

Grant Number: AFC719FO-100

Title: Research and Refinement of a Methane Watchdog System to Improve Longwall Mine Safety

Organization: West Virginia University

Principal Investigator(s): Derek Johnson

Partnerships: Sensors Incorporated

Focus Area: Health and Safety Interventions Topical Area: Fires and Explosion

SYNOPSIS

Research Focus: Longwall mining in underground coal mines is considered the safest and most productive mining method. However, due to its high productivity, methane emissions from the large, newly exposed coal face and from the gob area are often high. Mine explosions may be initiated by these high methane concentrations. Longwall mine safety continues to remain an area of ongoing research worldwide. We propose to build upon the findings from our previous research project to further develop and refine the Methane Watchdog System (MWS) and increase its ability to predict hazardous conditions. The MWS is a cost-effective, multi-nodal network of methane sensors that is distributed across the entire longwall system and serves as an intelligent method to detect localized zones of high methane concentration. The system will not only detect these scenarios but will also provide the ability to automatically de-energize or control equipment to avoid potential explosive scenarios. We will develop a second-generation system and focus on improving the performance of the system through additional experimental research, modeling, and simulated mine research. Key performance metrics will include continued focus on improvements of nodal accuracy and response time, as well as capabilities to pre-emptively predict hazardous conditions based on continuously monitoring methane across the face and gob areas. Our goal is to advance the knowledge-base and experimental data necessary to ensure that the MWS can be deployed in mines affordably in the interests of enhancing mine worker safety and maintaining productivity.

Expected Outcome: The expected outcomes from this additional research will include: a.) an improved second generation prototype system, b.) a proposed method for integration and compliance of a pre-production system within an active mine, and c.) the advancement and dissemination of results necessary to ensure our research results translate into real outcomes necessary to enhance the safety of longwall operations worldwide. We expect that the second-generation system will improve measurement accuracy, reduce response time, reduce water consumption, and demonstrate predictive capabilities through real-world demonstration at the WVU Mine Training Academy. Though we will not produce an MSHA certified system, we will work with MSHA to develop proposed modifications to include in the system design that would enable a future system to be certified and actively deployed in active underground mines. Finally, we disseminate the findings of both phases of research within the academic, scientific, regulatory, and industrial communities. Since the first phase final report was submitted, we have successfully protected the intellectual property (IP) of the MWS

with a provisional patent. This will facilitate open communication with potential developers and early adopters of this safety technology. We will continue to work with our Office of Technology Transfer to ensure that dissemination efforts are increased during this second phase – as to provide broader impact from this important research.

Specific Aims: The specific aims of the additional research will include:

- 1.) reducing water consumption of ejectors through redesign for compressed liquid streams at higher pressures,
- 2.) evaluation of state-of-the-art dual wavelength, non-dispersive infrared sensors to improve response time and accuracy,
- 3.) development of signal sharpening techniques to enhance predictive capabilities,
- 4.) develop new data sets for system performance in an established simulated mine facility,
- 5.) examine MSHA and shield integration requirements to enable future deployments in active mines,
- 6.) build upon previous modeling to assess additional benefits of shearer or ventilation control.

By addressing these research aims, we will advance the technology and address pathways for efficiency and improvement identified in the first phase. By completing this additional laboratory research, we will significantly increase the technology readiness level (TRL) of the MWS. These advances in the state-of-the-art will ensure that our basic and applied research results in benefits that can be realized for the mining community.