Appendix E – Environmental Protection Measures

Energy Fuels Resources Corporation ("Energy Fuels") plans to construct and operate the Piñon Ridge Mill Facility (the "Project" or the "Facility") in Montrose County, Colorado in order to process uranium and vanadium ore mined from its existing nearby operations and from area mines owned and operated by others. The following discussion presents an overview of the environmental control measures proposed for the Facility's primary components.

Mill Facility

The primary mill facilities will be enclosed within metal buildings with concrete floors designed with concrete curbs, spill collection sumps and other forms of secondary containment in areas where reagents, process solutions and finished products (e.g., uranium oxide ["U_3O_8"] concentrate [called yellowcake] and vanadium oxide ["V_2O_5"] concentrate) are handled and stored. Piping will be designed to be chemically resistant and will be double-walled or contained within lined trenches in those areas outside the buildings where secondary containment systems would not otherwise be present. Leak detection and emergency shutoff systems will be installed in critical areas to minimize the volume of a release should a leak or equipment failure occur. Spill control kits will be present at strategic locations and employees will be trained in the proper methods for controlling, cleaning up and reporting spills of the various chemicals and process solutions present in the mill. Should a release extend outside of a controlled area, the cleanup would be strictly regulated by the Colorado Department of Public Health and Environment ("CDPHE") requiring extensive sampling and monitoring to verify the adequacy of the cleanup effort.

Air emissions will be controlled through a variety of methods starting with the use of water sprays at the ore dumping platform, ore stockpiles and conveyor hopper. A dust collecting baghouse will be installed at the conveyor hopper to capture any dust generated during ore feeding into the hopper and conveyor system. From the hopper, the ore will be transported by conveyor to the semi-autogenous grinding ("SAG") Mill where it will be mixed with water and reagents. A dust scrubber will be installed at the SAG Mill to capture any dust generated during mixing prior to the ore being converted to slurry form. Gas scrubbers will be installed at all emission points during the processing of the slurry ore, including the pre-leach, leach, solvent extraction, precipitation, drying and packaging systems.

The plant will also be designed with newer technology that reduces the number and quantity of emissions. A good example of this is the yellowcake dryer system. Older dryers used a roasting method where hot gasses were passed through the yellowcake. These gases were then directed through a scrubber before being emitted. In the dryer proposed for the Facility, the yellowcake is totally contained within the dryer, which is heated externally by steam. Other improvements include using automated equipment within hermetically sealed rooms to package the yellowcake and vanadium oxide produced. The intent of these technical improvements and emission control devices is to limit exposure of mill employees and the general public to "as low as reasonably achievable" ("ALARA") levels of radiation and fugitive dust. Refer to Appendix G, Radiation and Worker/Public Safety, for further explanation of ALARA levels.

Waste Management Facilities

Tailings Cells

The tailings cells are designed and will be constructed to prevent seepage of solution from the tailings slurry to the surrounding environment. Figure E-1, Tailings Containment System, provides a schematic cross section of the proposed liner system. The design provides a double layer liner system with an intervening Leak Detection System ("LDS") over the limits of the tailings cells to contain process solutions, enhance solution collection and protect groundwater. The liner system design consists of upper and lower 1.5-millimeter thick (60-mil) high density polyethylene ("HDPE") geomembrane liners. A reinforced geosynthetic clay liner ("GCL") placed on a prepared subgrade will underlie the lower (secondary) layer of the HDPE liner system. Designed to collect any leakage through the upper geomembrane liner, the LDS consists of an HDPE geonet on the base of the tailings cells and drainage geocomposite on the sideslopes, which convey solution to a collection sump for monitoring and recycle. Additionally, the design of Tailings Cell A provides a split configuration, which allows half of the cell to be decommissioned and repaired while continuing mill operations if problems with the liner system develop. Tailings Cells B and C may also be constructed as split cells, depending on operations at the time of construction.

The proposed tailings liner system represents the latest technology and is similar to the liner system recently approved by the State of Utah for the new 40-acre tailings cell at the White Mesa Mill in Blanding. Modern synthetic liner systems are designed and installed with many safeguards to minimize the possibility of a puncture or tear. The liner system must meet strict quality assurance and quality control (QA/QC) requirements before it can be put into operation. Once in operation, the LDS is designed to intercept and remove any seepage that may occur through the upper HDPE geomembrane liner thus maintaining a very low hydraulic head on the lower HDPE and GCL liners.

The likelihood of this type of liner system developing a significant puncture or tear during operations that would compromise containment is low. If this type of situation were to occur, it would be detected in the LDS and the tailings discharge could be directed to the other sub-cell to allow for inspection and repairs. The biggest advantage of the split cell configuration is that it provides flexibility during milling operations. The mill operates 24 hours per day, 7 days per week. If a pump fails, a pipe becomes plugged, or if a discharge pipe has to be repositioned, the tailings discharge can be directed to the other cell while repairs and maintenance are being conducted on the first sub-cell. This reduces the possibility of having to shut down the mill for tailings-related maintenance work.

The tailings slurry consists of the sandy waste material and process water. After the tailings are deposited, the sands will settle and the water will be pumped back to the mill for reuse via a barge-mounted pump. The solution pond area will be kept small to reduce the amount of water held within the tailings sands. The sandy beach area will be sprayed with water from the evaporation ponds, as necessary, to control windblown fugitive dust. The evaporation pond water contains high levels of salt that create a hard, wind-resistant layer on top of the tailings sands. An underdrain system will capture the solution percolating down through the sands. The conveyance pipes, for pumping tailings to the tailings cells and for pumping reclaimed solution back to the mill, will be constructed of HDPE and will be installed within lined trenches to meet requirements for double containment.

Evaporation Ponds

Similar to the tailings cells, the evaporation ponds are designed with a double layer liner system with an intervening LDS layer. The evaporation system will consist of a series of approximately four-acre ponds with the process water being introduced at one end of the series and flowing from one pond to the next. Enhanced evaporation systems such as sprinklers will be employed in the center ponds to increase the rate of evaporation during the warm-weather months. The process water contained in the evaporation ponds is unsuitable for wildlife consumption; therefore, netting installed over the evaporation pond area will prevent waterfowl and other migratory birds from accessing the pond water. The entire Facility will be surrounded with chain-link fencing topped with barbed wire; accordingly, livestock and wildlife will not have access to the pond area.

Ore Pad Facility

The ore pad is designed as a zero-discharge facility with berms surrounding its perimeter to isolate drainage and with the pad base sloped to a lined stormwater pond. The stormwater pond is separated from the ore pad by a concrete sediment trap and sediments collected in the trap will be excavated as needed and placed back on the pad. The pad design incorporates an engineered liner system consisting of a GCL placed over prepared subgrade and overlain by compacted native soils (i.e., cushion material) and gravel (i.e., roadbase).

Fugitive dust emissions will be controlled during ore dumping operations by a bank of water sprays installed along the dump points. Moisture will also be added as needed to the stacked ore using a water truck. Magnesium chloride will be applied to the primary access roads and stockpile pad to further reduce fugitive dust emissions.

The stormwater pond design incorporates a single composite liner system consisting of an HDPE geomembrane overlying GCL, overlying prepared subgrade soils. The pond is sized to contain runoff from the 100-year design storm event and pass the 1,000-year design storm event (to subsequent containment) with additional capacity provided by one foot of freeboard. Water collected in the stormwater pond will be pumped back onto the stockpile for dust control, as needed, or used in the mill process.

Delivery and Storage of Consumables

Chemicals, reagents and diesel fuel will be delivered to the Reagent Unloading Area located on the south end of the mill (see Figure 5, Mill Facility, in the main body of this application). The Reagent Unloading Area is located outside the restricted area (i.e., Mill License boundary) so that delivery trucks will not be exposed to mill process areas where radiation levels are controlled and closely monitored. Bulk shipments of liquid reagents and fuels (e.g., sulfuric acid, sodium chlorate, kerosene, and diesel fuel) will be pumped from the Reagent Unloading Area to tanks that are located within various areas of the mill. Product lines, to the storage tanks and from the storage tanks to the processing buildings, are designed to be chemically resistant to corrosion (e.g., carbon steel or HDPE) and enclosed within a second line with leak detection. Bulk shipments of dry chemicals and reagents such as sodium carbonate and ammonium sulfate will be blown into storage tanks located at the Reagent Unloading Area. Similarly, propane will be delivered directly to tanks located within a fenced area adjacent to the Reagent Unloading Area.

Spill Control and Response Procedures

Energy Fuels will have trained personnel to respond to unplanned spill and leak incidents should they occur. Various locations within the Facility where incidents could occur include the site access roads, loading/unloading aprons, and areas within the mill facilities area and various mill buildings. Spills will be reported, as required by permits and environmental laws, to the appropriate local, state, and federal agencies.

Specific procedures and personal protective equipment ("PPE") used in a cleanup action will depend on the characteristics of the material spilled and will require the development of a detailed response manual as part of the site's Health and Safety Plan. Minimum PPE for cleanup actions will consist of hard-toed boots, hardhats, eye protection, and gloves. Respirators may be required when working in dusty areas. Protecting the health and safety of the spill responders and caring for any injured employees or contractors will be the first priority of any cleanup action.

General response procedures are described below for each area of the site:

Access Roads

A truck accident occurring on the access road to the mill could result in the spillage of uranium ore, chemical reagents, fuels, or mill concentrates (i.e., yellowcake and vanadium oxide). These types of accidents would be handled in a similar manner as an accident occurring on public roads. The impacted area would be cordoned off and traffic would be either stopped or detoured around the accident site. The spilled material would then be contained, collected, and either recycled for use or disposed of properly.

Dry materials such as ore, solid reagents, and finished product would be scooped up with shovels, rakes, brooms, skid loaders, or similar small hand tools and equipment. Spilled ore would be transferred to the Ore Pad Facility while reagents would be recycled for use in the mill or placed in the tailings cells. Mill concentrates would be returned to the mill for repackaging. Because of the fine-grained characteristics of yellowcake and its inherent radioactivity, a spill of yellowcake would likely require the application of water sprays to minimize dust and the use of specialized PPE and monitoring equipment to limit the radiation dose received by the cleanup crew.

Fuel and oil spills would be contained with portable oil booms or earthen berms constructed with onsite equipment. Any free product would be removed with sorbent pads and contaminated soils would be scooped up with shovels and small equipment. Depending on the size of the spill, the contaminated pads and soils would be placed in drums or a rolloff for later characterization and disposal at an appropriate landfill. The same procedure would occur on a smaller scale if a vehicle develops a leak in a hose or fitting and spills hydraulic oil, antifreeze, motor oil, or similar fluids.

Spills of liquid reagents would be contained and collected in a similar manner to fuel and oil spills; however, acids or bases could require neutralization with another chemical prior to removal. Contaminated soils and sorbent pads would be placed in the tailings cell.

Loading/Unloading Aprons

The aprons where solid and liquid reagents are unloaded will be constructed of concrete and sloped to drain to a concrete sump. The aprons will have wing walls that allow for containment of the largest tanker volume plus at least ten percent additional capacity. Potential spill scenarios in these areas include accidents, a leak or break in a transfer pipe, or an improper connection of a truck tank with the transfer pipe. A spill of dry reagent material will be scooped up with shovels, brooms, skid loaders, or similar small hand tools and equipment, and then transferred to the appropriate storage bin or disposed of in the tailings cells. Spills of liquid reagents would flow to the concrete sump area. Liquids collected in the sump will be pumped into the mill and directed (with predetermined valving) to the appropriate storage or process tank.

Fuel tanks will be located on a concrete pad with concrete sidewalls that provide secondary containment for the largest tank or tanker plus at least ten percent additional capacity. The adjoining concrete pad, where the fuel tankers will park when pumping fuel into the tanks, will be sloped to drain into the fuel tank pad area. If a spill occurs from either the tanker or the tanks, the fuel would be contained within the concrete walls of the fuel pad. Small spills and leaks would be cleaned up using sorbent material. A portable pump would be used to transfer larger fuel spills to drums or a vacuum truck for transport to a recycling facility.

Mill Facility Area

The mill facility area includes liquid storage and process tanks, dry storage bins, access roads, the ore pad, tailings cells, and evaporation ponds. The storage tanks and bins are equipped with secondary containment walls that will hold the contents of the largest tank plus ten percent. The pipelines from these tanks and bins will be located both above ground (in pipe racks) and below ground. The lines will consist of a carrier pipe within a larger leak-detection pipe. Any leakage from the carrier pipe would be detected at the tail end of the pipe where it flows into the next process or holding tank. The pipelines from the plant to the tailings cells and evaporation ponds will be contained within lined trenches. Any leakage from these pipes would be detected by the pumping instrumentation (i.e., change in pressure and operating parameters) and visually at the outfall into the tailings cells or evaporation ponds.

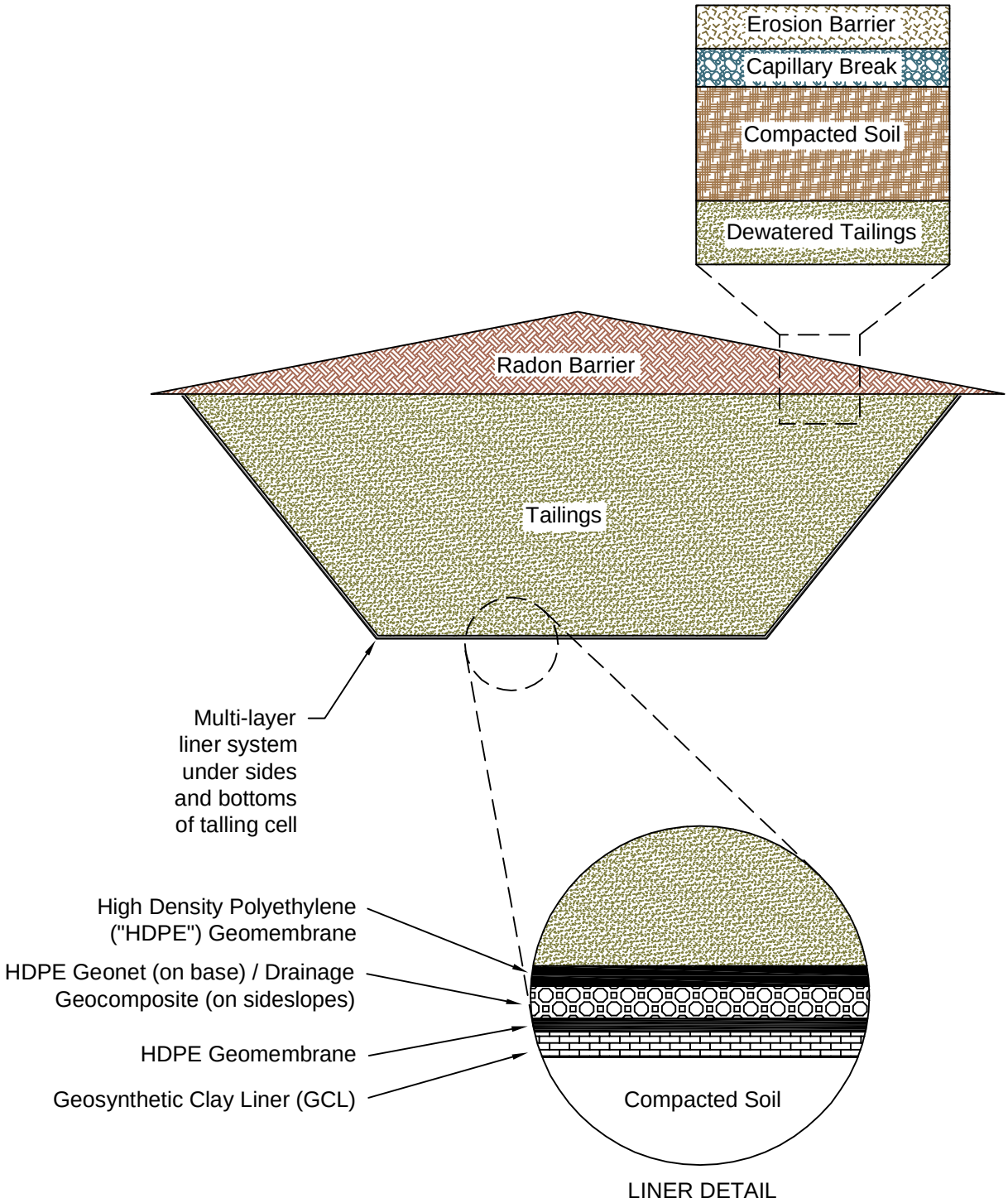
Another source of potential spills within the mill facility area is the mobile equipment, including pickup, flatbed and boom trucks, cranes, loaders, ore trucks, and ATVs. Generally, spills from mobile equipment are relatively small and result from broken radiator hoses or hydraulic fittings.

If a spill or release were to occur within the mill facility area, employees would be instructed to attempt to safely shutoff or stop the source of the leak and then attempt to contain the spilled liquid or solid material. Source control measures may include shutting of pipe valves, transferring fluids from a leaking tank to another tank, or making temporary repairs to broken lines or hoses. Portable oil spill booms and sorbent pads may be used to contain and clean up small spills while larger spills may require construction of earthen berms and over-excavation of contaminated soils. The chemicals and contaminated soils generated from the cleanup of spilled reagents, process streams, or tailings would be placed in the tailings cells while the cleanup of petroleum products would be containerized for offsite recycling and/or disposal.

Mill Buildings

Each mill building will be constructed upon a concrete pad with a continuous concrete curb extending around the perimeter of the pad. Accordingly, any spilled solutions or materials will be contained within the buildings. Each process area will be equipped with a concrete sump that will capture any spills that occur. The sump pumps will connect to pipes that can be valved to return the spilled solutions to one or more process tanks or to the tailings cells. In most cases, cleanup will be performed using high-pressure hoses.

The yellowcake and vanadium packaging facilities will be largely automated. If cleanup of spilled product is required, personnel will be required to wear appropriate PPE and implement dust control measures. Any cleanup of yellowcake will also require monitoring of dust and radioactivity levels in the affected area.



PROJECT ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE MILL FACILITY
MONTROSE COUNTY, COLORADO

TITLE

TAILINGS CONTAINMENT SYSTEM

Evisus CONSULTING GROUP, INC.	PROJECT No.	N/A	FILE NAME FigE1–TailContainSys	
	DESIGN	EFR	6/08	SCALE NONE REV. A
	CADD	CSM	7/7/08	**FIGURE E-1**
	CHECK	MAM	7/7/08	
	REVIEW	FF	7/7/08	