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Title: Development of Guidance for the Selection and Use of Atmospheric Monitoring Systems to Improve Decision-Making During Routine and Post-Accident Operations

Organization: Penn State University

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Partnerships: Alpha Natural Resources

Focus Area: Health and Safety Interventions
Topical Area: Monitoring Systems and Integrated Control Technologies

Problem Statement and Justification: The potential of mine wide monitoring systems to improve mine safety and health has been recognized for decades, and yet the deployment of these systems for such purposes has been extremely limited in the U.S. and globally. Although not perfect, the technologies to enable mine-wide atmospheric monitoring systems (AMS) have been commercially available, and to a great extent, technology itself has not been the barrier to widespread adoption of these systems. Rather, it has been a lack of knowledge on where the sensors will be placed and how the resulting information will be used to achieve specific safety or health outcomes. The on-going challenges and costs associated with acquiring AMS information are appreciable, and this underscores the need for a purposeful strategy for every installed sensor. The difficulty in actually using the large quantities of data to improve decision-making at the mine is a persistent problem. The question of "what to do with the volumes of data generated by these systems" is as difficult to answer today as it was thirty years ago. While large graphical displays of sensor values superimposed on maps and diagrams appear impressive, the practical use of this information to improve safety and health outcomes is another matter. The current state-of-technology makes it easier to incorporate a greater numbers of sensors, which will likely produce even larger quantities of data, with an even greater risk that meaningful information will be obscured. Furthermore, the interest in employing backup systems, such as tube bundle systems, to improve post-accident functionality increases the complexity of the problem faced by the mine operator. Mine operators need practical guidance on the selection and location of sensors to achieve defined safety goals, as well as guidance on the alignment of the performance characteristics of the monitoring system with these safety goals.

Impact of the Research: The selection and configuration of the atmospheric monitoring system(s) for routine and post-accident functionality at a mine must be based on a logical construct of exactly how the information will be used to improve safety. Definitive guidance to align sensor selection and location with decision-making requirements will be developed for both routine and post-accident application. Information requirements to support decision making inside the mine, for example to aid self-escape, as well as outside the mine, will be incorporated into the guidance. The purposeful use of atmospheric monitoring can result in the detection of hazardous conditions as they begin to develop, and could serve the needs of escaping miners for information on atmospheric conditions in the mine.

Objectives and Research Approach: Event scenarios for routine and post-accident decision making will be defined, and the sensory information needed to support those decisions will be identified, as will "sentinel" sensors that would serve as early warning of incipient hazards. These decision processes will be analyzed to identify the smallest set of sensors to support those processes, given practical constraints. Computer simulations will be used to study the event scenarios and the

corresponding affects on sensors, and the results of these will help to establish practical guidance on the location for specific sensors and their output changes that are significant. Data collected from an in-mine AMS, augmented with information in the literature, will be used to help formulate, evaluate, and validate a practical guidance document for mine operators.