



for the Improvement of Mine Safety and Health, Inc.

Solicitation and Call for Proposals (AFC719)

TARGETED TOPICS IN MINING SAFETY AND HEALTH RESEARCH

Background

The Alpha Foundation for the Improvement of Mine Safety and Health is a private foundation with the mission to improve mine safety and health through funding research and development projects at qualified academic institutions and other not-for-profit organizations. The goal is to address the root causes of disease, injuries, and fatalities in the mining industry and, where possible, to achieve successful implementation of practical solutions derived from the research effort. The Foundation's agenda includes all sectors of mining (coal, metal, and non-metal) as well as both underground and surface mining. Projects supported by the Alpha Foundation must be relevant to the U.S. mining industry and funding is limited to not-for-profit organizations. Information regarding the Foundation's mission and projects that have been funded can be viewed by visiting the Foundation's website at <http://www.alpha-foundation.org>.

The Alpha Foundation has to date supported a portfolio of research that comprises 58 projects awarded to 29 institutions with total funding of approximately \$23 million. The Foundation is now seeking proposals that address a number of topical areas that the Foundation judges to be especially important to fill gaps in our portfolio. Note that while proposals are especially encouraged in these topical areas, the Foundation is always interested in receiving strong proposals that address other compelling mining safety and health needs that are not explicitly listed.

In addition, while the Foundation's funded projects have been carried out by a broad group of researchers to date, the Foundation is interested in engaging new research teams to expand the effort in addressing these important mining safety and health problems, both from within and outside the traditional mining research community. Therefore, the Foundation is especially encouraging those who have not yet had an Alpha Foundation grant to submit a proposal for this solicitation. This encouragement is not meant to discourage, in any way, those who already have had an Alpha Foundation grant to again

submit a proposal. As always, proposals will be evaluated and selected based on the quality of the proposal as outlined later in this solicitation.

The Foundation is allocating \$2.5 million for projects that will result from this solicitation. It is expected that as many as 10 qualified grants with a maximum funding level of \$250,000 per grant and a maximum duration of 18 months will be funded. Significant additional funding will be made available to fund competitive follow-on proposals from projects demonstrating promise based on convincing evidence from the exploratory effort.

Solicitation Focus: Targeted Topics in Mining Safety and Health Research

The emphasis for this new solicitation is to address mining safety and health gaps in the portfolio of previously-funded Alpha Foundation projects. In order to provide guidance to proposers, a set of critical topics of priority interest are provided in the Appendix. While these topics are of particular interest for this solicitation, the Foundation is always interested in receiving strong proposals that address other compelling mining safety and health needs that are not explicitly listed.

Eligibility Criteria and Limitations

Research project proposals in response to this solicitation will be accepted only from U.S.-based academic institutions and not-for-profit organizations qualifying as exempt from taxation under the Internal Revenue Code.

It is Foundation policy that grant funds may not be used to support clinical trials of unapproved drugs, to construct or renovate facilities, for lobbying, for political activities, or as a substitute for funds currently being used to support similar activities.

Proposal Submission Requirements

Cover Page: A separate single cover page shall be labeled “Proposal to the Alpha Foundation on Targeted Topics in Mining Safety and Health Research, AFC719” It shall include the following information and must be signed by an authorized officer.

Title: Descriptive title of proposed work

Submitting Organization: Name and address of organization

Principal Investigator: Name and contact information (phone and email)

Administrative Contact: Name and contact information (phone and email)

Research Approach and Topical Area: Selected from areas designated in the solicitation or another area not specified.

Estimated Cost: Estimate of total project cost (\$250,000 maximum)

Period of Performance: Estimate of time required to complete the research (18 months maximum)

Research Plan (maximum 15 pages)

Research Approach and Topical Area: Identify the topical area chosen from the choices in the Appendix or an alternative area with well documented importance to mining safety and health. Any proposed research that does not address the particular approaches and focus areas identified in the solicitation must provide justification that the proposed area is both understudied and a priority need for common miner health or safety problems.

Problem Statement and Background: This section shall provide the necessary background information to justify the relationship of the proposed concept to the solicitation objectives and that the proposed effort represents a new approach. Provide a statement of the problem that is being addressed. Follow this with a concise description of the background to the problem including why it exists, the scale of the problem, and why it is important. Identify if the problem area is unique to a specific mining sector or is universal and which areas will receive focus during this particular study.

Research Strategy: Provide a description of the research tasks that will be undertaken including study design and methodology; where the work will be done and the mining operations that will be involved; what data will be collected, how it will be analyzed and whether there are any issues regarding access to this data; what facilities will be used; who will perform the various tasks and who will collaborate. Explain why this approach was selected, including an explanation of its strengths and weaknesses. Clearly state the proposed outcome to the problem being addressed, including one or more broad objectives for the research and one or more specific aims for each objective. If the proposed research will involve any human subjects the proposal must describe the steps that will be taken to ensure human subject protection.

Project Schedule and Decision Points (Maximum 2 pages)

Timeline and Decision Points: Identify key milestones for each of the objectives and aims described above. Note any points where a decision must be made that could significantly impact the direction of the project and any point where something must be completed before further progress is possible in a critical area. Note that interim reports will be required at 6 month intervals in the project.

Deliverables: Provide a listing and brief description of all specific outputs and products planned for this project

Resources and Commitments (Maximum 3 pages)

Facilities and Equipment: Detail the facilities and equipment needed and currently available to support or implement the proposed research. Identify any additional resources that will require budgetary support.

Personnel Plan: Provide the name, role, organizational status and percent effort for each project team member. Describe their specific contributions related to accomplishing the objectives and aims of the project.

Commitment of partners and stakeholders: Identify partnerships needed to fulfill the research objectives and whether commitments have been obtained with these essential partners. Identify any for-profit effort and provide a short justification for why it is needed with recognition that only fee for services or equipment purchases is permitted. It should be noted that contracts with for-profit organizations will be acceptable only if deemed highly critical to the outcome of the proposed work.

Budget (Maximum 3 pages)

A maximum budget of \$250,000 is available. Provide estimates of the following:

- **Salary:** Provide costs for proposed personnel
- **Travel:** Itemize travel requests, including the purpose of each trip
- **Supplies:** Estimate overall cost of supplies
- **Equipment:** Itemize major equipment needs including computers and software
- **Contractual:** Estimate the cost of all external contracts if applicable.
- **Other:** Itemize any other expenses by category and unit cost.
- **Indirect:** The Alpha Foundation limit on indirect costs is 20%

Appendices

Biographical Sketches: Attach biographical sketches of all personnel assigned to the project, one page maximum per person

Letters of commitment: Attach all letters of commitment with mining companies and any other partners or stakeholders whose cooperation or participation is necessary to complete the project.

How to Submit a Proposal

Proposals must be prepared in Adobe pdf format and adhere to the format provided above. The proposals must be submitted through the Alpha Foundation Grant Management System, which can be accessed at <https://glenmede.smartsimple.com/welcome/alpha>. The submission deadline for this solicitation is 5 pm Eastern Time on March 9, 2018. Any proposal, modification, or revision received after the exact time specified is “late” and will not be considered.

Disclaimer Notification: The Foundation is not responsible for the content or correctness of materials supplied in response to its solicitations, and generally and specifically disclaims any responsibility for the same. Proposers are expected to appropriately mark each page of their submission that contains proprietary information. The Foundation will exercise reasonable care in protecting proprietary information from unauthorized disclosure.

Questions regarding the submission of the Proposals can be addressed to grants@alpha-foundation.org.

Funding Decisions and Notifications

The proposals will be reviewed and selected grantees notified on or about May 11, 2018.

Appendix



for the Improvement of Mine Safety and Health, Inc.

TARGETED TOPICS IN MINING SAFETY AND HEALTH RESEARCH (AFC719)

CRITICAL TOPICS OF PRIORITY INTEREST

HEALTH & SAFETY INTERVENTIONS

Dust and Toxic Substance Control: *Prevention of health risks due to generation of dust or other toxic substances.*

Topic: Respirable Dust Material Composition

To combat elevated concerns over coal worker's pneumoconiosis (CWP), MSHA recently lowered the dust standard from 2.0 mg/m³ to 1.5 mg/m³. Current MSHA coal mine dust sampling only requires measurement of the total mass content of respirable dust as a means to assess the health risk associated with various mining occupations. It was generally presumed that the bulk of this dust in production operations is coal dust, which is known to be a contributor to "black lung" disease. However, a recent study of 8 mines completed under Alpha Foundation Grant AFC113-11 disputes this premise, instead revealing that respirable dust in these underground coal mines contained higher levels of carbonate, and non-carbonate materials (including aluminate silicates) than coal dust. This finding can have significant consequences on the interpretation and methods of compliance sampling, dust control technologies, and health risks. The Foundation is seeking additional studies of respirable dust composition to corroborate these initial sampling discoveries and provide more in-depth assessment of influential factors controlling the respirable dust composition. The study design could consider occupational comparisons within a particular mine and/or regional variances among mines of similar or diverse nature.

Ground Control: *Prevention of unstable ground conditions that result in collapses, ventilation disruption, and miner entrapment; roof and rib falls; and injuries due to insufficient support coverage.*

Topic: Understanding the Role of Overburden Mechanics in Pillar Design and Global Ground Stability

Some past and recent research (Van Der Merve, 1999, 2006; Esterhizen, 2010; and Frith, 2017) has suggested that global panel stability involves more than just pillar strength and tributary area loading. This previous work suggests that a reassessment of the interaction between pillar design and the overburden mechanics based on strength of materials principles and structural mechanics may produce a safer design method. Strategic efforts to achieve this reassessment might involve enhanced ground response and pillar modeling studies that include analysis of post-failure and time-dependent degradations.

Research questions that might be considered in this reassessment include:

- Can pillar strength be estimated from tributary area loading at collapse and are coal pillar capacities being overestimated in conventional tributary area design evaluations?
- Do coal pillars fail or yield prior to overburden failure or does the overburden failure cause pillar failure?
- Do coal pillars act to reinforce the overburden, and how?
- What effect does horizontal stress, horizontal bedding, and vertical joints play in overburden stability?
- What effect does the in-situ vertical stress have on pillar response? How does the in-situ stress effect the mining-induced compression required to produce pillar yielding and failure?

Topic: Pillar Stability of Old Workings in Underground Stone Mines

Underground stone mines benefit from inherently strong rock and generally experience good ground stability. Recent pillar design guidelines developed by NIOSH have also aided in establishing stable layouts for limestone mines. However, it is also common for travel ways to active areas in limestone mines to pass through old workings. A recent massive pillar collapse (2015) in older workings of an active limestone mine and reports of extensive regionalized roof falls in other mines suggest that time-dependent degradation behavior may require further basic research into the stability of older pillars and a reassessment of pillar design safety factor recommendations accordingly. Likewise, effective means of monitoring stability in older workings that can provide enhanced warning of pending instability is needed.

Fire and Explosion Prevention: *Prevention of conditions that cause or contribute to mine explosions and fires and effective intervention measures to extinguish their propagation.*

Topic: Evaluation of Current Seal Design Criteria

The requirements for seal design were modified following the Sago Mine explosion upgrading the design pressures from 20 psi to 120 psi for unmonitored mine areas. The result of this increase in design pressure was a change from a “wall-type” structure to a “plug” design. This change resulted in a switch of the critical material property from tensile strength to shear

strength. In addition, the ability to conduct full-scale performance validation of specific seal designs vanished with the loss of the NIOSH Lake Lynn Laboratory facility. The current approval process is based solely on analytical plug design formulation. There are several aspects of this approach which are less than ideal and worthy of further research. The Foundation is seeking a comprehensive proposal that would address the issues listed below or other topics that can provide evidence-based seal design criteria.

A number of relevant research questions for consideration include:

- What is a valid thickness ratio for plug design? Is the thickness ratio affected by entry geometry and/or seal material?
- What are the effects of scale and location on the properties of the seal material? How do the material cohesion and strength change with scale and field behavior compared to laboratory performance? How do the rib, roof and floor boundary conditions affect the seal strength?
- What are the time-dependent properties of the seal material? How do the time-dependent properties and environmental factors affect the seal strength and service life? There are no criteria associated with projectile damage to a seal. Is this a concern for current 50- and 120-psi seal designs?
- MSHA requires monitoring of convergence in the cross cut adjacent to the seal. How does this open entry convergence correlate to the seal deformation? What is the relationship of the seal deformation to the pillar deformation? What is the impact of deformation on the full-scale in-situ seal compared to a material property assessment based on the elastic modulus of the material?
- The approval also requires in-situ testing of the installed seal skin with a 1-inch calibrated penetrometer test. Realizing that this approach has virtually no value in assessing the integrity of the full body of the seal, what correlation is there between skin degradation due to environmental issues and seal integrity? What field test might be used to determine in-place seal integrity?
- Computational modeling has shown that pressures in excess of 120 psi are possible under detonation conditions. What seal design can be used to withstand these explosions? What impact does transient, high impulse loadings have on seal design? What entry modification can be done to mitigate high explosive pressures?

Monitoring Systems and Integrated Control Technologies: *Recognition and intervention of the escalation of conditions that lead to health and safety risks before they reach hazardous levels.*

Topic: Innovative Methods of Methane Detection Near the Face and De-energizing the Longwall Equipment

Longwall gobs, especially in bleeder designs routinely utilized by the United States, continue to be subjected to explosive zones despite the efforts to prevent them. The detection and control of methane in longwall gobs is an on-going problem, and the Foundation would welcome any

relevant study of this issue, particularly those that include mine measurements of methane liberation and flow. A topic of particular interest is methane liberation from the area immediately behind the shields onto the longwall face and tailgate corner. The specific aim of this topic area is to ultimately develop effective and innovative methods of methane detection/elimination along the longwall face in combination with the capability to de-energize the face equipment before an explosive range reaches the shearer.

Machine/Equipment Design and Ergonomics: *Prevention of injuries related to mining machinery or equipment operation, movement, handling, or repair.*

Topic: Development of Remote-Controlled Roof Bolting Capability

The Foundation has recently funded a project with the University of Kentucky (Grant AFC417-21) to design and demonstrate a remote-controlled shuttle car. With that effort, the only remaining machine in coal mining not operated by remote control and/or autonomously would be the roof bolter. The roof bolter operator is at elevated risk to silicosis from constantly drilling into rock strata, noise from the drilling operation, injury from rock and rib falls, injury from pinning accidents, and musculoskeletal injuries of various sorts. The Foundation is seeking to provide full remote capability of the bolting process that enables installation of roof bolts from a remote location sufficiently far away to remove the operator from all hazards associated with the bolting effort. It is noted that a proof-of-concept proposal would be acceptable for the initial effort.

Topic: Proof-of-Concept Development of Explosion Permissible Sensory or Robotic Equipment

A major reason why technology developments in mining, underground coal mining in particular, are more challenging than anywhere else is because they operate in potentially explosive environments due to the inherent methane gas and dusty conditions. Any machine, sensor, or instrument that is used in active areas of an underground gassy (coal) mine or following a mine disaster must be explosion permissible. As such, the Foundation would welcome any effort to overcome permissibility limitations that are preventing any relevant emerging technology from being implemented in the mining industry. It is noted that the Foundation sought similar proposals in solicitation AFC518 but achieved only one award (https://www.alpha-foundation.org/wp-content/uploads/2017/07/AFC518-23_Concept-Summary.pdf). Therefore, the Foundation is refocusing efforts in this area. While MSHA-approved permissible design is the ultimate goal, the Foundation recognizes the difficulty in achieving permissible designs at the concept stage. Therefore, the Foundation is willing to accept the more versatile IEC explosive protection standards if full permissibility as determined by MSHA approval does not appear to be attainable within the proof-of-concept effort.

MINE ESCAPE, RESCUE & TRAINING

Sheltering and Escape Strategies: *Developing escape strategies and technologies to aid in escape including systems that provide for sheltering when escape is not immediately attainable.*

Topic: Using Refuge Alternatives as a Base of Operations

Currently, refuge alternatives are generally designed only for sheltering. While some form of through-the-earth or medium frequency emergency communication may be available during escape efforts, more conventional communication technologies such as wireless node systems or leaky-feeders rely on two-way communications between personnel outside the mine and the miners inside the mine. If the network is fractured beyond the capability of the redundancy/robustness of the installation, the lines of communication are broken leaving the escaping miners without outside communication.

Is there a way to expand sheltering facility capabilities to allow the miner to take an active role in: 1) establishing local communication within the mine, 2) using the available network to continue to interrogate and receive mine sensory information, 3) repair or aid in the repair of a fractured network, 4) explore the area for escape options, 5) or other aspects that aid in escape? The Foundation is seeking proposals with a pro-active approach to empower the barricaded miner to more actively engage in the escape process.

INJURY & DISEASE EXPOSURE & RISK FACTORS

Topic: Examination of the Relationships between Mine Environment Exposures and the Development or Exacerbation of Asthma and COPD.

It is well known that the respiratory tract is vulnerable to environmental exposures in a variety of mining operations. The Alpha Foundation funded studies on lung cancer mortality, COPD mortality and rapidly progressive pneumoconiosis in selected groups of mineworkers are already underway, however research that focuses on morbidity and disability from asthma or COPD is a priority.

Topic: Identification of Mining Jobs and Operations with High Rates of Work-related Musculoskeletal Disorders (WMSD), including the Evaluation of the Effectiveness of Measures Intended to Reduce or Prevent These Disorders.

More than 30% of all MSHA reported injuries in underground mining are cumulative WMSDs. Several Alpha Foundation funded studies have looked at the risks for WMSDs associated with whole body vibration. Research focused on risks from forceful exertion, repetitive motions and awkward postures are a priority.

Topic: Characterization of Chemical Exposures and the Hazards They Pose to Miners in the Metal/Non-metal Sector.

A wide variety of toxic materials are used or generated in mining, processing and waste operations in this sector. These include cyanide, sulfuric and nitric acids, solvents, heavy metals, diesel exhaust, reagent chemicals and many others. This priority is designed to address the substantial lack of scientific efforts to inventory and describe these exposures or to study their potential to result in adverse health effects among exposed miners.