Form B: IGEM-HERC Full Proposal Cover Sheet
Idaho State Board of Education

PROPOSAL NUMBER: (to be assigned by HERC)		TOTAL AMOUNT REQUESTED: **$154,419**	
Proposal Track (select one): **Proof of Concept**			
TITLE OF PROPOSED PROJECT: **SONO-MSE Process for Permanent Magnets Manufacturing from Idaho-Sourced Minerals**			
SPECIFIC PROJECT FOCUS: **Critical Materials, Machine Learning, and Artificial Intelligence**			
PROJECT START DATE: **07/01/2025**		PROJECT END DATE: **12/31/2026**	
NAME OF INSTITUTION: **University of Idaho**		DEPARTMENT: **Nuclear Engineering and Industrial Management (NEIM)**	
ADDRESS: **Tingey Administration Building, Suite 312, 1776 Science Center Dr., Idaho Falls ID 83402**			
E-MAIL ADDRESS: amirkouei@uidaho.edu		PHONE NUMBER: **208-757-5420**	
	NAME:	TITLE:	SIGNATURE:
PROJECT DIRECTOR/ PRINCIPAL INVESTIGATOR	**Amin Mirkouei**	**Associate Professor**	
CO-PRINCIPAL INVESTIGATOR(S)	**Aleksandar Vakanski**	**Associate Professor**	
OTHER KEY PERSONNEL:	**Robert Morgan**	**VP of Exploration**	**Idaho Strategic Resources Inc. (IDR)**
NAME OF PARTNERING COMPANY: **Hydrova LLC.**		COMPANY: REPRESENTATIVE NAME: **Rostam Reifschneider** rostam@hydrovatech.com | https://hydrova.com/	
SIGNATURE:			
Authorized Organizational Representative	NAME: Sarah Martonick tc 2.25.25	SIGNATURE:	

1. **Name of primary Idaho public institution:** University of Idaho

2. **Project title:** SONO-MSE Process for Permanent Magnets Manufacturing from Idaho-Sourced Minerals

3. **Name and Institution of Principal Investigator(s) and Key Personnel:**
   - Amin Mirkouei (PI), Associate Professor, University of Idaho
   - Aleksandar Vakanski (co-PI), Associate Professor, University of Idaho
   - Rostam Reifschneider (Industry Partner), CEO, Hydrova LLC.
   - Robert Morgan (Key Personnel), Idaho Strategic Resources Inc. (IDR)

4. **Total amount requested:** $154,419

5. **Significance of project and project objective(s)**

5.1. Significance of project

Impact on Idaho's economy: Idaho's mining industry continues to thrive, with ongoing exploration and mining activities helping to unlock the state's vast mineral resources. Idaho's minerals production value reached around $483 million in 2023 [1]. The main state's mineral commodities are gemstones, gold, phosphate rock, and silver. These valuable resources are formed through a combination of geological activities, which date back millions of years. Currently, Idaho's minerals industry is an important contributor to the state's economy, providing jobs and revenue for local communities. While the U.S. landmass contains numerous high-quality deposits of critical minerals, the lack of extraction and processing ability creates foreign reliance. For rare earth metals (REMs), while 15% of the global supply is mined in the U.S. at Mountain Pass, less than 1% is processed domestically [1].

This project aims to increase the U.S. share of both global REM mining and processing. Idaho is endowed with an abundance of critical minerals and materials (CMMs), but many of these mineral occurrences have not yet been developed into economic deposits that the U.S. can reliably count on. Most of Idaho's CMMs, such as rare earth elements (REEs) occurrences, lie along a northwest-trending line that extends more than 70 miles across central Idaho from Lemhi Pass, through Diamond Creek, to the Mineral Hill district, before crossing the Idaho-Montana state line (**Figure 1**) [2]. Creating a low-cost manufacturing pathway for permanent magnets will encourage the development of Idaho's mineral occurrences into actively producing mines.

Figure 1. Rare earth element districts located in the U.S. (left) and in Idaho (right) [2].

5.2. Project goal and objectives

Our overarching goal is to advance Idaho-sourced REEs extraction and processing for low-cost REMs production. Our primary objective is to de-risk permanent magnets using neodymium-rich (Nd-rich) mischmetal (MM) as a potential commercialization pathway for Idaho-sourced REMs manufacturing through ultrasound-assisted organic acid leaching coupled with chloride-based molten salt electrolysis

(SONO-MSE). To meet our goal, we will both produce initial samples of Nd-rich MM alloy to use for Nd-rich MM-Fe-B permanent magnets (Figure 2) and perform initial techno-economic analysis (TEA) and life cycle assessment (LCA) of the proposed SONO-MSE pathway. The REMs present in the Nd-rich MM alloy are: neodymium (Nd), cerium (Ce), lanthanum (La), samarium (Sm), praseodymium (Pr), dysprosium (Dy), yttrium (Y), ytterbium (Yb), gadolinium (Gd), europium (Er), terbium (Tb), and erbium (Eb). The proposed SONO-MSE process produces an Nd-rich MM alloy as the final product. Then, the Nd-rich MM alloy is used to make permanent magnets through a milling, pressing, and sintering process.

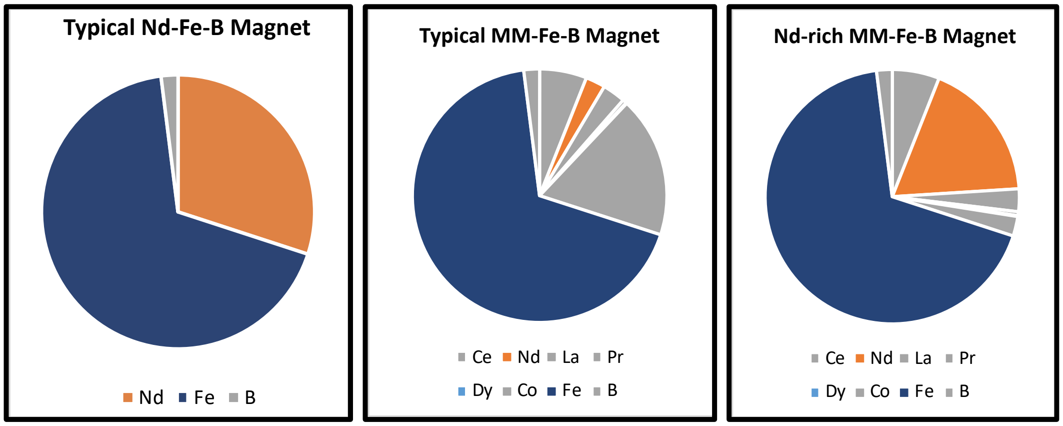

Figure 2. Typical Nd-Fe-B and MM-Fe-B permanent magnet compositions compared to expected composition of Nd-rich MM-Fe-B permanent magnet produced by SONO-MSE process

6. Specific project plan and timeline (18 months)

The overall work scope and approach to achieve the objectives are as follows:

Task 1. Nd-rich MM Alloy Production: Led by UI team in collaboration with Hydrova (14 months).
This task involves creating the Nd-rich mischmetal (MM) alloy that is representative of the expected product of single-stage organic acid leaching of Idaho-sourced REE-rich soil from the Lemhi Pass deposits.

Task 1.1. Design and build a custom vacuum induction melting and casting furnace (8 months).
Deliverables: Custom-built vacuum induction melting and casting process (**Figure 3**).
This task involves the construction of a vacuum induction melting and casting furnace. The furnace utilizes a water-cooled copper induction heating coil to melt REE charges inside of a boron nitride crucible to prevent contamination. The charges are cast into a water-cooled copper mold, which is necessary to maintain the purity of the alloy.

Task 1.2. Prepare melt charges under an inert atmosphere (2 months).
Deliverables: Melt charges with desired REEs.
This task involves handling metals that are highly prone to oxidation. All activities must be done under an inert atmosphere inside a glovebox. The metals involved include Nd, Ce, La, Sm, Pr, Y, Gd, Dy, and Eu. Some of these metals, Pr, La, Ce, and Eu in particular, oxidize immediately in contact with any amount of oxygen. It is highly important to open the packaging for these metals for the first time under a completely inert atmosphere. Once the desired amount has been removed, the vials must be sealed with parafilm and a vacuum-sealed outer layer. To create the Nd-rich MM alloy, the desired amount of each metal can be calculated using REE-rich ore deposit results from Lemhi Pass. These amounts will be weighed out under an inert atmosphere and added to labeled bags, which must be vacuum sealed before being removed from the glove box. To enhance efficiency, all sample bags needed for the duration of the project (beyond proof of concept) will be filled during Task 1.

Task 1.3. Perform vacuum induction melting using a boron nitride crucible and water-cooled copper mold to alloy metals (2 months).
Deliverables: Sample ingots of Nd-rich MM alloy.

Once all melt charges have been prepared, they will be melted using induction heating to alloy the metals together. In order to prevent contamination, a boron nitride crucible must be used with a water-cooled copper mold to pour the molten metal into. The metals will be heated with a two-stage heating curve, starting at 600W for 5 minutes and then dropping to 450W for 20 minutes. A powerful water cooler is needed to sustain the cooling water temperature for this long-duration melt. The melting must be done in an inert atmosphere, requiring a highly specialized inert gas vacuum induction melting furnace. Each sample must be cooled completely and vacuum sealed before being removed from the inert atmosphere.

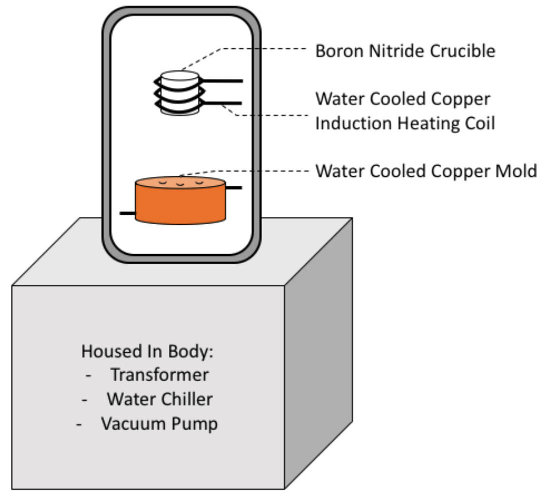

Figure 3: Schematic of custom-built vacuum induction melting and casting furnace for alloying REEs

Task 1.4. Characterize the composition of alloy, using UI ICP-MS machine (2 months)
Deliverables: Composition analysis
Once the alloy samples have been prepared, they will be analyzed via ICP-MS to verify their composition. This is necessary before attempting to produce a magnet using the alloy samples in future work. The composition analysis will determine if the desired ratios of metals have been achieved according to the REE-rich ore deposit results from Lemhi Pass. The analysis will also provide initial indications as to whether high-performance magnet production is possible using the Nd-rich MM alloy.

Task 2. Systematic analyses and process improvement, using machine learning (ML) and artificial intelligence (AI) techniques: Led by UI team (4 months)

Task 2.1. Finalize the process flow for the SONO-MSE process, along with determining the cost and waste from each step (4 months)
Deliverables: Process flow sheet, and techno-economic analysis (TEA) and life cycle assessment (LCA) reports for the proposed Nd-rich MM-Fe-B permanent magnet manufacturing pathway.
The initially developed SONO-MSE process flow will be influenced by the results of Tasks 1.3 and 1.4. If the analysis shows initial indications that high-performance magnet production is possible using the resultant Nd-rich MM alloy from Task 1, then the SONO-MSE process flow can continue to be developed based on a single stage of organic acid leaching without needing separations before metallurgy. If the analysis shows that some degree of separations, especially the removal of some Ce and La, would improve the performance characteristics of the final magnet, then the SONO-MSE process flow will be amended to include the required separations process. Multiple routes will be considered, including solvent extraction and enzymatic chromatography column-based element-specific targeted removal. These separation technologies can be licensed from partner organizations rather than developed in-house. Once the SONO-MSE process flow has been finalized, the cost and environmental impacts for each step will be estimated using traditional TEA and LCA techniques.

Task 2.2. Perform process improvement (4 months) – will be conducted after finishing Task 1
Deliverables: Process improvement reports for magnet production using the Nd-rich MM alloy.
Our team (led by co-PI Vakanski) will develop machine learning (ML)-based approaches to analyze the relationship between process parameters and outcomes in the SONO-MSE process. The main input variables will include soil composition and material properties derived from elemental analysis from Task 1.4, and other relevant SONO-MSE process parameters and conditions, such as organic acid solution concentration, melting conditions, and electrolysis conditions. These input variables significantly impact the overall SONO-MSE process and the performance of the Nd-rich MM permanent magnets. To assess the efficiency of SONO-MSE, we will evaluate the following output variables: alloy quality (estimated via the material composition and purity), yield, energy consumption, and waste. By employing ML methods, our objective is to identify correlations between the input and output variables that influence process

quality and efficiency, which will inform process optimization and refinement.

Particularly, we will conduct the two ML studies: (1) We will develop ML regression models to predict yield, alloy composition and purity, and energy efficiency of the SONO-MSE process. For this purpose, we will implement Gaussian process regression and gradient-boosted decision tree ensemble models to estimate continuous values of these parameters based on input parameters established in Task 1. We will also apply techniques for uncertainty quantification based on confidence intervals around the model predictions to assess variability in the predicted values. (2) We will design ML classification models using random forests and artificial neural networks to predict the probability of successful production of permanent magnets and the level of quality of produced Nd-rich MM alloys based on input parameters to the SONO-MSE process.

To analyze the impact of input features on the model predictions, we will employ ML explainability techniques, including SHAP (Shapley Additive exPlanations) values, permutation importance, and linear regression interpretability approaches. The explainability techniques will quantify the contributions of individual input parameters to model predictions and will allow identifying the most important process parameters that affect model performance. By prioritizing parameters with the greatest impact on product quality and production efficiency, we will optimize and refine the SONO-MSE process. The analysis will enable improvements in process efficiency and yield, reductions in waste and energy consumption, and improved quality and properties of the permanent magnets. To validate the predictive capabilities of the proposed models, we will conduct a comparative analysis with experimental data collected under different conditions.

7. Potential economic impact

Commercial viability: Every ton of REM from the conventional process produces 2,000 tons of hazardous waste [3]. Additionally, the conventional process requires significant energy [4], particularly 15.60–22.7 GJ/ton of energy for solvent extraction and 55.45 GJ/ton of energy for electrolysis [5]. Our SONO-MSE manufacturing pathway for Nd-rich MM-Fe-B permanent magnets can provide an energy-efficient approach to increasing the supply of REMs needed for various cutting-edge technologies. The SONO-MSE process employs a single organic solvent and creates 95% less hazardous waste, while reducing energy consumption by 10X during leaching [6] and by around 40% during electrolysis by using a molten halide salt [7]. Domestic production of Nd-rich MM-Fe-B permanent magnets will both decrease foreign reliance and power our daily lives through their widespread use in various sectors, such as energy, transportation, and healthcare. For example, neodymium (Nd) is a crucial component in the production of the strongest permanent magnet material, which is widely used in high-performance applications and sectors, such as defense, healthcare, transportation and energy. In emerging industries, praseodymium, neodymium, and dysprosium make up ~85% of rare earth elements used (**Figure 4**).

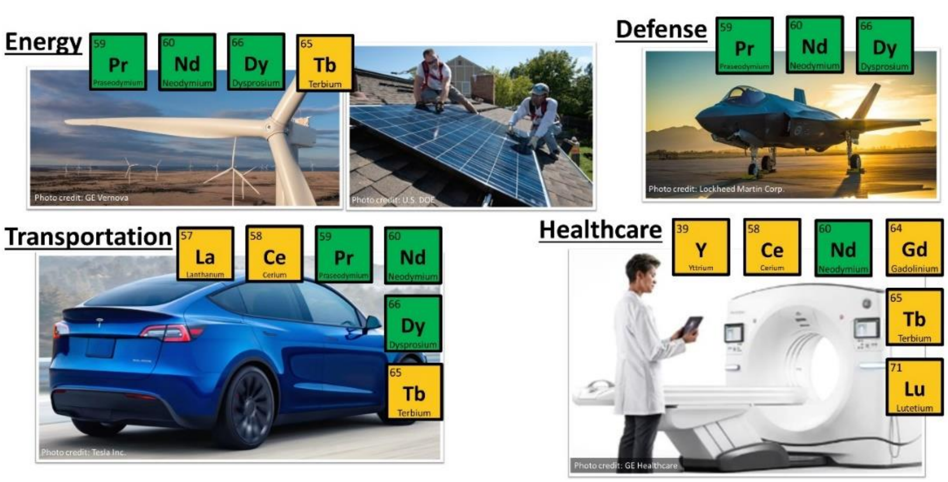

Figure 4. Examples of global rare earth metals industry

Project's path to profitability: The impact that HERC funding would have on this project is to provide critical support to: (1) perform the initial sample production of the Nd-rich MM alloy, (2) evaluate the potential for desirable magnetic properties in the Nd-rich MM alloy through characterization, (3) determine the economic feasibility and environmental impacts of the proposed manufacturing pathway for Nd-rich MM-Fe-B permanent magnets produced using Idaho-sourced minerals. Currently, processing REEs from natural deposits is costly due to high operational costs. The proposed partnership and approach in this project significantly reduce the number of steps involved in processing REE ores, including the highlighted steps shown in **Figure 5**, such as floatation and hazardous solvent extraction. The conventional extractive metallurgy route will generate several tons of waste for every ton of REE produced. **The proposed approach herein will result in less than 100 tons of chemical waste for every ton of REE, resulting in less waste generation and lower operational costs.**

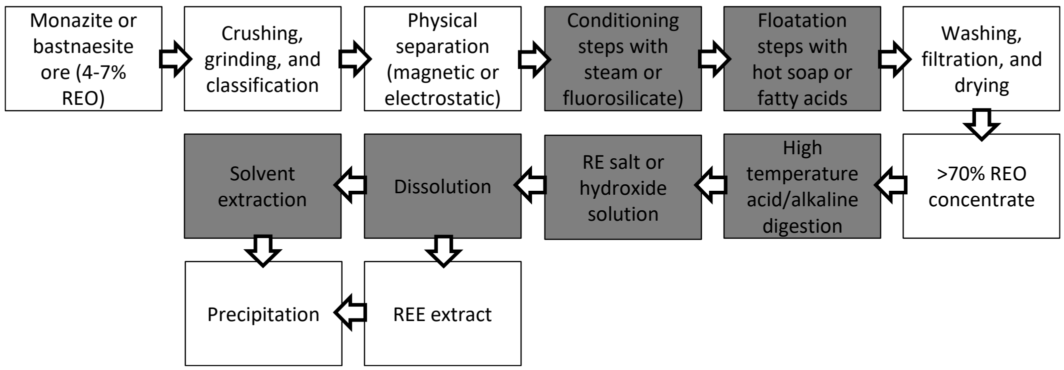

Figure 5. Conventional REEs processing route from ore to final separation (highlighted steps in gray produce hazardous waste chemicals and will be eliminated in our proposed manufacturing pathways)

Our commercialization timeline is as follows:

- 1.5-2 years research and process development.
- 2-4 years permitting and mine pre-development.
- 4-8 years scale-up plan, depending on funding, demand profile, and political will.

Our commercialization strategies are as follows:

- Build and test the Nd-rich MM alloy production process in collaboration with Hydrova and IDR.
- Integrate the proposed process with the existing REE-to-REM supply chains from Idaho-sourced minerals and explore reasonable pathways to be profitable.

The long-term impacts of this project are as follows:

- Anticipating domestic improvements in land use and economy (on-site REE-to-REM processes).
- Expanding Idaho-sourced REMs research and development
- Anticipating new mines and positive economic impacts on Idaho and the U.S.
- Anticipating new IPs on REM manufacturing
- Addressing national priorities, using Idaho resources, such as local job creation

The UI-Hydrova-IDR partnership would provide critical support and enable the commercialization of Idaho-sourced REE ores, specifically investigating Nd-rich MM-Fe-B permanent magnets as a potential commercialization pathway and end-use products. The long-term goal is to enable **Idaho-sourced REMs production in a low-cost manner.** The outcomes of this project can improve REMs supply chains and create Idaho solutions to national priorities (e.g., domestic job creation) stemming from the U.S. reliance on other countries' REMs.

8. Criteria for measuring success

For Task 1, the primary metric of success is the degree to which the compositions of the Nd-rich MM alloy samples match the compositions of the Idaho-sourced REE-rich soil results from Lemhi Pass. For example, for each metal, if the weight percentage in the final alloy is within +/- 3% of the target, the alloy sample will be considered a match and will proceed into magnet production in future studies.

For Task 2, the primary metric of success is the ultimate economic feasibility of the SONO-MSE process, as indicated by the results of the TEA and LCA. The target metrics are for the process to achieve a processing cost of under $500/ton of metal and less than 100 tons of chemical waste per ton of metal.

The critical success factors in achieving our goal include: (a) achieving the desired composition of Nd-rich MM without contaminants, (b) favorable TEA and LCA results in terms of economic feasibility and waste mitigation, and (c) our collaborative team, comprising University of Idaho, Hydorva LLC., and Idaho Strategic Resources Inc., with the required expertise and resources. To evaluate the potential of Nd-rich MM permanent magnets as a commercialization pathway, the Nd-rich MM alloy will be mimicked by alloying pure REMs according to the expected composition. Then, the Nd-rich MM alloy will be used to produce Nd-rich MM-Fe-B permanent magnets.

9. Anticipated development challenges/barriers

The primary technical challenge is construction of the custom-vacuum induction melting and casting furnace. If the construction becomes too costly or time-consuming within the scope of the project, then efforts will be redirected toward collaboration with a 3rd party lab, which already possesses the required melting and casting setup for REE alloying. Other technical challenges include preventing oxidation and contamination during the preparation of the melt charges and achieving a suitable Nd-rich MM alloy composition for high-performance magnet production, with the risk being that the composition based on sampling results from Lemhi Pass sites does not produce the desired magnetic properties in the final product. The commercial challenges include the processing cost and waste generation are not meeting the targets specified, although initial results indicate that the Nd-rich MM alloy composition would produce a highly desirable magnet chemistry and that the SONO-MSE process with higher solids loading ratios would enable lower processing costs.

10. Budget

Please check the attached budgets (**Form D: IGEM-HERC Full Proposal Budget**).

11. Budget justification

Table below provides an itemized budget for the proposed project. For more details, please check **Form D** and **Appendix D**.

Item	Justification	Total Request
Personnel (salary and fringe)	PI Mirkouei and Co-PI Vakanski will contribute to Tasks 1 and 2, requesting 3 and 2 weeks of summer salary, respectively.	**$30,532**
	Graduate Research Assistant to contribute to Tasks 1 and 2 for 18 months.	**$40,248**
Equipment	Custom-built Nd-rich MM alloy production process.	**$31,800**
Travel	Travel to the 2026 ASME IDETC/CIE conference to disseminate and present the results for two participants.	**$6,500**
Participant support	-	
Other direct costs	Research and laboratory materials and supplies	**$10,500**
	Materials characterization	**$15,000**
	Tuition and mandatory fees	**$19,839**
Total project costs requested		**$154,418**

12. Project management

This project will be managed as a joint research effort, involving industry partners and university researchers. The proposed project builds upon the preliminary studies by PIs, Hydrova, and IDR. It will expand previous collaborations. Our project team has a rich mix of expertise from ore mining to processes for REM production, along with business development and commercialization. Our project team is familiar with the convergent nature of existing intricacies and challenges in the proposed research and seeks to exchange ideas and stimulate interactions to meet the proposed project objectives. Our team has been collaborating for the past couple of years, and our prior efforts will be integrated with the proposed innovations in this proposal. We have discussed and reviewed all tasks/subtasks in detail and defined the specific roles to be performed by PIs and key personnel at the prime and sub-levels. If our proposal is selected for funding, PI Mirkouei will develop further agreements and arrangements, regarding the decision-making on the technical directions and publications. Communication between PIs, collaborators, and stakeholders will occur at regular intervals (at least monthly) by Zoom, MS Teams, email, phone, or in-person to discuss all aspects of the project, including project management and administrative responsibilities. PI Mirkouei will serve as lead PI and organizational contact for project personnel and the sponsoring agency. The table below provides more details about the timelines and development milestones of the project.

<table>
<tr><th rowspan="2">Tasks</th><th rowspan="2">Subtasks</th><th colspan="2">2025</th><th colspan="4">2026</th></tr>
<tr><th>July-Sept</th><th>Oct-Dec</th><th>Jan-March</th><th>April-June</th><th>July-Sept</th><th>Oct-Dec</th></tr>
<tr><td rowspan="4">1</td><td>1.1</td><td colspan="3">Custom vacuum induction melting and casting setup</td><td></td><td></td><td></td></tr>
<tr><td>1.2</td><td></td><td colspan="3">Melt charges with desired REEs</td><td></td><td></td></tr>
<tr><td>1.3</td><td></td><td></td><td colspan="3">Nd-rich alloy production</td><td></td></tr>
<tr><td>1.4</td><td></td><td></td><td></td><td colspan="3">Composition analysis</td></tr>
<tr><td rowspan="2">2</td><td>2.1</td><td></td><td></td><td></td><td colspan="3">TEA/LCA studies</td></tr>
<tr><td>2.2</td><td></td><td></td><td></td><td></td><td colspan="2">ML/AI studies</td></tr>
</table>

13. Additional institutional and other sector support

Collected IDR's sample results from Lemhi Pass have revealed rare earth grades up to 4.26% TREO, in which 2.56% of the TREO is solely Neodymium (Nd). The high concentration of Nd compared to other REEs provides an opportunity to produce a low-cost MM with an unusually high Nd amount. Typical MM composition is 45-60 at.% Ce, 23-25 at.% La, 9-20 at.% Nd, and 3-7 at.% Pr. The ratio of Nd to Cerium (Ce) ranges from 0.15 to 0.44 and averages 0.30 in MM-Fe-B permanent magnets produced using typical MM, which have an induction strength of 6.9 to 7.6 kg. Typical Nd-Fe-B magnets have an induction strength of 14-15 kg, about twice as high as typical MM-Fe-B magnets. The expected Nd:Ce ratio of MM-Fe-B magnets produced using IDR deposits ranges from 1.72 to 4.65, with an average of 2.91 across 7 samples. The higher Nd:Ce ratio (avg. 2.91 compared to avg. 0.30) could provide desirable magnetic properties at a low processing cost. The resulting Nd-rich MM-Fe-B permanent magnets are expected to have properties much closer to that of pure Nd-Fe-B magnets compared to typical MM-Fe-B permanent magnets. The proposed SONO-MSE process for producing Nd-rich MM-Fe-B permanent magnets can provide a low-cost manufacturing pathway with minimal waste and energy consumption. For more information, please check the **Form C: IGEM-HERC Institutional & Other Sector Support**.

14. Future funding

Additional support and future funding for this project could come from a variety of sources. Industry partners and VCs, including 1,517 Fund have initially indicated interest in following on if grant funding can be secured. No binding commitments have been made at this time. Our team also has plans to submit a proposal to NSF SBIR, DOE ARPA-E, and has a proposal actively under review with the 2024 CMI Open Call. Down the line, the overall goal of the project, given the success metrics are met, is to advance the technology to the point of a pilot demonstration sufficient for qualification for DOE LPO funding to build a full-scale production facility performing the SONO-MSE process for extraction and refinement of REE metals from US-sourced primary sources.

References

[1] U.S. Geological Survey. Mineral commodity summaries 2024. U.S. Geological Survey; 2024. https://doi.org/10.3133/mcs2024.

[2] U.S. Geological Survey. The principal rare earth elements deposits of the united states: a summary of domestic deposits and a global perspective. 2010.

[3] Kaiman J. Rare earth mining in China: the bleak social and environmental costs. The Guardian 2014.

[4] Zapp P, Schreiber A, Marx J, Kuckshinrichs W. Environmental impacts of rare earth production.

MRS Bulletin 2022;47:267–75. https://doi.org/10.1557/s43577-022-00286-6.
[5] Talens Peiró L, Villalba Méndez G. Material and Energy Requirement for Rare Earth Production. JOM 2013;65:1327–40. https://doi.org/10.1007/s11837-013-0719-8.
[6] Brown RM, Struhs E, Mirkouei A, Raja K, Reed D. Mixed rare earth metals production from surface soil in Idaho, USA: Techno-economic analysis and greenhouse gas emission assessment. Science of The Total Environment 2024;944:173945. https://doi.org/10.1016/j.scitotenv.2024.173945.
[7] Fatunde M. The race to produce rare earth materials | MIT Technology Review. 2024.

Form C: IGEM-HERC Institutional & Other Sector Support
(add additional pages as necessary)

A. LIST INSTITUTIONAL/ OTHER SECTOR DOLLARS (Source & Description)	**Amount**
Several laboratory spaces and facilities at UI Idaho Falls campus	-
Hydrova's shop, facilities, and equipment	-
IDR's facilities and equipment	-

B. FACULTY/ STAFF POSITIONS (Description)	**Amount**
Professor Indrajit Charit, Department Chair of Nuclear Engineering and Industrial Management	-
Two staff members (Meladi Lanier and Madeline Sticht)	-

C. CAPITAL EQUIPMENT (Description)	**Amount**
Ultrasound-assisted bioleaching process	-

D. FACILITIES & INSTRUMENTATION (Description)	**Amount**
ICP-MS for characterization	-
Raman microscope	-
XRF Spectrophotometer	-

Form D: IGEM-HERC Full Proposal Budget

FORM D: IGEM-HERC Full Proposal Budget Sheet										
Track (select one):	*Proof of Concept*									
PI First & Last Name:	Dr. Amin Mirkouei									
Project Title:	SONO-MSE Process for Permanent Magnets I									
Milestone description (if applicabl	*Enter milestone number and/or brief description here*									
Insert more rows in each section, as needed.			*Copy/paste cell formulas, as needed.*			*See cell notes for additional information.*				
Do not remove or hide rows.			*Shaded areas have preset formulas.*							
Personnel								**Year 1**	**Year 2**	**Total**
Name	**FTE (opt)**	**Months**	**Base Salary**	**Salary Request**	**Fringe R**	**Othe**	**Fringe Reque**	**Total**	**Total**	
Dr. Amin Mirkouei		0.75	$ 113,224.80	$ 7,076.55	0.295		$ 2,087.58	$ 9,164.13	$ 9,439.06	
Dr. Aleksandar Vakanski		0.5	$ 108,903.60	$ 4,537.65	0.295		$ 1,338.61	$ 5,876.26	$ 6,052.54	
Graduate Research Assistant		7.5	$ 52,000.00	$ 32,500.00	0.032		$ 1,040.00	$ 33,540.00	$ 6,708.00	
								$ 48,580.39	$ 22,199.60	$ 70,779.99
Equipment										
Item Description	**Units**	**Unit Cost**						**Total**	**Total**	
Custom-Built Process	0							$ 31,800.00	$ -	
Travel										
Tentative Date(s)	**# person**	**Total days**	**Transit cost/ pe**	**Lodging/ day**	**Meal per diem**			**Total**	**Total**	
Travel to ASME	2	5	$ 750.00	$ 183.00	$92.00			$ 6,500.00	$ -	
								$ -	$ -	
								$ -	$ -	
								$ -	$ -	
								$ -	$ -	
								$ 6,500.00	$ -	$ 6,500.00
Participant Support										
Description	**# person**	**Cost/ Stipend**						**Total**	**Total**	
								$ -	$ -	
								$ -	$ -	$ -
Other Direct Costs										
Item	**Units**	**Cost**						**Total**	**Total**	
Materials/Supplies	1	$ 10,000.00						$ 8,500.00	$ 2,000.00	
Materials Characterization	1	$ 15,000.00						$ 15,000.00	$ -	
Tuition, Mandatory Fees, and SHIP	1	$ 13,226.00						$ 13,226.00	$ 6,613.00	
								$ -	$ -	
								$ -	$ -	
								$ 36,726.00	$ 8,613.00	$ 45,339.00
							TOTAL DIRECT COST REQUEST	$ 123,606.39	$ 30,812.60	$ 154,418.99

APPENDIX A: FACILITIES AND EQUIPMENT

UI team will use two shared chemical laboratories to conduct this project. Our team has expertise in technology development, manufacturing processes, and chemical processes, as well as material processing and characterization. We have access to several chemical and biological laboratories with required equipment (e.g., incubators, autoclaves, shakers, glove boxes, fume hoods, furnaces) for REEs processing (e.g., extraction, filtration, separation, metallurgy), and built in-house several extraction processes (e.g., sono-bioleaching, pyrolysis, electrolysis), as well as characterization equipment, such as XRF spectrophotometer, ICP-MS, and Raman microscope.

Hydrova Inc. has a laboratory and shop with several pieces of equipment for conducting the separation process and providing scientific guidance during Task 1, especially a glovebox for preparing the melt charges. The shop has over 2,000 sqft of office and lab space and is located at 2020 S Susan St, Ste E, Santa Ana, CA 92704.

Idaho Strategic Resources Inc. (IDR) currently has three REE projects (i.e., Lemhi Pass, Diamond Creek, and Mineral Hill), over 18,000 acres of REE-rich lands, extensive mining experience, tools, and equipment, as well as a shop in Salmon ID, two highly qualified senior geologists for REEs exploration and advancement, great relations within the communities where it operates. IDR owns in-house exploration and drilling equipment to identify areas with high REE concentrations.

APPENDIX B: BIOGRAPHICAL SKETCHES

APPENDIX C: SENIOR PERSONNEL

APPENDIX D: OTHER / LETTERS OF SUPPORT

Please check the following attached files.

IDENTIFYING INFORMATION:

NAME: Mirkouei, Amin

ORCID iD: https://orcid.org/0000-0003-0644-3120

POSITION TITLE: Associate Professor

PRIMARY ORGANIZATION AND LOCATION: University of Idaho, Idaho Falls, Idaho, United States

Professional Preparation:

ORGANIZATION AND LOCATION	DEGREE (if applicable)	RECEIPT DATE	FIELD OF STUDY
Oregon State University, Corvallis, Oregon, United States	PHD	06/2016	Industrial and Manufacturing Engineering
University of Tehran, Tehran, Not Applicable, N/A, Iran	MS	06/2011	Industrial Engineering
Azad University, Tehran, Not Applicable, N/A, Iran	BS	06/2009	Industrial Engineering

Appointments and Positions

2023 - present	Associate Professor, University of Idaho, Idaho Falls, Idaho, United States
2017 - 2023	Assistant Professor, University of Idaho, Idaho Falls, Idaho, United States
2016 - 2017	Visiting Assistant Professor, Georgia Southern University , Statesboro, Georgia, United States
2014 - 2016	Instructor, Oregon State University , Corvallis, Oregon, United States
2014 - 2015	Researcher, Microproducts Breakthrough Institute, Corvallis, Oregon, United States

Products

Products Most Closely Related to the Proposed Project

1. Brown R, Mirkouei A, Reed D, Thompson V. Current nature-based biological practices for rare earth elements extraction and recovery: Bioleaching and biosorption. Renewable and Sustainable Energy Reviews. 2023 March; 173:113099-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1364032122009807 DOI: 10.1016/j.rser.2022.113099
2. Brown R, Struhs E, Mirkouei A, Raja K, Reed D. Mixed rare earth metals production from surface soil in Idaho, USA: Techno-economic analysis and greenhouse gas emission assessment. Science of The Total Environment. 2024 September; 944:173945-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0048969724040932 DOI: 10.1016/j.scitotenv.2024.173945
3. Struhs E, Mirkouei A. Techno-Economic and Environmental Impact Assessment of Phytomining for Extracting Rare Earth Elements in the Northwestern United States. Volume 5: 29th Design for Manufacturing and the Life Cycle Conference (DFMLC). ASME 2024 International Design Engineering Technical Conferences and Computers and Information in

Engineering Conference; Aug. - ; Washington, DC, USA. American Society of Mechanical Engineers; c2024. Available from: https://asmedigitalcollection.asme.org/IDETC-CIE/proceedings/IDETC-CIE2024/88391/V005T05A011/1208937 DOI: 10.1115/DETC2024-143247

4. Ohene Opare E, Mirkouei A. Environmental and Economic Assessment of a Portable E-Waste Recycling and Rare Earth Elements Recovery Process. Volume 5: 26th Design for Manufacturing and the Life Cycle Conference (DFMLC). ASME 2021 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference; Aug. - ; Virtual, Online. American Society of Mechanical Engineers; c2021. Available from: https://asmedigitalcollection.asme.org/IDETC-CIE/proceedings/IDETC-CIE2021/85413/V005T05A007/1128106 DOI: 10.1115/DETC2021-68555
5. Opare E, Struhs E, Mirkouei A. A comparative state-of-technology review and future directions for rare earth element separation. Renewable and Sustainable Energy Reviews. 2021 June; 143:110917-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1364032121002100 DOI: 10.1016/j.rser.2021.110917

Other Significant Products, Whether or Not Related to the Proposed Project

1. Struhs E, Mirkouei A, You Y, Mohajeri A. Techno-economic and environmental assessments for nutrient-rich biochar production from cattle manure: A case study in Idaho, USA. Applied Energy. 2020 December; 279:115782-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0306261920312678 DOI: 10.1016/j.apenergy.2020.115782
2. Thompson M, Mohajeri A, Mirkouei A. Comparison of pyrolysis and hydrolysis processes for furfural production from sugar beet pulp: A case study in southern Idaho, USA. Journal of Cleaner Production. 2021 August; 311:127695-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0959652621019132 DOI: 10.1016/j.jclepro.2021.127695
3. Hersh B, Mohajeri A, Mirkouei A, Xian M. Cyber-Physical Infrastructures for Advancing Pyrolysis Conversion Process: A Case Study of Biochar Production. Volume 9: 40th Computers and Information in Engineering Conference (CIE). ASME 2020 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference; Aug. - ; Virtual, Online. American Society of Mechanical Engineers; c2020. Available from: https://asmedigitalcollection.asme.org/IDETC-CIE/proceedings/IDETC-CIE2020/83983/Virtual,%20Online/1090023 DOI: 10.1115/DETC2020-22045
4. Albor G, Mirkouei A, McDonald A, Struhs E, Sotoudehnia F. Fixed Bed Batch Slow Pyrolysis Process for Polystyrene Waste Recycling. Processes. 2023 April 06; 11(4):1126-. Available from: https://www.mdpi.com/2227-9717/11/4/1126 DOI: 10.3390/pr11041126
5. Kerner P, Struhs E, Mirkouei A, Aho K, Lohse K, Dungan R, You Y. Microbial Responses to Biochar Soil Amendment and Influential Factors: A Three-Level Meta-Analysis. Environmental Science & Technology. 2023 November 09; 57(48):19838-19848. Available from: https://pubs.acs.org/doi/10.1021/acs.est.3c04201 DOI: 10.1021/acs.est.3c04201

Synergistic Activities

1. Relevant Grant: As UI PI, “Collaborative Research: CyberTraining: Implementation: Medium:

CyberTraining of Construction (CyCon) Research Workforce Through an Educational and Community Engagement Platform," NSF, OAC, Jan. 2023- Dec. 2026, $359,828 (total $999,998).

2. Nature Scientific Reports Editorial Board Member (https://www.nature.com/srep/about/editors)
3. Professional Services/Participation: ASME Organizer for "Design of Energy and Thermal Systems Symposium," ASME IDETC/CIE, DFMLC, 2017-present.
4. Educational Module Development: "An Educational Module for Sustainable Additive Manufacturing" for junior and senior undergraduate students, under NSF-Funded SMART Research Coordination Network, 2015-17; "A Pedagogical Module Framework to Improve Scaffolded Active Learning in Manufacturing Engineering Education," collaborated with University of California, Berkeley, 2016-17.
5. Honors and Awards: "2022 University of Idaho Interdisciplinary and Collaboration Excellence Award" and "University of Idaho, College of Engineering Mid-Career Faculty Award."

Certification:

When the individual signs the certification on behalf of themselves, they are certifying that the information is current, accurate, and complete. This includes, but is not limited to, information related to domestic and foreign appointments and positions. Misrepresentations and/or omissions may be subject to prosecution and liability pursuant to, but not limited to, 18 U.S.C. §§ 287, 1001, 1031 and 31 U.S.C. §§ 3729-3733 and 3802.

Certified by Mirkouei, Amin in SciENcv on 2025-02-24 11:04:51

IDENTIFYING INFORMATION:

NAME: Vakanski, Aleksandar

POSITION TITLE: Associate Professor

PRIMARY ORGANIZATION AND LOCATION: University of Idaho, Idaho Falls, Idaho, United States

Professional Preparation:

ORGANIZATION AND LOCATION	DEGREE (if applicable)	RECEIPT DATE	FIELD OF STUDY
Toronto Metropolitan University, Toronto, Ontario, Canada	PHD	04/2013	Mechanical and Industrial Engineering
Ss. Cyril and Methodius University, Skopje, Not Applicable, N/A, North Macedonia	MS	11/2003	Mechanical Engineering
Ss. Cyril and Methodius University, Skopje, Not Applicable, N/A, North Macedonia	BS	05/1998	Mechanical Engineering

Appointments and Positions

2023 - present	Associate Professor, University of Idaho, Idaho Falls, Idaho, United States
2017 - 2023	Assistant Professor, University of Idaho, Idaho Falls, ID, United States
2014 - 2017	Clinical Assistant Professor, University of Idaho, Idaho Falls, ID, United States
2014 - 2014	Partial Load Professor, Sheridan College, Brampton, Ontario, Canada
2013 - 2014	Postdoctoral Fellow, Toronto Metropolitan University, Toronto, Ontario, Canada

Products

Products Most Closely Related to the Proposed Project

1. Li L, Chang J, Vakanski A, Wang Y, Yao T, Xian M. Uncertainty quantification in multivariable regression for material property prediction with Bayesian neural networks. Sci Rep. 2024 May 8;14(1):10543. PubMed Central PMCID: PMC11078957.
2. Karimzadeh M, Basvoju D, Vakanski A, Charit I, Xu F, Zhang X. Machine Learning for Additive Manufacturing of Functionally Graded Materials. Materials (Basel). 2024 Jul 25;17(15) PubMed Central PMCID: PMC11313523.
3. Li L, Merickel JW, Tang Y, Song R, Rittenhouse JE, Vakanski A, Xu F. Dataset of tensile properties for sub-sized specimens of nuclear structural materials. Sci Data. 2025 Jan 11;12(1):48. PubMed Central PMCID: PMC11724850.
4. Karimzadeh M, Vakanski A, Xian M, Zhang B. POST-HOC EXPLAINABILITY OF BI-RADS DESCRIPTORS IN A MULTI-TASK FRAMEWORK FOR BREAST CANCER DETECTION AND SEGMENTATION. IEEE Int Workshop Mach Learn Signal Process. 2023 Sep;2023 PubMed Central PMCID: PMC10989244.
5. Zhang B, Vakanski A, Xian M. BI-RADS-NET: AN EXPLAINABLE MULTITASK LEARNING APPROACH FOR CANCER DIAGNOSIS IN BREAST ULTRASOUND IMAGES. IEEE Int Workshop Mach Learn Signal Process. 2021 Oct;2021 PubMed Central

PMCID: PMC9063460.

Other Significant Products, Whether or Not Related to the Proposed Project

1. Vakanski A, Xian M, Freer PE. Attention-Enriched Deep Learning Model for Breast Tumor Segmentation in Ultrasound Images. Ultrasound Med Biol. 2020 Oct;46(10):2819-2833. PubMed Central PMCID: PMC7483681.
2. Liao Y, Vakanski A, Xian M. A Deep Learning Framework for Assessing Physical Rehabilitation Exercises. IEEE Trans Neural Syst Rehabil Eng. 2020 Feb;28(2):468-477. PubMed Central PMCID: PMC7032994.
3. Vakanski A, Mantegh I, Irish A, Janabi-Sharifi F. Trajectory Learning for Robot Programming by Demonstration Using Hidden Markov Model and Dynamic Time Warping. IEEE Trans Syst Man Cybern B Cybern. 2012 Aug;42(4):1039-52. PubMed PMID: 22411023.
4. Shareef B, Xian M, Vakanski A. STAN: SMALL TUMOR-AWARE NETWORK FOR BREAST ULTRASOUND IMAGE SEGMENTATION. Proc IEEE Int Symp Biomed Imaging. 2020 Apr;2020:1469-1473. PubMed Central PMCID: PMC7733528.
5. Wang H, Xian M, Vakanski A. TA-Net: Topology-Aware Network for Gland Segmentation. IEEE Winter Conf Appl Comput Vis. 2022 Jan;2022:3241-3249. PubMed Central PMCID: PMC9063467.

Certification:

I certify that the information provided is current, accurate, and complete. This includes but is not limited to current, pending, and other support (both foreign and domestic) as defined in 42 U.S.C. § 6605.

I also certify that, at the time of submission, I am not a party to a malign foreign talent recruitment program.

Misrepresentations and/or omissions may be subject to prosecution and liability pursuant to, but not limited to, 18 U.S.C. §§ 287, 1001, 1031 and 31 U.S.C. §§ 3729-3733 and 3802.

Certified by Vakanski, Aleksandar in SciENcv on 2025-02-12 16:58:57

BIOGRAPHICAL SKETCH

Rostam Reifschneider
ORCID ID 0000-0001-8783-6940
CEO
Hydrova Inc. - Santa Ana, CA

PROFESSIONAL PREPARATION

PREVIOUS ORGANIZATION(S) & LOCATION(S)	DEGREE (if applicable)	RECEIPT DATE (MM/YYYY)	FIELD OF STUDY
Massachusetts Institute of Technology (MIT) Cambridge, MA	Bachelors of Science	06/2021	Mechanical Engineering

APPOINTMENTS AND POSITIONS

Start Date – End Date	Position Title	Organization	Location
March 2020 – Present	CEO	Hydrova, Inc.	Santa Ana, CA
January 2020 – June 2020	Research Assistant	MIT Department of Mechanical Engineering	Cambridge, MA
January 2018 – August 2020	Product Engineering and Data Analytics Intern	Desora, Inc.	Cambridge, MA

PRODUCTS - Products Most Closely Related to the Proposed Project
hydrova.com (password 60265)

Other Significant Products, Whether or Not Related to the Proposed Project
https://www.alcircle.com/news/hydrova-turning-dross-into-new-value-91027
https://aluminiumtoday.com/features/hydrova-enables-production-of-the-first-low-carbon-cement
https://www.lightmetalage.com/news/industry-news/recycling-remelt/hydrova-produces-low-carbon-cement-using-aluminum-drossrecycling-
technology/
https://www.recyclingtoday.com/article/hydrova-enhancing-sustainability-of-aluminum-recycling/
https://sandbox.mit.edu/hydrova

Synergistic Activities

Forbes 30 Under 30 List, 2024, Awardee. https://www.forbes.com/profile/hydrova/
Recognized on the 2024 Forbes 30 Under 30 list for my work in the Manufacturing and Industry category.

NSF I-Corps Regional Program, Summer 2024, Entrepreneurial Lead.
Began the customer discovery process by performing over 15 customer interviews in the magnet space.

776 Fellowship $100k Award, June 2022-June 2024, Climate Fellow.
Selected as 1 of 20 of the first ever cohort of 776 Climate Fellows by Alexis Ohanian and provided $100k to work on Hydrova for 2 years.

EPA SBIR $100k Award, Sept. 2022, PI.
Awarded EPA SBIR funding as PI to develop zero waste dross recycling technology as CTO of Hydrova.

Certification:
When the individual signs the certification on behalf of themselves, they are certifying that the information is current, accurate, and complete. This includes, but is not limited to, information related to domestic and foreign appointments and positions. Misrepresentations and/or omissions may be subject to prosecution and liability pursuant to, but not limited to, 18 U.S.C. §§287, 1001, 1031 and 31 U.S.C. §§3729-3733 and 3802.

Signature (Please type out full name):	Date:
Rostam Reifschneider	2/25/2025

X ______________

Robert Morgan, PG PLS. – Vice President of Exploration

Mr. Morgan has over 22 years of exploration experience, including 20 years focused on gold exploration, of which 12 years were in Northern Idaho and Montana. Mr. Morgan has worked for some of the world's leading gold exploration and mining companies including ASARCO and Newmont throughout the western United States, Alaska and South America. He is practiced in designing, implementing and managing large exploration programs for gold, silver, base metals and rare earth elements. His technical work has included geologic mapping, logging of drill holes, compilation and interpretation of multiple data sets for target identification. He has an extensive environmental background with emphasis on wetlands and water management. Mr. Morgan is a registered professional geologist with the State of Idaho and Professional Land Surveyor registered with the State of Montana.

Experience

Idaho Strategic Resources. Coeur d' Alene, Idaho. **Vice-President of Exploration, January 2018.**

2015 to present. Advanced the exploration and development of an orogenic, high-grade gold vein system in northern Idaho. This project went into production in 2014 and is the newest gold mine in Idaho.

July 2014 to December 2014. Conducted detailed underground geologic mapping of four mine levels at the McKinley Mine near Riggins, Idaho. Mapping used to develop cross-sections and generate drill targets.

United States Geological Survey. Grand Canyon, Arizona. *2014*. **Surveyor/Geologist.**

Member of the survey team conducting control traverses and topographic mapping in the Grand Canyon. This project provides data for experimental studies of high-flow or artificial flooding from Glen Canyon Dam. The experiments are designed to simulate pre-dam seasonal flooding on the Colorado River. This work focused on mapping the channel bathymetry and the erosion and restoration of sandbars.

Idaho Strategic Resources - Golden Chest Mine. Murray, Idaho. *2011-2013*. **Mine / Exploration Geologist.** Development drilling program, consisting of 120 core holes, defined a NI 43-101 compliant gold resource of 477,000 ounces. My geological interpretation was derived through core logging, cross-sections and detailed underground mapping. Other work included developing structural contour and grade thickness maps which predicted an ore trends. This resulted in locating additional ore bodies, previously unrecognized in both the modern and historical eras. One ore body, the Skookum Shoot, was leased by Juniper Mining, who promptly drove a new portal and underground tunnels to access this ore body.

Crescent Silver Mine. Kellogg, Idaho. *2011* **Senior Exploration Geologist.**

Charged with the exploration of areas adjacent the Crescent Silver Mine. This prospective ground is located between the Sunshine Mine (silver) and Bunker Hill Mine (base-metal). Our program located quartz-carbonate veining with ores of argentiferous galena, tetrahedrite and sphalerite along the South Vein and the Alhambra Fault. My responsibilities included; generation and development of surface and underground drill targets, geologic compilation and interpretation, technical exploration proposals, exploration budget management, and training (mapping, sampling, core logging, geotechnical) junior geologists.

Newmont Mining Company. Denver, Colorado. *2008-2010*. **Senior Exploration Geologist.** Project manager for the Toboggan Project Joint Venture between Newmont Exploration and Idaho Strategic Resources. Responsibilities included establishing a new exploration office, permitting the drill program through the US Forest Service, and developing the exploration program. Work included compilation and interpretation of historical/recent information regarding gold-telluride mineralization and its' associated potassium feldspar alteration occurring within quartz veining, quartz vein stockwork and hydrothermal breccia. The exploration program conducted 18,000 feet of core and reverse-circulation drilling. This drilling resulted in delineating an orogenic shear vein with significant gold-silver-tellurium-lead mineralization.

Plum Creek Timber Company. Ravalli County, Montana**.** *2007*. **Consulting Senior Geologist.**

Morrison-Maierle Inc. Missoula, Montana. *2002-2010*. **Geologist-Surveyor**

DJ&A, Professional Consultants. Missoula, Montana. *2001-2002*. **GIS Specialist**.

Carlin Trend Mining Services. Elko, Nevada. *1999-2001*. **Consulting Exploration Geologist**.

Independence Mining/AngloGold, Nevada. *1996-1999*. **Exploration/Project Geologist**.

ASARCO, Inc. Reno, Nevada / Iquique, Chile.*1992-1995*. **Exploration/Project Geologist.**

Newmont Exploration, Helena, Montana. *1991-1992***. Exploration Junior Geologist.**

ASARCO, Inc., Reno, Nevada. *1990-1991*. **Exploration Junior Geologist**.

EDUCATION

Geology-Bachelor of Science
California State University-Chico. 1986-1990
Economic geology and structural geology

Geology/GIS
University of Montana-Missoula. 1995-1997
GIS and Remote Sensing

CERTIFICATIONS

Idaho Professional Geologist, PG registration #PGL-1552
Montana Professional Land Surveyor, PLS registration #17302
Mine Safety and Health Administration (MSHA) Certification
US Army Corps of Engineers Wetland Delineation Certification
Hazardous Waste Operations and Emergency Response (HAZWOPER) Certification

HYDROVA

February 10, 2025

Hydrova, Inc.
2020 South Susan Street, Suite E
Santa Ana, CA 92704

via Email

SUBJECT: Letter of Support for Funding Opportunity Announcement: Idaho Global Entrepreneurial Mission Initiative (IGEM-HERC), Proposal Title "SONO-MSE Process for Permanent Magnets Manufacturing from Idaho-Sourced Minerals"

Dear IGEM-HERC Program Director:

I am delighted to support the activities of the project "SONO-MSE Process for Permanent Magnets Manufacturing from Idaho-Sourced Minerals" with the University of Idaho, along with their industry partner, Idaho Strategic Resources Inc. (IDR). Currently, I am the Chief Executive Officer of Hydrova, Inc. For the past 5 years, I have been working in the metals and minerals industry to increase waste recycling. In addition, I currently lead projects related to the valorization of metals processing wastes that include the recovery of valuable materials and metals. I have also worked on downstream production of unique end products, such as rare earth magnets. These end products, such as rare earth magnets, are found in modern and green technologies, such as cell phones, computers, electric vehicles, jet engines, wind turbines, etc. I have mentored undergraduate and graduate students (>5), authored or co-authored publications, patents, and reports (~10 total), and received the 776 Fellowship from Alexis Ohanian's 776 Foundation.

With demand growing every year, our nation is looking to establish a stable domestic supply of these rare earth elements (REEs). To that end, Hydrova is playing a part in developing solutions to build a domestic REE supply chain. Hydrova is a corporation located in Santa Ana, CA, and is home to both laboratory and pilot processing facilities. Hydrova has developed technologies to improve the metals industry by focusing on waste valorization. This experience in producing downstream products from metal wastes has positioned Hydrova well to focus its commercial and R&D efforts towards helping enable a diversified supply of domestic REEs.

Currently, I am collaborating with University of Idaho on their efforts in REE processing to assist with both downstream product development, including REE-based magnets, and with pilot demonstration and scale up of their funded REE project to improve the rare earth bioleaching yield, which resulted in publishing a high-quality journal, entitled "Current nature-based biological practices for rare earth elements extraction and recovery: bioleaching and biosorption" in Renewable and Sustainable Energy Reviews.

As an expert in scale up of first-of-a-kind chemical processes and metallurgy, I could contribute to the project by leading the technical objectives related to magnet R&D with the overall goal of developing a high-value product that achieves product-market-fit in one of various target applications for rare earth magnets. The relevance of this project not only impinges the industry-academia representatives, but the state-nation stakeholders as well. It also has tremendous future innovation potential and elevates local technological capabilities. I am very supportive of this project and certain that it aligns with the spirit of what IGEM-HERC is seeking to encourage in our state, and we hope for favorable consideration of this project.

Should you have any additional questions, please feel free to contact me at (650) 743-0855 or rostam@hydrovatech.com.

Sincerely,

Rostam Reifschneider
Hydrova Inc.