Rare Element Resources

March 19, 2021

Re: Demonstration Project Description

Rare Element Resources (RER) and General Atomics (GA) are developing a 100% U.S. domestic rare earth element (REE) processing and separation demonstration facility, entirely free from Chinese influence or control. Combining the RER-owned REE deposits in the Bear Lodge project located in northeastern Wyoming with the team's proprietary extraction and separation processes, the GA/RER team is capable of producing Neodymium/Praseodymium (NdPr) at >99.5% purity, as well as other Rare Earth Oxides (REO) to meet U.S. national production and security needs.

GA, in coordination with its European affiliate Umwelt-und Ingenieurtechnik GmbH Dresden (UIT) and Rare Element Resources, Inc. (RER), proposes to demonstrate the domestic production of NdPr and other REOs at up to 3 tons of ore/day as a research and development (R&D) scale-up for domestic production facility development.

In January 2021, formal selection notice was received from the U.S. Department of Energy (DoE) that the GA/RER project team had been selected to enter into financial award negotiations pursuant to the Critical Materials Funding Opportunity Announcement (FOA) for the engineering, construction and operation of a rare earth separation and processing demonstration plant.

GA, RER, and UIT along with LNV, an Ardurra Group, Inc. as engineering and construction subcontractor, submitted a formal proposal to the DoE in response to a published FOA in mid-2020 for the construction and operation of a rare earth separation and processing plant utilizing proprietary technology to produce commercial grade products. The DoE funding, in the amount of US$21.9 million represents one-half of the total estimated costs for the demonstration project and is contingent upon the negotiation of mutually agreeable documents which is expected to be completed within 60-90 days. The estimated project start date will be in the 2nd Quarter 2021.

The proposed demonstration plant will be located within the Upton Logistics Center Industrial Park at the site of an old BioMass facility. The location is an 8.2 acre site at 131 Buffalo Creek Road, Upton, Wyoming, 82730.

Bear Lodge Critical REE Resources

The Bear Lodge Project, located near Sundance, Wyoming, contains a historical mineral resource of 18.0 million tons averaging 3.07% Total Rare Earth Oxides (TREO), and an inferred resource of 31.8 million tons averaging 2.58% TREO. The high grade (7% TREO) zone within the resource is sufficient to support ten years of high-grade production with an overall mine life of 33 years. A bulk ore sample of 1,000 tons, averaging 10.1% TREO, has been previously extracted from the Bear Lodge property to support the demonstration project.

The Bear Lodge Project is rich in "critical" rare earths as defined in the 2016 Government Accountability Office report, including neodymium (Nd) and praseodymium (Pr). The deposit is also endowed with dysprosium (Dy), europium (Eu), terbium (Tb), and yttrium (Y). The distribution of REEs, including

Critical REE's (CREE), in the mineral resource is shown in Figure 1 which also provides the location of the Bear Lodge Project.

Distribution by Weight	
Critical Rare Earth Elements*	Distribution by Wt.
Neodymium (Nd)	17.9%
Praseodymium (Pr)	4.9%
Yttrium (Y)	1.3%
Europium (Eu)	0.7%
Dysprosium (Dy)	0.5%
Terbium (Tb)	0.1%
Subtotal CREOs	25.4%
Cerium (Ce)	43.0%
Lanthanum (La)	26.8%
Samarium (SM)	3.0%
Gadolinium (Gd)	1.6%
Other REEs**	0.2%
Total Rare Earth Oxides	100%

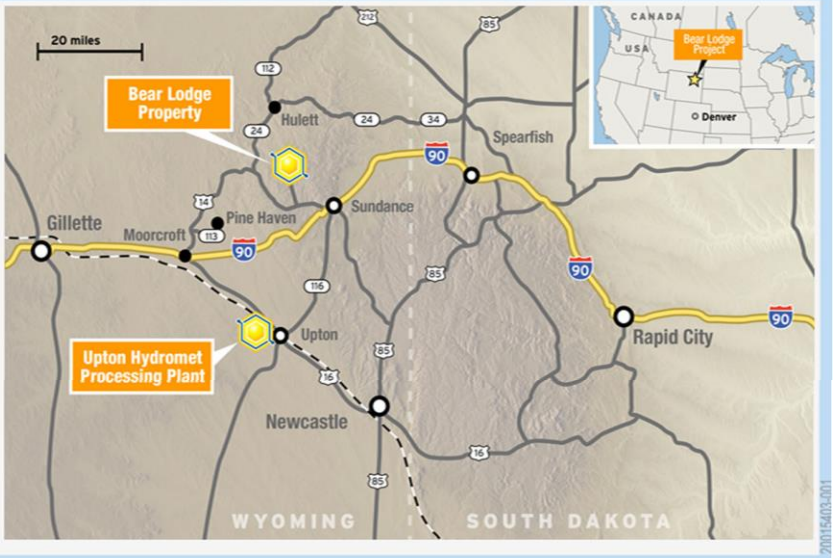

Figure 1. Bear Lodge REE Distribution and Facilities Location

The demonstration project would involve the physical processing of this already extracted ore followed by the handling and use of various extraction chemicals. In addition, the ore contains minor amounts of Naturally Occurring Radioactive Materials (NORM), in particular, Thorium (Th) Uranium (U), and radioactive progenies from U/Th decay chains that will be extracted, neutralized and disposed of in an off-site licensed storage facility. Existing GA and RER corporate safety policies would be followed, including employee training and monitoring, PPE required with engineering controls in place as required by the regulatory authorities. All chemicals will be managed in accordance with Federal, State, and local environmental and safety regulations.

Preliminary analysis of the ore sample indicates that the material contains an average concentration of approximately 1,500 ppm NORM, (Th and U and radioactive progenies) and RER anticipates that a source materials possession license will be required from the U.S. Nuclear Regulatory Commission (USNRC).

In addition, an air quality permit will be required from the Wyoming Department of Environmental Quality (WDEQ) and possibly a water discharge permit. The quantity and analysis of the air emissions and other generated waste will be determined during the first phase of the demonstration project. A road use permit will also be required from the U.S. Forest Service (USFS) to improve the access road to the sample storage location.

Approach and Facility Locations

In 2014, RER extracted approximately 1,000 tons of high-grade ore sample from an excavated trench within the Bear Lodge deposit. This sample was moved, covered, and stored on private land located on Wyoming State Section 16, Township 52 North, Range 63 West, 6th P.M. Crook County Wyoming.

The ore sample will be transported approximately 45 miles by over-the-road (OTR) trucks from State Section 16 to the Upton plant site via USFS roads 879.1, 851.1, and the Warren Peak Road to US Hwy 14. From there the trucks will travel on Wyoming State Hwy 116 to Upton and then onto Buffalo Creek Road to the demonstration plant site. A small portion (approximately 1 mile) of FS879.1 will be upgraded to accommodate the OTR trucks. (see Figures 2 and 3). A road use permit will be obtained from the USFS for this upgrade. The OTR trucks will comply with all WyDOT regulations, have covered payloads, and have placards indicating the transportation of minor amounts of NORM. The ore sample transport will only occur during daylight hours on a Monday-Friday schedule and would be completed within a 6 to 8 week timeframe.

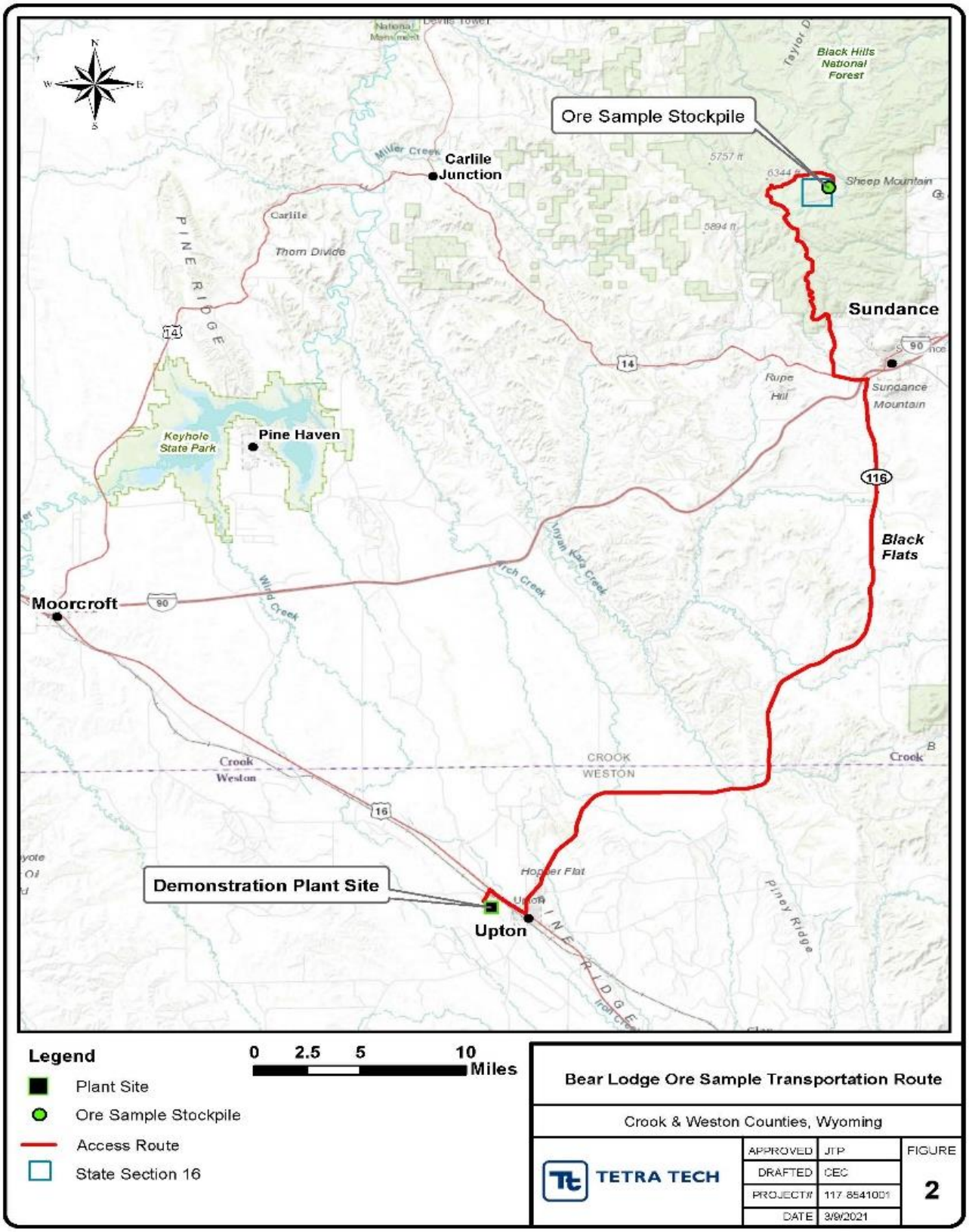

Figure 2. Demonstration Plant Ore Sample Transportation Route

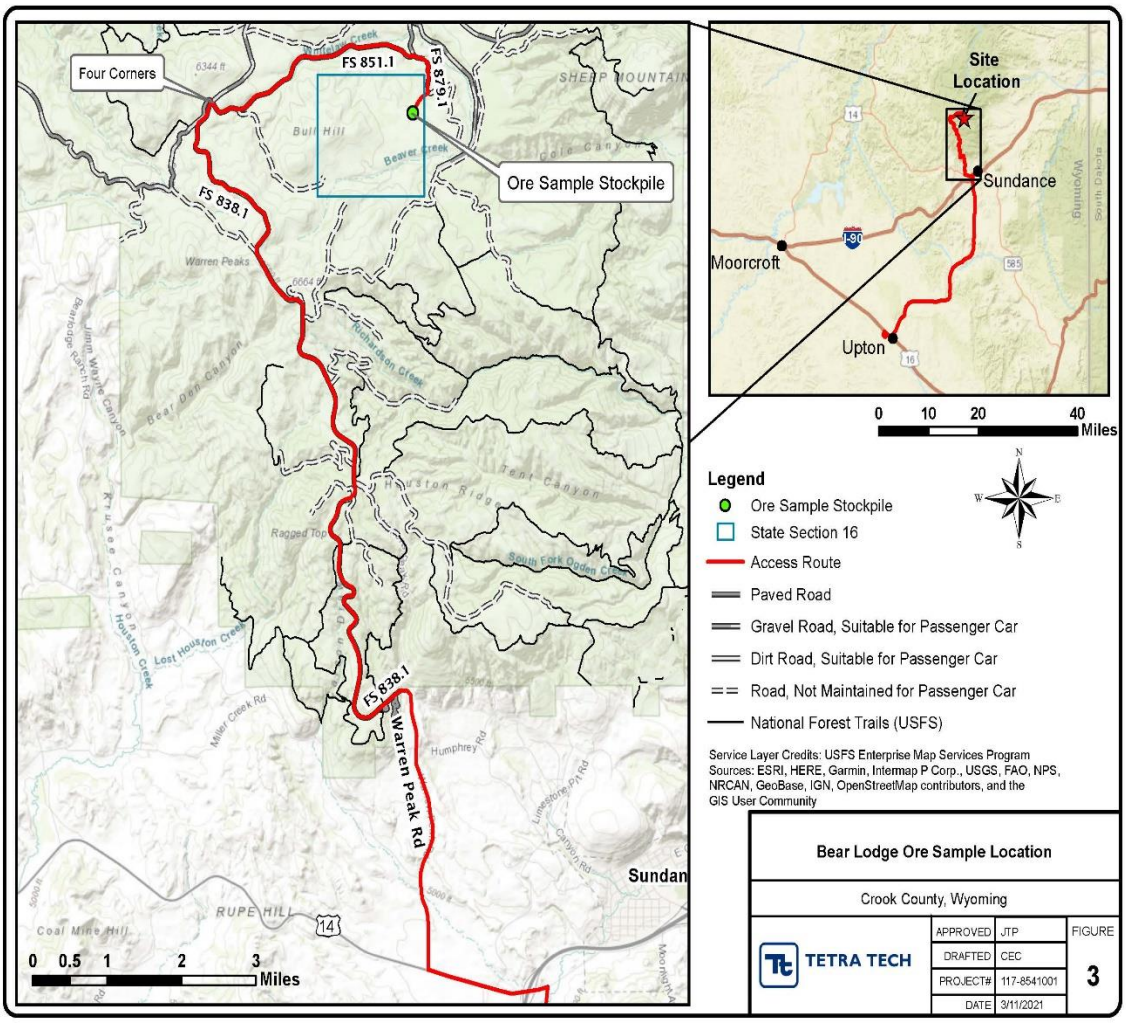

Figure 3. Bear Lodge Ore Sample Access Roads

The proposed demonstration plant will be located within the Upton Logistics Center Industrial Park. The existing facilities include a 75'x75' metal building, 40'x30' storage building, 30'x10' motor control room and other utility support facilities. An additional 18'x34'x32' building will be added to the facility to accommodate new larger equipment. The ore sample will be stored within the on-site storage facility building. (See Figures 4 and 5).

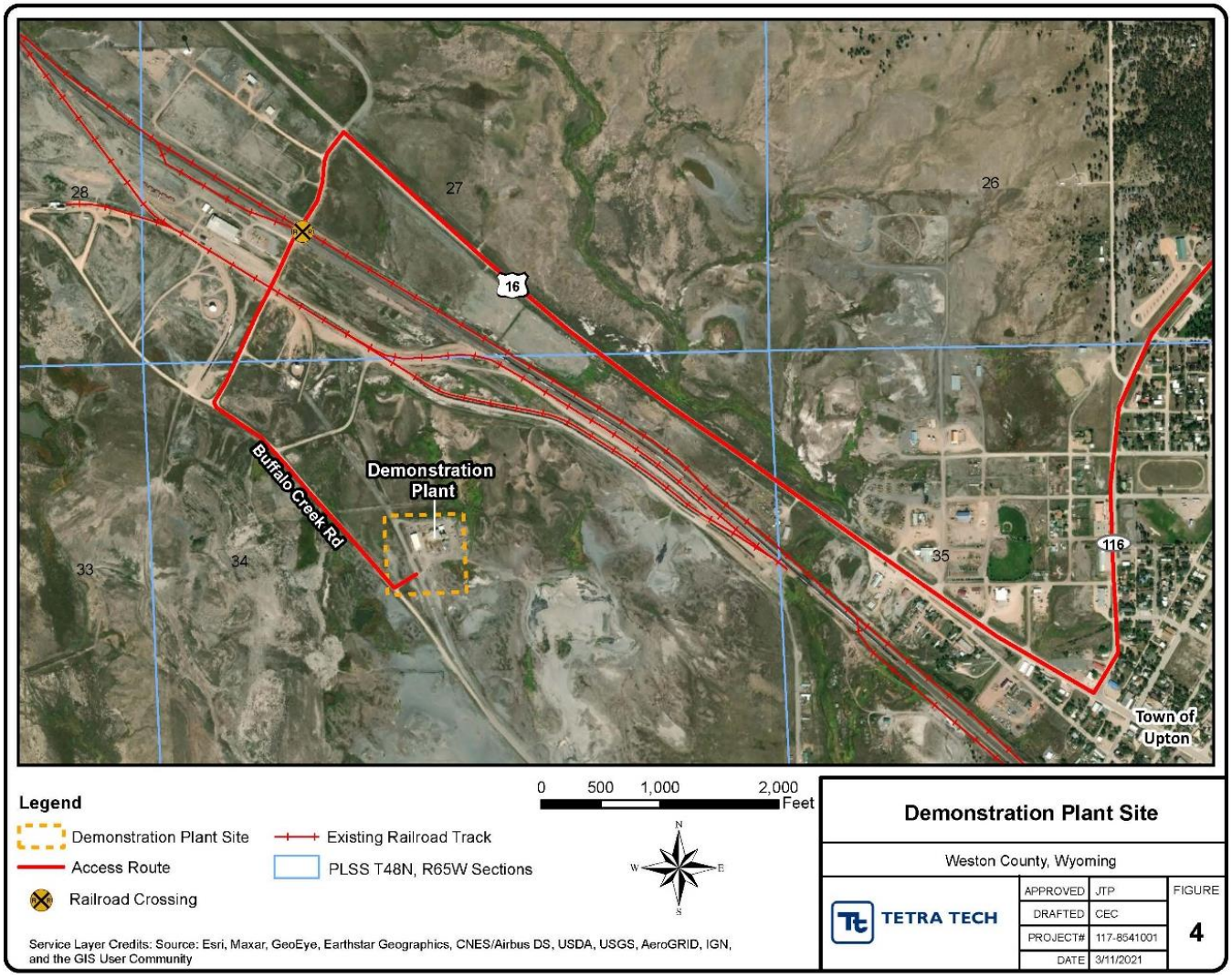

Figure 4. Upton Logistics Center

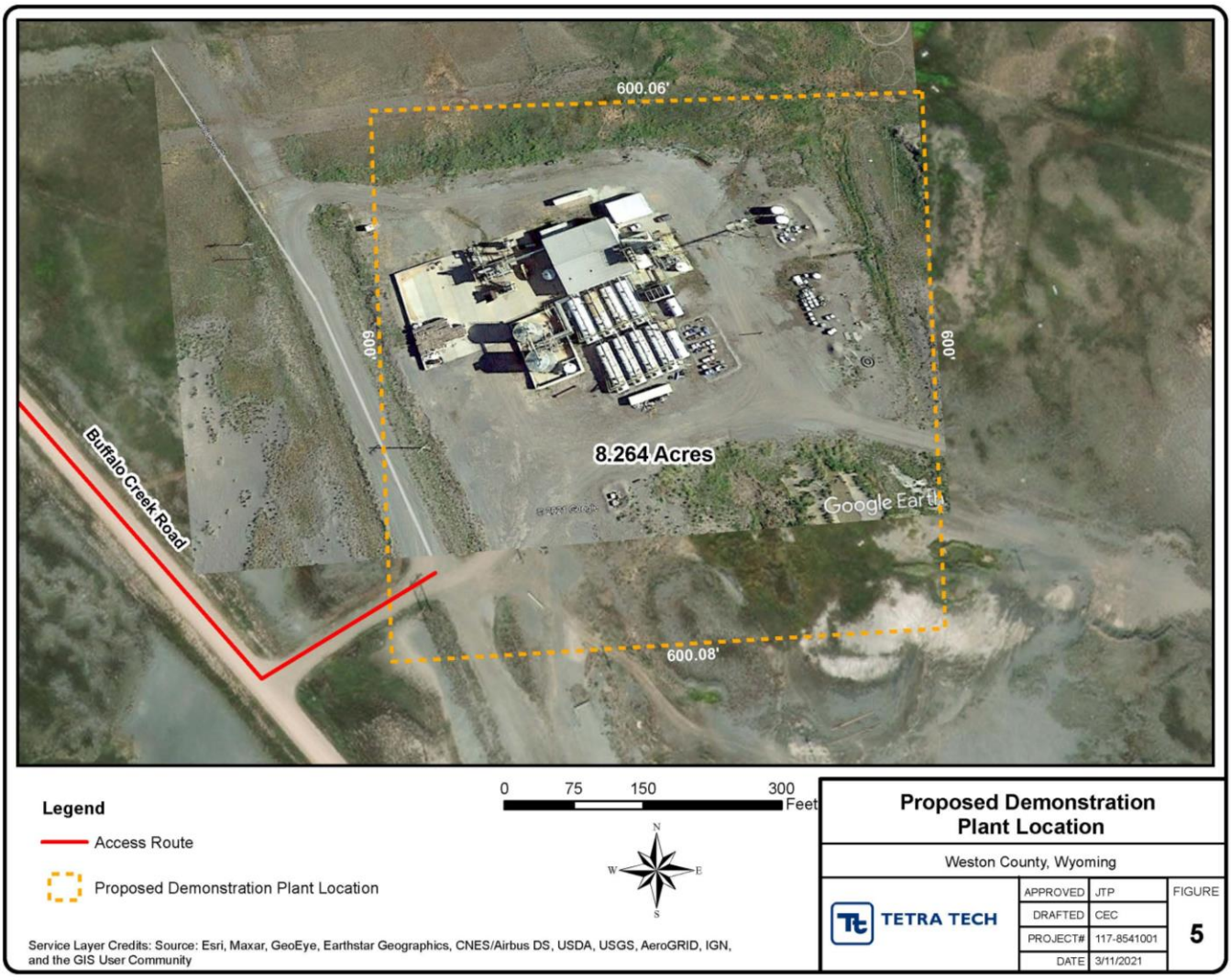

Figure 5. Proposed Demonstration Plant Location

Process Description

The demonstration plant will consist of five process stages shown in Figure 6. These include:

1) Physical upgrading.
2) Primary hydrometallurgical processing to produce a pure (>98%) TREO concentrate (the precursor), which separates out a significant portion of the natural radioactivity contained in the ore.
3) Final removal of radioactivity, mainly due to Th and progenies, together with Ce, which is not currently considered to be a marketable REO product.
4) Separation and refining of REO groups including highly pure NdPr oxide (the primary product), Lanthanum (La) oxide, Samarium, Europium, Gadolinium, (SEG) oxide concentrate, and heavy rare earth elements (HREE) oxide concentrate.

5) Optional further separation and refining of La, SEG, and HREE oxide concentrates into individual pure REO products including Tb, Sm, and Dy.

The design of processing stages (1) and (2) is deposit-specific, since it has been determined by the intrinsic mineralogical texture of the Bear Lodge deposit (silico-carbonatite dikes concentrated within margins of diatreme), whereas the REO separation technology in processing stages (3) through (5) is likely to have broader application to other mine concentrates.

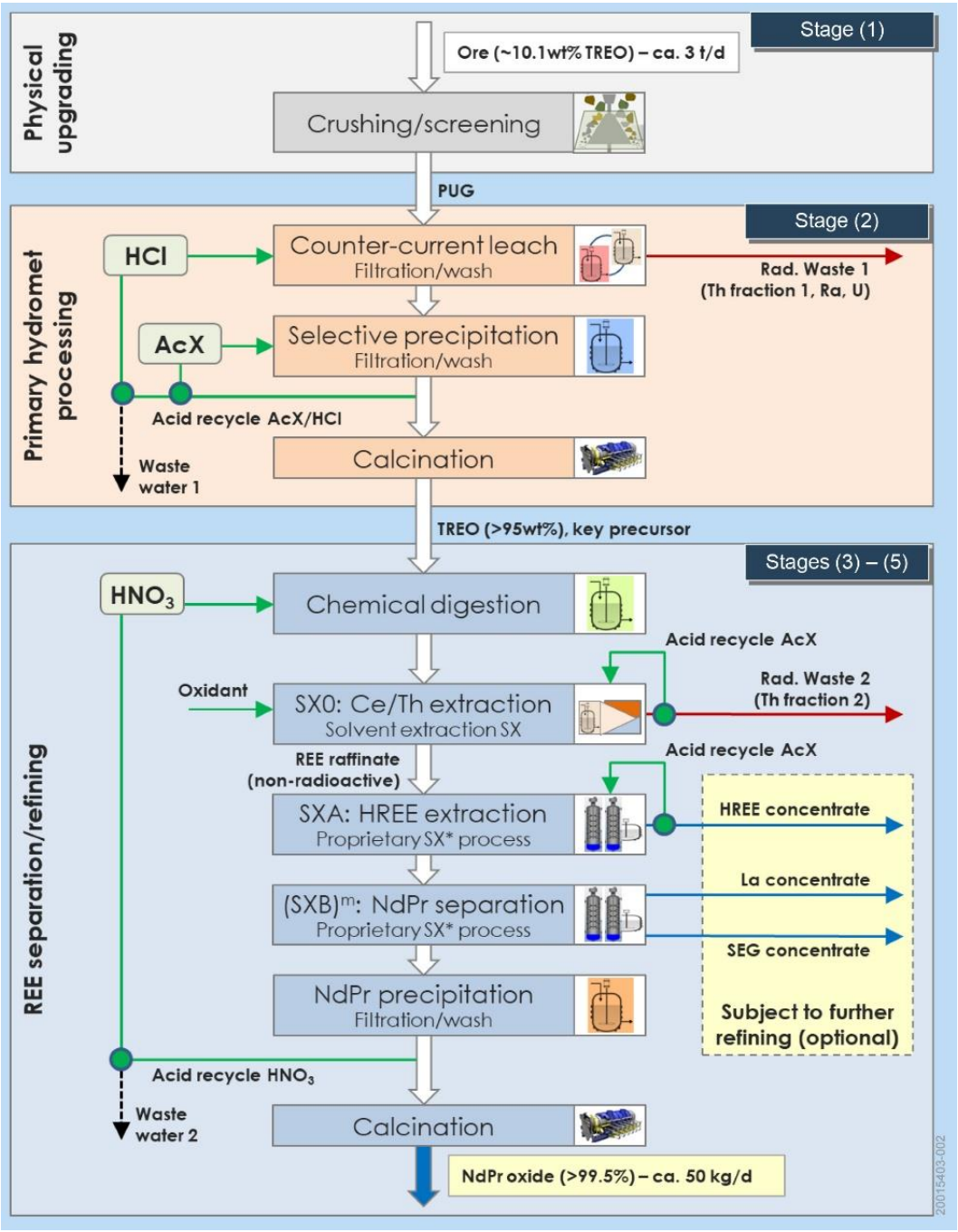

Figure 6. Metallurgical Processing Plant for Industrial-Scale Demonstration
(→ waste streams, → acid recycle streams, → waste water streams, → product streams)

Stage (1): Primary physical upgrading

Due to the inter-grown mineralogical texture and the high grade of the available Bear Lodge ore, specific upgrading technologies are not necessary for the ore to be processed in the demonstration plant. Hence, the physical processing of the ore will be limited to comminution and screening to provide the optimum particle size distribution for the subsequent hydrometallurgical processing step.

Stage (2): Hydrometallurgical processing

A highly efficient chemical digestion by a countercurrent HCl leach process will be applied to achieve a >92% yield of dissolved REE. Leaching of U and several other radioactive elements including Ra will be suppressed by additives to the leaching solution. The solid residue from the leach process will form an exempt waste under 10 CFR 40.13(c)(1)(vi). The pregnant leach solution will undergo a selective precipitation process by oxalic acid at optimized conditions to produce a highly pure (>98%) REE oxalate. This oxalate is then calcined under well-defined conditions (temperature, retention time) to produce a TREO concentrate ready for subsequent chemical digestion in stage (3).

Stage (3): Removal of Th and Ce

After re-dissolving the TREO concentrate in nitric acid under well-defined conditions, the solution is oxidized to form tetravalent Cerium (Ce) that, together with tetravalent Th, is completely removed by a conventional two-stage solvent extraction process. A novel three-phase strip of the Ce/Th stream enables the complete recycle of the organic extractants. The radioactivity of the REE raffinate from this process is well below applicable limits (essentially non-radioactive).

Stage (4): REE separation and refining for NdPr oxide production

This innovative, proprietary process consists of only a few stages of solvent extraction-scrubbing steps embedded in a sophisticated process network with partial recycling of raffinates to realize a maximized yield of the target metals. Both the extraction and scrubbing processes are operated by applying highly efficient countercurrent separation units. This non-conventional solvent extraction (SXT) process, already proven at pilot scale, includes complete recycling of the organic extractant in each stage. The resulting NdPr oxide has a nominal purity >99.5%, as required for magnet production.

Stage (5): Optional further separation and refining of La, SEG, and HREE oxide concentrates into individual pure REO products

The SXT processing system described for stage (4) can be applied to refine La, to extract Samarium (Sm) oxide from the SEG oxide concentrate, and to extract Dysprosium (Dy) and Terbium (Tb) oxides from the HREE oxide concentrates, by adjusting operational parameters to achieve optimum separation conditions in each case.

Chemical Recycling

Technology of this kind would not be economical without significant recovery and recycle of valuable chemicals, including hydrochloric acid (HCl), oxalic acid ($H_2C_2O_4$), and nitric acid (HNO_3). Initial targets (based on testing) include recovery of HCl via distillation, recovery of $H_2C_2O_4$ via forced crystallization based on a favorable temperature regime in the precipitation processes, and recovery of HNO_3. As previously mentioned, all organic extractants are completely recycled by applying efficient strip technologies, including a novel 3-phase strip for dedicated elements.

The estimated consumption of process chemicals during the life of the demonstration plant operation include:

- 300 stons of hydrochloric acid,
- 2 stons of sulfuric acid,
- 200 stons of reactant AcX,
- 80 stons of lime,
- 600 stons of nitric acid,
- 150 stons of ammonia.

In addition, the process will use approximately 3,000 gallons of organic extractant and 1,200,000 gallons of fresh water during the one year operation of the plant.

Waste Categories

All waste generated by the process will be shipped off-site to licensed storage facilities.

The main waste categories include:

1) Tailings – solid NORM waste to be conditioned (neutralized and immobilized) for disposal.
2) Th/Ce residues – solid NORM waste to be conditioned (de-watered) for disposal.
3) Filtrate from selective precipitation suspension (including wash water) in stage (2). If possible, this will be recycled.
4) Various filtrate categories from REO suspensions produced in stages (4) and (5). If possible this will be recycled.
5) Non-hazardous Industrial Waste.

The demonstration plant will generate neutralized leach residue, small quantities of NORM-containing waste, and potentially discharge treated excess process water. All solid wastes will be exempt under 10CFR 40.13 (c)(1)(vi) and shipped off site to a licensed storage facility. Both State and Federal permits will be required. Approximately 1,200 short tons of neutralized leach residue and 65 short tons of NORM containing waste will be generated during the operation of the demonstration plant.

Waste containing NORM will be placed into containers and temporarily stored on-site according to the USNRC licensing requirements. NORM material will be shipped regularly to a licensed storage facility as required by the license. The complete analysis of these waste materials will be determined during Phase 1 of this project.

Non-hazardous waste will only be generated at the demonstration plant location in Upton, Wyoming. The types of waste created on-site may include: sewage, laboratory wastes, and waste from the use of purchased materials. The proposed demonstration plant site is connected to the Public Owned Treatment Works (POTW) owned and operated by the City of Upton and all sewage will be disposed of according to their regulations. Waste laboratory chemicals will be containerized and stored within the laboratory for offsite disposal, if required. The generation of these wastes should be minimal and below quantities requiring hazardous waste regulation. There will be no effluent discharge from the laboratory facility to the environment. All waste streams generated from the use of purchased materials will be evaluated for proper handling. The first precaution taken to avoid generation of waste will be to utilize appropriate purchasing controls to restrict purchases to non- or least-toxic products, and to limit volumes purchased so that excess materials are not left-over. If possible, the waste materials will be re-used on site. If not re-usable, the waste (including oil and grease) will be recycled, if feasible. Finally, if disposal is the only remaining option, an appropriate off-site disposal strategy, created in accordance with applicable state and federal requirements will be followed. Solid waste will be taken to the Weston County transfer facility for disposal. Recycling will be a priority and options will be evaluated for the following waste materials: used oil and lubricants, spent solvents and paints, plant equipment; electronic equipment and components; office paper; lunch and break room wastes (beverage containers, newspapers, food containers, etc.); packaging wastes (pallets, cardboard and bubble-wrap); and scrap metal (machine shop millings, empty barrels, excess wiring, unusable parts and equipment).

Air emissions will only be generated at the demonstration plant location in Upton, Wyoming. Dust and particulate emissions will be generated during the physical upgrading. Emissions will also be generated during the hydrometallurgical leach process, from the calcination equipment, and from the rare earth extraction process. All chemical emissions will be collected and neutralized in a scrubber before discharge and all particulate discharges will be collected with a bag house dust collector. An air quality permit will be required from the WDEQ. The quantity and analysis of the emissions will be determined during Phase 1 of this project.

Project Schedule

To achieve the project objectives, the program is divided into three distinct performance periods.

1) Design – 6 – 12 months
2) Procurement and Construction – 12 months
3) Operations – 12 - 18 months

Licensing and permitting will proceed in parallel with periods (1) and (2) and may extend into early period 3.

The final outcome of Period 1 is completion of the design of the facility, with the process demonstration equipment being ready for procurement. This outcome is validated via the Final Design Review and subsequent Go/No-Go decision assessing the feasibility of the proposed design to achieve the project objectives.

The objective of Period 2 is procurement and construction of the demonstration plant facility and process equipment, and is validated by the readiness of the facility and equipment to begin operations.

A second Go/No-Go decision point allows for full review of the status of the facility, its safety and waste handling systems, as well as the status of the required licenses and permits. The final outcome of Period 2 is readiness for operations.

End-of-Project Goal

In the proposed program we will build a demonstration plant that will allow the engineering implementation of the processes that have been demonstrated such that, by the end of this demonstration program, there will be available for the first time in the U.S., a facility that:

- Is at a permitted and licensed domestic site.
- Demonstrates the separation of NdPr and La at high purity.
- Will produce up to 10 tons NdPr at >99.5% purity as well as La, SEG, and HREE concentrates, subject to further refining.
- Provides clear pathways for the separation of other rare earths, including Sm, Dy and other essential heavy elements.
- Provides a basis for scale-up to any future capacity the market requires.
- Provides a basis for demonstration of separation economics.
- Demonstrates a process which is capable of processing feed from any other source, either in the U.S. or obtained as a result of DoD initiatives to obtain TREO from allied countries.