Section 2.0
Alternatives

2.1 NO ACTION ALTERNATIVE

Under this Alternative, CDPHE would deny Energy Fuels' Mill License Application for the proposed Piñon Ridge Mill. Construction and operation of the conventional mill facilities would not occur, and environmental impacts associated with the Mill would not occur.

The positive economic benefits to western Montrose County resulting from additional employment and consumer stimulus to the local economy would not occur under the No Action Alternative. The No Action Alternative would require that mines in the area transport uranium/vanadium ore longer distances to Cotter's Cañon City Mill, which is not currently receiving and processing uranium/vanadium ore and which could be uneconomical for those mines, or to the White Mesa Mill in Blanding, Utah, where available capacity is uncertain and where toll milling is not currently being practiced. Uranium resources in the area would not be developed and could not support the Energy Policy Act of 2005 which emphasizes the reestablishment of nuclear power.

2.2 PROPOSED ACTION ALTERNATIVE

2.2.1 Site Location and Description

The Site is located in Montrose County, Colorado in Paradox Valley, approximately 12 miles west of Naturita and approximately 7 miles east of Bedrock, southwest of SH 90 along the northeastern edge of Davis Mesa. The Site is located on one 880-acre parcel owned by Energy Fuels. An adjacent parcel of approximately 80 acres to the west of the 880-acre parcel is a well field for the location of water supply wells. Specifically, the Proposed Action is located 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 Site is located on Bull Canyon and Davis Mesa USGS 7.5-minute topographic quadrangles. General access to the Site is along SH 90 to milepost 23. The general location is shown on Figure 1.1-1 in Section 1.1, Introduction.

2.2.2 Property Boundaries and Disturbance

The limits of the 880-acre parcel are considered to be the Property Boundary. The entire Property Boundary would be fenced except for the portion of the property on the north side of SH 90. The area inside the Mill License Boundary which consists of 307.8 acres would be fenced with a 6-foot chain-link fence topped with three strands of barbed wire and would include the following project components: the Mill, three tailings cells, 10 to 20 evaporation ponds, an ore pad, and ancillary facilities such as roads, stormwater diversions, mill offices, and laboratories. The facility layout is provided on Figure 2.2-1. Ancillary facilities outside of the Mill License Boundary include the main access road and some secondary roads, the ore dumping platform, the administration building, change house and laboratory building, warehouse, truck shop, guardhouse, stormwater diversions, and monitoring systems. The western portion of the Site would be used to stockpile soil excavated for project components within the Mill License Boundary that would eventually be used to reclaim the area within the Mill License Boundary (the restricted area). A 10-foot wide access road would be constructed outside of the Mill License Boundary to access water production wells south of the Mill License Boundary, and a 60-foot corridor with a pipeline and access road would be constructed west of the Mill License Boundary to access water supply wells on the adjacent 80-acre parcel.

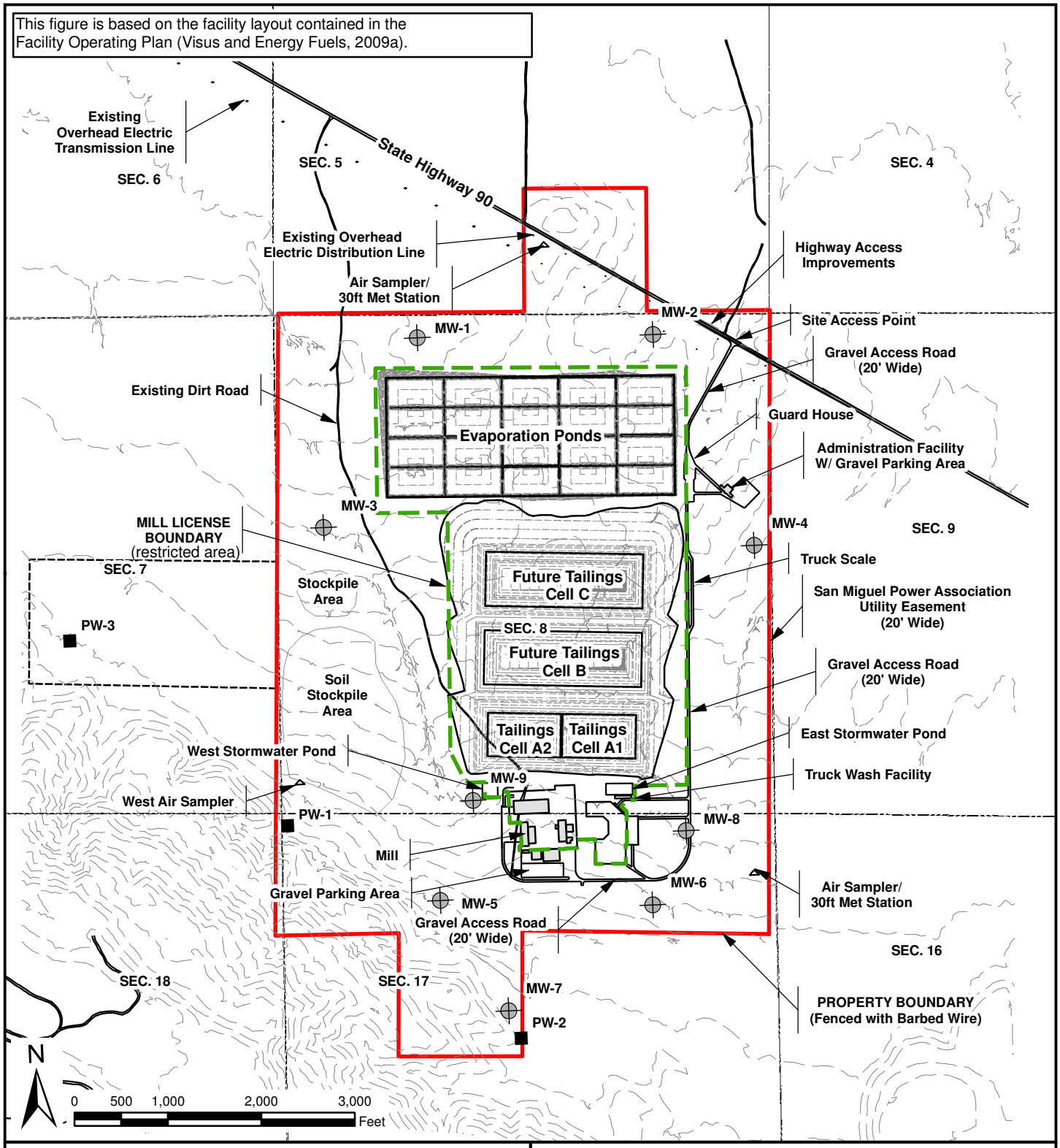


Figure 2.2-1

Site Plan

Table 2.2-1 provides the estimated surface disturbance for the Proposed Action both within and outside of the Mill License Boundary.

Table 2.2-1
Disturbance within and outside of Mill License Boundary

	Disturbance within Mill License Boundary (acres)	Disturbance outside of Mill License Boundary (acres)	Total Disturbance (acres)
Mill Components[1]	307.8	---	307.8
Stockpile	--	45.9	45.9
Topsoil Stockpile	--	6.0	6.0
Pipelines and Access Roads	--	5.6	5.6
Other	--	49.3	49.3
Total Disturbance	**307.8**	**106.8**	**414.6**

[1] Includes Mill, three tailings cells, 10 to 20 evaporation ponds, an ore pad.

2.2.3 Project Description

The Mill Facility consists of the Mill (i.e., mill processing buildings and equipment), tailings cells, evaporation ponds, an ore stockpile pad, and ancillary facilities including access roads, a truck scale, guard house, administration building, warehouse and maintenance buildings, laboratory, utilities, stormwater control structures, and soil stockpiles. At the start of operations, the Mill Facility would encompass approximately 300 of the 880 available acres and would gradually expand to encompass approximately 400 acres over the life of the Mill Facility or Proposed Action.

The Mill Facility would have a production rate of 500 tpd. With this production rate, most of the ore would be produced and delivered by mines owned by Energy Fuels. The balance of the ore would be purchased from, or toll milled for, other mines in the area. The life of the project is expected to be 40 years. Ore would be delivered to the Site and would be ground into a fine slurry and then leached with sulfuric acid to separate the uranium and vanadium from the remaining rock. Uranium and vanadium would be recovered from solution and precipitated as concentrates, which would be sealed in USDOT-approved 55-gallon steel drums and transported off site. The uranium concentrate would be sent to conversion facilities for uranium enrichment and the vanadium would be shipped to a plant that produces ferro-vanadium products.

2.2.3.1 Mine Locations and Hauling

Mine Locations and Resources. Mining methods, locations of mines, and regulatory requirements for mines are discussed in detail in the *Mine Operations Plan* (Energy Fuels, 2009d). Workforce requirements for the mines are also discussed in the *Mine Operations Plan* and considered in the workforce projections in Section 4.10, Socioeconomics.

The two, primary sources for uranium/vanadium ore delivered to the Site are the Energy Fuels Whirlwind Mine (formerly called the Packrat Mine and Urantah Decline) and the Energy Queen Mine (formerly called the Hecla Shaft Mine). These mines are located on the Colorado Plateau in Western Colorado and Eastern Utah, and are within reasonable truck hauling distance to the Site. More specifically, the Whirlwind Mine is located in Mesa County, Colorado and Grand County, Utah, approximately 5 miles southwest of Gateway, Colorado. The Energy Queen Mine is located in San Juan County, Utah between La Sal and La Sal Junction. Both of these mines are capable of producing 200 tpd or more of uranium ore and are fully permitted.

The balance of the ore feed could come from mines that are controlled and operated by other mining companies in the area. Energy Fuels also has approximately 20 additional uranium properties on the Colorado Plateau in Western Colorado and Eastern Utah that could become future sources of ore.

Ore Haulage Routes. The majority of uranium/vanadium ore transported to the Mill Facility would arrive on SH 90, from either east or west of the Site. Some of the ore may come to the Site directly from Monogram Mesa through the Cotter Corporation property located directly southeast of the Site. Ore delivered from the west would primarily come from several mines in an area located just south and east of La Sal, Utah. Additional tonnage would come from the north on U.S. Highway 191 from its junction with Interstate-70 and from the south on U.S. Highway 191 from mines located south of Monticello, Utah.

The route east of the Site would be used to deliver ore mined from the Monogram Mesa and Long Park areas via existing Montrose County roads connecting to SH 90 roughly 5 miles east of the Site. Ore would be transported to Vancorum from the north via SH 141 and then west via SH 90 to the Site. Ore from the north would be trucked from the mines to SH 141 on existing Montrose County and Mesa County roads. Ore from the south would come through Naturita via SH 141 and U.S. Highway 491. These highways are fed by numerous county roads located in both Colorado and Utah. Energy Fuels estimates that approximately 42 percent of the mill feed would come from west of the Site, 17 percent from near the Site and 41 percent east of the Site. Estimates of traffic related to ore hauling are provided in Section 2.2.6, Traffic.

The USDOT is the primary regulatory authority for uranium ore haulage. To allow for efficient interstate commerce, the Colorado Department of Transportation (CDOT) and the Utah Department of Transportation (UDOT) have adopted the USDOT regulations in their entirety. USDOT regulations for the transport of radioactive materials are codified in Title 49 of the Code of Federal Regulations (CFR). The *Ore Transportation Plan*, which is included as Appendix B to the *Mine Operations Plan* (Energy Fuels, 2009d), describes Energy Fuels' procedures and methods for shipping uranium/vanadium ore from a mine to an off-site mill. A brief summary of the plan follows.

The uranium/vanadium ore shipped would typically average 0.15 to 0.25 percent U_3O_8. At these levels, uranium ore is regulated as a Class 7 radioactive material under the USDOT hazardous material regulations. Uranium ores and concentrates of uranium ores, because of their low specific activity are generally exempt from most packaging, marking, labeling, and placarding requirements of other Class 7 radioactive elements.

The ore would be loaded into highway haul trucks with a front-end loader or from a bin, taking precautions to avoid spillage and inhalation of dust during loading. The ore would generally be probed and a sample collected for later compositing and grade analysis. Precautions would be taken to meet the road weight limit requirements and to minimize tracking of materials onto roadways.

Prior to hauling, the load would be covered and each transport vehicle would be surveyed for leakage and radiation. Shipping papers must be fully completed and in the possession of the driver. Records of the inspections and radiation scans for each shipment would be maintained on-site. The transport carrier would be responsible for compliance with all applicable laws and adhering to established procedures and protocols during the transport of the ore from the mine to the Mill.

Emergency response information would be immediately available to all persons who transport or handle uranium ore. The transportation contractor would be responsible for implementing the plan in the event of an accident that results in the spillage of uranium ore onto a public road. Energy Fuels would provide emergency response support in accordance with its contract with the ore transporter. This could range from verification sampling at the completion of the cleanup to a full response including medical aid, traffic control, ore isolation and cleanup, and verification sampling.

Mining and carrier personnel are trained for the proper loading and transporting of uranium ore. The training includes basic radiation concepts, dust and contamination control, vehicle scanning requirements, exclusive use transport provisions, and emergency response contact and response information. Training records would be documented and maintained at the mine site.

2.2.3.2 Ore Stockpile Pad

Energy Fuels proposes to construct an engineered ore pad to receive and store the ore that would be delivered to the Mill Facility for processing. Having the capability to stockpile ore would enable Energy Fuels to maintain a readily available source of mill feed, balance mining and milling operations, and maximize the mill efficiency by blending and feeding stockpiled ore to the mill at varying rates and grades as necessary. Furthermore, ore deliveries to the Mill Facility from area mines would not be jeopardized during scheduled and unscheduled mill shutdowns.

Approximately 1 acre of the ore pad would be lined with concrete and the remaining 5 acres would be lined with a geosynthetic clay liner (GCL) covered with a protective layer of compacted native soils and roadbase materials. The concrete pad would be located next to the feed hopper and conveyor, where equipment loading and unloading activity would be greatest. The 5-acre lined pad would have a horseshoe-shaped configuration encircling the feed hopper and concrete pad. A front-end loader would feed the dumped ore into the ore hopper. The hopper would be enclosed within a three-sided structure equipped with water sprays to minimize fugitive dust emissions.

Ore would be delivered to the Site in 24-ton capacity dedicated highway trucks via SH 90 at the estimated rate of 500 tpd, or 21 loads per day, predominately during daylight hours. Eastbound and westbound ore deliveries are expected to be approximately equal. The delivered ore would be stockpiled on the ore pad and ultimately processed in the Mill. After being weighed, the majority of the haul trucks would drive onto an elevated earthen platform (located on the east end of the ore pad) and dump their loads over a retaining wall onto the 5-acre ore pad without entering the ore pad area. Trucks dumping onto the pad from the dumping platform would not require washing prior to leaving the Site provided they pass radiation screening levels.

Some of the haul trucks delivering ore would enter directly onto the concrete ore pad or 5-acre ore pad to dump their loads. This could occur for a number of reasons including a fully loaded dumping platform (i.e., no space left to dump) or if the load were coming from a smaller mine that did not have a designated dumping point on the platform. Upon leaving the pad, these trucks would be washed at the on-site truck wash facility and screened for radiation prior to leaving the Site. When a haul truck needs to be released from dedicated ore haulage for maintenance or for other hauling activities, it would be required to pass through the truck wash and pass required gamma screening and surface sampling and analysis prior to leaving the Site.

2.2.3.3 Mill

Milling is the term used to describe the grinding and further processing of ore to extract the valuable minerals from the host rock. At the Mill, ore would be ground into a fine slurry and then leached with sulfuric acid to increase the solubility of the uranium and vanadium. Uranium and vanadium would be recovered from solution and precipitated as uranium oxide (U_3O_8) concentrate (called yellowcake) and vanadium oxide (V_2O_5) concentrate, respectively. The Mill Facility would be designed to treat up to 500 tpd of ore and to produce both U_3O_8 and V_2O_5 over a 40 year operating life.

Figure 2.2-1 shows the proposed layout of the Mill. The primary mill buildings and their respective square feet (ft^2) of floor space are the semi-autogenous grinding (SAG) Mill/Leach Tank Building (22,000 ft^2), the Boiler Building (6,000 ft^2), the Solvent Extraction (SX) Building (49,000 ft^2) and the Drying/Packaging Building (46,000 ft^2). These buildings would have varying heights of up to 85 feet. The areas outside these buildings would be surfaced with gravel and sloped to drain. A detailed description of each of the primary milling stages can be found in the *Facility Operating Plan* (Visus and Energy Fuels, 2009a).

The proposed milling stages would include:

- Grinding;
- Pre-leaching and Thickening;
- Leaching;
- Liquid/Solid Separation and Purification;
- Uranium Recovery; and
- Vanadium Recovery.

Each milling stage and associated chemical reagent storage locations would incorporate secondary containment in the form of concrete curbs or stem walls that are designed to contain the contents of the largest tank or processing component plus 10 percent. Floor sumps would also be double contained and would have leak detection systems in place to alert operators if the primary sump enclosure were to develop a leak. Pipes not located within secondary containment walls would be enclosed within an outer pipe sleeve or a lined trench and would have leak-detection observation points. The following is a brief description of each primary component of the milling process. Figure 2.2-2, provides a process flowsheet as shown in the *Facility Operating Plan* (Visus and Energy Fuels, 2009a) which illustrates the milling and process stages.

Grinding. Run-of-mine ore would be fed into the Mill Facility from on-site stockpiles using a front-end loader and/or trucks. The ore would be dumped into a feed hopper and delivered by belt conveyor to a SAG Mill located in the main mill building (Grinding and Leaching Building). In the SAG Mill, the ore would be combined with water and tumbled with steel balls. The tumbling action causes the larger ore pieces and steel balls to grind the ore into fine powder, exposing the uranium and vanadium mineral surfaces of the host rock.

Pre-leaching and Thickening. The resulting slurry from the SAG Mill, consisting of 0.03-inch sized particles and water, would be distributed to one of two large pulp storage tanks located outside in the area west of the Grinding and Leaching Building. The slurry would be pumped from the storage tanks to two pre-leach tanks where the pulp is mixed with the pregnant solution from the counter current decantation (CCD) thickeners, which carries excess sulfuric acid that starts the leaching process. The pulp would then report to a thickener tank. The overflow from

This figure is based on the Facility Operating Plan (Visus and Energy Fuels, 2009a).

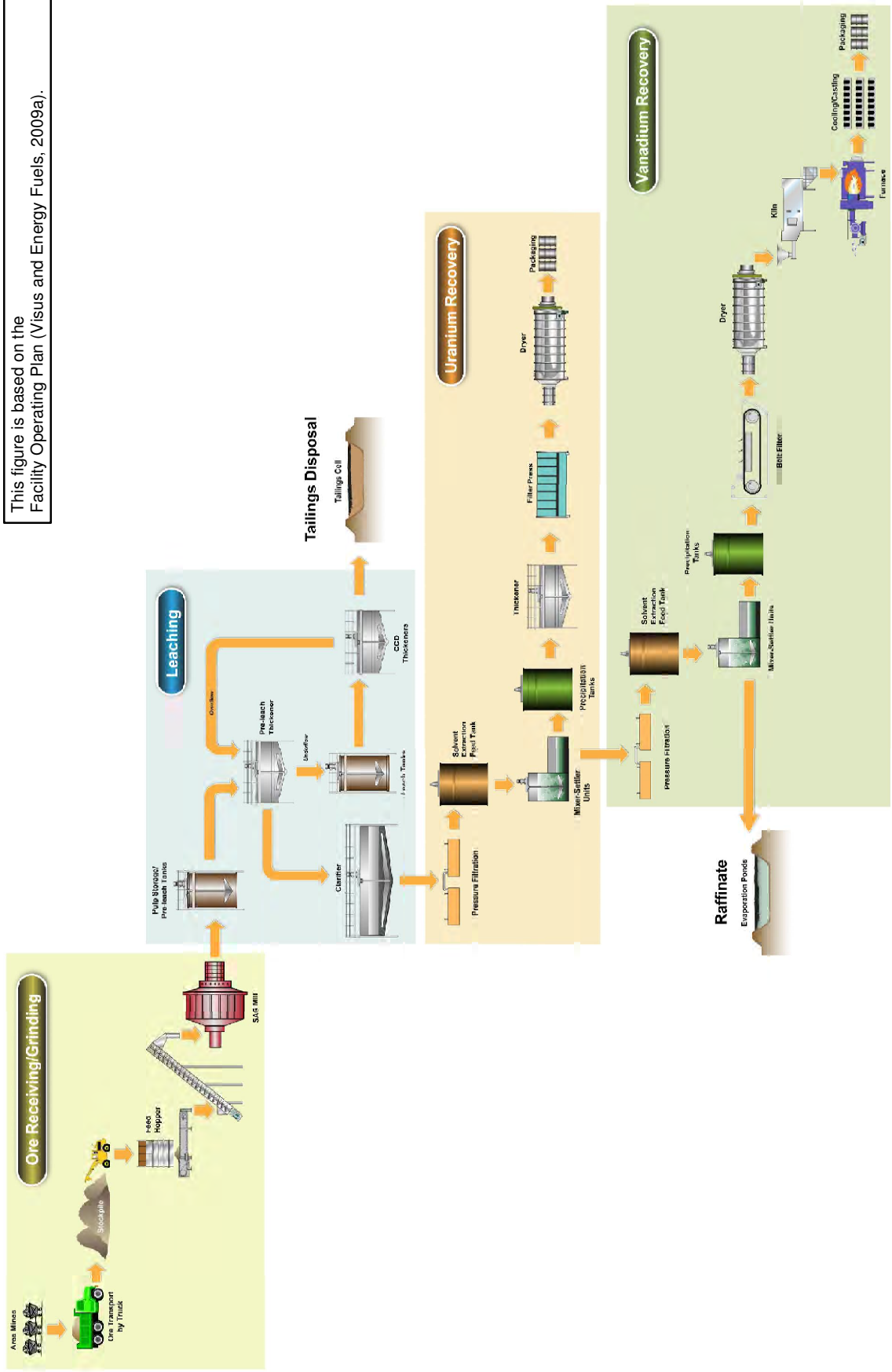


Figure 2.2-2

Process Flow

the thickener would be clarified, filtered, and sent to a feed tank for use in the uranium recovery circuit. The partially dewatered underflow from the thickener would be pumped to the leaching circuit.

Leaching. The leach circuit, located in the Grinding and Leaching Building, would consist of eight rubber-lined steel tanks with agitators. The tanks would be arranged in a cascading and staggered configuration so that individual tanks could be bypassed if necessary. In the leaching circuit, the pulp pumped from the pre-leach thickener tank would be heated with steam and then leached with sulfuric acid to dissolve the uranium and vanadium minerals. Sodium chlorate would be added as an oxidant, as necessary.

Liquid/Solid Separation and Purification. The leached pulp would be pumped to a series of 40-foot diameter CCD thickeners, where liquids and solids would be separated. The CCD thickener tanks would be located outside, on the north side of the Grinding and Leaching Building, and the CCD Thickener Building would run between the two rows of tanks. The uranium- and vanadium-bearing (or pregnant) solution would be separated from the remaining solids, called tailings, which consist of fine-grained sands mixed with low pH process water. The tailings also include low levels of radioactive elements that were present in the original ore. The pregnant solution would be pumped to the pre-leach tanks and subsequently to the uranium recovery feed tank while the tailings would be mixed with barren raffinate (i.e., wastewater) from the vanadium recovery circuit and pumped to the tailings cell.

Uranium Recovery. The uranium SX circuit would be located in the Solvent Extraction Building. In the SX process, the pregnant solution would be filtered and the uranium separated and concentrated using a kerosene-based solvent. The result is a pure, but weak, uranium solution. The uranium would be stripped from the solvent and concentrated using a sodium carbonate solution. The stripped solution would then be pumped to the Precipitation and Packaging Building, where the uranium would be continuously precipitated by adding hydrogen peroxide to the solution. The uranium would precipitate as a bright yellow powder referred to as yellowcake. The powder would be partially dewatered, washed, filtered, and dried in a zero-discharge vacuum dryer. Finally, the dried yellowcake would be packed, weighed, and sealed in USDOT-approved 55-gallon, steel drums for shipment. Each packed drum would weigh approximately 900 pounds. At an ore processing rate of 500 tpd, an average ore grade of 0.23 percent U_3O_8, and a 96 percent recovery rate, approximately 2,200 pounds of yellowcake (or 2.5 drums) would be produced per day.

Uranium Shipments. The drums of yellowcake would be shipped to a conversion plant by a USDOT-approved transportation contractor where the uranium would be converted to uranium hexafluoride, which can be enriched for use in nuclear power plants. Conversion plants currently in operation include the ConverDyn facility in Metropolis, Illinois, the Cameco facility in Port Hope, Ontario, and several more facilities in both France and Great Britain. Shipments to the North American facilities would be via trucks licensed to transport low-level radioactive material. Shipments overseas would require truck transport to a port, followed by ship transport. Typically, a transport truck can carry 25 to 27 tons of cargo, or up to approximately 55 to 60 drums of yellowcake. Approximately 15 truckloads of yellowcake would be shipped from the Mill Facility per year in accordance with USDOT regulations.

Vanadium Recovery. When uranium/vanadium ores are treated, the portion of the solution that remains after the uranium minerals have been recovered (i.e., the raffinate solution) would be prepared for vanadium recovery by oxidizing the vanadium ion species in solution with the addition of sodium chlorate, and reducing the acid concentration slightly by the addition of

ammonia. In a similar fashion to the uranium recovery process discussed above, the vanadium circuit would use an SX process to recover vanadium. The barren raffinate from the vanadium circuit would be pumped to the CCD circuit for use in transporting the tailings to the tailings cell or to the evaporation pond for disposal.

The vanadium SX circuit would be located in the Solvent Extraction Building. The vanadium would be precipitated by adding ammonium sulfate to the stripping fluid within the Precipitation and Packaging Building. The precipitate would be dewatered, dried, and removed of ammonium in a kiln. The V_2O_5 discharging from the kiln would be melted in a furnace and solidified into a black-flake product, which would be packed, weighed, and sealed in 55-gallon, steel drums for shipment. Each packed drum would weigh approximately 570 pounds. At an ore processing rate of 500 tpd, an average ore grade of 0.92 percent V_2O_5, and an 80 percent recovery rate, approximately 7,300 pounds of V_2O_5 (or 13 drums) would be produced per day.

Vanadium Shipments. The drums of V_2O_5 would be shipped via truck to a plant that produces ferro-vanadium products. Two of the larger of such plants include the Stratcor plant in Hot Springs, Arkansas and the Bear Metallurgical plant in Butler, Pennsylvania. Approximately 50 truckloads of V_2O_5 (which is not radioactive) would be shipped from the Mill Facility annually in accordance with USDOT regulations.

2.2.3.4 Waste Management Facilities

Following the extraction and recovery of the uranium and vanadium from the ore, the remaining waste products from the milling operation, which are classified as “11e.(2) byproduct material,” would be disposed of on-site, in engineered facilities designed to protect the environment. These facilities are designed to contain 40 years of waste material at a milling rate of 500 tpd. According to Section 11e.(2) of the Atomic Energy Act (as revised in 1978 and in 2005 by the Energy Policy Act), byproduct material is defined as “the tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.” Byproduct material is not considered a hazardous waste under EPA regulations. To be a hazardous waste, material must first be classified as a solid waste by EPA. Under the Resource Conservation and Recovery Act (RCRA) regulation 40 CFR 261.4(a)(4), source, special nuclear, or byproduct material as defined by the Atomic Energy Act is excluded from the definition of solid waste. Byproduct material was excluded from EPA’s RCRA regulations because the NRC adopted regulatory standards developed by EPA that were specific to tailings disposal operations (see Appendix A).

Tailing Cells. After extraction of the uranium, the finely ground byproduct (called tailings or 11e.(2) byproduct material) would be mixed with barren raffinate from the vanadium SX circuit and pumped as a slurry through a pipeline to a tailings cell for deposition, dewatering, and permanent disposal. The tailings consist of all materials remaining in the ore following the extraction of uranium and vanadium. The main radioactive materials remaining in the tailings would be Thorium-230 and Radium-226.

The National Emission Standards for Hazardous Air Pollutants (NESHAPs), 40 CFR 61, limits disposal in lined tailings cells to:

> (1) "Phased disposal in lined tailings impoundments that are no more than 40 acres in area and meet the requirements of 40 CFR 192.32(a) as determined by the Nuclear Regulatory Commission. The owner or operator shall have no more than two impoundments, including existing impoundments, in operation at any one time," or

(2) "Continuous disposal of tailings such that tailings are dewatered and immediately disposed with no more than 10 acres uncovered at any time and operated in accordance with §192.32(a) as determined by the Nuclear Regulatory Commission."

Energy Fuels would implement phased disposal, as described in alternative 1 above. Detailed design of the Mill Facility tailings cells is included in the *Tailings Cell Design Report* (Golder, 2008a). The tailings cells have been designed in accordance with 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001) and 40 CFR Parts 264 Subpart K and 192 Subpart D. The tailings cells would be synthetically-lined impoundments constructed predominately below ground level, covering approximately 30 acres each. A total of three tailings cells (Cells A, B, and C), each with a capacity of 2.3 million tons, would be required to store the tailings over a 40-year operating life. No more than two tailings cells, each not more than 30 acres, would be in operation or otherwise uncovered at any time. The tailings cells would be closed and covered in phases as well, in accordance with Criteria 6(3) and 6A(1) of Appendix A, 6 CCR 1007-1, Part 18 (CDPHE, 2001). The cells would be covered in the same order as they were initially constructed – Cell A, then B, and finally C. Cell A would be closed prior to initiating operations in Cell C. Therefore, not more than two 30-acre cells would be in operation at any time.

The design capacity of each cell would incorporate adequate vertical distance (freeboard) between the top elevation of the tailings material and the top elevation of the cell embankment. Cell A has been divided into two subcells (Cells A1 and A2) to provide operational flexibility in discharging tailings to the facility. Similar subcells may be constructed in Cell B and Cell C. After the tailings slurry is discharged to a cell, the sands settle and the majority of the process water would be recovered by a floating barge-mounted pump. The recovered water would be returned to the mill for reuse. Each cell or subcell would have an underdrain system designed to recover any water percolating through the sands and not recovered by the pump system. The water pool that collects on top of a tailings cell would be covered with floating plastic balls (a.k.a., bird balls) to deter birds and bats from landing on or drinking the process water.

Once a tailings cell reaches full capacity, the entire cell would be covered with an engineered cap consisting of soils derived from on-site excavation and imported rock aggregate products (see Section 2.2.7, Closure). The tailings cell covers have been designed to meet or exceed Criterion 6 of 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001) of Colorado's Radiation Management Program's regulations. The design includes a thick soil radon barrier that reduces radioactivity levels at the cover's surface to prescribed levels and gradual, armored surficial slopes and drainages that are resistant to erosion. Additional details regarding closure are included in Section 2.2.7.

The tailings cell design, shown in Figure 2.2-3, utilizes a double layer liner system with an intervening Leak Collection and Recovery System (LCRS) underlain by a third composite clay/synthetic liner. The liner system consists of the following components (from top to bottom):

Upper (Primary) Liner: The upper primary liner would consist of a textured 60-mil HDPE (high density polyethylene) geomembrane. An HDPE geomembrane liner was chosen for its long-term performance characteristics. It has excellent chemical resistance properties, resistance to ultraviolet (UV) radiation, high tensile strength, and high stress-crack resistance (Lupo & Morrison, 2005). Textured rubsheets would be extrusion welded over the top of the primary liner in high use areas (e.g., under tailings lines and walkways) to provide extra protection of the liner.

This figure is based on the Tailings Design Report (Golder, 2008a).

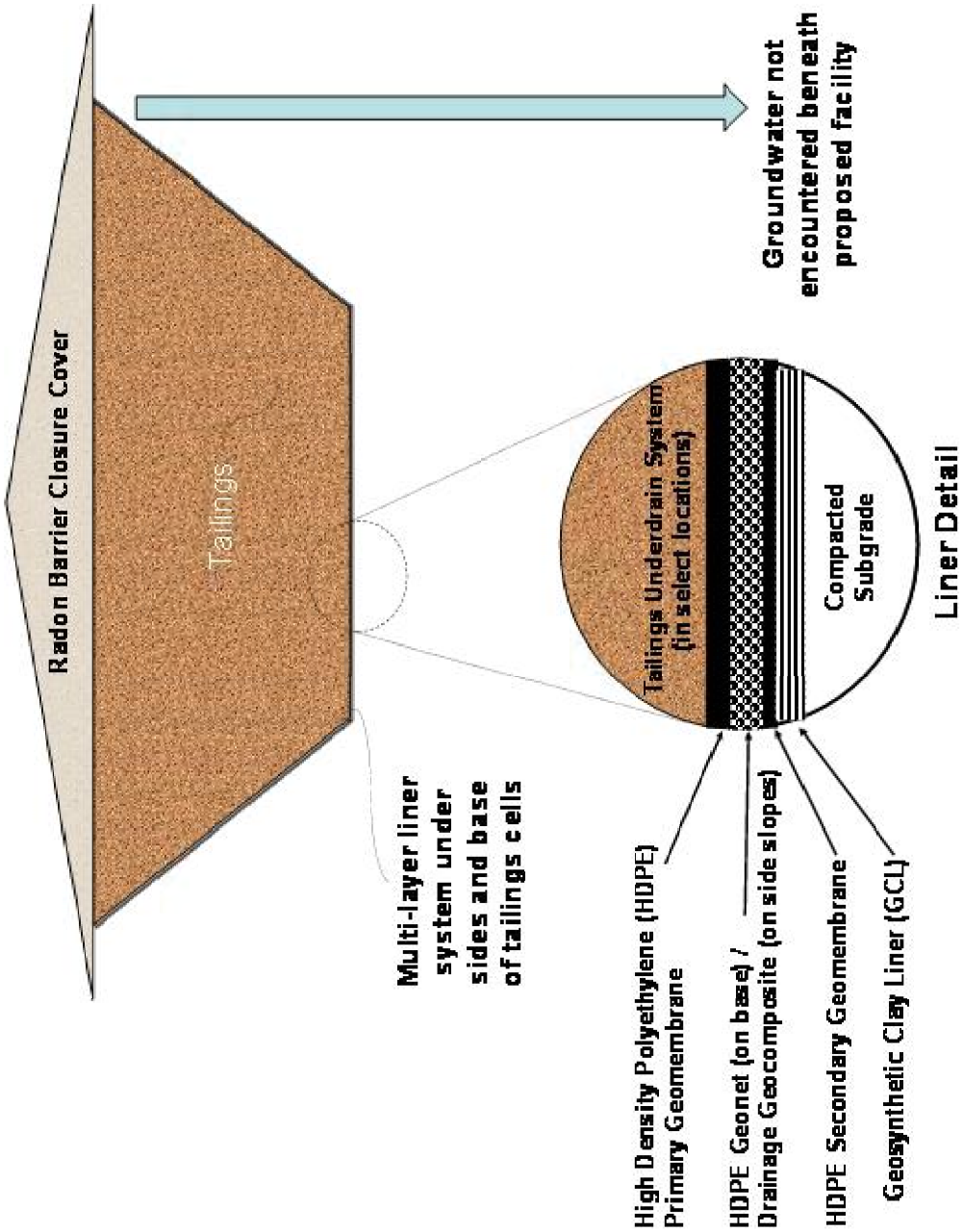


Figure 2.2-3

Tailings Cell Liner Concept

Leak Collection and Recovery System (LCRS): An important feature of the tailings cell liner system is the LCRS layer, designed per 40 CFR 264.221 (by reference from 10 CFR 40 and 6 CCR 1007-1, Part 18). The LCRS is designed to minimize the hydraulic heads on the lower geomembrane liner by utilization of HDPE geonet in the base of the tailings cells and a drainage geocomposite on the side slopes. In the event that leakage occurs through the upper geomembrane liner, it would be collected in the LCRS layer and routed (via gravity flow) to a LCRS sump. The LCRS sump would be inspected and pumped out, as needed, on a routine basis.

Lower (Secondary) Composite Liner System: Beneath the LCRS layer is a 60 mil HDPE geomembrane liner. This liner provides secondary containment of process solutions should leakage occur through the upper primary geomembrane liner. Because of the LCRS, minimal hydraulic head would be expected on the secondary liner.

Geosynthetic Clay Line (GCL): The lower secondary geomembrane liner would be underlain by a GCL, which consists of a layer of sodium bentonite encapsulated between two geotextiles with an upper woven geotextile and lower nonwoven geotextile, needle-punched together to form a hydraulic barrier material. The GCL would have a very low hydraulic conductivity of $5x10^{-9}$ centimeters per second (cm/sec) and would be constructed on top of a smooth and compacted subgrade. Compatibility testing of the proposed GCL with strong acid solutions (pH less than 2 standard units) indicated that tailings leachate would not significantly increase the permeability on the liner system.

Evaporation Ponds. The portion of the solution that remains after the vanadium minerals have been recovered (i.e., the barren raffinate solution) would be pumped to the CCD circuit to decrease the density of the tailings, which would enable pumping of the tailings to the tailings cells. Excess raffinate solution (an estimated 63 gpm) would be pumped to a series of connected, shallow pond cells for evaporation. The raffinate solution would contain high levels of salts that could not be economically recycled. The initial, total lined evaporation pond area would be 40 acres. Evaporation of the raffinate solution would be enhanced by mechanical means (i.e., the use of bubblers, fountains, or misters) within the central area of the ponds. As evaporation ponds fill with salts, new ponds would be constructed thus increasing the evaporation pond area to 80 acres over the life of the Mill Facility. Filled ponds would be closed by placing the liners and pond contents in a tailings cell.

The evaporation pond liner systems would be identical to the tailings cell liner systems with a LCRS between a primary and secondary liner, all underlain by a GCL on a prepared subgrade. Each of the 4-acre ponds would be equipped with its own LCRS that would be checked on a routine basis, and pumped out as necessary (Golder, 2008a). In the event that one or more ponds lose their water cover from evaporation during the summer months, raffinate solution from the other ponds would be sprayed over the exposed salts to keep them from drying out. The ponds would be covered with woven bird netting to exclude access to birds and bats.

2.2.3.5 Ancillary Facilities

Access. The access point to the Site is located near milepost 23 on SH 90. A road would be constructed to provide access to the Mill Facility from SH 90. The first 150 feet of the road would be asphalt and the remainder would be gravel. Gravel roads branching off the main access road would provide access to the ore pad and Administration Building. Secondary dirt or gravel roads would be constructed to provide access to all facility locations (e.g., tailings cells, evaporation ponds, water well field, etc.).

Energy Fuels commissioned a study to assess future traffic conditions at the Site access point along SH 90 in consideration of new traffic during construction and operation (TurnKey Consulting, LLC – TurnKey, 2008). Based on the results of the assessment and in accordance with CDOT criteria, a left-turn deceleration lane for westbound traffic on SH 90 would be constructed so that the Proposed Action would provide for safe ingress and egress. A 10-foot wide shoulder would be constructed along the south side (eastbound side) of SH 90, east of the Site access point. SH 90 would be widened along a length of approximately 2,175 feet to accommodate these improvements. Additional warning signs may be placed along the highway on either side of the access point to warn vehicles of the truck traffic.

Buildings and Parking. The following discussion describes the preliminary designs for the proposed on-site buildings and parking facilities. Detailed building and parking designs would be submitted to the Montrose County Building Department for review and approval prior to construction.

Administration Building Energy Fuels would construct a 9,000 ft^2, single-story building to house its office facilities for both milling and mining personnel. The building would be configured to allow for a 5,000 ft^2 future expansion if necessary. The Administration Building would accommodate approximately 26 offices/work areas, three conference rooms, a training room, break room, storage, and restroom facilities. The building design includes a garage for the on-site ambulance.

Secondary Mill Buildings Several metal buildings located next to the primary process facilities would support milling operations. These buildings include the Warehouse (10,000 ft^2), Laboratory/Change Room/Mill Offices Building (22,000 ft^2) and the Truck Maintenance Building (6,000 ft^2).

Access to the Mill Facility would be limited to mill employees and authorized visitors. All personnel would be required to enter and exit the Mill License Boundary through the Laboratory/Change Room/Mill Offices Building, where they would receive necessary information and training and would formally check in and check out. Radiation screening of all personnel and visitors would be required upon check out.

Parking Montrose County development standards require 62 spaces for a “professional office” building having 9,000 ft^2 of gross floor area, and four disabled accessible spaces, including one van-accessible space, for a parking lot with 51 to 75 regular spaces. Therefore, the preliminary parking lot design for the Administration Building provides 62 regular spaces, three disabled accessible spaces, and one van-accessible space. The parking lot would be surfaced with gravel with the exception of the disabled accessible parking area, which would be paved with asphaltic concrete.

Power and Heating Systems. Electric power to the Mill Facility would be supplied via an existing 69 kilovolt (kV) overhead transmission line or an existing 26.5 kV distribution line paralleling SH 90. A new overhead powerline connecting the existing line to the Mill Facility would be installed via the utility corridor on the east edge of the Property Boundary. The power company would construct and own the required on-site substation, from which power would be transformed to 4.16 kV for the Mill and 13.8 volts for the Administration Building. A 4.16 kV (2,000 kilowatt) diesel-powered generator, located at the Mill, would provide backup power to operate the critical mill facilities during line outages.

Small (500 to 2,000 ft^2) concrete block electrical rooms would be constructed at each of the primary mill buildings to house the electrical breakers for the various pumps, mixers and other mill equipment. These rooms would be equipped with air conditioning units to maintain positive pressure in the rooms.

Propane would be used to heat the Administration Building and mill buildings, and either propane or electricity would be used to heat the steam boilers used in the processing circuit. A natural gas line may be installed to the mill later if the operating income of the Mill justifies the added capital cost of installing 6 to 7 miles of new feeder line.

Fueling Station. Diesel and gasoline would be stored north of the Truck Shop and just outside the Mill License Boundary. The diesel and gasoline storage tanks would have 12,000-gallon and 2,000-gallon capacities, respectively. The double-walled storage tanks would be situated within a common concrete containment area (reinforced concrete pad and walls) provided with a floor sump. Concrete aprons would extend out from the concrete containment on both the east and west sides. The aprons would drain back into the containment area and provide secondary containment during transfer of fuel into and out of the storage tanks.

Transfer pumps, located within the concrete containment, would transfer diesel from the storage tank to the day tanks provided for the standby generator and the firewater pump and to two fueling stations (one inside the Mill License Boundary and one outside the Mill License Boundary). A third pump would transfer gasoline to two gasoline fueling stations that would be co-located with the diesel fueling stations. The gasoline and diesel fueling stations would be located within the concrete apron areas and would be used to refuel vehicles, heavy equipment (including the front-end loader), and miscellaneous small equipment. In most cases, a maintenance truck would be filled at the pump station and used to transport fuel to the larger pieces of equipment. System controls at the gasoline storage area would focus on the safe unloading of fuel, and preventing and containing spillage during offloading activities in accordance with the *Material Containment Plan* (Energy Fuels, 2009c) and the *SPCC Plan* (Energy Fuels, 2009b).

Water Supply. The estimated average water requirement for the Proposed Action is 144 gpm to support the milling process, dust suppression requirements, washrooms, truck wash, fire suppression systems, and other miscellaneous uses. Of this, it is estimated that 130 gpm would be required for mill process water, 11 gpm would be required for dust suppression/truck was/fire suppression, and 3 gpm of potable water would be required. Most of the water would be used for processing purposes even though process water would be recycled wherever feasible to minimize consumption.

<u>Primary Water Supply</u> Energy Fuels plans to pump water from five or more production wells located on the south end of the Site and on adjoining private property to the west. The sustainable pumping rate for these wells has been estimated to be between 100 to 175 gpm. Water would be pumped from the supply wells to a 320,000-gallon raw water storage tank which would supply water to process components, dust suppression systems at the ore pad facility, the truck wash, fire hydrants, and water trucks. Three of the planned wells have been permitted and completed. Eastern Paradox Valley, where the Site is located, is designated by the Colorado Division of Water Resources as a non-critical area; therefore, neither augmentation nor a water right is required to use the water. However, Energy Fuels applied for water rights for the existing and future production wells in November 2009 to secure a priority for these wells (Energy Fuels, 2009a). Surface water rights for the direct precipitation falling on the zero-

discharge portions of the Site (see stormwater above) were also included in the water rights application.

The groundwater in the production wells is suitable for most processing and dust suppression applications as it has a pH between 7 and 8 standard units and a total dissolved solids (TDS) concentration between 800 and 1,000 parts per million (ppm). The groundwater does not meet state and federal drinking water standards and would need to be treated before it could be used for potable purposes.

Naturita Non-Potable Contingency Water Supply A contingency water supply has been identified in the event that the on-site water supply cannot sustain the required 141 gpm of non-potable water needed for mill operations. An agreement has been made with the Town of Naturita to purchase raw untreated water from the town. The Town of Naturita's water originates from the San Miguel River and is of relatively good quality (neutral pH and low TDS levels) and would be suitable for mill use. The agreement allows for the purchase of up to 150,000 gallons per 24-hour period (equivalent to 104 gpm) for a period of 40 years, commencing in 2011, the anticipated start-up date of the Mill Facility. The untreated water would be obtained from the Old Water Treatment Plant and trucked to the mill in 5,500-gallon water trucks. The proposed haul route from Naturita to the Mill Facility is 14 miles in length.

Potable Water Potable water would be stored in a tank at the Administration Building and at the Mill. The tanks would be constructed of suitable material and would be appropriately sized for the expected usage. Treated potable water would be purchased and loaded out at the Naturita Town Hall, located on SH 141, and trucked to the Site. Assuming an average consumption of 30,000 gallons of potable water per week and a load limit of 5,500 gallons of water, an average of 5 to 6 truckloads of water would be required per week.

Septic Systems. The Administration Building would have restroom and shower facilities and the Mill would have a restroom, shower facilities, and laboratory sinks. The shower stalls would be located in the Administration Building and Mill change rooms. Effluent from the commodes and urinals would flow by gravity to engineered leach field septic systems designed according to state and county health and sanitation requirements for sewage disposal. Separate septic systems would be required for the Mill and Administration Building. Effluent from sinks and other drain systems would, if approved by the county and state, be recycled as part of a gray water system.

Stormwater Systems. The Mill, ore pad, tailings cells, and evaporation ponds would be designed as "zero discharge" facilities. Precipitation and stormwater runoff that would contact these areas would be contained on-site in lined ponds or cells and recycled for use in the Mill. Precipitation and runoff from the surrounding undisturbed/unimproved areas would be diverted around these areas into the existing drainage network. Stormwater runoff from the Administration Building and other site structures not within the footprint of the zero-discharge area (e.g., monitoring stations, water supply well field, secondary roads) would be handled using best management practices (BMPs) for stormwater and erosion control. These measures may include surface water diversion channels, energy dissipating structures, slope protection and sediment catchment basins. The CDPHE Water Quality Control Division regulates stormwater discharges during construction and requires that a Stormwater Management Plan be prepared and implemented during construction under a general construction discharge permit. A discharge permit is not required for operations because Energy Fuels has designed the Mill Facility so that all direct precipitation and runoff is contained on site and recycled or evaporated. Energy Fuels has, however, prepared and would implement measures included in

their *Stormwater Management Plan* for the Site (Golder, 2009a), which includes monitoring of contained and diverted stormwater.

Security Systems. The Property Boundary would be fenced with barbed wire and posted with no-trespassing (and no-hunting) signs to allow for livestock grazing on adjacent property. CDPHE would require that the portion of the Site that is licensed for uranium processing (the Mill License Boundary) be surrounded by chain-link fence topped with barbed wire. This security fence would be posted with warning signs indicating that unauthorized access is not allowed and points of access would be strictly controlled. A secondary road would be constructed around the perimeter of the fence to allow for daily security inspections. Energy Fuels has prepared and would follow their *Security Plan* (Energy Fuels, 2009i) which described security procedures for the Site.

A guardhouse would be installed near the entrance of the Site for the inspection and control of traffic entering the Mill Facility. The guardhouse would be manned 24 hours per day, 7 days per week. Only authorized personnel and vehicles would be allowed to continue beyond the gate to the mill area. Visitors would be directed to the Administration Building where they would receive training and instruction regarding on-site procedures and potential hazards, prior to being escorted on site by mill personnel. Ore deliveries would be directed to a truck scale and then to either the ore pad dumping platform or directly onto the ore pad. Delivery of process reagents and fuel would be directed to the south and west sides of the mill to either the Reagent Unloading Areas or warehouse, as appropriate. These vehicles would not be allowed to enter the area within the Mill License Boundary, which corresponds to the licensed portion of the site where access is controlled and potential radiation exposure is closely monitored.

Access to the area within the Mill License Boundary would be limited to mill employees and authorized visitors. All personnel would enter the Mill through the Laboratory/Change Room/Mill Offices Building where they would be required to check in and put on radiation badges before entering the area within the Mill License Boundary. Upon exiting the Mill License Boundary, employees and visitors would be scanned with a handheld gamma meter before they could check out. If the scanned readings indicate radioactivity above background levels, the individual would be required to clean their clothes (typically shoes) and/or shower before being rescanned.

Emergency Management. A firewater system, with hydrants and wheel-mounted hose reels at key locations would be constructed as a component of the overall fire protection system. The raw water storage tank or a separate tank dedicated to fire protection would feed the firewater system. Buildings would be equipped with sprinkler systems and fire extinguishers in accordance with building codes and county requirements.

Energy Fuels has prepared an *Emergency Response Plan* (Energy Fuels, 2009e) in accordance with 6 CCR 1007-1, Part 3 (CDPHE, 2005a) and the Federal Mine Safety and Health Act of 1977 (as amended by the Improvement and New Emergency Response Act of 2006 - Public Law 109-236). Because of potential radiation emissions associated with an emergency, Energy Fuels anticipates that most emergency response actions would be handled by trained employees under the direction of the Mill Incident Commander (typically the shift Mill Foreman). The facility's Radiation Safety Officer (RSO) and other members of the Safety Department would provide health and safety support during an emergency. The preliminary *Emergency Response Plan* (Energy Fuels, 2009e) has been developed in consultation with local law enforcement agencies and fire departments and would be further refined with local agency input prior to facility startup so that the roles of all involved personnel would be clearly defined, potential chemical and radiation risks would be quantified and adequate equipment would be

available to support emergency response efforts. Additional information regarding local law enforcement and fire department capabilities is provided in the Section 3.10, Socioeconomics.

The trucking companies transporting ore, chemical reagents, and fuel to the Mill Facility and yellowcake and vanadium oxide from the Mill Facility to other processing facilities would be required under USDOT regulations to have an emergency response plan in place for responding to accidents and cargo spills. As part of its contracting program, Energy Fuels would verify that these plans are in place and anticipates that carriers of ore, yellowcake. and other low-level radiation shipments would incorporate the Energy Fuels emergency response teams into their emergency management planning. The Energy Fuels response teams would have expertise in radiation control and would have the necessary specialized monitoring equipment that is generally not available to most law enforcement agencies, fire departments, and other first responders. In the event of a cargo spill of ore or yellowcake, Energy Fuels would also provide post-remediation sampling to verify that the spill cleanup met appropriate regulatory standards.

2.2.4 Schedule

Pending approval by Montrose County and CDPHE, construction would begin in the third quarter of 2010 and continue for 21 months through the first quarter of 2012. Any construction occurring prior to license approval would be limited to the portion of the property outside of the Mill License Boundary (e.g., improved highway access, main access road, well field). The Mill is scheduled to begin operations in the first quarter of 2012 and has an expected operational life of 40 years. Upon termination of operations, the Mill would be decommissioned and closed in compliance with CDPHE requirements and relevant NRC guidance. Once NRC concurs with the State of Colorado's determination that decommissioning is complete, the Site would be transferred to either DOE or the State of Colorado for long-term surveillance and monitoring. Decommissioning activities would continue for approximately 3 years and post-closure monitoring would be conducted for approximately another 5 years until final license termination.

2.2.5 Workforce

Construction of ancillary site facilities during the first two quarters of construction would require between 25 and 45 workers. Mill construction would begin in the first quarter of 2011 and continue through the end of the year, requiring between 125 and 200 workers. Upon opening in the first quarter of 2012, the Mill would employ 25 workers working a straight-day (8-hour) schedule 5 days per week. The Mill would employ another 60 shift workers. Four 15-man crews would work 8-hour shifts, 24 hours per day, 7 days per week.

2.2.6 Traffic

Traffic to and from the Mill Facility would consist of employees traveling to and from work and trucks hauling ore and other materials to the Site. During the first 6 months of construction, between 13 and 23 light vehicles, and 13 trucks hauling materials and equipment, would access the Site per day. During peak construction periods, approximately 100 light vehicles and between 10 and 17 trucks would access the Site daily (see Table 2.2-2).

During operations, between 21 and 29 trucks ore-hauling trucks and approximately 28 light vehicles with commuting workers would access the Site daily. Additional traffic during operations would include water trucks, miscellaneous deliveries, and visitors. Table 2.2-3 shows the average number of vehicles that would travel to the site daily during operations.

Table 2.2-2
Workforce and Traffic Associated with Mill Construction
(Number of Workers and Vehicles per day)

Calendar Quarter	Work Quarter	Construction Workers[1]	Construction Traffic	
			Light Vehicles[2]	Heavy Vehicles[3]
3rd Qtr 2010	1	25	13	13
4th Qtr 2010	2	45	23	13
1st Qtr 2011	3	125	63	9
2nd Qtr 2011	4	200	100	17
3rd Qtr 2011	5	200	100	10
4th Qtr 2011	6	150	75	12
1st Qtr 2012	7	10	5	1

[1] *Construction Plan* (Golder, 2009b).
[2] Light vehicle traffic includes one vehicle for every two workers (Filas, 2009).
[3] Based on material deliveries per quarter – *Construction Plan* (Golder, 2009b).

Table 2.2-3
Workforce and Traffic Associated with Mill Operations
(Number of Workers and Vehicles per day)

Traffic Type	Days/ Week	Operational Workers[1]	Light Vehicles	Heavy Vehicles
Ore deliveries[2]	7	NA	0	21 to 29
Straight-day workers[3]	5	25	13	0
Shift workers[4]	7	60	15	0
Water trucks[5]	5	NA	0	11
Misc. delivery traffic[6]	5	NA	3	0
Reagent and Fuel Deliveries[7]	5	NA	0	8
Visitor traffic[8]	5	NA	10	0

[1] Worker traffic estimates apply to direct mill employees only. NA = not applicable.
[2] *Mine Operations Plan* (Energy Fuels, 2009d).
[3] Assumes one light vehicle for every two workers (Filas, 2009).
[4] Assumes three 15 man shifts per day, and one light vehicle for every three workers (Filas, 2009).
[5] Assumes six deliveries per week of potable water and seven deliveries per week of non-potable from Naturita - *Water and Wastewater Plan* (Energy Fuels, 2009f)
[6] Includes smaller shipments of materials and parts *Special Use Permit Application* (Visus, 2009).
[7] *Special Use Permit Application* (Visus, 2009).
[8] Filas, 2008.

2.2.7 Closure

Once the Mill is no longer operating, closure and reclamation of the Mill Facility would begin. Closure and reclamation activities would take place approximately over a 3-year period. It is expected that post-closure monitoring and maintenance would be required for a period of approximately 5 years beyond reclamation before the site can be transferred to the State of Colorado or the DOE for long-term surveillance and monitoring.

The closure objectives for the Mill Facility 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 would be returned to rangeland use, with the exception of the tailings

cells, which would be capped with an engineered soil cover and transferred to the State of Colorado or DOE for long-term surveillance and monitoring pursuant to Section 83 of the Atomic Energy Act, as amended. Energy Fuels would provide adequate financial assurance in accordance with the closure and reclamation plans approved by the State of Colorado as required by 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001).

A preliminary *Mill Decommissioning Plan* (Kleinfelder, 2009b) has been prepared and a detailed Decommissioning Plan would be prepared prior to closure based on the site-specific conditions and the regulatory requirements that exist at that time. The Site would be decommissioned in accordance with applicable State of Colorado regulations and the NRC technical guidance documents. State requirements for decommissioning are contained in 6 CCR 1007-1, Part 3, RH 3.16.4 and in 6 CCR 1007-1, Part 18, RH18.3.1.5, RH 18.8 (Decommissioning Requirements) and in Criteria 5A, 6(6) and 6(7) of Appendix A thereto. Beyond these general requirements for decommissioning, the State of Colorado has no additional regulatory guidance of its own for mill decommissioning. More detailed guidance for decommissioning plans is provided by the NRC in NUREG-1757, Vol. 1 (NRC, 2006) and in NUREG-1620 (NRC, 2003b), as well as Regulatory Guide 4.14 (NRC, 1980a).

The *Tailing Cell Closure Design Report* (Kleinfelder, 2009c) addresses the requirement to design and construct a cover over the mill tailings that would satisfy the criteria contained in Appendix A of 6 CCR 1007-1, Part 18 (Criteria Relating to the Operation of Mills and the Disposition of the Tailings or Wastes from these Operations – CDPHE, 2001). The tailings cells area would be decommissioned to provide long term stability for the tailings in accordance with 6 CCR 1007-1, Part 18, Appendix A, Criterion 6(6). The tailings cells would be covered to limit the release of radon to 20 picoCuries per meter squared per second (ρCi/m^2/s) averaged over the individual cell. All other areas within the Site would be restored to radium concentration limits above background of 5 picoCuries per gram (ρCi/g) in the top 15 centimeters (cm) of soil and 15 ρCi/g in 15 cm intervals below 15 cm depth. If required by CDPHE at the time of closure, Energy Fuels would also sample for other radionuclides. An evapo-transpiration (ET) cover would be constructed over the top of each tailings cells to limit the infiltration of precipitation and runoff. The ET cover would be constructed with gentle slopes (5 horizontal to 1 vertical (5H:1V) to 10H:1V) that would be armored with rock to provide “reasonable assurance of control of radiological hazards to be effective for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years (Appendix A, Criterion 6(1)).”

The Mill Facility is expected to operate for 40 years, but potentially could operate for a longer period depending on future market and other conditions. Decommissioning would begin after cessation of milling and is expected to be completed in 2.5 to 3 years. Post-decommissioning monitoring and maintenance would be conducted for a period of time after completion of decommissioning activities to verify that the site is stable and meets the State of Colorado’s and NRC’s requirements for the long-term surveillance and monitoring of the Site.

2.2.7.1 Detailed Decommissioning Plan

Energy Fuels would prepare a detailed Decommissioning Plan prior to decommissioning activities. The detailed plan would include the following: facility operating history, permits, work plans, waste handling plans, radiological surveys and sampling plans, health and safety operating protocols (both radiological and non-radiological), environmental monitoring and control, quality assurance, and completion reports.

2.2.7.2 Uncontaminated Systems, Equipment, and Structures

Upon permanent cessation of milling, the inventory and radiological assessment (surveying) of mill systems and equipment would be updated, following the procedures described in the *Decommissioning Plan* (Kleinfelder, 2009b) to show the levels of contamination. Based on the results of these surveys and the radiological release limits in effect at the time of decommissioning, the systems and equipment would be classified as uncontaminated or contaminated. Before any equipment, materials, and structures could be removed from the Mill Facility, appropriate screening procedures would be performed to demonstrate that such items are uncontaminated (radiological levels below release limits) and could be removed from the Mill Facility and sold, recycled for off-site use, or disposed of in accordance with regulatory requirements in effect at that time. Uncontaminated systems and equipment could include electrical controls, communications, water tanks and pumps, and similar equipment that have not been exposed to radiological materials. Equipment in the Reagents Area, Utilities and Buildings Area, and the General Plant are expected to be uncontaminated. All facilities outside of the Mill License Boundary, including the Administration Building, meteorological towers, air monitoring stations, the guard house, well field, and the main access road, are expected to be uncontaminated and to remain in service during and after decommissioning to support decommissioning activities and post-closure environmental monitoring.

After uncontaminated and decontaminated systems and equipment are removed from the Mill Facility, the systems and equipment that are known or very likely to be contaminated above release limits would be removed from the mill area and placed into the vault in Tailing Cell C, described in the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c). Contaminated materials removed from the mill area would be transported within the Mill License Boundary over a temporary haulage/service road along the west side of the tailings cells. This road, originally a two-track dirt road used to access the Mill License Boundary fence and to service the pipeline from the west stormwater pond to the evaporation pond, would be improved as needed to support heavy equipment and trucks during all weather conditions. Improvements could include placement of additional granular fill, which could be obtained from uncontaminated fill used originally in the ore pad or mill pad. This fill could also be reused again in the closure of the vault in Tailing Cell C.

2.2.7.3 Contaminated Systems, Equipment, and Structures

Decontamination of equipment and removal and disposal of contaminated equipment would be done in accordance with written procedures documented and controlled by standard procedures or Radiation Work Permits (RWPs). Based on radiological surveys of these systems and equipment, it may be determined that some decontamination can be performed cost effectively, considering the remaining market value for re-use or sale. This would typically occur with equipment that has smooth surfaces that could be more easily cleaned. Such decontamination would be at Energy Fuels' discretion; otherwise, the contaminated system or equipment would be disposed of in the vault in Tailing Cell C.

The structures in the following areas are expected to be contaminated: ore storage pad, Grinding and Leach Building, CCD Thickener Building, SX Building, and Precipitation and Packaging Building. These structures would be decontaminated as necessary to facilitate safe handling and would be demolished using primarily mechanical methods, with specific equipment selected by the demolition contractor and Energy Fuels based on considerations of worker safety, protection against release of contaminants using As Low As Reasonably Achievable (ALARA) principles, and cost-effectiveness. Scaling and high-pressure washing might be employed to remove surface contamination. Large hydraulic shears and claws mounted on

crawler excavators are commonly used and are most likely to be selected by a contractor. As necessary for dust suppression, water sprays would be used; run-off (if any) from this activity would be collected in the stormwater ponds and discharged to the evaporation ponds.

Contaminated materials and equipment that are intended to leave the Site, both salvaged mill materials as well as equipment used in decommissioning, would be decontaminated before being released from the Site. Decontamination would occur at the truck decontamination station located at the northeast corner of the mill pad. Contaminated equipment and other materials remaining on the Site for disposal would be transported by truck along the service road to the vault for disposal. Foundations of structures and equipment would be removed and disposed of in the vault. The exception would be those foundations below uncontaminated structures and located in areas where the mill pad was cut or excavated below natural grade; these foundations may be left in place and covered during final site grading. Trucks and heavy equipment used for this purpose would remain within the Mill License Boundary until no longer needed, then the trucks and heavy equipment would be decontaminated and scanned before leaving Site.

2.2.7.4 Sequence of Removal of Systems, Equipment, and Structures

The sequence of removal of systems, equipment, and structures would be included in the detailed Decommissioning Plan, but in general, the sequence would be: waste materials, uncontaminated and decontaminated systems and equipment, uncontaminated structures, contaminated systems and equipment, contaminated structures, stormwater ponds and pipeline, and evaporation ponds. The truck decontamination station would remain in operation for this purpose for as long as necessary, and then would be removed with all materials going into the vault. A temporary decon station would be used as needed after the truck decontamination station is removed.

2.2.7.5 Soil Remediation

Soil remediation would occur in the following sequence after all equipment and structures have been removed: initial survey, soil clean-up, verification survey, final soil clean-up, and final closure of Tailing Cell C (cells A and B closed previously).

After demolition and removal of the Mill Facility (except for the environmental monitoring equipment, Administration Building, access roads, and well field), an initial gamma (direct radiation) survey would be performed (in accordance with 6 CCR 1007-1, Part 18, Appendix A, Criterion 6(6)) to evaluate potential areas where soil contamination might exceed background radium levels, based on gamma-radium correlations established in the *Baseline Radiological Investigation Report* (Environmental Restoration Group - ERG, 2009). This survey would occur on grids with 10-meter spacing across the “contaminated” systems and equipment areas, the evaporation ponds, main road, and the route of the haulage/service road along the west side of the tailings cells according to NUREG CR-5849 guidance (NRC, 1993). The haulage/service (service) road would follow the track of the dirt road used during operations for security patrol and maintenance of the pipeline to the evaporation pond.

Soil samples would be collected and tested at locations that register gamma readings that correlate with Radium-226 concentrations of more than 5 ρCi/g above background in the top 15 cm of soil and 15 ρCi/g in 15 cm intervals below 15 cm depth. Samples would be tested for concentrations in depth intervals of 0 to 15 cm and from below 15 cm. These locations would be cleaned up and resurveyed as needed to achieve levels not exceeding 5 ρCi/g of Radium-226 above background. The GPS-based gamma survey and soil sampling would occur along

transects spaced at approximately 10-meter intervals over and adjacent to: the ore storage pad, the grinding and leach building, the CCD thickeners and tailings pipeline, the Solvent Extraction Building, the Precipitation and Packaging Building, and the evaporation ponds.

The survey and sampling intervals would be 98 feet (30 meters) over other areas within and adjacent to the Mill License Boundary. Closer survey and sampling intervals would be applied to delineate the extent of contamination if detected within the 98-foot sampling intervals. If needed to assess potential doses from contaminated soil as a basis for making decisions about the extent of soil clean-up, the RESRAD Code would be used to estimate radiation doses and risks from residual radioactive materials in soils.

After soil clean-up has been performed and before final closure of Tailing Cell C, a verification survey would be performed on those areas that were used, and possibly contaminated, during decommissioning or that were found to have excessive Radium-226 levels in the soil during the initial surveys. The survey would be conducted on a 10-meter grid over the last evaporation pond not previously surveyed, the west service road from the Mill to Tailing Cell C, and any other areas over which demolition debris or contaminated soil was hauled.

With the precautions taken in the mill design, the *Facility Operating Plan* (Visus and Energy Fuels, 2009a), the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b), and the *Material Containment Plan* (Energy Fuels, 2009c), it is unlikely that conditions would develop during operations or upon decommissioning that would necessitate radium benchmark dose modeling, as described in NUREG-1620, Appendix H (NRC, 2003b). Therefore, radium benchmark dose modeling is not planned but would be performed in conjunction with the initial radiological survey, if required.

2.2.7.6 Tailings Cells

The *Tailing Cell Closure Design Report* (Kleinfelder, 2009c) addresses the requirement to design and construct a cover over the mill tailings that would satisfy the criteria contained in Appendix A of 6 CCR 1007-1, Part 18 (CDPHE, 2001). The tailings cell closure design is based primarily on performance objectives which include:

- Provide containment of 11e.(2) byproduct material for 200 years and, to the extent practicable, 1,000 years with no active maintenance or controls (Criterion 6(1)(i));
- Limit Radon flux from the entire cover surface to an average of <20 pCi/m^2/s (Criterion 6(1)(ii)); and
- Limit infiltration of moisture into, and release of contaminated liquid from, the tailings (Criteria 5B(1), 5E(3), 6(7), 7).

Secondary objectives include limiting the area of exposed tailings and facilitating progressive and expeditious closure (Criterion 6A (1)).

Tailings Cover Components. The tailings cover was designed to achieve the closure criteria and design objectives described above and in accordance with Appendix A of 6 CCR 1007-1, Part 18 (CDPHE, 2001). It would consist of multiple layers of natural earth materials, each layer designed for a particular function. The layers of the cover, from top to bottom, and the function of each is described below and is shown in Figure 2.2-4:

This figure is based on the Tailing Cell Closure Design Report (Kleinfelder, 2009c).

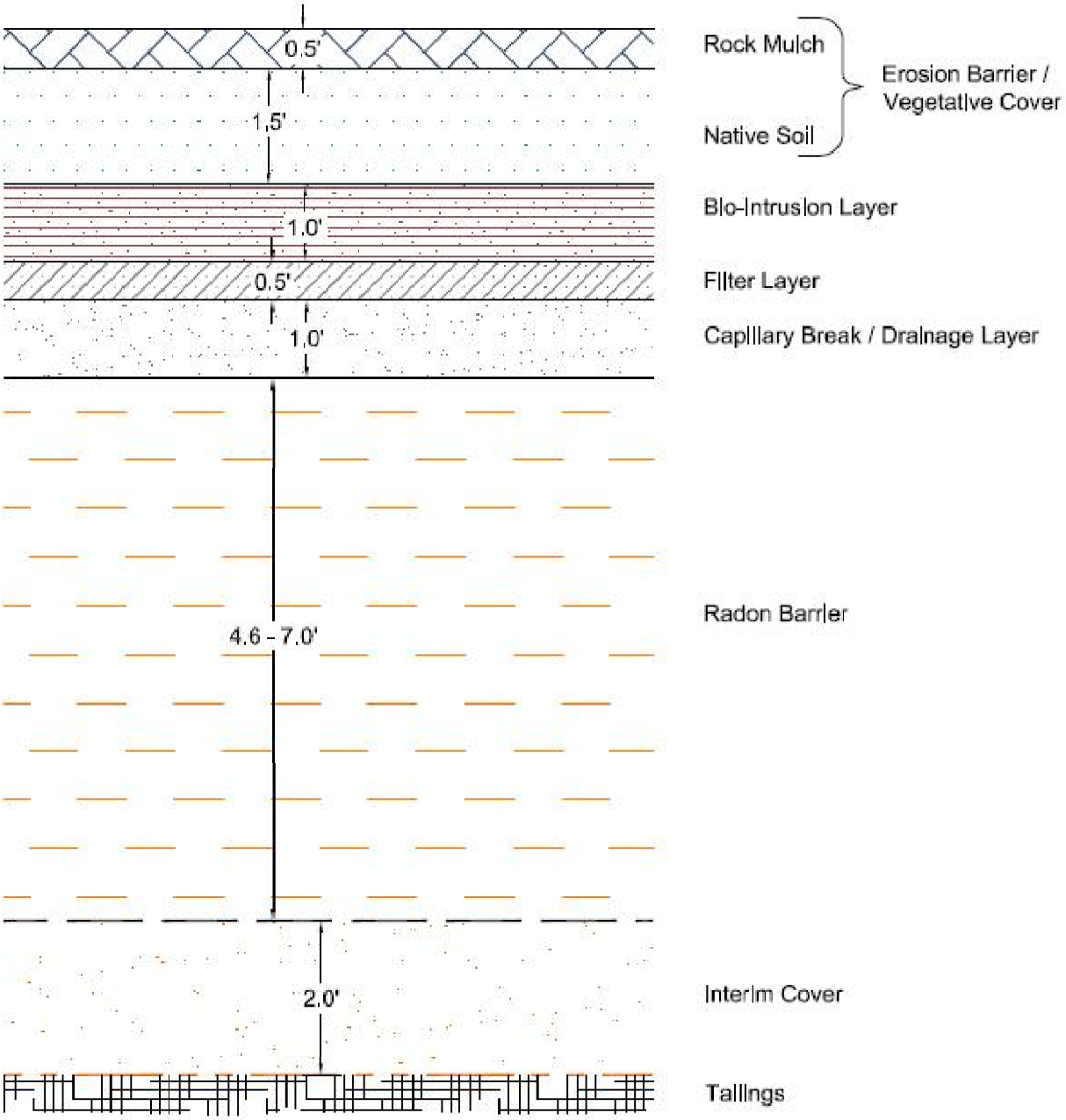


Figure 2.2-4

Typical Section of Tailing Cell Cover

- Erosion barrier/vegetative cover – provides protection against erosion and wind and water (runoff), limits infiltration. The topmost element of the cover system is the erosion barrier/vegetative cover. This layer is designed to resist erosion by wind and runoff and to provide a growth medium for the vegetative cover. It would be the primary barrier to infiltration of precipitation. The erosion barrier/vegetative cover has been designed according to guidelines suggested by the NRC in NUREG-1623 (NRC, 2002) Design of Erosion Protection for Long-Term Stabilization, Appendix A for design of soil covers. This cover would consist of 2.0 ft of native soil compacted to 85 percent Standard Proctor dry density with rock mulch (min. d50 = 0.5 inch durable rock) mixed with soil in the top 0.5 ft. The cover surface would be revegetated. The rock would meet the durability scoring criteria in Appendix D of NUREG-1623 (NRC, 2002). The finished cover would be sloped at a grade of 0.02 away from the center of each cell toward the cell perimeter. The tailings cell erosion barrier/vegetative cover has been designed to withstand the Probable Maximum Flood (PMF) across this 0.02 slope resulting from the Probable Maximum Precipitation (PMP), addressing Criterion 6(1)(i) of Appendix A, 10 CFR 40, for containment for a 200 to 1,000-year period. The erosion barrier/vegetative cover would extend over the entire final area of the tailings terminating against, and transitioning into, the outslope rock blanket.
- Bio-intrusion barrier – provides a barrier against burrowing animals. The bio-intrusion layer would protect underlying layers of the tailings cell cover from burrowing animals. It would consist of 1.0 ft of native soil matrix with nominal 3-inch rock (sound cobbles) and would be compacted to 85 percent Standard Proctor or approximately 100 pounds per cubic foot dry density. The cobbles would be placed so that they overlap within the soil matrix. The bio-intrusion layer would extend laterally beyond the outside edge of the underlying radon barrier and terminate at the rock blanket on the outslope.
- Filter layer – protects against downward migration of fine soil particles, contributes to limitation of percolation to the radon barrier. The filter layer would consist of 0.5 ft of granular soil (sand) meeting the specified d15/d85 particle size ratio with the bio-intrusion barrier and would be compacted to not less than 90 percent Standard Proctor dry density per ASTM D-698. It would terminate at the rock blanket on the final outslope and above the original cell berm. The filter layer would work in combination with the capillary break/drainage layer to limit infiltration. The filter layer would protect the capillary break/drainage layer from migration of soil fines from the overlying native soil in the bio-intrusion barrier, thus preserving the hydrologic properties of the capillary break/drainage layer. The filter layer would also provide a firm base for placement of the cobble-size particles of the bio-intrusion layer.
- Capillary break/drainage layer – provides the primary barrier to infiltration of water, provides a pathway to drain moisture laterally to the edges of the tailings cell. The capillary break/drainage layer would consist of 1.0 ft of granular soil (sand and gravel) satisfying a d15/d85 particle size ratio with the filter layer material. This granular soil would be imported from an off-site source. The layer soil would be compacted to 50 percent relative density, or about 115 to120 pounds per cubic foot dry unit weight, to make it essentially incompressible under design loads but preserving substantial effective (drainable) porosity. The capillary break/drainage layer would intercept most moisture infiltrating downward from the cover surface and drain it laterally along this layer to the top of the tailings cell berm crest, where the moisture would discharge to the rock blanket covering the tailings cell outslope. The capillary break/drainage layer would also limit root penetration by concentrating available soil moisture and encourage roots

to advance along this layer rather than penetrating deeper into the drier underlying radon barrier.

- Radon barrier – provides the primary barrier to radon release from the tailings cell. The radon barrier would consist of 4.6 ft to 7.0 ft of compacted native soil, based on the results of numerical modeling using the RADON code (the Visual Basic version of the RAECOM code). The radon barrier would extend across the interim cover and would terminate laterally against the geomembrane liner on the inside slope of the tailings cell impoundment berm. The radon barrier thickness varies as a function of the thickness of underlying tailings. The radon barrier would be 4.6 ft thick at the cell margin, where the tailings would be 1.0 ft or less, then thicken progressively to 7.0 ft over tailings that are 15 ft or more in thickness. Due to the attenuation of radon in the upper 15 ft of tailings, no additional radon barrier is needed over tailings exceeding 15 ft of thickness. However, in order to establish the 0.02 grade needed in the overlying layers of the cover, the top surface of the radon barrier will be completed at a 0.02 grade towards the cell perimeter. As a result, the radon barrier may be more than 7.0 ft thick toward the center of the cells. The bounding limits of radon barrier thicknesses were determined using the RADON code and the analytical procedures described in NRC Regulatory Guide 3.64, Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailing Covers (NRC, 1989). The radon barrier cover soil would be placed in lifts of not more than 8 inches uncompacted thickness, moisture conditioned to within 2 percent of optimum moisture content, and compacted to not less than 95 percent maximum dry density per ASTM D-698 (Standard Proctor).
- Interim cover – provides immediate protection against windborne release of tailings after cessation of cell operation and prior to placement of radon barrier, serves as a firm base for radon barrier construction. The cover would consist of not less than 2.0 ft of uncontaminated native soil placed in lifts over the regarded tailings surface and compacted to not less than 85 percent maximum dry density per ASTM D-698 (Standard Proctor). This compaction requirement takes into account the expected condition of the underlying tailings; although dewatered of free-draining moisture, the tailings are expected to retain substantial moisture content and remain uncompacted at the time of interim cover construction. These conditions are likely to make moisture-conditioning of the native soil impractical and to limit the size of equipment used for interim cover placement to small dozers with low ground pressure treads. Consequently, the lift thickness, estimated initially at 1.0 ft, would be determined in the field under initial placement conditions dictated by tailings density and retained moisture. The interim cover would extend across the final tailings surface, terminating laterally against the geomembrane liner on the inside slope of the tailings cell impoundment berm.

Modeling. The design of the cover layers was an iterative process focused on optimizing the function of each layer and satisfying the design objective of the cover system as a whole. The design was based in part on the properties of the available borrow soil (primarily the native soil) and on regulatory agency guidelines. Layer thicknesses were initially selected based on experience and engineering judgment, then evaluated and refined through numerical modeling of the cover performance against the three design objectives. Details of radon modeling and runoff and erosion modeling are provided in the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c).

Closure Construction. The cover for each tailings cell would be constructed within several years after cessation of that cell's operation. The time of cover construction after cessation of cell operation would depend on the rate of dewatering of each cell; the first step in cover

construction would be preparation of the cell surface for placement of interim cover and would begin as soon as the tailings surface is dry and firm enough to support earthwork equipment in accordance with 6 CCR 1007-1, Part 18 Appendix A Criterion 6A (CDPHE, 2001). This criterion requires that the final radon barrier must be completed as expeditiously as practicable considering technological feasibility after the pile or impoundment ceases operation in accordance with a written approved reclamation plan.

Several steps are required for preparation of the tailings cells for closure. These steps are described in detail in the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c) and include: dewatering, regrading, and installation of settlement monitoring points. Once these steps are accomplished, construction of the cover layers would begin. Cover construction would be performed in accordance with earthwork specifications in the *Specifications for Closure and Reclamation for Mill Facilities* (Golder, 2009c).

Interim Cover Construction Construction of the interim cover would begin as soon as possible after regrading of the tailings has started. Interim cover would be placed progressively from the edges of each tailings cell toward the center, following tailings regrading as closely as surface stability and safety considerations would allow. To build out the interim cover from the tailings berm, native soil from stockpiles or other on-site sources would be dumped along the crest and inside slope of the tailings berm. From there, the soil would be moved by dozer and spread in lifts (estimated to be 1.0 ft thick on average) across the tailings surface. Compaction effort would be provided by multiple passes of the dozers. Moisture would be added only if needed for dust control; the underlying tailings are expected to have high moisture content at the time of interim cover placement. The minimum final thickness of the interim cover would be 2.0 ft, with actual thickness likely to be greater over the more compressible fine tailings in the center of the cell.

During interim cover placement, settlement monitoring points would be installed on a grid pattern over the top of the tailings. The interim cover is designed to provide protection against windborne release of tailings until the radon barrier can be constructed. The latter event would occur only after tailings dewatering and the resulting settlement of tailings are essentially complete, as indicated by the results of settlement monitoring. The time required for this condition to develop cannot be predicted with certainty but would likely be 1 to 3 years, based on experience with previous tailings cells.

Radon Barrier Construction The radon barrier of each cell would be constructed in a continuous operation. Allowing for reasonable interruptions due to inclement weather, the radon barrier should be started and completed within one annual construction season. Radon barrier would not be placed when temperatures are likely to drop below freezing on a daily basis. The top surface of the radon barrier would be completed at the elevations and grades required to achieve the final cover configuration, less the thickness of the ET cover. The top surface would slope at a uniform grade of 0.02 from the west-east centerline of the cell toward the tailings cell berms.

Radon barrier construction in each cell would begin after the settlement monitoring data indicate that primary settlement (settlement resulting from consolidation of tailings due to dewatering) has reached approximately 90 percent of the asymptotic value on the log time-settlement curve. Native soil to be used in the radon barrier would be drawn from the soil stockpile or from excavation of future tailings cells if these activities are occurring at the same time.

Evapo-transpiration Cover Construction The layers of the ET cover (capillary break/drainage layer, filter layer, bio-intrusion layer, and erosion barrier/vegetative cover) would be constructed for each cell as soon as practicable after construction of the radon barrier. Each layer may be constructed across the entire cell before the next, or the layers may be constructed in stair-step order progressively across the cell. It may not be feasible to construct both the radon barrier and the ET cover in the same construction season. If placement of the ET cover does not occur during that same year, the surface of the radon barrier would be scarified, moisture conditioned and re-compacted prior to construction of the overlying ET cover.

Rock materials needed for the capillary break/drainage layer, filter layer, and top lift of the erosion barrier as well as the cobbles in the bio-intrusion layer would be imported from an off-site borrow source. Larger rock needed to cover the outslopes of the tailings cells and the drainages between the tailings cells would also be imported to the Site. Rock sources in the nearby San Miguel River valley were used for the durable rock layers at the nearby Durita site and are expected to be available for this project. The Cotter limestone quarry in La Sal, Utah has also been identified as a potential source of durable rock. Samples of rock material would be obtained for durability testing in accordance with NRC guidelines (NRC 1982b, 2002, 2003b) to demonstrate that the selected rock would meet NRC performance standards. The selected material would be produced off-site and transported by truck to the site for either temporary stockpiling or direct placement in the ET cover.

The rock mulch in the top lift of the erosion barrier/vegetative cover would be applied after the last lift of native soil is placed, then mechanically mixed into the soil before final finish grading. Seeding of this finished surface would occur during the same year as ET construction and at the end of the season, before first snowfall. A rock blanket would be placed on the outslopes of each tailing cell from the toe of slope to the top of slope to provide protection against erosion of the underlying tailing cell dike and outer edge of tailing cell cover. The rock blanket would consist of 1.0 ft of graded durable rock (average diameter of 2.5 inches) placed over a sand/gravel bedding layer on a gradual 10H:1V slope. The rock blanket protecting the 5H:1V slopes between cells A and B and between cell B and C would consist of the same rock but with a larger average diameter of 3.5 inches. Run-out rock aprons and the rundown channels between tailings cells would consist of much larger rock, average diameter of 8 inches and 18 inches, respectively, to provide erosion protection against the 1,000-year storm event.

2.2.7.7 Surface Restoration

After contamination has been removed from the mill area and the evaporation pond area and the verification survey has confirmed that these areas meet the standards for Radium-226 and other radionuclides described in Section 14 of the *Mill Decommissioning Plan* (Kleinfelder, 2009b), the Mill License Boundary would be contracted to include only the capped tailings cells. The remaining boundary (Restricted Tailings Cell Area) would enclose the tailings cells for long-term protection against byproduct (tailings) release as required by 6 CCR 1007-1, Part 18 (CDPHE, 2001); the other portions of the Mill License Boundary would be released for unrestricted use.

With the exception of the Restricted Tailings Cell Area, the area within the Property Boundary would be reclaimed by regrading to approximately the original (pre-construction) configuration, as illustrated in the *Mill Decommissioning Plan* (Kleinfelder, 2009b). The previous removal of liners, foundations, and contaminated soils from the ore pad and mill pad area would result in a non-uniform surface area. These areas would be regraded to approximate the pre-construction contours with additional subsoil and topsoil brought in, as necessary, from the soil stockpiles to

achieve final grades. A similar approach would be used in the evaporation pond area after the removal and sequestering of pond sediments, pond liners, and any contaminated soil within the final tailings cell. The surface water diversions constructed for the Mill Facility would be left in place to divert runoff away from the tailings cells. The regraded surfaces would be revegetated using the procedures and seed mixes described in *Specifications for Closure and Reclamation of Mill Facilities* (Golder, 2009c).

The Site Access Road would be left in place for the subsequent user of the land surface outside of the final license boundary as well as for access to monitoring wells and air monitoring stations. At the time of surface restoration, the two meteorological towers would be taken out of service except for the air monitoring components.

Surface water drainages on the Site experience intermittent flow following large precipitation events. After decommissioning, the tailings cells would be the only mill features remaining that could be impacted by, or cause impact to, surface water. Surface water control structures originally constructed to divert sheet flow away from the mill and the tailings cells would be left in place and protected with riprap as described in the *Site Drainage Analysis and Design Report* (Kleinfelder, 2009d). The *Tailing Cell Closure Design Report* (Kleinfelder, 2009c) addresses erosion control measures, including grading and rock cover, to protect the tailings cells against erosion by surface water runoff. Those erosion control measures are designed to protect the tailings from release for 1,000 years, accomplished by designing for erosion protection against the peak runoff from the probable maximum precipitation (PMP) event, as required by 6 CCR 1007-1, Part 18, Appendix A (CDPHE, 2001). Runoff from the restored mill area would flow to the north, toward Tailing Cell A, where it would be intercepted and diverted to the east and west by a diversion berm constructed in front of (south of) the south outslope of Tailing Cell A as described in the *Tailing Cell Closure Design Report* (Kleinfelder, 2009c).

2.2.8 Monitoring

Operational Monitoring. Energy Fuels has developed an *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b) that outlines the methods to be used for ongoing monitoring of environmental resources, process waste attributes and controls, and health and safety aspects during operation of the Mill Facility. Specifically, the *Operational Monitoring Plan* provides monitoring schedules and procedures to assess radiation doses and determine the concentrations of radionuclides and other constituents 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 CFR Part 20, “Standards for Protection Against Radiation,” and Part 40 “Domestic Licensing of Source Material;” however, CDPHE is the sole regulator of radioactive material in Colorado. In accordance with these applicable regulations, the monitoring programs provided in the *Operational Monitoring Plan* are designed to provide accurate

information on the specific radionuclides in effluents from the Mill Facility, 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. The *Operational Monitoring 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 (NRC, 1988a);
- Regulatory Guide 4.13 – Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry; Environmental Applications (NRC, 1977);
- Regulatory Guide 4.14 – Radiological Effluent and Environmental Monitoring at Uranium Mills (NRC, 1980a); and
- Regulatory Guide 4.15 – Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) – Effluent Streams and the Environment (NRC, 2007).

Table 1-1 in the *Operational Monitoring Plan* (Visus and Energy Fuels, 2009b) 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. Each monitoring program provided in the *Operational Monitoring Plan* contains an individual table summarizing the specific monitoring conducted for that particular environmental resource and/or Mill Facility component. The results of this operational monitoring program would be compiled quarterly and submitted to CDPHE semiannually, annually, and at times of license renewal as required by specific license conditions.

Closure Monitoring. Operational monitoring would continue during the closure period. Additional monitoring would also be implemented during closure according to the *Tailings Cell Closure Design Report* (Kleinfelder, 2009c) and *Specifications for Closure and Reclamation for Mill Facilities* (Golder, 2009c). Closure monitoring would include:

- Radiological surveys and soil sampling to identify contaminated soils for excavation and placement in the final tailings cell.
- Settlement monitoring designed to evaluate settlement and determine the appropriate time for placement of various cover materials.
- Dewatering sump monitoring designed to measure the rate of liquid released during tailings consolidation.
- Geotechnical sampling and testing of cover materials prior to and during placement including soils, rock, and aggregate.
- Radon canister measurements on the final cover to verify compliance with Criterion 6(2) of 6 CCR 1007-1, Part 18 Appendix A (CDPHE, 2001) for radon flux levels.
- Periodic visual inspection of the cover during and after construction to identify and mitigate, as necessary, potential areas of concern including subsidence, erosion, burrowing animals, and areas of poor vegetation.

2.2.9 Post-Closure Monitoring

Post-closure monitoring and maintenance would continue after conclusion of closure and reclamation activities. Monitoring would be established based on site-specific conditions at the time of closure; however, it would likely include carryover of some of the operational monitoring of environmental media (air, surface water, groundwater, soils, and biota) as well as radiation levels on-site. Maintenance would consist of repairing areas of erosion, reseeding as necessary, and inspecting and repairing the fence around the Restricted Tailings Cell Area.

2.3 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

2.3.1 Site Location Alternatives

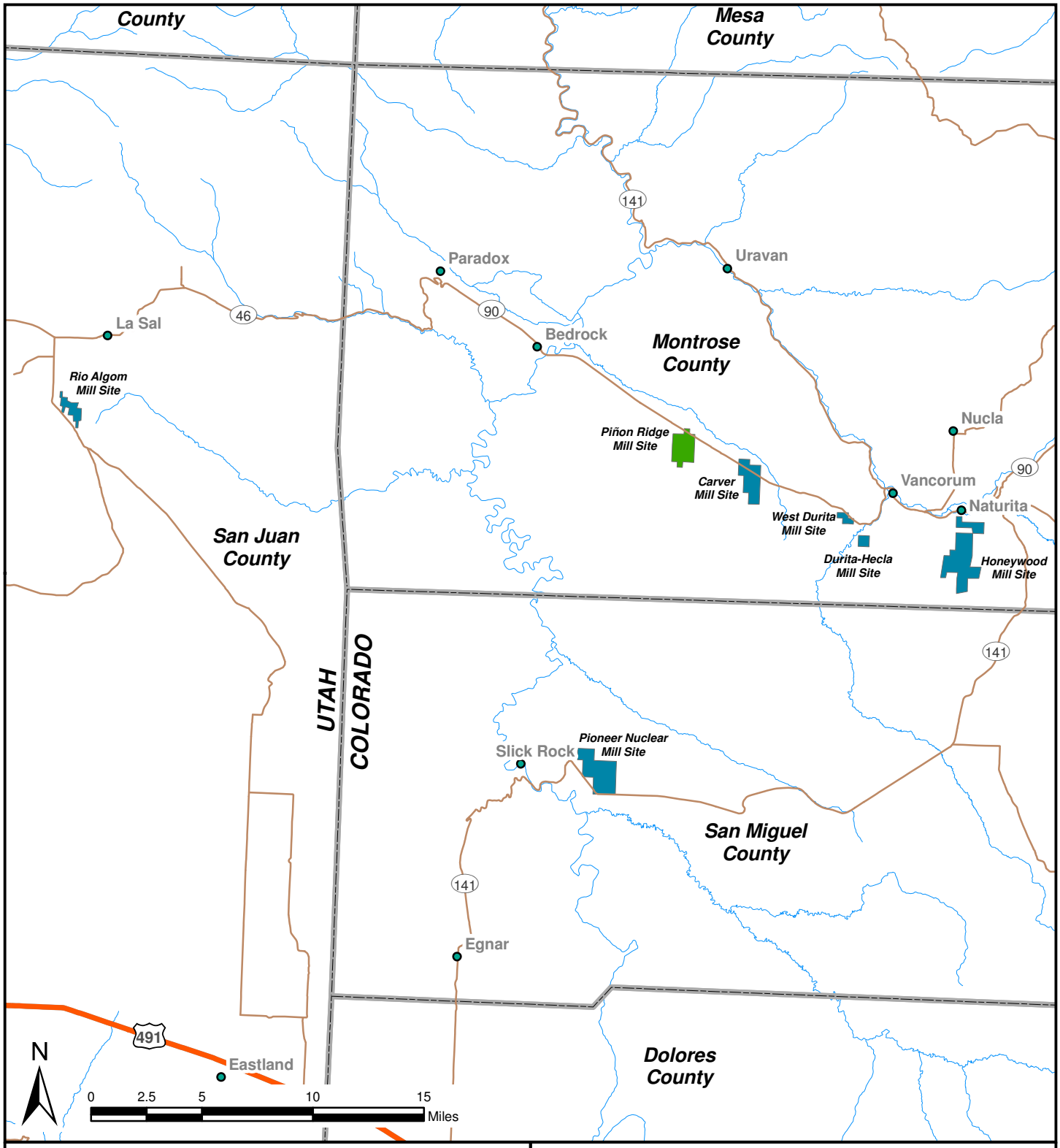
Seven potential site locations, including the Piñon Ridge Site, were evaluated in detail as potential candidates for the location of the Mill Facility. Descriptions of the six sites that were eliminated and the reasons for their elimination are described below. In conformance with 6 CCR 1007-1, Part 18, Appendix A, Criterion 2 (CDPHE, 2001), two of the six sites were considered because they were previously used for uranium recovery and waste disposal operations. The other former mill sites in the region (e.g., Uravan) did not meet NRC and State of Colorado siting criteria. Figure 2.3-1 provides the locations of the alternative sites.

2.3.1.1 Former Rio Algom Mill Site

The Rio Algom Mill site is located on approximately 758 acres in San Juan County, Utah, four miles south of La Sal and 10 miles from the Colorado/Utah border (portions of Sections 21, 22, 27 and 28, Township 29 South, Range 24 East). The site is accessed via SH 46 at La Sal Junction then south on the Lisbon Valley County Road. It is a reclaimed, former conventional carbonate-leach uranium ore refining plant which included underground mine and surface milling operations. Most of the infrastructure has been removed and reclamation was completed in December 2006, with the completion of a rock cover over the tailings area. The site had power at that time, but water rights and supply wells were either traded away or sold. The available area for a new mill is to the north of the reclaimed site; however, sufficient land is not available and it is within close proximity to existing residences that could be impacted by tailings disposal activities. Additionally, regulatory issues associated with pre-existing groundwater contamination were a concern at this site. The State of Utah had recently acquired regulatory authority over uranium milling and 11e.(2) byproduct material from the NRC and objected to the size of the Alternate Concentration Limits (ACL) plume that was previously approved by the NRC. ACLs are risk-based groundwater corrective action standards. The ACLs currently in place at the Rio Algom mill site requires monitoring through 2015. Due to the unavailability of sufficient land, proximity of residential housing, and the regulatory issues associated with the groundwater contamination, this site was eliminated from further consideration.

2.3.1.2 Pioneer Nuclear Site

The Pioneer Nuclear site is located on 1,425 acres in San Miguel County, Colorado, approximately 4 miles west of the former town of Slick Rock (Sections 26, 27, 34, and 35, Township 44 North, Range 18 West). The site is accessed via SH 141. In the late 1970's this was a previously permitted mill that proposed burying dewatered tailings in a series of trenches. The permit was approved; however, the project never started due to depressed uranium prices. The site was determined to be suitable, is fenced and surrounded by BLM-administered land, and is outside areas prone to flooding. Power is readily available near the site; however, the property does not convey any water rights. Pioneer Nuclear proposed obtaining water rights on



Potential Mill Sites
Selected Mill Site

Figure 2.3-1

Alternate Sites

the Dolores River and pumping via pipeline across BLM-administered lands. Shallow groundwater could also limit the depth of potential tailings cells that could be constructed below grade. The site was eliminated from further consideration primarily due to lack of public acceptance. Although the residents in the west end of San Miguel County would probably support the mill, the majority of the population of this county is centered in Telluride, which is currently strongly opposed to natural resource development. The site is also located in the extreme south end of the Uravan Mineral Belt, which would result in higher haul distances and, there are no towns or cities in close proximity that could supply the labor force needed to operate the mill.

2.3.1.3 Durita-Hecla Site

The Durita-Hecla Site is located on 160 acres approximately 4 miles west of Naturita in Montrose County, Colorado (Section 34, Township 46 North, Range 16 West). The north end of the site is accessed via SH 90 then south on County Road GG25 to County Road EE21. The site is currently closed and contains existing reclaimed uranium tailings heaps and ponds. The land is owned by a mining company but would eventually be transferred to the DOE under the long-term surveillance program once the site meets all closure requirements. Adjacent land includes BLM-administered land to the east and private land to the west. The site is underlain by low permeable Mancos shale. Water rights can be obtained from the nearby San Miguel River and power is readily available in the area. This site is limited in size and in the availability of sufficient adjacent useable land for facility construction and potential site expansion. Much of the adjacent fee land (Anderson property) is bottom land and is not suitable for tailings disposal due to flood concerns. Due to the lack of sufficient land area and the flood concerns, this site was eliminated from further consideration.

2.3.1.4 West Durita Site

The West Durita Site is located on 160 acres near Naturita in Montrose County, Colorado, (Sections 27 and 28, Township 46 North, Range 16 West) just northwest of the Durita-Hecla Site and the Anderson property mentioned above. Access to the site is from the intersection of SH 90 and County Road EE22. The site is currently undeveloped and is privately owned by George Glasier, President and CEO of Energy Fuels. The site was preferred based on expected permitability and general community acceptance. The property does not have water rights, but like the Durita-Hecla site, water rights could be obtained from the San Miguel River. Power is readily available. This site was eliminated due to its relatively small size, close proximity to a ranch house on adjoining property, and that adjacent land to the south is not available for purchase.

2.3.1.5 Honeywood Site

The Honeywood Site is located on a plateau immediately southeast of Naturita in Montrose County, Colorado (Sections 27, 28, and 34, Township 46 North, Range 15 West and Sections 3, 4, 5, and 9, Township 45 North, Range 15 West). The main access to the site is from SH 141 just east of its intersection with SH 145 and an unnamed county road approximately 3 to 4 miles east of Naturita. This 1,200-acre site includes a reclaimed surface coal mine and approximately 112 acres have been backfilled, graded to approximate original contours, and topsoiled. The site is surrounded by a mixture of private and BLM-administered land parcels of various sizes. The local landfill is located about 1 mile southeast of the Honeywood Site. Shallow groundwater is present over the entire site; however, it would be necessary to gain surface water rights from the San Miguel River basin or groundwater rights from deeper formations to meet the daily fresh water requirements for mill operations. The site is underlain by low permeability bentonitic

shales that would provide additional protection of groundwater resources from the construction and operation of the tailings disposal facilities. Broad Canyon Landfill, southeast of the mill site, was permitted without a synthetic liner due to the existence of this shale layer. The property is currently in an active state of reclamation. This site was eliminated due to its proximity to Naturita, transfer of regulatory responsibility (and bond release) of the site from the Colorado Division of Reclamation, Mining and Safety (DRMS) to the CDPHE, and because it would be necessary to drill and blast to place tailings cells below ground level.

2.3.1.6 Carver Site

The Carver Site is located in the Paradox Valley on 900 acres approximately 10 miles southeast of Bedrock and 9 miles west of Naturita in Montrose County, Colorado, (Sections 10, 11, 14, and 23, Township 46 North, Range 17 West). Access to the site is from SH 90. The site is bordered on its west side by BLM-administered land and on its other three sides by a mixture of private and BLM-administered land parcels. Two residences are located in close proximity, one immediately east of the site on adjacent land. A reclaimed underground uranium mine is located on adjacent BLM-administered land south of the site near the toe of Monogram Mesa. The site and most of the surrounding property is used to graze cattle during the winter and early spring. The site is characterized by numerous dry washes or arroyos that carry surface water runoff from Monogram Mesa after precipitation and snow melt events. This site was eliminated due to the proximity of residences, the lack of usable land due to the numerous drainages, and long-term geomorphology concerns. Due to the abundance of surface water runoff at the site, reclamation of tailings cells to the 1,000-year standard could be difficult to achieve.

2.3.2 Technical Alternatives

The alternatives for processing uranium are limited to conventional acid- or alkaline-leach milling, heap leaching, and in-situ leaching. In the case of the Uravan Mineral Belt ores, which comprise the majority of the feed for this project, conventional-acid leach milling (Proposed Action Alternative) provides the highest recovery rate of uranium and vanadium at the lowest price per pound recovered. The disadvantages of the other three recovery technologies for this specific application are discussed below.

2.3.2.1 Conventional Alkaline-Leach Milling

Alkaline leach mills, such as the former Rio Algom Mill, use carbonate compounds (i.e., sodium bicarbonate, sodium carbonate or carbon dioxide) rather than sulfuric acid to leach the ores. Alkaline leach circuits require longer retention times than acid circuits and result in lower recoveries of uranium and vanadium. They are typically employed when the ore feed has high limestone content (i.e., 12 percent or more carbonate content), which would result in excessive consumption of sulfuric acid in a conventional-acid leach circuit. Although some of the mines in Utah that could supply ore to the mill have ore bodies with higher carbonate concentrations, most of the mines in the region including all of the Uravan Mineral Belt mines have relatively low carbonate concentrations.

2.3.2.2 Heap Leaching

Heap leaching consists of crushing and placing the mined ore on a lined pad and then spraying the top of the ore pile with leach solution. As the solution percolates through the ore, it dissolves the uranium from the crushed rock. The solution is collected in lined ponds located at the base of the heap and is then either shipped to a mill for further processing or is processed in an on-site precipitation and packaging facility. The uranium recovery percentage using heap leaching is much lower than those attained in conventional mills, which typically average more than 90

percent recovery; however, the capital cost to build a heap leach facility is substantially less than for a mill. This method has been used successfully where mining costs are low and vanadium recovery is not required. The Durita Heap Leach site near Naturita is a good example of this type of facility. Tailings from a historic vanadium mill were trucked to the site and then leached to recover uranium. This resulted in minimal mining costs (i.e., surface excavation and trucking) and adequate recovery of some of the uranium content with a relatively small capital investment.

Heap leaching is, in most cases, an uneconomical option for processing ores from the Uravan Mineral Belt and the other mining districts in eastern Utah. The sandstones from these formations break down into very fine-grained sands that plug off and do not allow for good percolation through the crushed ore. Underground mining costs using split-shooting methods are also high and require good recoveries of both uranium and vanadium during processing to be economical. In addition, this method results in much higher water consumption rates due to evaporation when compared to conventional milling.

2.3.2.3 In-Situ Leaching

In-situ leaching (ISL), also known as in-situ recovery (ISR), consists of injecting a leaching solution into porous uranium-bearing strata through a series of injection wells. Once in contact with the mineralization, the leach solution or lixiviant oxidizes the uranium minerals, which allows the uranium to dissolve in the groundwater. Production wells, located between the injection wells, intercept the uranium-bearing lixiviant and pump it to the surface. At the surface, a centralized ion-exchange facility extracts the uranium from the lixiviant. Once the ion-exchange resin is fully loaded with uranium, it is stripped or eluted. The uranium is then precipitated from the eluate as a yellow cake slurry, dried, and packaged.

Although a sulfuric acid solution is allowed and used as the lixiviant in some countries, ISLs in the United States typically add dissolved oxygen and carbon dioxide to the native groundwater to produce a weak alkaline lixiviant. This results in less environmental impact to the groundwater. ISL systems are considerably less expensive to install and operate than a conventional mining and milling operation. They are also much safer than extracting the uranium ore using surface or underground mining methods.

ISL methods are not applicable to the majority of the ore bodies found in western Colorado and eastern Utah. These ore bodies are very fine-grained and do not have the necessary permeability for injecting and extracting lixiviants.