



for the Improvement of Mine Safety and Health, Inc.

The Alpha Foundation is pleased to present its 2019 Annual Report.

The report provides a summary of activities directed toward the realization of the Foundation's mission to improve mine health and safety through funding research and development projects by qualified academic institutions and other not-for-profit organizations.

### **Grantmaking Summary**

Since its beginning in 2011, the Alpha Foundation has supported a portfolio of research that comprises 89 projects awarded to 34 institutions including 41 active grants in 2019. These grants address the four major focus areas of the Foundation, with award percentages as indicated:

- Safety and Health Interventions - 57%
- Mine Escape, Rescue & Training - 7%
- Safety & Health Management & Training - 10%
- Injury & Disease Exposure & Risk Factors - 30%

### **Projects completed in 2019**

Most projects have a performance period of 2 to 3 years. A number of projects funded under five different solicitations were completed in 2019 covering a range of topics. The Final Reports for all these have been approved and are posted on the Foundation's website.

- AFC215-01 (The Pennsylvania State University) - Development of Guidance for the Selection and Use of Atmospheric Monitoring
- AFC215FO-71 (Virginia Polytechnic Institute and State University) - Advanced Low Noise Fan Array System
- AFC316-49 (University of Kentucky) - Experimental Testing and Design of Protective Measures for Communications and Tracking Systems Subjected to Catastrophic Events in Underground Coal Mines
- AFC316-53 (University of Illinois, Chicago School of Public Health) - Linkage of Active Miner Surveillance, Former Miner Disability Evaluations, and Mortality Data Sets to Evaluate and Prevent Lifetime Risk of Cardiopulmonary Disease in U.S. Miners
- AFC316-54 (University of California, Berkeley) - Chronic Obstructive Pulmonary Disease (COPD) Mortality and Diesel Exhaust in Miners

- AFC518-02 (Oakland University) - Miniaturized and Real Time Gas Sensors for Mine Safety and Health
- AFC518-10 (University of Connecticut Health Center) - Improving Communication in Noise for Miners Wearing Hearing Protection
- AFC518-16 (Colorado State University) - Development of Direct Sensing Sampler for Submicron Mining Particles Including Coal, Silica and Nano-Sized Diesel Particulates
- AFC518-17 (Oregon State University) - Simple and Accurate Positioning to Enable Vehicle Autonomy in Underground Mines
- AFC518-24 (University of Arizona) - A Hybrid Geopolymer-Biopolymer Cementitious Material for Pumpable Roof Support
- AFC518-25 (Virginia Polytechnic Institute and State University) - Collecting Mine Dust Particles with Liquid-Coated Vibrating Meshes
- AFC518-40 (Virginia Polytechnic Institute and State University) - A Smart Device for Mine Dust Characterization and Coal Workers' Health Improvement: Combining Non-Destructive, Element-Specific X-ray CT with Big Data Analytics & Machine Learning
- AFC518-48 (Colorado School of Mines) - Flying Underground
- AFC518-54 (University of Nevada, Reno) - Development of an Advanced Real-Time Personal Coal Dust Monitoring Instrument Based on Photo-acoustic Spectroscopy
- AFC518-67 (Montana Technological University) - Demonstration of a UAV-based Digital Photogrammetry System for Geological Mapping and Geotechnical Characterization of Fractured Rock Masses at Hazardous Underground Sites
- AFC618-1 (University of California, Merced) - The Effect of Dust Particles on Airway Mucus Viscosity and Mucociliary Transport
- AFC618-4 (University of California, San Francisco) - Coal Mining Risk of Arthritis, Including Auto-Immune Rheumatologic Disease
- AFC618-38 (Oregon State University) - Effects of Whole-Body Vibration Exposure on Physiological Stresses in Mining Heavy Equipment Vehicle Operators
- AFC618-53 (University of North Carolina, Chapel Hill) - Innovations in Applied Decision Theory for Mine Surveillance and Health and Safety Efforts
- AFC618-63 (University of California, Berkeley) - Explore the Integration of Distributed Lag Models for Diesel Exhaust with Methods to Control Healthy Worker Survivor Bias to Assess Benefits of Exposure Interventions in Non-metal Miners
- AFC618-68 (Oregon State University) - Evaluating the Effects of Multi-axial Whole-Body Vibration Exposure on Postural Stability in Mining Heavy Equipment Vehicle Operators
- AFC719-57 (Rebuilding Their Future Foundation, Inc.) - Investigation of Improved Communication from Portable Refuge Alternatives to Facilitate Mine Escape and Rescue

### **Grants awarded in 2019**

An open spoliation in 2019 in which 59 proposals were submitted and reviewed by an Advisory Panel and Foundation staff resulted in the funding of 12 new awards.

### **AFC820 Solicitation**

- AFC820-14 (University of Massachusetts, Lowell) - Opioid Hazard Awareness Training for Sand, Stone and Gravel Workers
- AFC820-15 (University of California, Berkeley) - Reducing Mortality Risks in the Extended Diesel Exhaust and Miners Study (DEMS)
- AFC820-22 (Oakland University) - Miniaturized and Low Cost Electrochemical Particulate Matter (PM) Sensor for Mine Dust Exposure Assessment
- AFC820-43 (Colorado State University) - The Effect of Coal and Mine Respirable Dust Size on Lung Cells and Exposure Assessment
- AFC820-50 (Colorado School of Mines) - Integrating Real-Time Personal Dust Exposure Monitoring with Location Tracking
- AFC820-52 (Colorado School of Mines) - Large Scale Testing and Modeling of Supported and Unsupported Pillar Analogs
- AFC820-54 (Colorado School of Mines) - Lifting the Veil: Fusing RaDAR and Sound to Provide Enhanced Perception in Obscured Environments
- AFC820-59 (University of Illinois at Chicago School of Public Health) - Elucidating the Individual and Combined Toxicity of Coal Mine Dust Constituents and Their Contribution to Disease in Modern US Coal Miners
- AFC820-68 (University of Kentucky) - Roof Bolting Module Automation for Enhancing Miner Safety
- AFC820-69 (West Virginia University) - Autonomous Robotic Early Warning System for Underground Stone Mining Safety
- AFC820-82 (University of Utah) - Development of A Wireless Borehole Instrument Device to Measure 3D Rock Mass Stress and Strain Change from Modifications to A Friction Rock Bolt

Follow up funding was also provided to three universities whose previous project demonstrated a successful outcome with potential for further accomplishments.

#### Follow up grants

- AFC113FO-87 (The University of Utah) - Application of Pressure Balancing Techniques at the West Elk Coal Mine
- AFC518SP-89 (Virginia Tech) - Collecting Mine Dust Particles with Liquid-Coated Vibrating Meshes, Phase 2
- AFC518SP-92 (University of Connecticut Health Center) - Improving Communication for Miners Wearing Hearing Protection: Algorithms for Mine Machinery Noises

#### **Research Spotlights**

A number of project outcomes have been posted in a spotlight section on the Foundation website created to make public research highlights and impact. Examples include:

- University of Kentucky develops longwall shearer scrubber that reduces dust concentrations in face walkway by 74 % and with 56 % less dust leaving the longwall face.
- University of California, Berkeley finds that failure to consider the healthy worker survivor bias can lead to highly misleading conclusions of health impact when analyzing exposures to risk factors.
- Colorado School of Mines constructs test facility and studies flame propagation through rock rubble to investigate explosive behavior in longwall gobs, finding rubblized zones can increase explosion potential and severity.
- University of Maryland computational explosion modeling finds that rock debris in coal mines can be conducive to detonation explosions.
- Northeastern University researchers find that heavy surface mine equipment operators are likely to exceed ISO daily vibration limits when operating equipment for a full (8-hr) shift.
- Virginia Tech researchers find three sources of respirable dust in studied coal mines: the coal and rock strata being cut or drilled, and rock dusting products being applied with the latter predominating.
- Virginia Tech researchers find that rail and roof mesh can significantly extend the transmission range of Magnetic Communication Systems (MCS).
- Colorado School of Mines demonstrates that squat coal pillars can fail violently resulting in coal bumps.
- University of Illinois researchers, using surveillance, federal benefits, and state workers' compensation data sets to study cardiopulmonary disease in miners, find a relationship between simple pneumoconiosis and declines in lung function, indicating that simple pneumoconiosis is not a benign condition.
- University of Nevada, Reno develops a new and innovative technology to recognize hazardous atmospheric conditions in a mine before these evolve and cause an accident.
- University of Utah develops pressure balancing techniques that can be used to control and prevent spontaneous combustion in underground mines.
- West Virginia University incorporates brain-sensing headband into integrated surface mining safety system to eliminate equipment-related injuries.

### **Preparing for Final Grant Awards**

The Foundation has approximately \$8.5 million funds remaining for additional research awards and is currently studying options for pursuing high quality research for these remaining funds.

### **Alpha Foundation Board of Directors**

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Dr. David Wegman, Director and Treasurer

### **Alpha Foundation Staff**

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Dr. Michael Silverstein, Technical Associate