Alpha Foundation for the Improvement of Mine Safety and Health

FIVE ALPHA GRANTEES WILL PRESENT THEIR RESEARCH STUDIES

- Connecting Dust Characteristics and Worker Health in Underground Coal Mining (University of Pittsburgh)
- The Application of Flooded Bed Dust Scrubbers to Longwall Mining System (University of Kentucky)
- Improved Safety through Applications of Risk Management in US Underground Coal Mines: A RISKGATE Approach (Virginia Tech)
- Whole Body Vibration Exposure and Injury Prevention of Heavy Equipment Operators in Open Pit Coal Mines. (Northeastern)
- Ischemic Heart Disease and Lung Cancer Mortality in Relation to Respirable Particulate Matter and Diesel Exhaust in Non-metal Miners (University of California, Berkeley)

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Preview of Focus Areas and Research Efforts Funded by the Alpha Foundation for Freeing Miners of Workplace Injury and Disease

GENESIS

- **December 2011: The United States Attorney's Office for the Southern District of West Virginia, the United States Department of Justice and Alpha Natural Resources, Inc. ("Alpha") entered into a Non-Prosecution Agreement".**
  - *Alpha agrees to establish a trust within 120 days to fund projects designed to improve mine health and safety.*
  - *During the two-year period commencing on the date of this Agreement, Alpha will pay a total of $48,000,000 into the trust.*

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MISSION: TO IMPROVE MINE HEALTH AND SAFETY THROUGH FUNDING RESEARCH AND DEVELOPMENT PROJECTS BY QUALIFIED ACADEMIC INSTITUTIONS AND OTHER NOT-FOR-PROFIT ORGANIZATIONS

VISION: To enable miners in the future to be free of work-related injury or disease.

An Overview of the Research Portfolio After Two Award Cycles

Thomas M. Barczak

Technical Director

Two Award Cycles

- First Full and Open Solicitation
  - 16 projects funded
  - $9.5 million
  - 13 different non profit organizations
  - 4 different focus areas
- Short Term Innovative Solicitation
  - 5 projects funded
  - $750k investment

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Problem Areas Being Investigated

- Health and Safety Intervention Focus Area
  - Coal bumps and rock bursts
  - Dust control on longwall faces
  - Better rock dust sampling systems
  - Spontaneous combustion
  - Operational safety in surface mining

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Coal Bumps and Rock Bursts

Project - Numerical Modeling Methodologies for Assessing Bust Potential in Coal Mines (Colorado School of Mines)

- Bumps remain the dominant unanswered concern in ground control.
- While mechanisms are defined, identifying conditions that produce impending bumps remains elusive.
- Project uses energy assessment as a tool to identify bumping conditions.
- Back analyses of previous coal bump event.

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SPONTANEOUS COMBUSTION

Project - Control of Spontaneous Combustion Using Pressure Balancing Techniques (University of Utah)

- Sponcom accounts for 15% of the fires in the U.S. since 1990.
- Seals are not airtight structures and can allow some leakage of air into the gob.
- Maintaining pressure differentials is a key to controlling gob conditions.
- Project uses pressure balancing techniques to maintain the gob at higher than barometric pressure.

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DUST CONTROL ON LONGWALL FACES

Project - The Application of Flooded Bed Dust Scrubbers to Longwall Mining System (University of Kentucky)

- Longwall mine exhibit greater difficulty in maintaining compliance with dust regulations.
- Scrubber technology has been proven to be effective in capturing and removing harmful dust.
- This project is designing a functional prototype scrubber system that can be integrated onto a longwall shearer.

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BETTER ROCK DUST SAMPLING SYSTEMS

Project - Development of a New Rock Dust Sampling Instrument (Colorado School of Mines)

- The quantity and quality or rock dust has come into question following the Upper Big Branch explosion.
- Current sampling methods require sampling with a brush and dust pan.
- This project is developing pneumatic, handheld device to sample mine dust.
- The pneumatic action more closely mimics the dust entrainment process that happens during a coal dust explosion.

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OPERATIONAL SAFETY IN SURFACE MINING

Project - Integrated Surface Mining Safety System (West Virginia University)

- 85% of truck- related fatalities and 85% of loader-related fatalities and 87% of dozer-related fatalities occur in surface mining.
- This project will develop and deploy an integrated safety system.
- The system will include:
  - proximity warning technology
  - non-invasive eye detection and tracking system for drivers fatigue
  - vehicular motion profile

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Problem Areas Being Investigated

- Mine Rescue and Escape Focus Area
  - Improving through the earth communication technology

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IMPROVING THROUGH THE EARTH COMMUNICATION TECHNOLOGY

Project - Operational Sensitivity of Through-the-Earth Communication (Virginia Tech)

- Through-the-Earth (TTE) technology plays an important role in mine rescue operations.
- How to effectively deploy TTE in the complex geologic settings of an active underground mine is not fully understood.
- This project will analyze and define the operational envelope of the TTE system, allowing the system to be optimally deployed.

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Problem Areas Being Investigated

- Safety and Health Management
  - Implementing a healthy workplace
  - Adapting risk management practices
  - Incorporating economic benefits in risk assessment
  - Hazard identification in metal mines

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IMPLEMENTING A HEALTHY WORKPLACE

Project - The Mining Healthy Workplace Program (MHWP) (University of Connecticut Health Center)

- The morbidity and mortality risks to Appalachian coal miners exceed those of many other working populations.
- No precise division between exposures and risks that occur within and outside of the workplace.
- This project will revise the apprenticeship and recertification programs for West Virginia miners by introducing a more integrated health curriculum.

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ADAPTING RISK MANAGEMENT PRACTICES

Project - Improved Safety through Applications of Risk Management in US Underground Coal Mines: A RISKGATE Approach (Virginia Tech)

- Recent high profile mine accidents, including the UBB Explosion, have highlighted the need for innovative and effective approaches to mine safety.
- While risk assessment and management is a well-recognized approach to improving health and safety, it is seldom applied in US mines.
- This project will develop strategies for implementation of risk management approaches in the US utilizing the RISKGATE body of knowledge.

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INCORPORATING ECONOMIC BENEFITS IN RISK ASSESSMENT

Project - Implementation of Risk Management Programs: Identification of Best Practices to Reduce Injuries and Maximize Economic Benefits) (University of Arizona)

- Evaluate current risk management implementation in the U.S. mining industry.
- Determine the effectiveness of risk management interventions in reducing injuries and economic costs.
- Develop business cases to help move industry to adopt these interventions.

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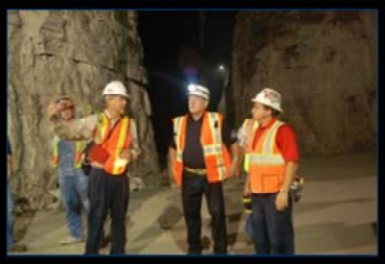
HAZARD IDENTIFICATION IN METAL MINES

Project - Characteristics of, and Barriers to Effective Hazard Identification and Control Programs in U.S. Metal and Nonmetal Mines (United Steelworkers)

- The safest workplaces go beyond compliance and manage safety and health through effective hazard identification and control.
- MSHA strongly recommends that all mines implement such "find and fix" programs.
- The USW is the predominant union in metal & non-metal mining (125 mines).
- Leverage this membership to understand best practices and transfer this knowledge to other mines.



UNITED STEELWORKERS
USW
UNITY AND STRENGTH FOR WORKERS

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Problem Areas Being Investigated

- Training
  - Applying active training methods
  - Training to use new safety technologies

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APPLYING ACTIVE TRAINING METHODS

Project - Effective Mining Safety Training - Design, Implementation, and Evaluation (University of Arizona)

- More than $100B is spent each year on training including millions of dollars on mine training.
- Research from other industries suggests that active learning can result in increased knowledge acquisition.
- The project will provide guidance to mine trainers on how to modify existing training courses to include more active and engaging learning experiences.

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TRAINING TO USE NEW SAFETY TECHNOLOGIES

Project - Enhanced Mobile Equipment Experiential Learning and Safety Technology Demonstration (West Virginia University)

- Nearly 800 miners were injured and 6 killed in accidents involving shuttle cars and scoops in underground coal mines (2000 and 2010).
- Machine mounted cameras and proximity detection systems can improve situational awareness and prevent these injuries.
- But without proper training, operators may rely too much on this technology and the benefits of this technology may not be fully realized.

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Problem Areas Being Investigated

- Health Studies
  - Impact or respirable particulates and diesel exhaust on lung and heart disease
  - Early black lung issues in Appalachian coal mines
  - Linking data sets to increase clarifying trends in adverse health issues related to mining
  - Problems with shock and vibration to heavy duty mining equipment operators

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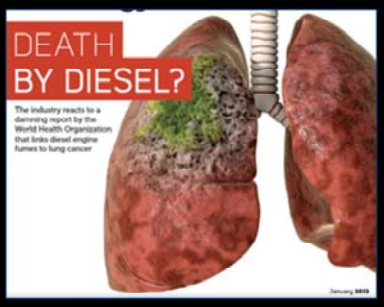
Impact of respirable particulates & diesel exhaust on lung & heart disease

Project - Ischemic Heart Disease and Lung Cancer Mortality in Relation to Respirable Particulate Matter and Diesel Exhaust in Non-metal Miners (University of California)

- Miners are exposed to levels of respiratory particulate matter that far exceed general population exposures in air pollution.
- Provide exposure-response curves for ischemic heart disease and lung cancer mortality.
- That can be used to guide MSHA regulations for RPM and REC in coal and other non-metal mines.



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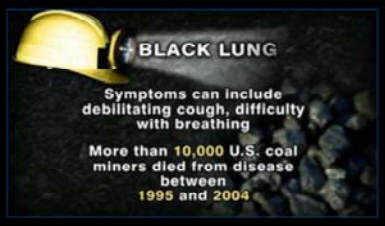
EARLY BLACK LUNG ISSUES IN APPALACHIAN COAL MINES

Project - Connecting Dust Characteristics and Worker Health in Underground Coal Mining (University of Pittsburgh)

- After 30 years of decline, the recent and unexplained rise in debilitating lung disease in young coal miners represents an urgent concern.
- Excessive dust concentrations are perhaps not the primary root of the problem.
- Associate lung function among coal miners with exposure to specific dust characteristics.
- Study difference between Central Appalachian and Northern Appalachian coal mines.



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SHOCK AND VIBRATION TO HEAVY DUTY MINING EQUIPMENT OPERATORS

Project - Whole Body Vibration Exposure and Injury Prevention of Heavy Equipment Operators in Open Pit Coal Mines (Northeastern University)

- Miners who operate heavy equipment vehicles in open pit mines have a high prevalence of musculoskeletal disorders (MSDs).
- Characterize whole body vibration exposures in order to develop feasible and effective approaches for reducing exposure.
- Identify potential engineering controls and seat suspension technology to reduce the exposure to these peak and impulsive shock.

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LINKING DATA SETS TO INCREASE CLARIFYING TRENDS

Project - Clarifying Distribution, Trends, and Determinants of Adverse Health in United States Miners: Exploration and Integration of Existing Data Systems and Clinical Materials (University of Illinois Chicago)

- Disease and death from mining-related chronic health disorders are more difficult to identify and affect a much larger portion of the mining population than safety issues.
- Epidemiologic methods will be used to analyze datasets from multiple agencies and organizations
- Integrate these data to document determinants of miners' risk for respiratory and cardiovascular disease.

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INNOVATIVE RESEARCH

Is there a way to attack this problem differently?

Think out side the box!

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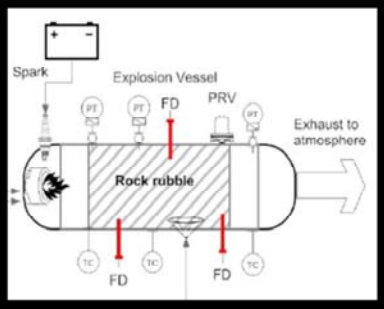
Combustion Modeling of Explosive Gas Zones in Longwall Gobs

- Explosive gases can accumulate and explode within gobs of underground longwall coal mines and expand into the active face areas of the mine.
- A gob explosion simulation apparatus will be constructed to study flame propagation through rock rubble.
- Combustion model to simulate explosions within the gob to determine the explosion hazard to miners working in the face or bleeder areas surrounding the gobs.



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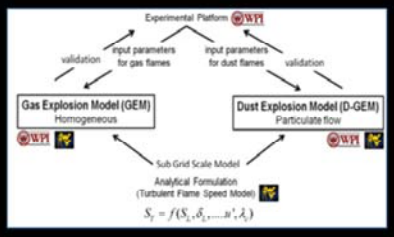
Development of a Gas and Dust Explosion Model

- A computational platform for modeling gas and dust explosions is needed.
- Current models are linked to particular configurations and therefore require an experimental quantification of the phenomenological coefficients.
- This research incorporates a turbulent flame speed model that is analytically developed from the first principles and will work everywhere within its validity domain.



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The Precise Determination of Rockbolt Performance Underground

- Current roof bolting instrumentation has significant shortcomings:
  - failure to capture the entire strain profile along the bolt
  - Use of two slots easily misrepresent any reactive loads in the bolt depending on where the load is applied
- This project uses optical fibers in three slots and represents the most innovative rock bolt monitoring technology to date.

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SIU CARBONDALE

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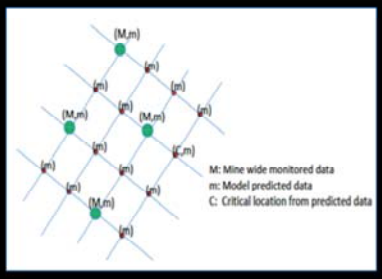
Early Warning Safety Hazard Predictor for Preventive Ventilation Management

- Recognition of safety hazard is difficult because of the complex nature of information from atmospheric and other conditions underground.
- Large amount of monitored data may be available from measurement by sensors, however, it is difficult to recognize problem-causing trends from the measurement data with time-dependent variations.
- This research will develop Early Warning Predictor that forward- predicts ventilating air conditions at before the hazard actually fully develops.



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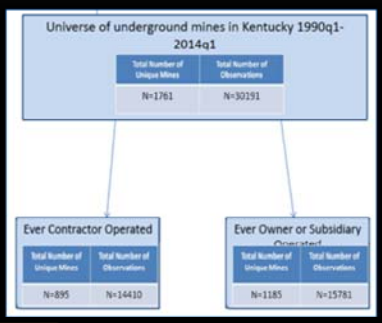
The Impact of Contractor Utilization on Health and Safety

- Contractor utilization, as measured by MSHA, in underground coal mining has experienced sustained growth over the past 25 years.
- This research will assess the safety record of contractor operated mines.
- A statistical analysis of a number of outcomes, such as injury rates and citation occurrences, will be done to determine the relationship between contract operations and miner health and safety risks.



BOSTON UNIVERSITY

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THANK YOU

Thomas M. Barczak
technical_director@alpha-foundation.org