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# 1.0 PROPOSED ACTIVITIES

Lost Creek ISR, LLC (LC ISR, LLC) is submitting this Technical Report (TR) to the United States (US) Nuclear Regulatory Commission (NRC) in support of a source and byproduct material license to operate the Lost Creek Project (Project) in accordance with the Atomic Energy Act of 1954, as amended, Title 10 Code of Federal Regulations (CFR) Parts 20, 40, 51, and 70, and other applicable laws, regulations, and NRC guidelines. Issuance of this license would authorize LC ISR, LLC to conduct uranium In Situ Recovery (ISR) in Sweetwater County, Wyoming.

## 1.1 Licensing Action Requested

An NRC source and byproduct material license is required under the provisions of 10 CFR Part 40, Domestic Licensing of Source Material, to recover uranium by ISR techniques. Under the Atomic Energy Act of 1954, as amended, and the Uranium Mill Tailings Radiation Control Act of 1978, as amended, NRC has determined that it has the authority to regulate ISR facilities. The National Environmental Policy Act (NEPA) of 1969 requires federal agencies to consider the potential environmental impacts of major federal actions under their jurisdiction.

Per NEPA, federal agencies are obligated to evaluate and mitigate potential environmental impacts and to evaluate potential means to mitigate such impacts. NRC and the Bureau of Land Management (BLM) are the federal agencies with jurisdiction over the Project and Project area respectively. Under 10 CFR Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, NRC is required to perform an environmental evaluation of the proposed licensing activities. BLM has jurisdiction over leases related to the use of the Permit Area. After consultations with both federal agencies, it was agreed that NRC will take the lead on implementing the NEPA process for the Project. NRC will prepare a Technical Evaluation Report (TER) and a Safety Evaluation Report (SER) related to the Project. To facilitate the creation of the TER and SER, this TR is organized in accordance with the guidance provided in NUREG-1569, Standard Review Plan for In Situ Leach Uranium Extraction License Applications, which was published in June 2003.

Uranium ISR is also regulated by the State of Wyoming. Prior to commencing ISR operations, a Permit to Mine must be obtained from the Wyoming Department of Environmental Quality (WDEQ). This Permit to Mine includes an Underground Injection Control (UIC) Permit for the ISR wells (Class III wells), and in Wyoming, WDEQ has primacy from the U.S. Environmental Protection Agency (EPA) for the UIC

program, which is part of the Safe Drinking Water Act of 1974, as amended. A separate application package has been prepared and will be submitted to WDEQ for the Permit to Mine. Other permits that must be obtained prior to the commencement of operations include, but are not limited to: a UIC permit for the ISR disposal (Class I) wells from WDEQ; aquifer exemptions from the EPA; an Air Quality Permit from WDEQ; and a Storm Water Discharge Permit from WDEQ.

This TR provides detailed information on the facilities, equipment, and procedures to be used for the Project. In addition, an Environmental Report (ER) was also prepared to address the potential impacts of the Project on public health and safety, and the environment as required by 10 CFR 51.45, 51.60, and 51.66. The ER for the Project is submitted simultaneously with this TR.

The ISR operations at the Lost Creek Permit Area (Permit Area) will be conducted with proven technologies following standard industry operating procedures developed to assure adequate protection of public and occupational health and safety, and the environment. According to NUREG-1569, ISR uranium recovery operations are much more environmentally benign than conventional uranium mining and milling, and pose lower risk of occupational hazard. Operations of the Project will be conducted in compliance with applicable regulations and guidelines to assure adequate protection of workers, public health, and the environment.

## 1.2 Project Background

The discovery of uranium deposits in the Permit Area and consequential exploratory drilling and studies have occurred over the course of four decades.

In 1968, American Metals Climax Inc. acquired the property and discovered low-grade mineralization. Texasgulf Inc. (Texasgulf), in 1976, optioned the property from Valley Development Inc. and exercised their option in 1979. Exploration drilling, carried out by Texasgulf from 1976 through 1982, identified the main mineral trend.

In 1969, Conoco Inc. (Conoco) acquired the adjacent property to the east and conducted a major exploratory drilling program, including installation of groundwater monitor wells. In 1978, Texasgulf optioned a 50 percent interest in Conoco's property, and continued the exploratory drilling of the main mineral trend at Lost Creek to the east. In 1981, Texasgulf carried out laboratory column leach testing of core samples with carbonate lixiviant, which resulted in uranium extraction in excess of 89 percent. In 1982, Texasgulf conducted pump tests on the mineralized sandstones at Lost Creek. The hydrological characteristics of the mineralized sandstones indicated that uranium

extraction could be conducted with ISR methods (Poole, 1984). In 1983, Texasgulf and Conoco discontinued their exploration activities and studies due to economic reasons.

In 1986, the Japanese-owned, PNC Exploration, USA acquired the lode claims in the Permit Area and carried out additional delineation drilling, geologic and resource studies of the deposit through 1992 (Fruchey and Groth, 2004). New Frontiers Uranium, LLC (NFU) purchased the property from PNC Exploration, USA in 2000. NFU subsequently transferred the Permit Area along with its other Wyoming properties to NFU Wyoming, LLC.

From June 2005 through June 2007, Ur-Energy USA, Inc. (Ur-E), a Colorado corporation, purchased 100 percent ownership of NFU. During that time, at the Permit Area, NFU conducted engineering feasibility studies, core drilling for metallurgical studies, and delineation drilling to outline and define the uranium resources. In addition, NFU conducted comprehensive baseline studies, including installation of additional monitor wells for hydrological testing and water-quality sampling and a meteorological station within the Permit Area.

In July 2007, NFU transferred its Lost Creek property to LC ISR, LLC, a wholly owned subsidiary of Ur-E formed for the specific purpose of owning and developing the Permit Area. LC ISR, LLC is currently proposing the extraction of uranium using ISR techniques in the Permit Area.

## 1.3 Site Location and Description

The Permit Area is located in the northeast portion of Sweetwater County, south-central Wyoming. **Figure 1.3-1** shows the regional location of the Permit Area and the general geographic features of the region. A series of paved and unpaved county and BLM roads provide access to the Permit Area, which is located about 30 miles from the closest state highway, and the road network in the Permit Area is comprised of un-maintained two-track roads, passable year-round by four-wheel-drive vehicles. The Permit Area, which includes approximately 4,220 acres, is remotely located on public land administered by BLM and the State of Wyoming, and consists of 199 unpatented federal lode claims and one state mineral lease. The Permit Area is within Township 25 North and Ranges 92 and 93 West of the Sixth Principal Meridian; and approximately centered at 42 degrees, eight minutes North latitude and 107 degrees, 51 minutes West longitude. Rawlins is 38 miles southeast; Rock Springs is 80 miles southwest; Casper is 90 miles northeast; and Jeffrey City is 25 miles north. The nearest population center, located 15 miles northeast of the Permit Area, is Bairoil, a small town with less than 100 people.

The Permit Area is geographically located in the northeastern portion of the Great Divide Basin. The Great Divide Basin is an oval-shaped structural and topographic depression, encompassing approximately 3,500 square miles in Sweetwater and Fremont Counties, in south-central Wyoming. The Great Divide Basin is broadly bounded by mountains and hills on all sides: the Wind River and Granite Mountains to the north, the Rawlins Uplift to the east, the Wamsutter Arch to the south, and the Rock Springs Uplift to the west. The Great Divide Basin occurs between two bifurcating branches of the North American Continental Divide, which separates south of and rejoins north of the Great Divide Basin.

The regional rolling landscape has draws, rock outcroppings, ridges, and bluffs. The Permit Area is characterized by low-relief, sagebrush-dominated plains, dissected by small, ephemeral drainage networks. Within the Permit Area, there are no drainages with perennial surface water flow or permanent water bodies.

## 1.4 Orebody Description

The physical characteristics of the main mineral trend in the Permit Area are defined by data from historic and current exploratory drill holes. The main mineral trend strikes east for at least three miles and is as much as 2,000 feet wide. Uranium mineralization is known to occur in almost flat-lying sandstones of the Eocene Battle Springs formation. The sandstones are interbedded with siltstones and shales. The uranium mineralization generally occurs between 350 and 700 feet in depth, with a thickness varying from three to 40 feet. **Figure 1.4-1** shows the Lost Creek ore trend within the Permit Area. Detailed descriptions on the geology and mineralogy of the orebodies in the Permit Area are presented in **Section 2.6** of this report.

In 2006, a resource audit of the property was completed by Roscoe Postle Associates Inc. for Ur-E. The audit conforms to the classification of resources as required by the Canadian National Instrument 43-101. The current indicated resources of the Project are 8.5 million tons of uranium ore at a grade of 0.058 percent, which equals 9.8 million pounds of uranium oxide ($U_3O_8$) , and inferred resources of 0.7 million tons of ore at a grade of 0.076 percent, which equals, 1.1 million pounds of $U_3O_8$ (Wallis, 2006).

## 1.5 Solution Mining Method and Recovery Process

The Project will use ISR technology to extract uranium from permeable, uranium-bearing sandstones located at depths ranging from 350 to 700 feet. For uranium ISR to be successful, the host formation must: 1) be permeable, 2) lie below the water table, and 3) contain uranium minerals in economic quantities that can be dissolved with a recovery

solution. In addition, separation of the uranium-bearing sandstones by shales from other water-bearing formations helps restrict the ISR process to the targeted sandstone horizons. As demonstrated by the materials presented in this report, the geological, mineralogical, and hydrogeological characteristics of the mineralized sandstones in the Permit Area meet all of the above conditions.

The processes currently used for uranium ISR are based on well-established industry practices. **Figure 1.5-1** provides a schematic drawing of a typical ISR operation. A recovery solution (lixiviant), formed by adding gaseous carbon dioxide and oxygen (or other oxidizing agents such as peroxide) to native groundwater, is injected into a uranium-ore-bearing sandstone formation through a series of injection wells. As the barren lixiviant moves through the formation and contacts the ore, uranium is dissolved into the solution as uranyl carbonate.

The uranium-bearing solution (pregnant lixiviant) flows to production wells (also called recovery wells), where the solution is pumped to the surface by means of submersible pumps, and transported through a piping system to the Plant, where the pregnant solution will be processed (**Figure 1.5-2a**,**b**). The dissolved uranium will be first chemically adsorbed onto ion exchange resin at the Plant. The loaded resin is then transferred to another portion of the Plant, where it is stripped of uranium through an elution process. The resultant eluate then runs through a precipitation circuit and a filtering circuit before the final product, yellowcake slurry, is obtained. The lixiviant, once again barren, is refortified and reinjected to recover more uranium. The yellowcake slurry will be transported off-site to a licensed drying facility, where it will be processed into dry yellowcake.

Detailed descriptions of the entire ISR process are presented in **Section 3** of this report.

## 1.6 Operating Plans, Design Throughput, and Production

LC ISR, LLC will design and construct mine units and facilities in order to recover the uranium resources in the Permit Area. Each mine unit will consist of injection and production well patterns, typically arranged in a 'five-spot' pattern with four corner injection wells and one central production well per pattern (**Figure 1.6-1**). Fluids will be conveyed between the Plant and the mine units through buried pipelines. Small groups of injection and production wells will be connected with pipes to central distribution centers, called header houses, where oxygen (or another suitable oxidizer) will be added to the injection fluid. Carbon dioxide will be added to the injection stream at either the Plant or the header house due to its soluble nature in water. Necessary ancillary

equipment will include truck-mounted well workover units, hose reels, mechanical integrity test (MIT) truck(s), electrical generators, backhoes, all-terrain forklifts, trailer-mounted cementing units, motor grader(s) and light-duty four-wheel-drive vehicles. The wells will be installed by contracted well drillers who will use truck-mounted rotary drilling rigs and water trucks.

The processing facility, known as the Plant, will be used to capture and concentrate uranium. The product of the Plant will be yellowcake slurry. The Plant design is intended to process 6,000 gallons per minute (gpm) of lixiviant through the ion exchange circuit. The elution and precipitation circuits will be designed to handle two million pounds per year of yellowcake slurry. Offices and water treatment facilities will also be constructed at the Plant site.

**Section 3** of this report provides a detailed description of the operations and design of the mine units and the Plant.

Although the specific amount of yellowcake produced will depend on the market price and the cost of production, LC ISR, LLC anticipates producing about one million pounds of yellowcake ($U_3O_8$) per year through the Project life of at least eight years.

# 1.7 Project Schedules

## 1.7.1 Pre-Operational Development Schedule

Prior to Project start-up, a series of federal, state, and local permits and approvals must be received. **Figure 1.7-1** presents the pre-operational development schedule. The critical tasks in this phase will be the approval of: the Permit to Mine and the Mine Unit Number 1 by WDEQ (i.e., the UIC permit for Class III wells); the Source Materials License by NRC; the Operations Plan by BLM; and the UIC permit for the Class I wells from WDEQ; and aquifer exemptions from EPA.

## 1.7.2 Operations Schedule

The projected operations schedule is based on an initial production rate of 45,000 pounds of $U_3O_8$ for the first year and will increase to a reasonably sustainable production rate based on flow and grade from the ore-bearing formation, currently estimated at one million pounds per year. The actual development schedule and production rates will be

adjusted in response to actual mine unit conditions (e.g., flows, recovery rates, etc.) and the market demand for uranium.

**Figure 1.7-2** provides a current estimated schedule of operational activities at the Permit Area. Additional ore reserve and resource areas are known to exist within the Permit Area, but are not adequately characterized to evaluate for ISR planning at this time. These reserve areas have the potential to extend the ultimate Project life beyond this initial projected period.

## 1.8 Waste Management and Disposal

The major types of wastes generated at the Project will include non-radiologically contaminated domestic and industrial solid and liquid wastes, and radiologically contaminated 11(e)(2) byproduct materials. The 11(e)(2) byproduct material is defined in Chapter 2, Section 11 of the Atomic Energy Act of 1954 (42 US Code 2014(e)(2)), as amended, as "the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." In 2000, this definition was interpreted to include more of the fluids associated with ISR than had been previously included in the definition (NRC, 2000).

Domestic sewage will be disposed of in conventional septic/leach field systems, and by the use of portable chemical toilets. Domestic solid wastes (e.g., paper, wood products, office and food wastes) and other non-hazardous solid wastes (not directly associated with uranium recovery operations) will be collected and stored on-site in commercial waste containers and periodically removed for disposal at a local certified landfill. Petroleum waste will be collected and appropriately stored on-site and periodically removed by properly licensed contractors. Liquid 11(e)(2) byproduct materials generated from ISR operations will be disposed of via UIC Class I wells. Solid 11(e)(2) byproduct materials, such as ion exchange resin, filter media, and process equipment, will be stored on-site in appropriate containers or designated areas and periodically removed for disposal at an NRC-licensed disposal facility.

Details of the proposed waste management and disposal plans are provided in **Section 4** of this report.

## 1.9 Source and Byproduct Material Transportation

During the Project, source and byproduct materials will be transported to and from the Permit Area. These materials include yellowcake slurry and 11(e)(2) byproduct

materials.

The yellowcake slurry produced from the Plant will be transported by properly licensed contractors, driving trucks with trailer tanks approved for such use by the US and Wyoming Department of Transportation (US DOT and WYDOT, respectively), to an off-site facility for drying and packaging. At an annual production rate of one million pounds of $U_3O_8$, about 70 shipments per year are expected.

The 11(e)(2) byproduct materials will be transported by properly licensed contractors in DOT-approved vehicles to an NRC-licensed disposal facility off-site.

The transport of source and byproduct materials as well as the risk of transport accidents is discussed in detail in **Section 7.5** of this report.

## 1.10 Groundwater Restoration

After the economic recovery limit of a mine unit has been reached, the injection of lixiviant is discontinued and groundwater restoration is initiated. The restoration process will be similar to that used to restore mine units at other ISR sites, and consists of three basic activities.

- Groundwater sweep: Water will be pumped from the mine unit (with no associated injection), which results in an influx of baseline-quality water from the mine unit perimeter.
- Groundwater treatment and reinjection: Water from the mine unit will be pumped to the Plant, where ion exchange, reverse osmosis (RO), filtration and/or other treatment methods take place. The treated water will be reinjected into the aquifer. The concentrated brine will be sent to the UIC Class I well.
- Mine unit recirculation: Water from the mine unit will be circulated within the mine unit to provide consistent water quality. Recovered groundwater will be commingled and redirected to the injection wells without additional purification treatment. This phase of restoration will homogenize the water quality of the aquifer. The use of a reductant (e.g., hydrogen sulfide or other) and application of bioremediation may also be considered as warranted to supplement the primary restoration efforts.

Following these restoration activities, a groundwater stabilization monitoring program will be initiated. Once the approved restoration values are reached and maintained, restoration is deemed complete. Results will be documented in a Restoration Report and submitted to WDEQ and NRC for approval.

Detailed discussion on groundwater restoration is presented in **Section 6** of this report.

## 1.11 Decommissioning and Reclamation

As soon as practical after groundwater restoration has received final regulatory approval, each mine unit will be reclaimed. This reclamation process includes abandonment and plugging of all wells, removal of all buried pipelines and overhead utilities, and removal of all surface facilities.

Prior to the commencement of surface reclamation, affected areas and buildings will be decontaminated, and facilities and ancillary equipment will be decommissioned and removed or reused in another area of the Project. With regulatory agency approval, certain buildings and roads may be left for future use.

During reclamation, the land will be returned to approximate its contours prior to Project disturbance. Vegetation will be re-established using a seed mixture approved by WDEQ and BLM.

Decommissioning and reclamation are discussed in detail in **Section 6** of this report.

## 1.12 Surety Arrangements

Prior to commencing ISR operations, LC ISR, LLC will establish and maintain appropriate surety arrangements with NRC and WDEQ. Both WDEQ and NRC will be provided with the necessary information to verify that the financial assurance will permit the completion of groundwater restoration, radiological decontamination, facility decommissioning, and surface reclamation of sites, structures, and equipment used during the Project. Details of the surety arrangement are provided in **Section 6** of this report.