

DEPARTMENT OF ENERGY Expression of Interest—DOE’s Office of Environmental Management (DOE-EM) Critical Minerals and Materials Inventory.

AGENCY: Office of Environmental Management, Department of Energy.

ACTION: Expression of Interest (EOI).

SUMMARY: The U.S. Department of Energy (DOE) Office of Environmental Management (EM) publishes the following questions regarding potential collaboration with interested parties for the reuse of its critical and rare earth minerals and materials. The goal is to ensure surplus critical minerals and materials within the DOE inventory are repurposed to bolster and diversify the U.S. supply chain. This will support domestic scientific, manufacturing, and energy needs.

A list of materials and minerals in DOE’s inventory is supplied as an attachment. Respondents should note that industry partners would be responsible for the subsequent extraction or reprocessing of the material.

THIS IS AN EXPRESSION OF INTEREST ONLY. THIS NOTICE DOES NOT CONSTITUTE A NOTICE OF FUNDING OPPORTUNITY (NOFO). A NOFO DOES NOT EXIST AT THIS TIME. DOE will not provide funding or compensation for any information submitted in response to this EOI. This EOI is not seeking or accepting applications, and a response to this EOI will not be viewed as a binding commitment to develop or pursue the ideas discussed. No material submitted for review will be returned.

DATES: Responses to the EOI must be received no later than November 2, 2026. A virtual Industry Day will be held on September 30, 2026. For questions and a link to attend, please email Rob Seifert, robert.seifert@em.doe.gov.

ADDRESSES: Interested parties are to submit comments electronically to robert.seifert@em.doe.gov with the subject line “EM Critical Minerals Inventory” no later than November 2, 2026. All responses must be submitted as a Microsoft Word document (.doc/.docx) of no more than five (5) pages in length, with black, Times New Roman, 12-point font, and 1-inch margins as an attachment to an email. The document cannot exceed 2MB in size. Only electronic responses to the above email address will be accepted. DOE will not consider responses submitted by any other means.

FOR FURTHER INFORMATION CONTACT: Rob Seifert, (301)-250-5239, robert.seifert@em.doe.gov.

Questions seeking input on potential collaboration with DOE-EM on Critical Minerals and Materials Inventory

Specific Questions:

Note: The terms recovery, reuse, repurposing, and reprocessing are viewed as interchangeable in this context but DOE will use the term reuse throughout for consistency.

1. What specific needs or demands does your organization have for rare earth metals, critical minerals, or materials that could be met by the DOE inventory?
2. Describe your organization's technical capabilities and experience in handling, processing, mining, or extracting rare earth metals, critical minerals, or materials.
3. Please detail your proposed plan's material requirements, specifying the minimum viable quantity, the optimal quantity for maximizing impact, and how the plan's scalability accommodates varying amounts from the available inventory.
4. What potential applications, domestic sectors, or market demand does your organization foresee for your proposed reuse?
5. Describe how your proposed reuse of inventory material(s) and any resulting products will primarily benefit U.S. domestic needs and contribute to the resilience of the U.S. energy and manufacturing supply chain.
6. How would your organization propose collaborating with DOE-EM to facilitate the reuse of the inventory materials?
7. Outline any significant technical, logistical or regulatory challenges anticipated in the reuse of material(s) from the DOE inventory and how these would be addressed or contingency plans.
8. What are your proposed plans for the management and disposal of any waste streams or byproducts generated from your processing or repurposing activities involving the inventory materials?
9. Would your organization be interested in exploring the possibility of leasing land or developing a facility on a site for material processing, repurposing, or related activities? If so, please provide details on your potential interest and any requirements or considerations for such an undertaking.

Proprietary Business Information: To the extent possible, DOE recommends that responders to this EOI do NOT provide confidential information. However, if this cannot be avoided, pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be proprietary business information and exempt by law from public disclosure should submit via email two well-marked copies: one copy of the document marked as Controlled Unclassified Information – Proprietary Business Information or “CUI//PROPIN” per 18 U.S.C. § 1905 with clear delineations therein as to which information is believed to be proprietary business information, and one copy of the document marked unclassified, uncontrolled information or “UI” with the information believed to be CUI//PROPIN deleted. Submit these documents via email. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. DOE will make its own determination about the confidential status of the information and treat it according to its determination. The federal government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose as authorized by law.

Critical Mineral Resource Potential at Paducah Site

Bounding Analysis

U.S. Department of Energy, Office of Environmental Management

Executive Summary

Approximately 8,000 tons (56 million pounds) of aluminum and 2,000 tons (4 million pounds) of copper have been identified in legacy inventories at the U.S. Department of Energy (DOE) Paducah Gaseous Diffusion Plant site in Kentucky. These large inventories, along with 0.75 tons (1,500 pounds) of tungsten, two silver inventories (500 pounds of silver-tungsten alloy contacts and 0.3 pound of machine turnings), 76 pounds of platinum, and 1,000 pounds of selenium, represent a substantial domestic resource of critical materials derived from historical site operations.

Based on initial characterization, the materials are present in consolidated forms, including solid process-gas equipment, electrical windings, breaker alloys and contacts, machine turnings, resistors, and clean platinum wire. Aluminum, and copper are primarily superficially contaminated with uranium. Aluminum and copper are rated “Feasible”; tungsten, selenium, and the 500-pound silver-tungsten inventory are rated “Good”; the 0.3 pound silver inventory is rated “Excellent”; and a process exists to extract the platinum.

These estimates are based on site inventory data and should be considered bounding figures. The materials are already mined, processed, and consolidated at a single, secure industrial site with direct access to major infrastructure. The Paducah portfolio remains a near-term opportunity to convert legacy material into a domestic resource, subject to characterization, decontamination, and project-specific economic evaluation.

1. The Material

1.1 What Is There

The critical mineral inventories at the Paducah site are byproducts of the site's long-standing historical mission as a uranium enrichment facility. The materials are not raw ores but processed metals, components, and alloys recovered from decommissioned infrastructure. They include aluminum process-gas equipment from compressor/cooler systems; copper from large electrical motors; tungsten and silver in high-voltage breaker components; additional silver machine turnings; platinum clean wire; and selenium-bearing resistors.

1.2 Location

All identified inventories are located within the controlled-access boundaries of the Paducah Gaseous Diffusion Plant site in Paducah, Kentucky. Specific locations referenced in the inventory data include compressor/cooler process-gas equipment, plant electrical switchyards, Power Operations (PG) buildings, and the C-720 building. This consolidation at a single industrial complex is a significant logistical advantage.

1.3 Material Distribution and Form

The materials exist in solid, recoverable forms that are conducive to industrial-scale handling and processing:

- **Aluminum:** Present as approximately 8,000 tons of solid process-gas equipment in PAD compressor/cooler systems.
- **Copper:** Exists as electrical windings from large motors in the Power Operations facilities.
- **Tungsten and Silver:** Co-located in silver-tungsten alloy high-voltage breaker contacts in the PAD switchyards.
- **Silver:** A separate 0.3 pound inventory of machine turnings is located at PAD C-720.
- **Platinum:** Present as 76 pounds of clean wire at PAD C-720.
- **Selenium:** Contained in resistors within electrical cabinets in the PAD PG buildings; the material is identified as RBA.

2. Bounding Inventory and Grade Data

2.1 Summary by Material Type

The data summarized here are derived from internal DOE inventory collection forms. The information highlights a portfolio of materials with high recovery potential.

Table 1. Bounding In-Place Inventory and Extractability Estimate for the Paducah Site

Material Type	Estimated Quantity	Form	Location	Extractability Potential
Aluminum (Al)	8,000 tons	Solid	PAD Compressor/Coolers	Feasible
Copper (Cu)	2,000 tons (4,000,000 lbs)	Electrical Winding	PG & Aux Motors	Feasible
Tungsten (W)	1,500 lbs	Silver-Tungsten Alloy	PAD Switch Yards	Good
Silver (Ag)	500 lbs	Silver-Tungsten Alloy	PAD Switch Yards	Good
Silver (Ag)	0.3 lbs	Machine Turnings	PAD C-720	Excellent
Selenium (Se)	1,000 lbs	Resistors	PAD PG Buildings	Good
Platinum (Pt)	76 lbs	Clean Wire	PAD C-720	Process Exists to Extract

3. Key Considerations

3.1 Material Characteristics

- **Contamination:** The primary contaminant for the aluminum and copper inventories is surficial uranium. The selenium-bearing resistors are identified as RBA. The silver-tungsten alloy has no listed contaminants, the 0.3 pound silver inventory has no listed contaminant, and the platinum is described as clean wire.
- **Extractability and Recovery:** The recovery profile is positive but varies by stream. Aluminum and copper are rated “Feasible.” Tungsten, selenium, and the 500-pound silver-tungsten inventory are rated “Good.” The 0.3 pound silver inventory is rated “Excellent,” and a process exists to extract platinum.

3.2 Infrastructure and Access

- The Paducah site is a major, secure industrial complex with direct access to road, rail, and river transportation corridors.
- Decades of DOE operations have established robust infrastructure, including heavy utilities, support facilities, and a workforce skilled in handling industrial and radiological materials. This existing framework eliminates major capital hurdles for a potential recovery operation.

3.3 Economic Context

The economic case for the Paducah inventories is promising but should not be characterized as demonstrated by a Paducah third-party recovery agreement. The elimination of mining, crushing, and milling costs provides a potential advantage, but each stream remains subject to characterization, decontamination, processing, and project-specific economic assessment.

4. Historical Precedent: DOE Asset Management and Metals Recycling Programs

4.1 Background

The DOE and its predecessor agencies have a multi-decade history of managing, recycling, and recovering valuable materials from legacy infrastructure. These initiatives, particularly those under the Office of Environmental Management, provide a direct historical precedent for the recovery actions contemplated for the Paducah inventories. Past programs focused on reducing long-term liabilities and, where possible, returning assets to productive use.

4.2 Historical Precedent: Gaseous Diffusion Plant (GDP) Metals Decommissioning

The most directly relevant historical precedent is the broader decommissioning program for the Paducah, Oak Ridge, and Portsmouth Gaseous Diffusion Plants. These massive efforts generated vast quantities of scrap metal, primarily steel, and copper.

- **Grade Comparability and Process Applicability:** The copper inventory at Paducah is the direct result of past operations. Historically, metals with manageable surficial contamination were often successfully decontaminated and free-released. The current Paducah inventories represent a continuation of this practice, now applied to materials whose value has increased dramatically. The processes for handling and decontaminating surficially contaminated scrap are well-established, forming a reasonable starting point for any recovery concept.
- **Scale Advantage:** The Paducah copper inventory is a large, consolidated resource. This scale is a substantial advantage, improving per-ton economics by distributing the fixed costs of mobilization, characterization, and processing across a multi-million-pound resource base.
- **Commodity Price Context:** An issued EOI for Paducah nickel is a direct indicator of current DOE interest in recovery concepts. It does not, by itself, establish commercial viability for the material offered in this EOI. Any recovery proposal remains subject to material characterization, decontamination performance, processing costs, and market conditions.

Critical Mineral Resource Potential at the Oak Ridge Reservation

Bounding Analysis

U.S. Department of Energy, Office of Environmental Management

Executive Summary

Approximately 12,000 pounds of lithium hydride has been identified in legacy inventories at the U.S. Department of Energy (DOE) Oak Ridge Reservation. The material is the result of historical site operations at Oak Ridge National Laboratory (ORNL) and represents a significant potential domestic source of lithium as a critical mineral.

Based on historical reports, lithium hydride is contained within shielded transport casks. The material is already consolidated at secure, highly developed DOE site with direct access to critical infrastructure. While significant processing challenges related to contamination exist for some inventories, the potential to recover the material aligns with national strategic goals for securing domestic supply chains for energy and technology manufacturing. Any party seeking to advance a recovery concept would be expected to conduct independent sampling, characterization, and metallurgical test work as a foundational step.

1. The Material

1.1 What Is There

The critical mineral inventories at Oak Ridge consist of processed materials and legacy assets remaining from historical site missions in isotope production, and materials research. The lithium hydride shields were constructed for use in experiments at the Tower Shielding Facility (TSF), designed and built for radiation-shielding studies conducted at ORNL.

1.2 Location

The inventory is located within the Oak Ridge Reservation in Tennessee:

- **Oak Ridge National Laboratory (ORNL):** The site houses inventory of lithium.

1.3 Material Distribution and Form

- **Lithium Hydride:** Present as solid lithium hydride contained within a series of large, shielded assemblies. One large shield is considered more readily recoverable because it can be disassembled; the remaining shields are sealed and more difficult to access.

2. Bounding Inventory and Grade Data

Table 1. Estimated Bounding Inventory of Oak Ridge Materials

Material Type	Location	Estimated Quantity	Extractability Potential
Lithium hydride	ORNL	~12,000 lbs	Medium

3. Key Considerations

3.1 Material Characteristics

- **Contamination:** Radiological contamination is the primary consideration for the largest inventories. The lithium hydride shields may contain minor activation products and, in some cases, depleted uranium.
- **Extractability:** The recovery potential is rated "Medium," reflecting the complex remote handling, hot-cell processing, and mechanical extraction from shielded assemblies required for recovery.
- **Processing Requirements:** Recovery of lithium will require significant, purpose-built, or modified processing circuits capable of handling radiological materials and separating contaminants to commercial specifications.

3.2 Infrastructure and Access

- The Oak Ridge Reservation is a secure, operational DOE complex with direct interstate highway and rail access.
- The sites possess extensive infrastructure, including robust utilities, support facilities, and a highly skilled workforce experienced in radiological and industrial operations.
- The lithium hydride shields are currently stored in RCRA-permitted facility at ORNL and may remain there only until final transfer to a processing facility or facilities. Recovery planning therefore must coordinate characterization, authorization, and availability of the receiving processing facility before transfer. The shields are not currently in DOT approved shipping containers and would have to seek a DOT exemption for the packaging.

3.3 Economic Context

The more relevant economic comparator for the inventory is not primary ore grades but rather secondary recovery from complex, processed materials. The consolidation of these materials at a

single, accessible location eliminates the mining cost that dominates primary mineral economics. The central driver for this opportunity is the rising demand and strategic importance of lithium for the battery and electric vehicle supply chains. While radiological processing entails significant cost, current market prices for these commodities and the strategic value of a domestic resource create a fundamentally different economic environment than that of past decades. Any prospective offeror would need to conduct their own economic assessment under current and projected market conditions.

Critical Mineral Resource Potential at the Portsmouth Site

Bounding Analysis

U.S. Department of Energy, Office of Environmental Management

Executive Summary

An estimated 1,100 tons (2.2 million pounds) of copper, 280 pounds of fluorine, and 3.1 grams of platinum have been identified in legacy inventories at the U.S. Department of Energy (DOE) Portsmouth Gaseous Diffusion Plant site in Ohio. These materials, byproducts of the site's historical enrichment mission, represent a substantial opportunity to recover domestically sourced critical materials.

Based on initial characterization, the inventories are present in consolidated industrial forms, copper electrical windings. The bulk-metal contaminant profile is predominantly surficial uranium. Fluorine and copper are rated "Feasible," and a process exists to extract the small platinum inventory.

These bounding estimates are based on site inventory data. The material is already mined, processed, and consolidated at a single, secure industrial site with access to critical infrastructure. The platinum inventory remains subject to the ownership and radiological constraints described below. The Portsmouth portfolio presents a near-term opportunity to transform a legacy environmental liability into a valuable national asset.

1. The Material

1.1 What Is There

The critical mineral inventories at the Portsmouth site are the material legacy of the facility's decades of operation as a key part of the U.S. uranium enrichment complex. These are not raw ores but valuable processed materials recovered from decommissioned plant and support infrastructure. The inventories directly reflect their historical functions: copper was vital to electrical motor and distribution systems; fluorine was a key component in chemical and process operations; and a small platinum inventory is present at X-710.

1.2 Location

All identified inventories are consolidated within the controlled-access boundaries of the Portsmouth site in Pike County, Ohio. This single-site consolidation provides a major logistical and economic advantage for any potential recovery operation.

1.3 Material Distribution and Form

The materials exist in well-defined, recoverable forms that are conducive to industrial-scale handling and processing.

- **Copper:** Exists as high-purity electrical windings from large motors.
- **Fluorine:** Stored as a gas, implying containment within secure cylinders or tanks suitable for industrial gas handling.
- **Platinum:** A 3.1-gram quantity of solid material at PORTS X-710 with fixed radionuclide contaminants, mostly uranium.

2. Bounding Inventory and Grade Data

2.1 Summary by Material Type

The data summarized here are derived from internal DOE inventory collection forms. The information highlights a portfolio of large-scale materials with clear and established processing pathways.

Table 1. Bounding In-Place Inventory and Extractability Estimate for the Portsmouth Site

Material Type	Estimated Quantity	Form	Contaminant Profile	Extractability Potential
Copper (Cu)	1,100 tons (2,200,000 lbs)	Electrical Winding	Surficial (Mostly Uranium)	Feasible
Fluorine (F)	280 lbs	Gas	N/A	Feasible
Platinum (Pt)	3.1 g	Solid	Fixed Radionuclides (Mostly Uranium)	Process Exists to Extract

Important Caveat: The 3.1-gram platinum inventory at X-710 is the property of Centrus. The data call notes that transfer may be difficult because the material has fixed radionuclide contamination, mostly uranium, with a uranium-235 assay greater than 20 percent. This is an ownership and radiological-management constraint in addition to the technical extraction requirement.

3. Key Considerations

3.1 Material Characteristics

- **Contamination Profile:** The primary contaminant for the bulk copper assets is surficial uranium, a profile that is conducive to established surface-decontamination techniques. Fluorine has no listed contaminants. The platinum inventory has fixed radionuclide contaminants, mostly uranium, and is subject to the ownership and assay constraint described above.
- **Extractability and Recovery:** The recovery outlook for the Portsmouth portfolio is strong. Copper and fluorine are rated “Feasible.” A process exists to extract platinum, although its availability is constrained by ownership and radiological conditions.

3.2 Infrastructure and Access

- The Portsmouth Site is a major, secure industrial complex with a full suite of supporting infrastructure, including heavy-haul roads and rail access.
- Decades of DOE operations have established robust utilities, security, and a local workforce with experience in complex industrial projects. This legacy infrastructure provides a substantial capital advantage for any new recovery operation.

3.3 Economic Context

The economic case for the Portsmouth inventories is materially de-risked by the specified processing technology and the draft third-party agreement for its largest asset. This technical pathway, combined with multi-million-pound inventories of copper, supports continued evaluation under current market conditions. The platinum inventory is technically extractable but subject to the separate ownership and radiological constraints described above.

4. Historical Precedent: Gaseous Diffusion Plant Metals Decommissioning and Recovery

4.1 Background

Historical decommissioning and asset-management programs at the gaseous diffusion plants generated and characterized large inventories of copper scrap.

4.2 Portsmouth as a Model for Technical Readiness

The historical programs for managing the GDP assets did more than simply quantify liabilities; they also involved extensive characterization to identify viable disposition paths. The Portsmouth nickel inventory is a prime example of this success.

- **Grade and Scale:** The precedent for successfully decontaminating and recycling superficially contaminated metals is well established. The scale of the Portsmouth inventories— over a thousand tons of valuable industrial metals—justifies the investment in a dedicated processing circuit, leveraging the economic advantages of a large, consolidated feedstock.
- **Shifting Economic Viability:** The combination of a known technical solution and favorable market conditions has brought the Portsmouth opportunity to the forefront. A process that may have been deemed uneconomic when scrap prices were low is now a highly compelling proposition. The Portsmouth portfolio is a testament to how long-term stewardship of legacy materials can create significant national assets when technology and market demand align.

Critical Mineral Resource Potential in the Moab UMTRA Tailings Stream

Bounding Analysis for the Crescent Junction Disposal Cell

U.S. Department of Energy, Office of Environmental Management

Executive Summary

The Moab Uranium Mill Tailings Remedial Action (UMTRA) material at Crescent Junction is one landfilled uranium mill tailings stream containing multiple co-located critical minerals. Approximately 16.2 million tons are currently disposed in the engineered cell, and approximately 1 million additional tons are expected through the project's tentative 2029 completion. The future material is expected to include off-pile and subpile radiologically contaminated material and may not have the same composition as the existing bulk tailings.

Vanadium is the most developed mineral-specific case. Historical, pre-relocation programs reported a mean grade of approximately 0.094% V₂O₅ (about 530 mg/kg elemental vanadium) across 58 Atlas Corporation samples; SRK Consulting's 2001 summary reported average vanadium concentrations of about 1,004 mg/kg in unconsolidated silt (slimes), 1,124 mg/kg in consolidated silt, 433 mg/kg in wet sand, and 211 mg/kg in dry sand; and the 1998 ORNL boring program reported values up to approximately 2,460 mg/kg in slime tailings. These data demonstrate vanadium occurrence and strong material variability, but they do not establish a current whole-cell average grade, contained vanadium tonnage, or recoverable mineral resource.

The data call identifies a suite of critical minerals of interest in the stream: aluminum, antimony, arsenic, beryllium, bismuth, boron, chromium, cobalt, copper, lithium, magnesium, manganese, nickel, tin, titanium, tungsten, vanadium, zinc, and zirconium. Rare earth elements have not been analyzed. Recovery readiness is constrained by the cell's UMTRCA/NRC status, the DOE land withdrawal from the Bureau of Land Management, an average Ra-226 activity of 477 pCi/g in 2012-2025 loadout measurements, incomplete mapping of higher-grade zones and disposed debris, the absence of site-specific metallurgical recovery testing, and the lack of processing infrastructure. This appendix is a screening-level bounding analysis.

1. The Material

1.1 Stream Definition and Origin

The Crescent Junction material is a single stream of uranium mill tailings and related contaminated material relocated from the former Atlas Corporation mill site near Moab, Utah. The original mill processed Colorado Plateau uranium-vanadium ore from 1956 through 1984 using acid-leach and alkaline-leach circuits, including a dedicated vanadium solvent-extraction process. The tailings therefore represent post-extraction residuals; for vanadium in particular, the material has already undergone primary recovery and should be evaluated as a secondary resource.

The stream was processed for transport and disposal during the ongoing UMTRA project but was not fully homogenized. It is a blended solid mass that includes fine-grained slimes, sands, limited super sacks, contaminated building debris, surcharge material, and subpile soils. The 16.2-million-ton figure is the current mass of the overall disposed stream, not the mass of any individual mineral.

1.2 Location and Accessibility

The engineered Crescent Junction disposal cell is in Grand County, Utah, approximately 31 miles north of Moab and adjacent to the I-70/US-191 interchange. An active Union Pacific Railroad mainline runs alongside the site and has been used at multi-million-ton scale to transport material from Moab to Crescent Junction. The remote, arid setting reduces nearby population and receptor concerns but must be considered in workforce, utility, and logistics planning.

The transportation corridors are proven, but the material is inside an NRC/UMTRCA-regulated disposal unit. Physical access for characterization, processing, or removal would require regulatory authorization and coordinated planning with DOE-EM and the U.S. Nuclear Regulatory Commission (NRC).

1.3 Physical Form and Distribution

The data call describes the approximate physical composition of the blended stream as follows:

Table 1. Approximate Composition of the Moab Tailings Stream

Material Type	Approximate Percentage of Total
Slimes (>70% passing No. 200 sieve)	49%
Sandy-slimes	23%
Slimy sands	20%
Sand (<30% passing No. 200 sieve)	7%
Other (surcharge, subpile soils)	~1%

The bulk material is not containerized and is placed in an engineered cell approximately 4,400 feet long, 1,800 feet wide, and 50 feet in total depth; extending 25 feet above grade and 25 feet below grade. A limited number of super sacks and a significant but unquantified quantity of contaminated building debris are also present. The current cover is not yet fully complete and is planned to transition from the existing rock-armored configuration to an evapotranspiration cover system. No active liquid-containment vessels are present within the cell.

Distribution within the cell is not uniform. Based on disposal sequencing, higher-grade slime fractions are believed to be concentrated on the west side of the cell. The location and extent of super sacks and building debris have not been comprehensively mapped in the source documents, and those materials have not been separately characterized from the bulk tailings.

2. Bounding Inventory and Analytical Data

2.1 Stream Inventory

Table 2. Bounding Inventory and Stream Status

Inventory or Status Item	Bounding Information	Qualification
Current disposed stream	Approximately 16.2 million tons	Single engineered disposal cell at Crescent Junction.
Expected additional material	Approximately 1 million tons through tentative 2029 completion	Expected to include off-pile and subpile radiologically contaminated material; may not all be direct tailings and is not separately characterized.
Long-term generation	Finite after remediation completion	No further routine growth expected absent a separate decision to place material from another source in the cell.
Processing availability	No existing mineral-recovery facilities	Any loadout, handling, beneficiation, leaching, extraction, or refining facilities would have to be newly established on-site or off-site.

The quantities above describe the total material stream. They should not be interpreted as contained-mineral quantities.

2.2 Critical Mineral Availability

Table 3. Source-Supported Critical Mineral Availability

Material or Group	Availability Supported by the Source Materials	Current Evaluation Status
Vanadium	Measured in multiple historical programs and consistently associated with uranium mill tailings, with the highest reported values in fine-grained slime material.	Lead mineral-specific case. A current whole-cell grade, contained tonnage, recovery factor, and extractability rating have not been established.
Other critical minerals of interest	The updated data call identifies aluminum, antimony, arsenic, beryllium, bismuth, boron, chromium, cobalt, copper, lithium, magnesium, manganese, nickel, tin, titanium, tungsten, zinc, and zirconium in addition to vanadium.	Presence is identified, but the source package does not provide defensible whole-stream tonnages or site-specific recovery factors for these constituents.
Rare earth elements	No identified characterization program analyzed REEs.	Data gap; absence of analysis is not evidence of absence.

The SRK program directly analyzed a subset of the broader critical-mineral list, including aluminum, antimony, arsenic, beryllium, chromium, cobalt, copper, magnesium, manganese, nickel, tin, titanium, vanadium, zinc, and zirconium. The updated data call draws on the full historical source package for the broader list. Other co-located measured metals include barium, cadmium, calcium, iron, lead, mercury, molybdenum, selenium, silver, strontium, thallium, thorium, and uranium.

2.3 Vanadium Grade Indicators

Table 4. Historical Vanadium Analytical Indicators

Program and Sampling Basis	Reported Vanadium Indicator	Interpretation and Limitation
Atlas Corporation (1979); 58 tailings samples collected during active milling	Mean grade of approximately 0.094% V ₂ O ₅ , equivalent to roughly 530 mg/kg elemental vanadium.	Largest identified single-program sample count for vanadium, but it predates relocation and homogenization and addresses vanadium only.
SRK Consulting (2001); solids sampled across multiple borings and material types	Average vanadium concentrations reported in the summary table: 1,004 mg/kg in unconsolidated silt, 1,124 mg/kg in consolidated silt, 564 mg/kg in dry silt, approximately 433 mg/kg in wet sand, and 211 mg/kg in dry sand.	Shows facies-related variability and generally higher concentrations in fine-grained material. Results are pre-relocation and are not a current whole-cell average.
ORNL (1998); two borings through the former tailings pile	Vanadium reported up to approximately 2,460 mg/kg at depth in slime tailings.	Useful cross-check on vertical and facies variability, but based on only two locations.

mg/kg is approximately equivalent to parts per million by mass. All reported vanadium data above predate final relocation of the stream to Crescent Junction.

Important Caveat: The available grade data should not be multiplied across the 16.2-million-ton stream and presented as an established contained-vanadium inventory. The source programs are historical and limited relative to the scale of the cell; the stream is heterogeneous; higher-grade slimes are believed to be spatially concentrated; the incoming approximately 1 million tons are compositionally uncertain; and no site-specific recovery factor is available. No extractability rating is assigned in this appendix.

3. Key Considerations

3.1 Material Characteristics and Co-Contaminants

- **Radiological profile:** Ra-226 averages 477 pCi/g in Radiological Control Program loadout measurements from 2012 through 2025. Fine-grained slime material has historically carried both the highest metals concentrations and the highest Ra-226 activity. Other measured radionuclides include gross alpha and beta activity, lead-210, polonium-210, radium-228, and thorium-230.
- **Chemical profile:** Uranium, ammonia, and sulfate are expected process-related constituents. A broader suite of metals is also present. Post-relocation concentrations may differ from pre-disposal measurements because transport and disposal mixed the material without fully homogenizing it.
- **Speciation and extractability:** Metals occur in multiple mineral phases, and solubility and extractability vary with pH, redox conditions, and element-specific mineralogy. Radiological management and mineral recovery are coupled engineering problems, particularly in the slime fraction.

3.2 Characterization and Recovery Readiness

No site-specific metallurgical test work is known to have been completed for vanadium or any other constituent in the Crescent Junction stream. The source package therefore supports occurrence screening, not process selection or recovery forecasting. A defensible next-stage evaluation would require independent sampling of current cell zones and material types, mapping and separate consideration of super sacks and building debris, characterization of incoming material, and laboratory testing to establish mineralogy, leachability or other process amenability, contaminant partitioning, and achievable product specifications.

REE analysis is a separate data gap. Any future analytical program intended to evaluate the full critical-mineral suite should include REEs explicitly rather than treating the historical omission as a negative result.

3.3 Regulatory Framework and Land Use

The disposal cell is regulated under UMTRCA and, after cover completion and NRC concurrence, is expected to operate under an NRC general license. Any disturbance of disposed material would require engagement and authorization from DOE-EM and the NRC. Regulatory approvals should be treated as a primary project schedule and cost driver.

The cell is located on land permanently withdrawn from the Bureau of Land Management to DOE for the remediation mission. Processing, reuse, or recovery outside that mission would likely require an additional land-use action, such as a withdrawal modification, authorization, or interagency agreement, separate from the UMTRCA/NRC approvals.

3.4 Infrastructure and Processing

Direct highway access and the adjacent active Union Pacific mainline are significant logistical assets. Those corridors were used for the ongoing bulk relocation program and demonstrate that large-scale material movement is possible. However, a recovery project would likely require new loadout and handling facilities, rail siding or track modifications, utilities, radiological controls, and processing infrastructure that have not been scoped in the source package.

The existing on-site infrastructure supports an active disposal mission, not mineral processing or reuse. Any heap leach, solvent-extraction, physical separation, or other recovery circuit would need to be newly established either at Crescent Junction, subject to regulatory and land-use approvals, or at an off-site facility.

4. Historical Processing Context and Recovery Implications

4.1 Original Atlas Mill Processing

The Atlas Corporation mill processed uranium-vanadium ore between 1956 and 1984 using both acid-leach and alkaline-leach circuits. Historical process descriptions identify reagents including sulfuric acid, sodium hydroxide, ammonia, and sodium chlorate, together with a dedicated vanadium solvent-extraction process. This history helps explain the mixed chemical suite that remains in the tailings and confirms that vanadium was an intentional recovery target during original milling.

4.2 Implications for Secondary Recovery

Because the material is post-extraction tailings, historical grades represent residual, partially depleted concentrations rather than untreated ore grades. The higher vanadium concentrations reported in slime material identify a logical characterization target, but the same fraction also carries the highest radiological burden and presents the most demanding material-handling conditions. Historical grade alone therefore cannot establish economic or technical recoverability.

The appropriate screening conclusion is that Crescent Junction contains a very large, single-location secondary material stream with a well-supported vanadium occurrence and a broader suite of co-located critical minerals. Vanadium should be retained as the lead quantified case, while the remaining minerals should be presented as identified constituents requiring additional characterization. Advancement beyond this bounding stage depends on current-cell sampling, mineralogical and metallurgical testing, a radiological management concept, and a viable regulatory and land-use pathway.

5. Key Source Documents

Document	Relevance to This Integrated Appendix
Critical Minerals/Rare Earths Updated Data Call - Moab UMTRA Project, Crescent Junction Disposal Cell	Primary source for the definition of the single tailings stream, current and future quantity, physical form, distribution, transportation access, regulatory status, land-use constraints, and stated data gaps.
SRK Consulting (2001), Tailings Geochemistry Atlas Mill Site, Moab, Utah	Primary laboratory source for tailings solids, porewater, metals, radionuclides, and material-type variability. The summary table reports substantially higher average vanadium concentrations in silt/slimes material than in sand.
ORNL (1998), Limited Groundwater Investigation of the Atlas Corporation Moab Mill	Two-boring cross-check showing the highest metals and radium concentrations at depth in slime tailings, including vanadium up to approximately 2,460 mg/kg.
DOE (2003), Site Observational Work Plan for the Moab, Utah, Site	Synthesis of historical and DOE characterization data, including subpile soils, pore-fluid chemistry, mineralogy, and geochemical evolution.
Atlas Corporation (1973), Environmental Report Moab, Utah Facility	Process-history source describing the acid-leach and alkaline-leach circuits, reagents, and original tailings-disposal configuration.
Atlas Corporation (1979), Source Material License Renewal Application	Reports the mean 0.094% V ₂ O ₅ grade across 58 tailings samples collected during active milling and provides the largest identified single-program vanadium sample count.

This integrated appendix uses the updated data call as the controlling description of the current Crescent Junction stream and uses the historical analytical programs as screening-level evidence of constituent occurrence and variability.

Lead Resource and Disposition Potential: DOE EM Nevada Program

Inventory and Location Analysis

U.S. Department of Energy, Office of Environmental Management

Executive Summary

The U.S. Department of Energy (DOE) Office of Environmental Management (EM) Nevada Program has identified an inventory of legacy lead materials located at the Nevada National Security Site (NNSS) in Area 25. These materials, consisting of lead bricks and lead shot, were originally utilized as radiation shielding for legacy operations at the Engine Maintenance Assembly and Disassembly (EMAD) facility.

The currently identified inventory is planned for phased availability starting now. The immediately available inventory consists of 402 lead bricks that have been characterized as non-radiological and are ready for disposition as recyclable material. The projected future inventory includes additional variable-dimension lead bricks and lead shot presently integrated into existing structures or drums and is expected to be available by January 1, 2027.

Because on-site processing or reuse of this material is not feasible at the NNSS, the inventory is available for ground transportation and transfer to off-site facilities for processing, recycling, or reuse. Access to the material is subject to site permission and coordination with the DOE EM Nevada Program.

Current contract terms require the full lead inventory to be dispositioned prior to May 1, 2027. If no user is identified by this date, the material will be compliantly disposed of at NNSS.

1. The Material

1.1 Origin and Technical Context

The lead inventory at Area 25 was generated as a result of legacy operations at the Engine Maintenance Assembly and Disassembly (EMAD) facility. During active operations, high-purity lead was deployed in various physical configurations, predominantly as standardized shielding bricks and particulate shot, to protect personnel and sensitive instrumentation from radiation.

Following the cessation of legacy EMAD operations, these shielding materials were consolidated. Residual analytical profiles for some portions of the inventory, particularly the

projected future materials, are currently pending final verification. However, the immediately available inventory of 402 lead bricks has been verified as non-radiological.

1.2 Location

The materials are situated within Area 25 of the Nevada National Security Site (NNSS), a secure federal reservation located in Nye County, Nevada.

- **Site Access:** The NNSS is a highly restricted security environment. Any physical access, inspection, or extraction of the material requires formal site permission, badging, and coordination with the DOE EM Nevada Program.
- **Logistical Infrastructure:** The site is accessible via established ground transportation corridors. Heavy haulage and standard ground freight represent the primary mechanisms for material egress.

1.3 Material Configuration and Storage

The inventory is divided into distinct physical forms and storage configurations based on its current operational status:

- **Lead Bricks (Active Storage):** The immediately available inventory consists of 402 lead bricks of standardized dimensions (2 in × 4 in × 8 in). These are currently stacked and secured on two pallets.
- **Lead Bricks (Active Storage and generating):** Some variable-dimension bricks are in storage and the remaining variable-dimension bricks will continue to be generated, stored and projected for availability starting January 1, 2027, but no later than May 1, 2027.
- **Lead Shot (In Structures/Drums):** The lead shot inventory is slated for availability starting January 1, 2027, but no later than May 1, 2027. The material is currently stored in 30-gallon drums, with additional quantities remaining within legacy facility structures awaiting dismantling or recovery.

2. Inventory and Projections

The following table details the current and projected inventory of lead materials at the EMAD facility, including planned transition timelines and radiological profiles.

Table 1. Lead Material Inventory and Disposition Schedule

Material	Date Available	Planned Disposition	Quantity	Dimensions	Contamination Type	Configuration/Location	Current Status
Lead Bricks	Currently Available	Dispositioned as recyclable	402	2"x4"x8"	Non-Radiological	Palletized (2 pallets) at NNSS	In Storage
Lead Bricks	January 1, 2027, through May 1, 2027	Unknown	Unknown	Variable	Non-Radiological	NNSS	In Storage
Lead Shot	January 1, 2027, through May 1, 2027	Unknown	Unknown	Variable	Unknown	Stored in eight 30-gal drums / NNSS	In Storage and Structures

3. Key Considerations

3.1 Regulatory Framework

Any proposed transfer, transport, or reuse of the NNSS lead materials must comply with DOE Order requirements and NNSS site-security protocols. Because the material is located within a secured national security site, prospective off-site users or recyclers must coordinate closely with the DOE EM Nevada Program contact to secure necessary transport clearances and verify waste/recycling profiles.

3.2 Material Characteristics and Purity

- **Chemical Composition:** The primary material is elemental lead (Pb). While historical shielding applications typically utilized high-purity lead to maximize density, site-specific metallurgical testing and exact purity assessments are currently unknown or pending.
- **Analytical Profiles:** Complete chemical and radiological analytical profiles for the the projected future inventory (including the lead shot and variable brick portions) are pending. Prospective receivers will need to account for these pending analyses in their processing and hazard communication plans.

3.3 Logistics and Infrastructure

- **No On-Site Processing:** The NNSS does not possess the active infrastructure or mission authorization to process, melt, or reform lead materials for local reuse. Consequently, all viable disposition pathways require transport off-site.
- **Transportation Limitations:** Ground transit is the sole transport modality available for removing materials from Area 25. The physical weight of lead necessitates appropriate

freight vehicles, pallet securing, and adherence to Department of Transportation (DOT) weight limits for interstate highway transit.

- Current contract terms require the full lead inventory to be dispositioned prior to May 1, 2027. If no user is identified by this date, the material will be compliantly disposed of at NNSS.

4. Historical Precedent: DOE-Commissioned Radiation Shielding Lead Decontamination and Recycling

4.1 Background

During the late 1990s and early 2000s, the U.S. Department of Energy (DOE) initiated several complex-wide pollution prevention (P2) and waste minimization programs to divert legacy metallic wastes from landfills. Historically, massive quantities of lead, primarily in the form of shot, bricks, and sheets, were deployed across the DOE nuclear weapons complex to provide high-density radiation shielding at reactors, accelerators, hot cells, and testing facilities.

Decommissioning these facilities generated millions of pounds of excess lead. Under traditional waste management streams, this lead was frequently classified as mixed low-level radioactive waste (MLLW) due to real or suspected surface radiological contamination, leading to extremely high disposal costs. To mitigate these life-cycle liabilities, DOE successfully demonstrated and implemented verification, decontamination, and commercial recycling pathways that serve as a direct historical precedent for the EM Nevada Program's Area 25 lead inventory.

4.2 Hanford C Reactor Decontamination Demonstration (1998)

Site Overview

In May 1998, the DOE Richland Operations Office, in coordination with the C Reactor Technology Demonstration Group, completed a landmark testing and decontamination program evaluating the recycling potential of legacy lead shielding bricks. The bricks, originally used as reactor shielding in the late 1970s, had been stored on wooden pallets in a secure area within the C Reactor compound, developing heavy surface oxidation and localized radiological contamination.

Analytical and Decontamination Testing

The program utilized specialized chemical decontamination techniques (specifically TechXtract® technology) to remove surface oxidation and radioactive particulates without altering the core structure of the elemental lead (Pb).

- **Surface Contamination Treatment:** The decontamination process successfully reduced surface radiological contamination to levels below DOE free-release limits.

- **Material Integrity Preservation:** The chemical process preserved 100% of the physical dimensions and structural integrity of the bricks, eliminating the need for costly secondary smelting.
- **Secondary Waste Minimization:** The process proved highly efficient, meeting as low as reasonably achievable (ALARA) safety considerations while minimizing secondary liquid waste generation.

Economic Impact

The demonstration verified that decontaminated shielding lead possessed significant salvage value. By removing the material from hazardous and radioactive waste classifications, DOE transformed a high-liability waste stream into a cost-neutral or cash-flow positive commercial recycling resource. This proved that decontaminating and recycling legacy lead shielding was a technically viable and economically preferred alternative to long-term disposal.

4.3 Relevance to the EM Nevada Program

- **Material and Functional Comparability:** The EMAD lead bricks (2" × 4" × 8") and lead shot are physically and chemically identical to the shielding materials successfully decontaminated and recycled at Hanford, Los Alamos National Laboratory, and Rocky Flats.
- **Radiological Verification Advantage:** Unlike the Hanford C Reactor project, which required active chemical decontamination, the EM Nevada Program has already verified the immediately available inventory of 402 lead bricks as non-radiological. This allows for direct transfer to commercial recyclers without the operational overhead of chemical treatment.
- **Avoided Disposal Costs:** Disposing of lead as MLLW at the Area 5 Radioactive Waste Management Complex (RWMC) incurs long-term stewardship costs and violates complex-wide waste minimization goals. Utilizing off-site commercial recycling paths represents a cost-avoidance mechanism for the EM Nevada Program.^[1]
- **Recycled Lead Market Context:** Lead is one of the most highly recycled industrial metals. The purity of legacy shield blocks makes them highly sought after in the commercial recycled lead market for use in new battery technologies, data center uninterruptible power supplies, and medical radiation shielding.

5. Key Source Documents

Document	Relevance
DOE (1998), <i>Lead TechXtract Chemical Decontamination (Tech ID 1450)</i>	Detailed case study of lead shielding decontamination, radiological surveys, and commercial salvage recycling.
LANL (1998), <i>TA-53 Accelerator Lead and Steel Recycling Project</i>	Documented success of shielding verification, segregation, and free-release pathways, resulting in \$25.5 million in cost savings.
DOE O 458.1, <i>Radiation Protection of the Public and the Environment</i>	Establishes the regulatory basis, safety guidelines, and authorized limits for the clearance and release of personal property containing residual radioactive materials.