# Rowow LLC, DLA SBIR Phase I proposal L26BZ-NV002-0512, Volume 2 technical volume (public copy)

> Public copy, November 2026. This is Volume 2, the Technical Volume, of Rowow LLC's DLA SBIR Phase I proposal L26BZ-NV002-0512 under topic DLA26BZ02-NV002. The text is reproduced as submitted, with headings and section order unchanged, and has not been corrected or updated. Text in square brackets is added by the editor. Where text was removed for publication, the place is marked `section shortened`. The running header and footer printed on each page of the submitted PDF are not repeated. The volume has no figures or tables.
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> Status, November 2026: Rowow LLC submitted this proposal in June 2026 under DLA SBIR topic DLA26BZ02-NV002. It was not selected; the decision is dated September 9, 2026. The Department of Energy National Energy Technology Laboratory application described below as pending was declined on July 29, 2026. Wording about the award, the period of performance, Phase II and Phase III describes the plan as proposed, not work that took place.
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> Brand name: the technology is now written S.E.M Technology (Salt Electro Mining Technology). This record keeps "SEM TECH" as submitted.
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> Rare earth recovery: in this process rare earths do not plate out as metal from water. They come out on the cathode side of the cell as a precipitate, rare earth hydroxide, which becomes rare earth oxide after calcining. Passages below that read as plating or as direct recovery of rare earth metal or oxide in the cell should be read as describing this precipitation route.
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> Claims: statements of results and performance are those made in June 2026. Notes dated November 2026 mark each one that is not a verified current result.

## 1. Identification and Significance of the Problem or Opportunity

Rare earth separation is the single most concentrated chokepoint in the United States defense materials supply chain. Although rare-earth-bearing feedstocks exist domestically in quantity (mine tailings, neodymium-iron-boron magnet scrap from end-of-life electronics, and other electronic-scrap streams), nearly all separation of mixed rare earths into individual high-purity oxides, salts, and metals occurs overseas. The reasons are the three the topic itself identifies: operations cost and profitability, feedstock sourcing, and hazardous chemistry. Conventional solvent-extraction trains require hundreds of mixing-and-settling stages, large volumes of organic solvents and bulk acids, continuous waste-acid disposal, and capital scales that only make sense at very high throughput. Artificial price controls by dominant foreign producers then strand any domestic entrant that tries to amortize that capital. The result is that defense platforms which each depend on small quantities of scandium, yttrium, neodymium and praseodymium, samarium, gadolinium, terbium, and dysprosium sit exposed to a supply chain with a single point of failure.

The opportunity is to change the cost structure rather than subsidize the old one. Rowow LLC has developed SEM TECH (Salt Electro Mining Technology), an ion-exchange-membrane electrolysis platform in which the leaching chemistry (in-situ hydrochloric acid plus a sodium chlorate and hypochlorite oxidizer, generated from a salt-water electrolyte) is regenerated electrochemically every cycle. The process is closed-loop: no bulk acid purchases and no spent-acid disposal stream, with electricity as the dominant input. The enabling component is Rowow's membrane: pulverized commercial ion-exchange resin dispersed in a polyvinyl chloride matrix and solvent-cast, costing under one dollar per square foot against hundreds of dollars per square foot for commercial benchmark membranes (United States non-provisional patent application No. 19/531,984). Note, November 2026: the regeneration of the leaching chemistry every cycle, the closed-loop operation with no spent-acid stream, and the membrane cost of under one dollar per square foot are claims as submitted in June 2026, before later work. None is a verified current result. At that membrane cost, electrochemical separation cells can be sized generously and staged in series without membrane area dominating capital cost, which is precisely what multi-element separation requires. The platform is modular by construction (a cell-stack architecture in containerized units) and scales by replication rather than by redesign, directly answering the topic's call for modular, easily scalable production.

Rowow has validated the platform at Technology Readiness Level 5 on real ore, mine tailings, and liquid mine waste in its 1,400 square foot laboratory, with recovery yields up to 99 percent and demonstrated dissolution coverage for the majority of the United States critical minerals list in a single leaching chemistry. Note, November 2026: the Technology Readiness Level 5 validation, the recovery yields of up to 99 percent and the dissolution coverage of most of the United States critical minerals list are claims as submitted in June 2026, before later work. None is a verified current result. Critically for this topic, Rowow has already demonstrated staged selective separation of platinum group metals from mixed feedstock liquors: the process extracted all of the platinum group metals and precious metals present in the processed material, confirmed by independent third-party inductively coupled plasma mass spectrometry analysis. Platinum group metals and rare earths present the same class of problem, namely chemically similar elements co-dissolved in one liquor that require sequential, selectivity-controlled recovery. Phase I transfers this demonstrated staged-separation methodology from the platinum group metal system to the rare earths. Note, November 2026: the statements in this paragraph that staged separation of platinum group metals was demonstrated and that all platinum group metals and precious metals present were extracted, confirmed by inductively coupled plasma mass spectrometry, are claims as submitted in June 2026, before later work. Neither is a verified current result.

## 2. Phase I Technical Objectives

The overarching Phase I question is whether SEM TECH's staged membrane electrolysis can separate rare earths from real mixed domestic feedstocks into high-purity fractions at energy and reagent costs that beat imported-oxide pricing. There are four objectives, each with quantitative success criteria.

**O1. Rare earth leaching and bulk rare-earth-group recovery from three domestic feedstock classes.** Demonstrate dissolution and bulk rare-earth recovery from (a) neodymium-iron-boron magnet scrap recovered from end-of-life electronics, (b) mine tailings already characterized in Rowow's laboratory,

and (c) printed-circuit-board shred. Success: at least 90 percent rare-earth dissolution from magnet scrap, and a rare-earth-group concentrate recovered from all three feedstocks with measured grade.

**O2. Staged intra-rare-earth separation proof of concept.** Apply the staged selective-recovery methodology demonstrated on platinum group metals to the rare-earth liquor: a light/heavy group split, then target-pair separations producing a neodymium/praseodymium-rich fraction and a dysprosium/terbium-rich fraction. Success: at least 95 percent rare-earth purity in the neodymium/praseodymium fraction (target) and quantified separation factors for adjacent-lanthanide pairs, verified by independent third-party analysis. Note, November 2026: the platinum group metal demonstration this objective builds on is a claim as submitted in June 2026, before later work. Not a verified current result.

**O3. Closed-loop reagent regeneration in rare-earth service.** Run repeated leach-recover-regenerate cycles on one solution inventory with rare-earth feedstocks and close the mass balance. Success: at least 95 percent reagent regeneration per cycle, impurity accumulation quantified, and makeup chemical demand defined.

**O4. Preliminary techno-economic analysis and commercialization roadmap.** Update Rowow's existing techno-economic model with measured Phase I values (kilowatt-hours per kilogram of rare earth oxide recovered, membrane lifetime, reagent makeup, and purity-yield curves) and produce the cost-per-kilogram comparison against imported rare earth oxide prices, plus the Phase II pilot specification. Success: a defensible techno-economic analysis delivered with the final report, and a roadmap from Phase I bench work to a Phase II pilot (no more than 18 months, section shortened, domestically sourced inputs) to Phase III production.

These objectives sit squarely in the topic's required readiness window: the platform is proven at Technology Readiness Level 5, but rare-earth-specific staged separation is at Level 3 today and will reach Level 4 to 5 by Phase I completion. Note, November 2026: that the platform is proven at Technology Readiness Level 5 is a claim as submitted in June 2026, before later work. Not a verified current result.

## 3. Phase I Statement of Work (12 months) section shortened

**Task 1 (Months 1-2): Feedstock acquisition, preparation, and baseline characterization.** Prepare the three feedstock lots: neodymium-iron-boron magnet scrap already on hand at Rowow's laboratory, the existing characterized tailings inventory, and printed-circuit-board shred. Demagnetize and comminute the magnet scrap and assay all three lots section shortened to establish input rare-earth content. Deliverable: feedstock baseline report. Milestone M1: three characterized domestic feedstock lots ready.

**Task 2 (Months 2-5): Rare earth leaching and bulk recovery (O1).** Adapt SEM TECH leach chemistry to rare-earth dissolution per feedstock; run the recovery cell to a bulk rare-earth concentrate; measure dissolution kinetics, recovery yield, and energy per kilogram. Decision gate G1 (Month 5): at least 90 percent dissolution from magnet scrap achieved, or operating-window adjustments identified and tested.

**Task 3 (Months 4-9): Staged intra-rare-earth separation (O2).** Configure staged cells (cation and anion membrane selection, stage chemistry, potential control) following the platinum-group-metal separation playbook. Sequence: bulk rare-earth concentrate, then light/heavy split, then neodymium/praseodymium fraction, then dysprosium/terbium fraction. Iterate formulation and operating parameters and characterize separation factors per stage. All key product fractions are verified by independent third-party analysis. Milestone M2 (Month 9): measured separation factors and purity for the target fractions.

**Task 4 (Months 6-10): Closed-loop regeneration endurance in rare-earth service (O3).** Run a multi-cycle campaign on a fixed solution inventory using magnet-scrap feed; track reagent regeneration efficiency, impurity accumulation, and membrane condition (resistance, permselectivity) over a target of 500 or more cumulative operating hours. Milestone M3 (Month 10): mass balance closed across at least 10 full cycles.

**Task 5 (Months 9-12): Techno-economic analysis, commercialization roadmap, final reporting (O4).** Update the techno-economic model with measured data; produce the cost-per-kilogram of rare earth oxide versus import benchmarks; specify the Phase II pilot (containerized, domestic-input compliant); and deliver the technology development and commercialization roadmap and the draft and final reports including the business case. Milestone M4: final report and Phase II proposal basis delivered.

**Deliverables throughout:** a project objectives and milestones plan, monthly status reports, public one-page project summaries as required, and draft and final reports with a commercialization and transition plan.

**Risk register (abbreviated):** R1, adjacent-lanthanide selectivity insufficient in a single pass, mitigated by multi-pass staging and chemistry swaps between stages (the same approach that resolved platinum-group-metal co-deposition). Note, November 2026: that this approach resolved platinum group metal co-deposition is a claim as submitted in June 2026, before later work. Not a verified current result. R2, oxidative membrane degradation in rare-earth service, mitigated by formulation variants on hand, with the lifetime model from Task 4 feeding the techno-economic analysis honestly. R3, feedstock variability, mitigated because the three feedstock classes hedge each other and all mass balances are anchored to independent assays.

## 4. Related Work

Rowow designed, built, and validated the complete SEM TECH platform between 2023 and 2026: the membrane formulation and casting line, the Continuous Mining Unit for leach-and-recover operation, and the Continuous Refining Unit for selective stripping of mixed concentrates. Validation has used real feedstocks throughout (ore, mine tailings, and liquid mine waste) at under 33 kilowatt-hours per 255 gallons of liquid mine waste and 300 to 2,200 kilowatt-hours per ton of ore depending on grade and chemistry. Recovery yields reach 99 percent. The platform's leach chemistry has demonstrated dissolution coverage of most of the minerals on the United States critical minerals list in a single solution. Note, November 2026: the platform validation, the energy figures of under 33 kilowatt-hours per 255 gallons of liquid mine waste and 300 to 2,200 kilowatt-hours per ton of ore, the 99 percent recovery yield and the critical

minerals coverage stated in this paragraph are claims as submitted in June 2026, before later work. None is a verified current result.

Most relevant to this topic, Rowow has executed staged selective separation of platinum group metals from mixed liquors, recovering all platinum group metals and precious metals present in the processed feedstock, with the recovered material verified by independent third-party inductively coupled plasma mass spectrometry. This is the methodological template that Phase I applies to the rare earths. Note, November 2026: the recovery of all platinum group metals and precious metals present, verified by inductively coupled plasma mass spectrometry, is a claim as submitted in June 2026, before later work. Not a verified current result.

The foundational membrane is the subject of United States non-provisional patent application No. 19/531,984 (filed February 2026). Rowow's defensible position for this defense application is the integrated process developed and held in-house: the staged separation cell designs, the rare-earth leach and stage chemistries, the closed-loop regeneration circuits, and the membrane manufacturing process. A key resilience point for this topic is that the enabling membrane is produced domestically from commodity, off-the-shelf inputs rather than from controlled or foreign-sourced specialty materials, so the supply chain for the consumable itself carries no foreign dependency.

## 5. Relationship with Future Research or Research and Development

Phase I buys down the single technical risk, intra-rare-earth selectivity, that stands between the validated platform and a domestic rare-earth separation product. Note, November 2026: that the platform is validated is a claim as submitted in June 2026, before later work. Not a verified current result. Phase II (no more than 18 months, section shortened) establishes the pilot-scale process: a containerized staged-separation line processing domestically sourced magnet scrap and tailings, with product characterization for elemental purity, a business case spanning Department of War and commercial markets, and supply-chain partner collaboration. The Phase II pilot reuses Rowow's existing containerized unit engineering. Rowow's pending Department of Energy National Energy Technology Laboratory application addresses the complementary mining-scale maturation program (bulk throughput, Technology Readiness Level 5 to 7); there is no duplication, because this effort is rare-earth separation chemistry and staging while that one is bulk mining throughput (disclosed in Section 11).

## 6. Commercialization Strategy

**Department of War market.** The customer this topic serves is the Defense Logistics Agency Strategic Materials function and the defense supply chain behind it: magnet producers, propulsion and guidance suppliers, and prime contractors needing domestic neodymium and praseodymium, dysprosium, terbium, and samarium sources. Rowow's path is a Phase II pilot leading to a qualified domestic supplier of high-purity rare earth oxides and salts at modular scale, growing capacity by unit replication to fill Department of War orders (Phase III without dedicated funding, per the topic structure).

**Commercial market.** The identical units serve magnet recyclers, electronic-scrap processors, and tailings owners. The United States discards rare-earth-bearing magnet scrap continuously (hard drives, motors, consumer electronics); recyclers today export it or landfill it for lack of domestic separation capacity. SEM TECH's containerized unit lets feedstock holders capture separation margin on site. Unit economics rest on the under-one-dollar-per-square-foot membrane, closed-loop reagents, and an electricity-dominated operating cost; preliminary modeling indicates processing costs near 50 dollars per ton of feedstock, with the Phase I techno-economic analysis producing the per-kilogram figure against import prices. Note, November 2026: the membrane cost of under one dollar per square foot, the closed-loop reagents and the processing cost near 50 dollars per ton of feedstock are claims as submitted in June 2026, before later work. None is a verified current result.

**Business status and path.** Rowow is pre-revenue and self-funded to date, financing its work internally and through paid small-scale waste-processing demonstrations for domestic mining clients, with federal proposals under review. section shortened

## 7. Key Personnel

**Robert Karas, Principal Investigator (Founder and Owner, Rowow LLC).** Karas conceived, designed, built, and validated the entire SEM TECH platform: membrane formulation and manufacturing, electrochemical cell and stack design, leachate chemistry, closed-loop regeneration circuits, and the integrated mining and refining units, working hands-on in Rowow's laboratory. He is the sole inventor on United States non-provisional patent application No. 19/531,984 covering the membrane and its manufacturing process. His record demonstrates the combination this program's evaluation criteria seek: the technical capability to execute the research and development (a working Technology Readiness Level 5 platform built from first principles) and the commercialization drive to carry it to market (an active federal proposal pipeline and direct industry outreach to recyclers, original equipment manufacturers, and engineering firms). Karas is employed full-time by Rowow LLC and satisfies the SBIR primary-employment requirement. Note, November 2026: the validation of the platform and its status as a working Technology Readiness Level 5 platform are claims as submitted in June 2026, before later work. Neither is a verified current result.

section shortened

## 8. Foreign Citizens

No foreign citizens, foreign nationals, or persons holding dual citizenship with a foreign state will participate in this project in any capacity. All work will be performed in the United States by United States persons, consistent with the ITAR and EAR restriction on this topic.

## 9. Facilities and Equipment

Rowow operates a 1,400 square foot electrochemistry laboratory in Florida, built by the Principal Investigator specifically for this technology and adequate for the entire proposed scope. Relevant

capability includes a wet-chemistry area with fume hoods, ventilation, leak detection, and chemical containment rated for chlorine-evolving electrolysis; a membrane manufacturing line (resin pulverization, solvent mixing, and casting); a computer-numerical-control router table for electrolysis-cell fabrication; bench and prototype electrolysis cells in mining and refining configurations, including multi-cell electro-separation stacks; direct-current power supplies and rectifiers, pumps, and solution-handling tanks for acidic oxidizing chemistries; comminution capability for magnet-scrap preparation; a laboratory oven for membrane and resin drying to constant mass; ceramic kilns and a 12 kilowatt induction heater for product calcining and melt work; a fire-assay kit for gravimetric confirmation of gold, silver, platinum, and palladium independent of instrumental methods; a Rigaku NEX DE energy-dispersive X-ray fluorescence spectrometer for feedstock and product screening; and an oxidation-reduction-potential meter. section shortened No government-furnished equipment or facilities are required. The closed-loop design minimizes hazardous-waste generation, and the facility conforms to applicable environmental and safety requirements. Rowow will complete a Cybersecurity Maturity Model Certification Level 2 self-assessment during the period of performance, as projected for this topic.

## 10. Subcontractors and Consultants

section shortened

## 11. Prior, Current, or Pending Support of Similar Proposals or Awards

Rowow LLC has a pending application under the Department of Energy National Energy Technology Laboratory (Mine of the Future, Proving Ground Initiative), titled "SEM TECH, Ion Exchange Membrane Electrolysis Mining," currently under review. That proposal addresses Technology Readiness Level 5 to 7 maturation of bulk mining and recovery throughput and does not include intra-rare-earth separation research and development; there is no overlap in scope, tasks, or budget with this proposal. Rowow holds no prior or current federal awards. Should any other federal effort be funded, scopes will be deconflicted with the cognizant program managers.

## 12. Identification and Assertion of Restrictions on the Government's Use of Technical Data

Rowow asserts SBIR data rights (DFARS 252.227-7018) on technical data generated under this contract pertaining to staged separation cell configurations and operating parameters, rare-earth-specific leachate and stage chemistries, regeneration circuit designs, and the internals of the techno-economic model, which together constitute the actual separation capability and Rowow's protectable positio

Note, November 2026: the submitted PDF ends here, partway through a word, at the foot of its last page. The text file from which the PDF was produced continues: "position. The base membrane recipe was previously released publicly

and is unrestricted; this does not diminish the asserted rights above, which cover the proprietary process rather than the membrane material. A detailed assertion table is provided in Volume 5."

[License note, November 2026: the public domain (CC0) release of the membrane recipe that the word "unrestricted" refers to was retired on June 18, 2026. The membrane hardware and design are now licensed under CERN-OHL-S v2 and the documentation under CC BY-SA 4.0.]