (Golder 2009b) provides a description of the wells and springs identified in the vicinity of the site through database searches and field investigations. Appendix B, Mitigation Plan for Pumping Production Wells, provides the measures that Energy Fuels will implement if any of the offsite water sources owned by others (i.e., five wells and one spring) exhibit a significant decrease in productivity or deterioration in water quality.

5.4.1 Offsite Wells

Figure 5-3 shows the eight, offsite wells completed in the Chinle formation and located within a five-mile radius of the site. The Chinle formation is the formation in which the mill production wells are completed. Table 5-2, Offsite Water Wells and Springs in the Chinle Formation, presents the information obtained from the state database and field reconnaissance for these wells. Of these eight wells, five wells (permit numbers 258704, 269575, 226684, 253522, and 234136) appear to be functional wells while the remaining three wells (91065, 86582, and 86583) are either dry wells or intermittent producers. With permission of the owners, the five functional wells will be monitored prior to and during mill operations to determine whether water productivity and/or quality are impacted by operation of the production wells.

Monitoring of the wells includes pumping each well at full capacity of the pump/valve system for approximately 20 minutes, and measuring and recording the pumping rate every five minutes. Water quality field parameters (pH, specific conductivity, temperature, oxidation reduction potential and dissolved oxygen) will also be recorded on five-minute intervals. Should pumping cause the water level to drop to or below the pump intake level, the rate is adjusted to continue pumping without running the well dry. If accessible, static water levels

will be taken prior to the start of the pumping test and after the test is completed. The offsite wells will be monitored for productivity and water levels on a quarterly basis during the pre-operational period and during the first two years of mill operations. Thereafter, the wells will be monitored annually for productivity and water levels.

Water sampling and analysis will be conducted on an annual basis during both the pre-operational and operational periods. The water sample will be collected during the second half of the flow test. Samples will be analyzed for the annual suite of parameters shown in Table 5-1, which is the same parameter suite analyzed for the groundwater samples collected from monitoring wells at the mill site. Although these offsite wells are used for domestic and livestock watering purposes, they are located greater than two kilometers (1.25 miles) from the Property boundary. Sampling frequency may be increased at a well if water production or quality exhibits a significant change over time. A water sample will also be collected any time that a water quality field parameter (other than temperature) changes by 20 percent or more between monitoring events.

5.4.2 Offsite Springs

Three springs have been identified within the drainage basin. As shown on Figure 5-3, these springs include Stone Spring, Merrill Spring, and Oublier Spring. Stone Spring is located approximately five miles northwest of the mill site on public land administered by the BLM. The spring flows from a 120-foot long tunnel in the Chinle formation and is piped approximately 1,000 feet to two residences. When inspected in June 2009, it was flowing at approximately 10 gallons per minute ("gpm"); however, the flow varies seasonally and the spring reportedly stopped flowing for a three-month period in 2003. Merrill Spring is located just east of Stone Spring on public land managed by the BLM. The spring also emanates from the Chinle formation, but was not flowing when inspected in June 2009. Oublier Spring is located approximately five miles southeast of the mill on BLM managed land. This spring flows from near the base of the Salt Wash Member of the Morrison formation, which is stratigraphically considerably higher than the Chinle formation.

Merrill Spring will not be monitored given that it was not flowing in June 2009, a time when springs and seeps have typically exhibited higher flows. Oublier Spring also will not be monitored given that it is completed above the production wells in a different formation. Stone Spring, located five miles downgradient (northwest) from the site (Figure 5-3), will be monitored quarterly for flow rate during the pre-operational period and during the first two years of mill operations. Thereafter, flow monitoring will continue on a semiannual basis (late spring and early fall) during mill operations. Sampling and analysis will be performed on a semiannual basis both prior to operations and during operations. Sampling will take place in the late spring, when flow is expected to be highest, and in late fall during the low-flow season. Water samples will be analyzed for the parameters listed in Table 5-1. Flow measurements will be taken after any stored hydraulic head is first dissipated. Because the spring is located upgradient of its point of use and builds up hydraulic head between uses, the water will be allowed to flow freely until the flow rate stabilizes. At that time, the flow rate and water quality field parameters will be measured and, if scheduled, the water sampled.

5.5 Sampling and Analyses Methods

The Groundwater Sampling (Procedure No. EV-050) provides the methods for sampling groundwater at the monitoring, production, and domestic wells on and near the mill site during the operational phase and through the post-closure phase of the Facility. It specifies methods for the collection, handling, documentation, analysis, and reporting of groundwater samples; and is based on the Groundwater Sampling Work Plan (Kleinfelder 2008a) used during the baseline data collection phase of the Project. The procedure has been prepared in general accordance with 6 CCR 1007-1, Part 18, State Board of Health Licensing Requirements for Uranium and Thorium Processing, November 2001; NRC Regulatory Guide 4.14 (NRC 1980); and 5 CCR 1002-41 (Water Quality Control Division) The Basic Standards for Groundwater, amended November 8, 2004. The Groundwater Sampling QA/QC Procedure (Procedure No. EV-051) specifies the methods for performing QA/QC reviews of analytical data for the groundwater samples collected and the types of QA/QC samples collected and methods for analyzing the sample results. The data must meet the project standards for PARCC, and must be scientifically valid, defensible, and of a defined quality. The results are used to determine radionuclide concentrations for groundwater. Refer to Appendix A for the above-mentioned procedures.

As discussed in Section 5.3 above, production well PW-3, which is located within two kilometers of the tailings cells, is used for watering of livestock in addition to providing a raw water supply to the mill. Therefore, this well will be analyzed for both dissolved and suspended radionuclides. No other groundwater sources that are used for drinking water or watering of livestock or crops are located within two kilometers of the tailings cells. Therefore, with the exception of well PW-3, groundwater samples from the monitoring network are analyzed for dissolved radionuclides. Any groundwater samples from future sources that could be used as drinking water for humans or livestock will be analyzed separately for dissolved and suspended radionuclides.

5.6 Reporting Schedule

Groundwater monitoring data is submitted on an annual basis to the CDPHE. Annual reports compile data for the entire period and include a summary of the monitoring activities, sampling data sheets and analytical reports, and contain an evaluation of data trends. The annual reports are submitted by July 1 of the following year.

Table 5-1
Groundwater Monitoring Parameters

Parameter	Laboratory Analytical Method	Reporting Limit
Indicator Parameters - Monthly/Quarterly Suite(1)		
Arsenic	200.8	0.001 mg/L
Boron	200.7	0.1 mg/L
Cadmium	200.8	0.005 mg/L
Copper	200.7	0.01 mg/L
Manganese	200.7	0.01 mg/L
Nickel	200.7	0.05 mg/L
Selenium	200.8	0.001 mg/L
Zinc	200.7	0.01 mg/L
Sulfate	SM4500-SO4 D	1 mg/L
Uranium-natural(2)	200.8	0.0001 mg/L
Radium-226	903.0/9315	1 pCi/L
Radium-228	9320	1 pCi/L
Thorium-230	ESM 4108/4506 TOPO Extraction	1 pCi/L
Lead-210	Ei Chrom OTW01	4 pCi/L
pH (field)	--	--
Specific conductivity (field)	--	--
Temperature (field)	--	--
ORP (field)(3)	--	--
Dissolved oxygen (field)	--	--
Annual Suite(4)		
Total Suspended Solids	SM2540D	1 mg/L
Total Dissolved Solids	SM2540C	10 mg/L
Total Alkalinity	A2320B	1 mg/L
Ammonia as Nitrogen	A4500-NH3 G	0.05 mg/L
Silica	200.7	0.1 mg/L
Carbonate	A2320B	1 mg/L
Chloride	SM4500-Cl	1 mg/L
Sulfide	376.2	0.1 mg/L
Nitrate/Nitrite	353.2	0.1 mg/L
Calcium	200.7	1 mg/L
Potassium	200.7	1 mg/L
Sodium	200.7	1 mg/L
Magnesium	200.7	1 mg/L
TOC(5)	SM5310B	1 mg/L

Table 5-1 (continued)
Groundwater Monitoring Parameters

Parameter	Laboratory Analytical Method	Reporting Limit
Annual Suite(4) (continued)		
Aluminum	200.7	0.1 mg/L
Barium	200.7	0.1 mg/L
Cesium	200.8	0.01 mg/L
Chromium	200.7	0.05 mg/L
Fluoride	SM4500-F C	0.1 mg/L
Iron	200.7	0.03 mg/L
Lead-210	Ei Chrom OTW01	4 pCi/L
Mercury	245.1	0.001 mg/L
Molybdenum	200.7	0.1 mg/L
Vanadium	200.7	0.1 mg/L
Gross Alpha	900.0	2 - 4 pCi/L
Gross Beta	900.0	2 - 4 pCi/L

Notes:

(1) Monthly during the first year of operations and quarterly thereafter.

(2) For quarterly sampling events, only samples collected in the mill area will be analyzed for uranium. For annual sampling events, all samples will be analyzed for uranium.

(3) ORP: Oxidation Reduction Potential.

(4) Annual sampling events will include the quarterly suite of parameters and the additional annual suite of parameters.

(5) TOC: total organic carbon.

(6) The lower limit of detection (LLD) for radionuclide samples is highly sample specific and may be higher or lower than the reporting limit expressed in this table.

Table 5-2
Offsite Water Wells and Springs in the Chinle Formation

Permit No.	Proposed for Monitoring (Yes/No)	Owner/Name	Well Depth (ft)	Well Yield (gpm)	Depth to Water (ft)	Construction Date	Distance from Site Boundary (miles)	Status	Permitted Use
Wells									
258704	Yes	BLM	280	15	168	2/28/2004	2.6	Operational	Stock
269575	Yes	Fehlmann, Lin D. & Davis, Robert M.	302	8	158	1/21/2007	3.2	Operational	Domestic & Stock
226684	Yes	Hurdle, Sylvia S.	320	14	134	7/30/2000	4.0	Operational	Domestic
253522	Yes	Boren, Verl	100	20	28(1)	--	5.0	Operational	Domestic
234136	Yes	Herron, William & Katherine Gray	255	10	157	10/26/2001	4.0	Operational	Domestic
91065	No	Russell, John D.	143	10	103	1st use: 5/16/1978	4.0	No longer in use	Domestic & Stock
86582	No	Blackburn Ranches	160(2)	15	Varies(2)	--	3.2	Intermittent use only	Stock
86583	No	Blackburn Ranchettes	160(2)	0	Dry(2)	--	3.2	Dry(2)	Stock
Springs									
NA	Yes	Stone Spring (used by Verl Boren)	NA	~10(3)	NA	NA	4.8	Flowing	--
NA	No	Merrill Spring	NA	--	NA	NA	4.7	Dry in June 2009	--

Notes:

Well information obtained from the Colorado Division of Water Resources, Well Permit Database, accessed September 30, 2008 and June 19, 2009.

NA: Not Applicable.

(1) Depth to water provided from personal communication between Verl Boren and Energy Fuels Resources Corporation, June 17, 2009. Depth to water from state permit database is 40 ft.

(2) Information provided from personal communication between Dan Cooper and Dick White of Energy Fuels Resources Corporation, October 1, 2008.

(3) Information obtained from site visit to Boren property on June 17, 2009. This spring flows from near the base of the Salt Wash Member of the Morrison Formation, which is stratigraphically much higher than the Chinle Formation.

Table 5-3
Groundwater Monitoring Summary

Type of Sample	Sample Collection				Sample Analysis		Sampling Procedure
	Number	Location	Method	Frequency	Frequency	Type of Analysis	
Downgradient wells	Nine	Hydrologically downgradient wells (MW-1, MW-10, MW-11S, MW-11D, MW-12S, MW-12D, MW-13S, MW-13D, MW-14S)	Grab	Monthly (first year) and Quarterly (after first year)	Each sample	Table 5-1 (dissolved radio-nuclides)	EV-050
Upgradient wells	Four control samples	Hydrologically upgradient wells (MW-5, MW-6, MW-7, MW-8b)	Grab	Quarterly	Each sample	Table 5-1 (dissolved radio-nuclides)	
Production wells and piezometers	One	Well PW-3 (used for watering of livestock)	Grab	Quarterly	Each sample	Table 5-1 (dissolved and suspended radio-nuclides)	
	Four (or more)	Wells PW-1, PW-2, PW-4 and PW-5 (and any future production wells)	Grab	Quarterly	Each sample	Table 5-1 (dissolved radio-nuclides)	
	10 (or more)	Water levels at 10 (or more) piezometers	Water level probe	Twice each month (initially) and monthly (following steady-state conditions)	Each measure-ment	Record water levels	
Offsite wells	Five	Offsite (see Figure 5-3)	Grab, pump test, and water level probe	Quarterly (productivity and water levels Annually (water quality)	Quarterly and Annually	Table 5-1 (dissolved radio-nuclides)	
Offsite springs	One	Stone Spring located five miles northwest of site (see Figure 5-3)	Grab, Flowrate measure-ment	Flowrate (Quarterly first two years of operation and semiannually thereafter) Water Quality (Semiannually)	Quarterly and Semi-annually	Flowrate, Table 5-1 (dissolved radio-nuclides)	

6.0 Air and Meteorological Monitoring

An Air Monitoring Work Plan (Kleinfelder 2008b) has been prepared to provide guidance for the ongoing assessment of the local air quality through collection of various air quality measurements at the mill site. The purpose of the meteorological measurement component is to provide the meteorological information needed to make assessments to assist in demonstrating that the Facility design and operations are such that releases of radioactive materials to unrestricted areas are kept as low as reasonably achievable ("ALARA"). During construction and operation of the mill, data will be collected at five air monitoring stations (network) located on site (three stations) and one each upwind and downwind of the site vicinity in order to obtain a representative block of data for assessment. Monitoring will continue through the operational phase and until closure and reclamation activities have been satisfactorily completed. Revisions to the monitoring plan may be made in the future based on permit requirements.

The same monitoring sites used for the baseline data collection program are used for the operational monitoring program. These monitoring locations were originally chosen according to guidance outlined in NRC Regulatory Guide 3.63, Onsite Meteorological Measurement Program for Uranium Recovery Facilities – Data Acquisition and Reporting (NRC 1988); NRC Regulatory Guide 4.14 (NRC 1980); and EPA Meteorological Monitoring Guidance for Regulatory Modeling Applications ("MMGRMA") (EPA-454/R-99-005).

The five monitoring locations are discussed below.

- Air Monitoring Site No. 1: This location is also referred to as Met Site No. 1 and is located near the northern boundary of the site. This location includes a 10-meter tall meteorological tower and is one of the two onsite PM-10 monitoring locations.
- Air Monitoring Site No. 2: This location is also referred to as Met Site No. 2 and is located near the eastern boundary of the site. This location includes a 30-meter tall meteorological tower and is one of the two onsite PM-10 monitoring locations.
- Air Monitoring Site No. 3: This location is also referred to as West Site and is located near the western boundary of the site.
- Air Monitoring Site No. 4: This location is also referred to as the Cooper Site and is located northwest of the site. This site is upwind and will be the background site following startup of operations.
- Air Monitoring Site No. 5: This location is also referred to as the Carver Site and is located southeast of the site. This site is downwind and was chosen as the location of the nearest residence.

All five air monitoring stations are equipped with instrumentation for sampling radionuclides. Additionally, Air Monitoring Sites No. 1 and No. 2 are equipped to collect PM-10 data and a comprehensive range of meteorological data. Refer to Figure 6-1, Air and Meteorological Monitoring Locations, for the locations of the monitoring stations in relation to the Property boundary.

The following sections describe the program for monitoring air quality and meteorological conditions during operation of the Facility. Table 6-2, Air and Meteorological Monitoring Summary, summarizes the monitoring conducted for each particular component of the program.

6.1 Meteorological Monitoring Stations

The Meteorological Monitoring Procedure (Procedure No. EV-060) describes the meteorological monitoring program utilized at the mill site (see Appendix A). Meteorological data is collected continuously at Air Monitoring Sites No. 1 and No. 2 and is retrieved on a daily basis via an automated Data Collection System ("DCS"). The following parameters are measured based on EPA MMGRMA guidance:

- Wind speed, direction and sigma theta;
- Vertical wind speed;
- Temperature;
- Relative humidity;
- Delta temperature;
- Barometric pressure;
- Solar radiation;
- Precipitation (Site No. 1 only); and
- Evaporation (Site No. 1 only).

6.2 Point Sources (Stack Sampling)

The Stack Sampling Procedure (Procedure No. EV-070) describes the methods of collection, analysis, and reporting of effluents from mill equipment during the operational phase of the Facility (see Appendix A). The procedure and the number of and types of analytes for the samples are based on requirements provided by NRC Regulatory Guide 4.14 (NRC 1980).

The yellowcake dryer used at the Piñon Ridge Mill is a zero-emissions unit. As air is heated and water evaporates in the yellowcake dryer, the moist air is drawn through the dryer's baghouse unit where particles are captured on the filter socks. When the socks become loaded, the sock cage is automatically vibrated causing the dust to fall back through the baghouse port into the dryer. The air flowing from the baghouse is drawn by a vacuum to a condenser where the water and any remaining particulates are removed from the air and pumped to the uranium thickener feed box. The clean air is vented back to the yellowcake packaging room. Therefore, monitoring of effluents from the yellowcake dryer is not required.

Effluents from the vanadium vent stack (i.e., packaging stack) are sampled quarterly during normal operations. The sampling is isokinetic, representative, and adequate for determination of the release rates and concentrations of U-nat, Th-230, Ra-226, and Pb-210. Other stacks are sampled semiannually and the samples are representative (not necessarily isokinetic) and adequate for the determination of the release rates and concentrations of U-nat, Th-230, Ra-226, and Pb-210. All stack flow rates are measured at the time of sampling. The air sample analyses

results are used to determine the radionuclide release rates for the stacks and the radionuclide concentrations for the stacks and other sampling locations.

6.3 Total Suspended Particulates (TSP)

The Air Particulate Sampling Procedure (Procedure No. EV-080) specifies methods for environmental air quality particulate monitoring for radionuclides in the ambient air around the perimeter of the mill site. Procedure No. EV-080 further specifies methods for sampling, sample handling, equipment monitoring and maintenance, documentation, analysis, and reporting associated with these air particulate samples. Air particulate filters are changed biweekly (or more frequently as required due to loading) and composite samples are analyzed quarterly for U-nat, Pb-210, Ra-226 and Th-230. Each air particulate sampler is calibrated quarterly. The Calibration of Environmental Air Samplers Using the Plate Orifice Method Procedure (Procedure No. EV-081) provides guidance and instruction for the calibration of environmental air samplers using a variable resistance orifice plate calibrator or a calibration orifice with individual resistance plates. Refer to Appendix A for the above-mentioned procedures.

6.4 PM-10

The PM-10 Sampling Procedure (Procedure No. EV-090) specifies methods for environmental air quality monitoring for particulate matter less than 10 microns ("µm") in size ("PM-10"). Procedure No. EV-090 further specifies methods for sampling, sample handling, equipment monitoring and maintenance, documentation, analysis, and reporting associated with these PM-10 samples. Air particulate filters are run for 24 continuous hours on a 1-in-3 day sampling schedule. Filters are changed between sampling days. The filters are submitted to the laboratory for analysis of PM-10 content on a monthly basis. The Calibration of PM-10 Samplers Procedure (Procedure No. EV-091) provides guidance and instruction for the calibration of PM-10 samplers using a certified flow standard. Refer to Appendix A for the above-mentioned procedures.

6.5 Radon Monitoring

6.5.1 Radon Ambient Air Monitoring

In accordance with NRC Regulatory Guide 4.14 (NRC 1980), passive track etch detectors were placed at each of the five air monitoring station locations to measure Radon-222 ("Rn-222") air concentrations. Rn-222 measurements were collected for over a year, March 8, 2008 through July 1, 2009, with detectors exchanged quarterly. Table 6-1, Baseline Radon-222 Measurements, summarizes the results of the Rn-222 analyses.

Table 6-1
Baseline Radon-222 Measurements

Dates of Exposure	Range of Results (pCi/L)	Average Result (pCi/L)
March to June 2008	0.6 to 0.9	0.8
July to September 2008	1.7 to 1.9	1.8
October to December 2008	1.6 to 3.2	2.0
January to March 2009	3.3 to 4.1	3.7
April to June 2009	0.7 to 1.3	0.9

On average these measured background values are within the range, albeit on the high end, of reported worldwide ambient background radon concentrations, 0.027 to 2.7 pCi/L [United Nations Scientific Committee on the Effects of Atomic Radiation ("UNSCEAR" 2000)]. Operational monitoring levels are compared to measured background values.

The Radon-222 Air Surveys Procedure (Procedure No. EV-100) describes the methods utilized for collection, analysis, and reporting of environmental air concentrations of Rn-222 in and around the mill site during the operational phase of the Facility (see Appendix A). The procedure applies to all environmental samples of Rn-222 taken at outlying locations from the mill and is based on Regulatory Guide 4.14. Unexposed Rn-222 monitors replace exposed Rn-222 monitors on a quarterly basis or as determined by the RSO. For QA/QC purposes, a duplicate detector is placed at one location during each sampling event. The exposed radiation detectors are shipped to the laboratory for analysis and the RSO reviews the analytical results for any values that exceed historical measurements and implements any needed corrective action.

6.5.2 Radon Flux Measurements

In accordance with NRC Regulatory Guide 4.14 (NRC 1980), three rounds of Rn-222 flux measurements were taken in October 2007, April 2008, and July 2008 to characterize pre-operational conditions. Rn-222 flux emission rates were measured from nine locations within the area of the tailings cells. Sampling for all periods yielded an average flux of 1.7 picocuries per meter squared second (pCi/m^2-s). Rn-222 flux rates ranged from 0.41 to 3.78 pCi/m^2-s. These values are one to two orders of magnitude below the National Emissions Standards for Hazardous Air Pollutants ("NESHAP") requirements of 20 pCi/m2-s specified in 6 CCR 1007-1, Part 18, Appendix A, Criterion 6. Although the latter requirement applies to tailings and thus is not directly relevant to this characterization, it is useful as a context to demonstrate the relative magnitude of baseline Rn-222 flux levels measured in the central portion of the site.

The Radon Flux Measurements Procedure (Procedure No. EV-110) describes the methods for measuring the Rn-222 emanation rates from the tailings cells during the operational phase of the Facility (see Appendix A). The procedure applies to the collection of samples and the measurement of the emanation rate from the tailing cells in order to demonstrate compliance with the Federal requirements at 40 CFR, Part 61, Subpart W, NESHAP for Radon Emissions from Operating Mill Tailings. Procedure No. EV-110 describes the number of samples and the

collection locations for each round of testing. Measurement testing is performed annually, during the summer when meteorological conditions are optimal for testing. Radon flux canisters are analyzed using EPA Test Method 115, Monitoring for Radon-222 Emissions, and a written report is provided to the APCD of CDPHE summarizing the results.

6.6 Reporting Schedule

Data is submitted on a semiannual basis to the Air Pollution Control Division ("APCD") and the RMP of CDPHE. The semiannual reports summarize monitoring activities at the sites and provide monthly averages of meteorological conditions, sampling data sheets, analytical reports, audit and calibration sheets, along with an evaluation of data trends. The reports are submitted to the APCD and RMP within 90 days after the end of each six-month reporting period.

Table 6-2
Air and Meteorological Monitoring Summary

Type of Sample		Sample Collection				Sample Analysis		Sampling Procedure
		Number	Location	Method	Frequency	Frequency	Type of Analysis	
Meteorology		Two	Air Monitoring Sites No. 1 and 2	Continuous	Daily	Daily	DCS	EV-060
Point Source Emissions (Stacks)	Particulates	One	Packaging stack	Isokinetic	Quarterly	Each sample	U-nat, Th-230, Ra-226, and Pb-210, Measure stack flow	EV-070
	Particulates	One for each stack	Other stacks	Represen-tative grab	Semiannually	Each sample	U-nat, Th-230, Ra-226, and Pb-210, Measure stack flow	
Air	Total Suspended Particulates	Five	Five air monitoring stations	Continuous	Biweekly filter change, or more frequently as required by dust loading	Quarterly composite (by location) of weekly samples	U-nat, Ra-226, Th-230, and Pb-210	EV-080
		One	Nearest residence or occupiable structure (Carver Site – Air Monitoring Site No. 5)	Continuous	Biweekly filter change, or more frequently as required by dust loading	Quarterly composite of weekly samples	U-nat, Ra-226, Th-230, and Pb-210	
		One	Control Location (Cooper Site – Air Monitoring Site No. 4)	Continuous	Biweekly filter change, or more frequently as required by dust loading	Quarterly composite of weekly samples	U-nat, Ra-226, Th-230, and Pb-210	
	PM-10 (Particulate Matter less than 10 µm)	Two	Air Monitoring Sites No. 1 and 2	24-hour composite	1-in- 3 day	Monthly	PM-10	EV-090
	Radon Gas	Five or more	Same locations as for air particulates	Continuous or at least one week per month	At least one week per calendar month representing approx. the same period each month	Monthly	Rn-222	EV-100
	Radon Flux	200 (100 per testing round)	Exposed tailings beach(s) and soil-covered beach regions	Canister-type collector	Annually (during summer)	Each sample	Rn-222	EV-110

7.0 Direct Radiation Measurements

Energy Fuels collected environmental dose rate measurements at the five air monitoring station locations using optically stimulated luminescence ("OSL") dosimeters. The measurements were collected in accordance with the Radiological Work Plan (ERG 2007). Ambient exposure rates were determined for four periods, using OSL dosimeters supplied and analyzed by an accredited laboratory. The monitoring periods were the third Quarter 2008 through the second Quarter 2009. Table 7-1, Control Corrected Ambient Gamma Dose Rates using OSL Dosimeters, summarizes the ambient gamma dose rate monitoring results. All dose rates are within the average worldwide exposures to natural radiation sources comprised of cosmic radiation, cosmogenic radionuclides, and external terrestrial radiation reported in the UNSCEAR Report to the General Assembly, Sources and Effects of Ionizing Radiation, Annex B. The typical ranges of average worldwide exposures reported in this reference document are to 60 to 160 millirem per year ("mrem/yr").

The Environmental Dosimetry Procedure (Procedure No. EV-120) provides the methods to determine gamma radiation levels in the environment on and around the mill site during operation of the Facility (see Appendix A). The monitoring procedure is based on requirements provided by NRC Regulatory Guide 4.14 (NRC 1980) and applies to all TLD and/or OSL systems distributed in the environment around the mill. In accordance with the procedure, OSL dosimeters are placed at each of the five air monitoring station locations to measure external ionizing radiation exposure. For QA/QC purposes, a duplicate dosimeter is placed at one location during each sampling event. Refer to Figure 6-1, Air and Meteorological Monitoring Locations, for the locations of the air monitoring stations.

These exposure measurements are collected over one year with dosimeters exchanged quarterly by Energy Fuels personnel. The dosimeters are provided and analyzed by a National Voluntary Laboratory Accreditation Program ("NVLAP") certified laboratory. Upon receipt of the TLD/OSL measured radiation doses from the laboratory, the RSO evaluates the exposure levels for the specific sites and reports this data, conclusions and any recommendations based on statistical and trend analysis in the semiannual report to the Plant Manager and to the CDPHE.

The Environmental Dose Assessment Procedure (Procedure No. EV-130) provides the methods to calculate doses to offsite members of the public for planning or compliance purposes. The procedure applies to all modeling calculations made to estimate doses to members of the public resulting from effluents from the Piñon Ridge Mill. MILDOS® software is used to assess the offsite radiation dose from the mill on an annual basis and as needed.

Table 7-2, Direct Radiation Sampling Summary, summarizes the program for sampling direct radiation during operation of the Facility.

Table 7-1
Control Corrected Ambient Gamma Dose Rates using OSL Dosimeters

Location	Period (Quarter)	Dose (mrem)	Average Dose per Monitoring Period (mrem)	Projected Annual Dose (mrem)
AMS-01	3rd QTR 2008	27.0	25.5	101.8
	4th QTR 2008	23.2		
	1st QTR 2009	24.3		
	2nd QTR 2009	27.3		
AMS-02	3rd QTR 2008	36.2	31.8	127.2
	4th QTR 2008	30.1		
	1st QTR 2009	31.1		
	2nd QTR 2009	29.8		
AMS-03	3rd QTR 2008	30.0*	30.2	120.8
	4th QTR 2008	30.1		
	1st QTR 2009	30.0		
	2nd QTR 2009	30.7		
AMS-04	3rd QTR 2008	31.2	28.4	113.4
	4th QTR 2008	25.5		
	1st QTR 2009	27.0		
	2nd QTR 2009	29.7		
AMS-05	3rd QTR 2008	34.0	31.3	125.1
	4th QTR 2008	30.1		
	1st QTR 2009	28.8		
	2nd QTR 2009	32.2		

Notes: *Dosimeter was damaged during processing; result is an estimated value from the laboratory.

Table 7-2
Direct Radiation Sampling Summary

Type of Sample	Sample Collection				Sample Analysis		Sampling Procedure
	Number	Location	Method	Frequency	Frequency	Type of Analysis	
Gamma Dose Rates	Five	Five air monitoring stations	Continuous (OSL dosimeters)	Quarterly change of dosimeters	Quarterly	Gamma exposure rate	EV-120
Dose Assessment Modeling	Various	Various receptor points as determined by the RSO	MILDOS® computer modeling software	Annually	Annually	Calculation of offsite radiation dose from mill	EV-130

8.0 Cultural Resources

Cultural resource surveys were conducted of the mill site and the well field area, located west of the mill site. Twenty-four archeological sites and sixteen isolated finds were identified. Four of the archeological sites and none of the isolated finds were National Register of Historic Places ("NRHP") eligible. A treatment plan was implemented for one NRHP eligible site, as disturbance of the area was necessary.

Prior to future disturbance of any areas of the mill site, the RSO will review identified cultural resource areas to ensure that they are not disturbed during site work. The RSO will provide a plan to avoid the identified cultural resource areas, if possible. If avoidance is not possible, a qualified archeologist will be contracted to prepare an avoidance plan or conduct treatment of the area to properly collect cultural resources that would be disturbed by the site work.

If previously unidentified or buried suspected cultural resources are discovered during site work, the work in the area will be suspended immediately. Work in the area will not continue until the cultural resources can be evaluated by a qualified archeologist. The archeologist will inspect the area for evidence of artifacts, cultural features, stained occupation surfaces, or human remains. The cultural resource inspection will include close coordination between the project archaeologist and construction personnel and recordation of the detected cultural materials, consisting of:

- completion of a site form for newly discovered sites;
- establishing a site-specific, permanent datum outside the disturbance zone so that the cultural remains can be mapped (distance and bearing from the datum to each feature or material concentration will be noted);
- photographing definable features;
- attempting to define the relationship between the cultural features and natural stratigraphy; and
- collection of samples for ancillary studies (e.g., radiocarbon dating, macro- and micro floral analyses), as determined necessary by the archaeologist.

At the discretion of the archeologist, auger/shovel probes and hand-dug test units may be conducted at the time of discovery or after construction is completed. Auger/shovel probes will be systematically placed to encompass the area containing the cultural materials. Formal hand-dug units will be excavated as necessary to gain a better understanding of the geomorphic and geoarchaeologic context of the cultural materials and to aid in the evaluation of the remains.

Five to ten meter spacing between probes is normal for most sites. All excavated sediment from the probes is screened through ¼-inch screen. Characteristics of the natural strata, their depth and thickness, and presence or absence of any cultural manifestations are all recorded for each probe. Shovel probes typically do not exceed a depth of 80 cm or until bedrock is reached. They are useful in detecting buried cultural horizons and material culture. Augers are most effective in documenting the presence of charcoal-stained soil with minimal impact to the

resource; their small size (10-cm diameter bucket) makes them less effective than shovel probes for detecting features or material culture.

Formal hand-dug units are used to examine cultural features detected during the open trench inspection. The purpose of test units is to gather stratigraphic and contextual data, which will aid in evaluation of the remains. Units are typically one square meter in size. A number of units may be excavated adjacent to one another to investigate large features. Standard excavation techniques are employed: all sediment is screened and excavators record descriptions of all recovered material and stratigraphic associations.

Feature excavation would proceed according to standard techniques:

- the feature is exposed in plan view;
- the feature is drawn and/or photographed;
- half the feature is excavated, with the fill bagged;
- any internal stratification is noted during the profile recordation;
- then the remainder of the feature is excavated and fill collected; and
- after excavation, final plan views and profiles are produced and a feature record is completed which contains dimensions, stratigraphic position and association, associated material culture, and any insights from the excavators.

Collections made during testing are generally limited to material recovered from the probes and hand-dug units. Burned stone is not usually collected; it is counted, described, and weighed in the field. Feature fill is collected to facilitate ancillary studies, such as radiocarbon dating or botanical analyses. Results of most ancillary studies must be interpreted within the context of the entire assemblage, which is not possible unless data recovery is also conducted. In general, radiocarbon dates may be desirable to: a) date specific deposits, which would provide information on the depositional history of the area, and b) date specific cultural manifestations, which would facilitate evaluation in terms of a project-wide data recovery program. Micro- and macro-botanical analyses of feature fill is unlikely during evaluative testing. These types of analyses might be conducted if well-preserved unique features were encountered, and if such studies would provide specific information relevant to site evaluation and project goals.

The cultural materials will be evaluated using NRHP criteria A and D (36 CFR 60.4, 7/1/89 edition) and various supporting state and federal guidelines for the evaluation of significant cultural resources.

Criterion A deals with historic era cultural properties and states that significant sites are those that are associated with events that have made a significant contribution to the broad patterns of history. For example, historic trails, town sites, and other localities, which played a major role in the development of the west, are usually considered significant.

Criterion D states that eligible properties are those that have yielded, or may be likely to yield, information important to the understanding and interpretation of history or prehistory. These data may include, but are not limited to, culturally and temporally diagnostic artifacts and features, charcoal or other materials suitable for radiocarbon dating, and preserved flora, fauna, and other materials that would provide information on prehistoric subsistence and settlement

patterns. Also of interest are soils data and pollen, which can provide information on past depositional regimes and paleoclimatic models. It is generally understood that physical integrity is the primary criterion necessary for cultural materials to be considered significant.

9.0 Process Monitoring

This section of the Operational Monitoring Plan describes the program for monitoring the process water and waste and the related control systems during operation of the Facility. Table 9-1, Process Monitoring Summary, provides a summary of the monitoring conducted for each particular component of the program.

9.1 Tailings Cells and Evaporation Ponds

Routine sampling of the raffinate solution (discharged to the evaporation ponds) and the tailings solution and sands (discharged to the tailings cells) is conducted to provide continuous tail grade characterization of these byproduct wastes during the operational phase of the Facility. Samples of the tailings slurry are collected daily at the Tailings Collection Box located at the mill complex, immediately northwest of the Counter Current Decantation ("CCD") thickeners. Additionally, quarterly samples of the tailings sands and supernatant solution are collected at the tailings cells for characterization. Samples of the raffinate and evaporitic salts are collected at the evaporation ponds on a quarterly basis for characterization. Tail grade samples are analyzed for uranium and vanadium and may be analyzed for other constituents (e.g., bicarbonate) on an as needed basis. Characterization samples will be analyzed for the suite of parameters listed in Table 9-2, Characterization Monitoring Parameters.

9.2 Leak Collection and Recovery Systems

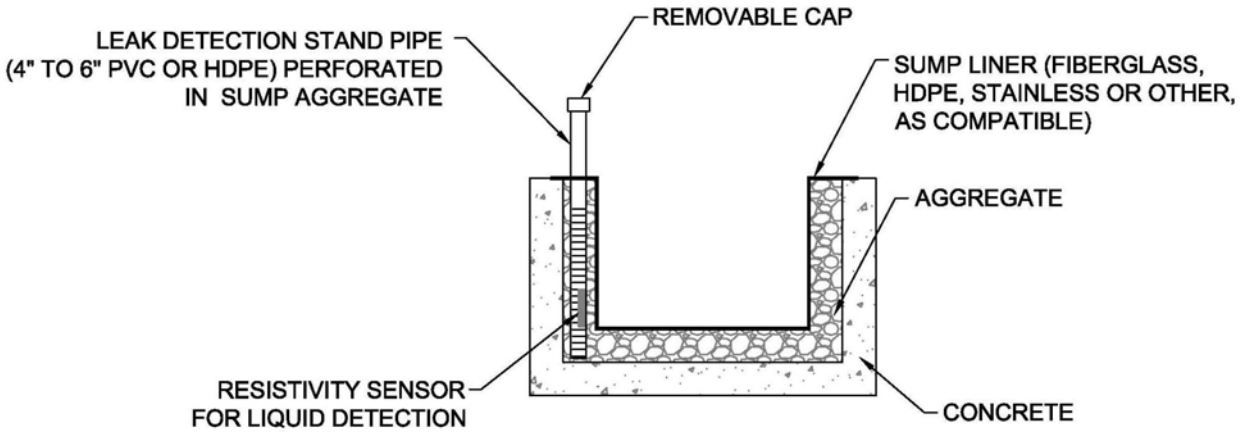
The tailings cells and evaporation pond cells each have multiple liners with a dedicated leak collection and recovery system ("LCRS") located below the primary liner for seepage collection. Any seepage through the primary liner is collected in the LCRS and routed via gravity flow to an LCRS sump located in each tailings cell and evaporation cell. Two 10-inch diameter, high density polyethylene ("HDPE") riser pipes (primary and backup) extend from the sump beneath the primary liner to the surface. The riser pipes are slotted within the sump area and booted to the liner where they perforate the primary liner at the surface.

The LCRS sumps are equipped with water level indicators, and portable submersible pumps installed in the riser pipes, as necessary, to automatically remove any water collected in the sump to the respective tailings cell or evaporation pond cell. Additionally, the LCRS risers are instrumented to automatically report to the mill control and alarm system, providing continuous, online monitoring.

9.3 Mill Floor Sumps

Secondary containment is provided for reagent storage, processing, and waste disposal areas so that any leaks or spillage from primary containment does not impact the surrounding environment (i.e., soils, surface water, and groundwater). Secondary containment within the reagent storage and processing areas consists primarily of concrete floors or slabs and curbs or walls around the tanks, pipes, and other mill equipment. The concrete containment floors, walls, and floor drains (where present) are inspected routinely for cracks and other defects. Leak detection systems are also provided at those locations where visual monitoring is not practical.

The contained areas are typically equipped with one or more sumps where solution and slurry can collect for pumping back into the system or to the active tailings cell. Since these sumps may be subjected to higher levels of hydraulic head, they are also equipped with secondary containment as illustrated below. Primary containment typically consists of a sump constructed of fiberglass, HDPE or an equivalent material that is compatible with the solutions or slurries in that area of the mill. Secondary containment typically consists of a concrete box structure around the outside of the primary sump. Washed aggregate is placed between the primary and secondary containment to provide a porous media for collection of any leakage. A standpipe, located in one corner of the secondary containment, is used to monitor for the presence of solution. The standpipe is typically 4-inch diameter PVC or HDPE pipe placed between the primary and secondary containment. The pipe, which is perforated within the sump area, extends several feet above the mill floor and is equipped with a removable cap. This secondary containment standpipe is instrumented with a resistivity probe or similar device that alerts mill personnel should moisture be detected between the sump's primary and secondary containment. The system automatically reports to the mill control and alarm system, providing continuous, online monitoring. Mill personnel also manually check the standpipes for solution on a routine basis.



FLOOR SUMP CROSS-SECTION
N.T.S.

9.4 Process Pipelines

Process and reagent lines, which are not within a concrete secondary containment area, are placed inside an outer pipe sleeve, lined pipe rack, or lined trench. In each case, the secondary containment discharges into a concrete containment area with a double-contained floor sump (described above). If the inner pipe develops a leak, the solution will drain by gravity to the double containment area and then to the sump. This system provides for containment and detection of leaks. Mill maintenance personnel inspect leak detection points daily.

The larger tailings and raffinate disposal lines are located in a lined trench that daylights at the tailings cell and evaporation ponds. With the exception of vehicle crossing points, the trench is open and leakage may be detected through visual observation of the pipes. The lined trench

slopes down from the mill to the tailings cells and evaporation ponds; therefore, if a leak were to occur in a disposal line, the solution would be contained within the trench liner and flow into a tailings cell or evaporation pond. Tailings personnel inspect the tailings pipelines daily.

9.5 Ore

Routine sampling of the feed pulp (ore and water slurry) will be conducted each shift for head grade characterization. A portion of each sample will be composited and the composite sample will be dried and analyzed quarterly to provide characterization of this material during the operational phase of the Facility. Head grade samples are analyzed for uranium and vanadium and may be analyzed for other constituents (e.g., bicarbonate) on an as needed basis. Characterization samples will be analyzed for the suite of parameters listed in Table 9-2, Characterization Monitoring Parameters.

9.6 Surface Seepage

Sampling of any unusual releases (such as surface seepage) that are not part of normal operations will be conducted on a per occurrence basis. Surface seepage sampling, if necessary, will be performed in a similar manner to surface water sampling. The samples will be analyzed for constituents to be determined based on the suspected source of the seepage and at the discretion of the RSO.

Table 9-1
Process Monitoring Summary

Type of Sample		Sample Collection				Sample Analysis		Sampling Procedure
		Number	Location	Method	Frequency	Frequency	Type of Analysis	
Tailings Cells and Evaporation Ponds	Tailings slurry	One	Tailings Collection Box	Grab	Daily	Each sample	Tail grade	Onsite Laboratory SOP
	Tailings supernatant solution and sands	Varies	Active tailings cells (beaches and supernatant ponds)	Grab (composite)	Quarterly	Quarterly	Table 9-2	Per RSO direction
	Raffinate	Varies	Active evaporation ponds					
	LCRS	Varies	Active tailings cells and evaporation ponds	Probe	Continuous	Large leaks (Action Leakage Rate)		
Mill Floor Sumps	Reagents and process solutions	Varies	Reagent storage and processing areas	Probe	Continuous	Large and rapid leaks	Table 9-2	Perform repairs as necessary
Pipelines	Reagents and process solutions	Varies	Process and reagent pipelines and containments	Visual	Daily	N/A	Visual inpsec-tions	Perform repairs as necessary
Ore	Pulp (ore/ water slurry)	One	Between pulp storage and pre-leach tanks	Grab	Per shift	Per sample	Head grade	Onsite Laboratory SOP
		One	Between pulp storage and pre-leach tanks	Grab (composite)	Per shift	Quarterly composite	Table 9-2	
Surface Seepage	Process solution	Per occurrence	Where surface seepage is observed	Grab	Per occurrence	Each sample	Table 4-2	Per RSO direction

Notes:
(1) N/A = Not Applicable.

Table 9-2
Characterization Monitoring Parameters

Total Metals	Major Ions	Total Radionuclides	Physical Properties	Organics
Aluminum	Alkalinity	Uranium	Conductivity	Total Organic Carbon (TOC)
Antimony	Bicarbonate	Gross Alpha	Hardness	Total Petroleum Hydrocarbons (TPH)
Arsenic	Calcium	Gross Beta	pH	
Barium	Chloride	Radium-226	TDS – Total Dissolved Solids	
Beryllium	Fluoride	Radium-228	Conductivity	
Boron	Magnesium	Thorium-230		
Cadmium	Nitrate	Lead-210		
Calcium	Nitrate+Nitrite			
Chromium	Phosphorus			
Copper	Potassium			
Iron	Silica			
Lead	Sodium			
Magnesium	Sulfate			
Manganese				
Mercury				
Molybdenum				
Nickel				
Phosphorus				
Potassium				
Selenium				
Silica				
Silver				
Sodium				
Thallium				
Uranium				
Vanadium				
Zinc				

10.0 Radiological Monitoring

The Radiation Safety Laboratory is located within Area 900, General Arrangements Change House and Laboratory Building. This laboratory will house the survey and measurement equipment required to perform on site radiological and personnel surveys in support of the radioactive materials license. The room will be enclosed, ventilated and properly sealed to create a low radiological background environment, provide a reduced air particulate/dust atmosphere and provide a secure area for equipment, supplies and sources required for radiation measurements.

The following identifies specific radioactive measurements required for the Radiological Monitoring Program:

- Direct Gamma Radiation;
- Personnel Dosimetry via TLD/OSLs;
- Airborne Particulates - Long Lived Radionuclides;
- Radon Progeny;
- Surface Contamination Surveys;
- Bioassay, including Urinalysis and In Vivo Programs.

Procedures for these Radiation Safety Monitoring programs are included in the Piñon Ridge Mill Health and Safety Plan (Energy Fuels 2009c).

In addition to the CDPHE Hazardous Materials And Waste Management Division 6 CCR 1007-1 State Board Of Health Rules And Regulations Pertaining To Radiation Control Part 4: Standards For Protection Against Radiation and its cited references, NRC regulatory guides and NRC Regulation ("NUREG") documents have been referenced. These include NRC Regulatory Guide 8.30, Health Physics Surveys In Uranium Recovery Facilities, and Regulatory Guide 8.31, Information Relevant To Ensuring That Occupational Radiation Exposures At Uranium Recovery Facilities Will Be As Low As Is Reasonably Achievable. These documents will be used as guidance as will be NUREG/CR-0041 revision1, Manual of Respiratory Protection Against Airborne Radioactive Material, January 2001.

A general list of equipment used for radiological monitoring includes:

- high volume (area) and low volume (breathing zone) air sampling pumps and associated calibration bubble tubes;
- ratemeter (scaler) paired with alpha measurement photomultiplier detector for air filter counting;
- microroentgen ("µR") meter for performing area gamma surveys;
- ratemeter (scaler) paired with an alpha radiation detection probe and a beta/gamma thin window probe for personnel and equipment monitoring;
- respiratory protection equipment; and
- support supplies, check sources, etc. required to perform radiation safety and health measurements on site.

10.1 Airborne Particulate - Long Lived Radionuclides

Surveys for airborne uranium ore dust are necessary to:

- demonstrate compliance with the 10 mg soluble uranium weekly intake limit for workers specified in Colorado Regulations 4.6, Occupational Dose Limits for Adults, Section 4.6.5.2;
- demonstrate compliance with internal dose limits specified in Colorado Regulations 4.7, Compliance with Requirements for Summation of External and Internal Doses, 4.8, Determination of External Dose from Airborne Radioactive Material and 4.9, Determination of Internal Exposure;
- determine the areas that need to be posted as "Airborne Radioactivity Areas" as specified in NRC May 2002 Regulatory Guide 8.31, Information Relevant To Ensuring That Occupational Radiation Exposures At Uranium Recovery Facilities Will Be As Low As Is Reasonably Achievable;
- determine whether precautionary procedures, such as additional administrative or engineering controls, limitations on working times, use of respiratory equipment, or other precautions need to be implemented; and
- determine whether exposures to airborne radioactive materials are being maintained to levels that are ALARA.

Breathing-zone and area air samples are used to estimate radionuclide intakes via inhalation by mill workers. Exposure to soluble uranium is limited to a weekly intake of 10 mg based on chemical toxicity. Air monitoring results will be reviewed by the RSO or designee within two working days after receipt of the analytical results.

Under routine mill operating conditions, breathing zone air samples are used to assess radionuclide concentrations in air when those concentrations could be greater than 0.1 derived air concentration ("DAC"). In contrast, area air samples may be used exclusively to measure air concentrations in areas where the radionuclide concentrations range from 0.01 to 0.1 DAC. Below 0.01 DAC, air samples are not required but should be collected periodically to demonstrate radionuclide concentrations are low. Using the above criteria, the RSO makes the decision as to the types of air sampling and frequencies most appropriate for the work conditions.

10.2 Radon Progeny

Significant air concentrations of Rn-222 and its progeny may occur near ore storage bins, near crushing and grinding circuits, or in enclosed locations where large quantities of dry ore are found. Indoor radon progeny (daughter), working level (WL), measurements will be the preferred sampling and measurement method utilized. However, the need for continuous radon progeny concentration measurements may be required, as determined by the RSO.

The modified Kusnetz method for measuring radon progeny in working levels will be used to assess radon progeny concentrations. Automated equipment such as the Radiansa Durridge RAD7 (or equivalent) continuous radon in air measurement system may also be used.

10.3 External Beta/Gamma Radiation

Gamma radiation surveys will be performed at least semiannually throughout the mill and facility representative of where workers are potentially exposed. These areas are represented by the following, but are not limited to:

- ore feed hopper;
- ore conveyor gallery;
- ore sampling preparation area;
- semi-autogenous mill ore feed area;
- semi-autogenous mill ore discharge area;
- leach tank area;
- countercurrent decant thickener area;
- solvent extraction area;
- yellowcake precipitation tank area;
- yellowcake thickener area;
- yellowcake drum filter area;
- yellowcake drier area;
- yellowcake packaging area;
- yellowcake storage area;
- laboratory area;
- lunch area;
- change room;
- maintenance shop area;
- shift foreman office; and
- main office area.

The RSO will evaluate methods to lower exposure rates to levels that are ALARA. Gamma surveys performed for this purpose must be representative of both routine and non-routine work so that their whole-body radiation exposures can be estimated. Thus, measurements are generally made at about waist height and 12 inches from surfaces. Surface "contact" exposure rate measurements are not used to establish radiation area boundaries or estimating personnel whole-body exposures, because these exposures are not representative of the worker's true exposures.

10.4 Personnel Dosimetry and Alpha Contamination

Personnel monitoring required to measure dose equivalents arising from exposures to photons (x or gamma rays), will have a deep, lens of eye and shallow value measured. Beta exposure will be reported as a shallow dose equivalent.

10.5 Surface Contamination Surveys, Alpha Beta/Gamma

Surface contamination surveys (both for fixed and removal contamination) will be routinely conducted to control the spread of radioactive contamination within both radiation restricted and unrestricted areas to minimize radiation doses to workers and the public.

10.6 Bioassay, Urinalysis and In-vivo Lung (thorax)

Bioassays are required for all mill operation personnel during both routine and non-routine operations where reason exists that an exposure could exceed 30 percent of the ALI or a weekly intake of 3 mg weekly intake of soluble uranium.

The urinalysis program conducted at the mill follows the CDPHE Regulations and its citations, the NRC Regulatory Guide 8.22, "Bioassay at Uranium Mills" and the NRC Regulatory Guide 8.25, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program."

In- vivo lung counts are conducted in response to confirmed urinalysis results in accordance with the criteria in NRC Regulatory Guide 8.22, "Bioassay at Uranium Mills."

The radiological monitoring program to be used within the mill during mill operations is summarized in Table 10-1, Operational Radiological Health and Safety Monitoring, Table 10-2, Mill Radiological Control Program – Operational, and Table 10-3, Acceptable Surface Contamination Levels.

Table 10-1
Operational Radiological Health and Safety Monitoring

Health and Safety Sample Type and Sampling Criteria				
Type	Location	Frequency	Method	Parameter to be Measured
Airborne long lived radionuclides	Designated facility areas	Occupied Areas > 1.0 DAC Daily 0.3-1.0 DAC Weekly <0.3 DAC. Monthly	Breathing zone samples for >0.1 DAC, area air samples may be used for 0.01-0.1 DAC	Gross alpha activity
	Equipment	Gast Rotary Vane Pump, or equivalent vendor, for high flow area air sampling. Ludlum 2241-2 ratemeter or equivalent connected to a 43-10 sample counter or equivalent. An Eberline DNS11 0.001 to 0.01 uCi or equivalent supplier, certified Thorium-230 plated check source.		
Radon Gas, Radon-222 and Radon Progeny	Designated facility areas	Weekly >0.08 WL Monthly 0.03-0.08 WL Quarterly <0.03 WL	Modified Kusnetz	Radon progeny (daughters) in Working Levels (WL)
	Equipment,	Gilian 3500, or equivalent vendor, breathing zone sampling pump. Ludlum 2241-2 ratemeter or equivalent connected to a 43-10 sample counter or equivalent. An Eberline DNS11 0.001 to 0.01 uCi or equivalent supplier, certified Thorium-230 plated check source.		
	Designated facility areas	Quarterly	Track Etch or equivalent system	Radon Gas
	Equipment	Landauer Radtrak® Dosimeter or equivalent vendor		
Facility Gamma Radiation	Designated facility areas	Semiannually	Survey meter	Exposure Rate (μR/hr)
	Equipment	Ludlum or equivalent vendor Micro R meter Model 19 or equivalent		
Personnel Beta/Gamma	Mill operations personnel and Declared Pregnant Worker	Quarterly	Dosimeter monitoring system or equivalent	Skin Dose Equivalent Lens Dose Equivalent Deep Dose Equivalent
	Contractors/Long-term Visitors	Daily or Quarterly depending on the duration of stay		
	Equipment	Personnel and long term contractors or visitors - Landauer LUXEL+ monitoring system or equivalent vendor Visitor and short term contractors -Direct reading dosimeter Ludlum AT-138 or equivalent vendor		
Personnel Alpha	All operations, visitors, personnel within the restricted area	Upon leaving restricted area	Direct surface measurement (fixed)	Fixed or removable Alpha
	Equipment	Ludlum 2241-2 ratemeter or equivalent connected to a 43-93 probe for alpha surveys, or equivalent vendor. An Eberline DNS11 0.001 to 0.01 uCi or equivalent supplier, certified Thorium-230 plated check source or a similar non certified check source.		

Table 10-1 (continued)
Operational Radiological Health and Safety Monitoring

Health and Safety Sample Type and Sampling Criteria				
Type	Location	Frequency	Method	Parameter to be Measured
Surface contamination	Eating areas, change areas, control rooms	Weekly if above 500 dpm alpha per100 cm^2 otherwise every two weeks	Direct surface measurement (fixed) and smear (removable)	Removable, and fixed alpha contamination
	Equipment release	Released to an unrestricted area	Direct surface measurement (fixed) and smear (removable) and beta/gamma	Removable, and fixed alpha, beta/gamma contamination
	Administrative offices	Monthly	Direct surface measurement (fixed) and smear (removable)	Removable, and fixed alpha contamination
	Yellowcake areas	Daily	Visual	Particulate Contamination
	Personnel	Leaving restricted area	Direct surface measurement of skin and clothing	Alpha contamination
	Equipment	Ludlum 2241-2 ratemeter, or equivalent vendor, connected to a 43-10 sample counter or equivalent for removable (smear) samples and 43-93 probe for fixed alpha surveys, or equivalent vendor. An Eberline DNS11 0.001 to 0.01 uCi or equivalent supplier, certified Thorium-230 plated check source. Ludlum Beta/Gamma probe, 44-9, or equivalent, connected to Ludlum 2241-2 ratemeter. An Eberline CS7A 5+/- 1 uCi or equivalent supplier, non-certified cesium 137 plastic check source.			
Urinalyses	All mill workers	Monthly	Urinalysis by an outside laboratory recognized/accepted by CDPHE NRC Regulatory Guide 8.22, "Bioassay at Uranium Mills."	U-nat
	Yellowcake packaging	Weekly		
	Equipment	ICP-MS or equivalent performed by an approved outside laboratory		
In vivo lung count	Mill personnel with work assignments in airborne radioactivity areas	Two consecutive urinalysis results >35 ug/L or one result >130 ug/L	NRC Regulatory Guide 8.22, "Bioassay at Uranium Mills." The actions taken in response to the results of in-vivo lung counting are outlined in Table 2 of NRC Regulatory Guide 8.22	U-nat
	Equipment	In vivo lung measurement will be performed by an outside laboratory recognized/accepted by CDPHE		
Respirator Program	Certified personnel	As required for specific activities	Testing of respirators for operability (user seal check for face sealing devices and functional check for others) immediately prior to each use	ALARA for inhalation hazards
	Equipment	Respiratory protection equipment approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration		

Table 10-2
Mill Radiological Control Program – Operational

Sample Collection, Inspection or Calibration				
Type	Location	Frequency	Method	Parameter to be Measured
Instrument calibrations	All instruments in use	Annually or mfg's suggested interval whichever is sooner or after major repair	Voltage plateau Pulse Source	Instrument response
Air sampler calibrations	Air samplers	Quarterly	Bubble tube or equivalent	Flow rate
Visual inspections	Mill work and storage areas	Daily Documented weekly	Visual inspections	Radiation work practices, housekeeping, safety
Radiological & Operational Procedures	N/A	Annual review	Performed by RSO, Management & Supervisors	Procedure adequacy for current mill operating conditions
ALARA audit	N/A	Annually	Performed by in-house or independent knowledgeable individual(s)	License Compliance and workplace conditions
Radiological survey of equipment leaving restricted area	Exit points from restricted area	As needed	Fixed and removable Alpha surface measurements, Beta- Gamma	Alpha, Beta- Gamma surface contamination
Respiratory protection program	As required	Initial fit test prior to first task assignment requiring respirator then every 12 months thereafter or periodically at a frequency determined by a physician	OSHA Fit Testing Procedures (Mandatory) - 1910.134 App A	Proper fit and compatibility of respirator and user

Notes:
(1) N/A = Not Applicable.

Table 10-3
Acceptable Surface Contamination Levels

Nuclides(1)	Average(2,3,6)	Maximum(2,4,6)	Removable(5,6)
U-nat, U-235, U-238, and associated decay products	5,000 dpm alpha/100 cm^2	15,000 dpm alpha/100 cm^2	1,000 dpm alpha/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra- 224, U-232, I-126, I-131, I-133	1,000 dpm/1 00 cm^2	3,000 dpm/1 00 cm^2	200 dpm/1 00 cm^2
Beta-gamma emitters(nuclides with decay modes other than alpha emissions or spontaneous fission) except Sr-90 and others noted above	5,000 dpm beta-gamma/100 cm^2	15,000 dpm beta-gamma 100 cm^2	1,000 dpm beta-gamma/100 cm^2

Source: Reprinted from U.S. Nuclear Regulatory Commission, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source or Special Nuclear Material," November 1976

Footnotes:

(1) Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma emitting nuclides should apply independently.

(2) As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

(3) Measurements of average contaminant should not be averaged over more than one square meter. For objects of less surface area, the average should be derived for each such object.

(4) The maximum contamination level applies to an area of not more than 100 cm2.

(5) The amount of removable radioactive material per 100 cm2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

(6) The average and maximum radiation levels associated with surface contamination resulting from beta- gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

11.0 References

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Figures

Certain figures contained in this Operational Monitoring Plan are based on the original drawings contained in the Hydrogeologic Report for the Piñon Ridge Project prepared by Golder Associates, Inc., dated July 2009 (Golder 2009b). Those figures that are based on the Golder Hydrogeologic Report are noted as such.

Appendix A – Environmental Procedures

1) Procedure No. EV-010	Soil Sampling Procedure
2) Procedure No. EV-011	Soil Sampling QA/QC Procedure
3) Procedure No. EV-020	Vegetative Sampling Procedure
4) Procedure No. EV-030	Animal Tissue Sampling Procedure
5) Procedure No. EV-040	Surface Water Sampling Procedure
6) Procedure No. EV-041	Surface Water Sampling QA/QC Procedure
7) Procedure No. EV-050	Groundwater Sampling Procedure
8) Procedure No. EV-051	Groundwater Sampling QA/QC Procedure
9) Procedure No. EV-060	Meteorological Monitoring Procedure
10) Procedure No. EV-070	Stack Sampling Procedure
11) Procedure No. EV-080	Air Particulate Sampling Procedure
12) Procedure No. EV-081	Calibration of Environmental Air Samplers Using the Plate Orifice Method Procedure
13) Procedure No. EV-090	PM-10 Sampling Procedure
14) Procedure No. EV-091	Calibration of PM-10 Samplers Procedure
15) Procedure No. EV-100	Radon-222 Air Surveys Procedure
16) Procedure No. EV-110	Radon Flux Measurements Procedure
17) Procedure No. EV-120	Environmental Dosimetry Procedure
18) Procedure No. EV-130	Environmental Dose Assessment Procedure

Appendix B – Mitigation Plan for Pumping Production Wells