

DEPARTMENT OF HEALTH AND HUMAN SERVICES

CENTERS FOR DISEASE CONTROL AND PREVENTION

Investing in Mine Safety: Preventing Another Disaster

Witness appearing before the

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Introduction

Good afternoon, Mr. Chairman and other distinguished members of the Subcommittee. My name is John Howard, and I am the Director of the National Institute for Occupational Safety and Health (NIOSH), part of the Centers for Disease Control and Prevention (CDC), within the Department of Health and Human Services. I am accompanied by Dr. Jeffery Kohler, NIOSH Associate Director of Mine Safety and Health Research and Director of the Office of Mine Safety and Health Research (OMSHR), which was permanently established by the Mine Improvement and New Emergency Response (MINER) Act of 2006.

The goal of NIOSH's Office of Mine Safety and Health Research is the elimination of mining fatalities, injuries, and illnesses through research and prevention. Collaborations with its stakeholders, which encompass industry, labor, and government, provide a knowledgeable and diverse foundation for formulating a relevant research portfolio that addresses the most pressing mine safety and health issues of our time. So, Mr. Chairman, you can imagine the anguish and frustration that OMSHR, its partners, and I experienced when the disheartening news of the Upper Big Branch Mine explosion broke on April 5th. While the specific causes of this latest tragedy will not be known until the Mine Safety and Health Administration (MSHA) completes its investigation, this explosion already serves as a poignant reminder of the need to maintain a focus on the prevention of mine disasters through research and safety interventions.

A review of mine disasters over the last decade, including those at the Sago mine, the Darby mine, and at Crandall Canyon, reveals that no two mine disasters are identical. With most mine disasters, a number of precipitating factors occur concurrently to create conditions to cause a calamity. Some of these factors are within human control even if others are not. To consider simultaneously all permutations of factors that may contribute to a mine disaster is impractical; however, we know that eliminating one of the factors may prevent or at least mitigate the effects of a catastrophe. For example, a mine explosion requires a fuel source (such as methane or coal dust), a minimum concentration of oxygen to support combustion, an explosive mixture of the fuel with air, and an ignition source. All contributing factors do not have to be eliminated to prevent an explosion. In fact, an explosion can be avoided if any single factor is removed. The key to preventing catastrophes is to identify and eliminate the controllable common thread through technology and engineering interventions.

I will now present an overview of NIOSH's on-going research and accomplishments that primarily relate the mandates of the MINER Act and disaster prevention. Since I have begun to address the topic of mine catastrophes, I will start with an overview of our disaster prevention projects, then move on to disaster response.

Disaster Prevention

Coal Dust Explosion Prevention: NIOSH will soon complete an important report on the explosion hazard implications of finer dusts that modern mining methods generate. This Report of Investigation, called "Recommendations for a New Rock Dusting Standard to Prevent Coal Dust Explosions in Intake Airways," recommends revision to the current minimum requirement of 65 percent for incombustible content in dusts found in intake airways. The report is in the final stages of review.

NIOSH is aggressively pursuing commercialization of the Coal Dust Explosibility Meter, the CDEM. The CDEM provides the mining industry with a means to assess accurately and in real time the hazard of coal mine dust explosibility. Recent mine disasters have renewed interest in this technology, and NIOSH has found a manufacturing partner with broad experience in the manufacture and marketing of field instruments. The CDEM will be commercially available next year.

Sealed Area Explosion Prevention: The 2006 explosions at the Sago and Darby mines were due to the existence of explosive atmospheres within sealed areas of underground coal mines. Preventing this condition from occurring is a priority under the technology development mandate of the MINER Act, so NIOSH developed and demonstrated a system to extract nitrogen gas from the mine atmosphere and inject it into a sealed area to render it inert or extinguish a fire. This compact system, designed for easy transport in coal mines, is now commercially available.

Improving Coal Mine Seals: In 2007, NIOSH released an influential Information Circular called “Explosion Pressure Design Criteria for New Seals in U.S. Coal Mines,” that established a scientific basis for upgrading the design requirements for seals in underground coal mines. Since that publication, NIOSH has engaged in further research, including cooperative research with the Naval Research Laboratories and the U.S. Army Corps of Engineers, to improve methods for evaluating seal designs. When completed, this research will provide a sound engineering foundation and enhanced tools to evaluate seal designs to ensure they will provide adequate protection to miners.

Belt Fire Prevention: As directed by section 11(A) of the MINER Act, NIOSH initiated research in response to the report, “Technical Study Panel on the Utilization of Belt Air and the Composition and Fire Retardant Properties of Belt Materials in Underground Coal Mining.” This research has included full-scale testing of belt materials to validate the Belt Evaluation Laboratory Test (BELT) as a means of evaluating the fire resistance of belt materials. Research is continuing to evaluate the efficacy of current standards for water-based suppression systems as well as alternative systems used to control fires over the range of belt air velocities. The research is also investigating new approaches in early detection of belt fires and improvements to mine fire modeling software to assess the potential impact of a fire on escape routes. NIOSH is communicating results of this work directly to MSHA and to mining stakeholders through industry conferences and publications.

Mine Atmospheric Monitoring: Continuous monitoring of gas concentrations in sealed and active gob areas (mined out areas made up of caved in rock) would allow mine operators to identify changing conditions that indicate developing gas explosion or spontaneous combustion hazards. However, monitoring these areas with conventional electronic systems can introduce an ignition source to this potentially hazardous area of a mine. To address this problem, NIOSH procured a monitoring system, used in approximately 50 coal mines internationally, that continuously draws air samples from the mine through a network of tubing to a gas analyzer on the surface. NIOSH is currently demonstrating this “tube bundle system” at a longwall coal mine to serve multiple research goals including:

- assessing combustible and toxic gas concentrations in real-time in the active areas of the mine;

- monitoring for developing spontaneous combustion hazards in the active longwall gob to validate modeling software developed by NIOSH; and
- documenting the mixing of gasses in a mine gob after completion of the longwall panel to improve ventilation design models.

The tube bundle system also has the potential to remain in operation during response to certain mine emergency events without increased risk to rescuers.

Ground Control Study of Deep Cover Retreat Mining: NIOSH conducted, in collaboration with the University of Utah and West Virginia University, a study of the recovery of coal pillars through retreat room and pillar mining practices in underground coal mines at depths greater than 1500 feet. This study was of special interest following the tragedy that occurred at the Crandall Canyon Mine. NIOSH has investigated the safety implications of retreat room and pillar mining practices, with emphasis on the impact of full or partial pillar extraction mining and has developed recommendations and research requirements for addressing the safety issues of ground control under these mining conditions. At NIOSH's request, MSHA is reviewing this study, and NIOSH expects that the study will soon be completed.

Disaster Response

Contracts and Grants Program: As mandated in section 6 of the MINER Act, NIOSH established a contracts and grants program that funds the development and adaptation of safety technologies for mining applications. Under this program, NIOSH has funded 29 proposals. This year NIOSH received an additional 38 proposals, which are undergoing technical review. Awards for the most meritorious proposals are expected this fiscal year. In addition, NIOSH established a contracts program for mine ventilation research and capacity building to expand the number of trained professionals which work in this area. The contracts are designed to support research, exploratory development, testing, or evaluations of innovations and new technologies to improve mine health and/or safety in the area of mine ventilation. NIOSH has awarded seven five-year contracts for ventilation research to universities throughout the United States.

In addition, NIOSH established an Inter-Agency Working Group to provide a formal means for federal government agencies to share technology that can be applied to mining safety. The Working Group includes representatives from NIOSH, MSHA, the National Aeronautics and Space Administration (NASA), the Naval Research Lab, the U.S. Army Engineering and Research Center, Sandia National Laboratory, and a number of additional research labs or offices within the Departments of Defense, Energy, and Homeland Security.

The NIOSH Contracts and Grants Program can be divided into three primary areas as defined by the MINER Act: communications and tracking, refuge alternatives, and self-contained self-rescuers.

Communications and Tracking: The MINER Act established requirements for post-accident communications and tracking and charged NIOSH with developing and improving mine safety technologies. Furthermore, each coal mine was required to submit an emergency response plan, which incorporates post-accident communications and tracking, to MSHA within three years of the enactment date. In 2006, virtually no MSHA-approved communications and tracking systems that met the intent of the MINER Act were commercially available.

In response NIOSH established with its domestic and international partners a comprehensive strategy and research program to develop new, and enhance existing, communications and tracking technologies for post-accident applications in underground coal mines. This strategy is designed to deliver improved post-accident functionality within the MINER Act timeframe, while facilitating continuous improvements to these platforms. The private sector developed additional technologies in parallel with NIOSH's efforts.

NIOSH categorizes its communications research into two major areas – Primary Systems and Secondary Systems. Primary Systems operate in conventional radio bands, use small antennas that permit wearable transceivers with long battery life, and provide sufficient throughput for routine, daily mine communications. Secondary Systems operate in non-conventional frequency bands, use large antennas that are best suited for fixed or portable applications, and do not have sufficient throughput for everyday mine communications. Thus, Secondary Systems are primarily intended for emergency use.

Primary Systems include leaky-feeder systems, which use perforated coaxial cables to carry radio signals, and node-based communications, which employ a network of nodes using a digital format. Becker/Pillar and Innovative Wireless/L3, respectively, developed the systems under NIOSH contracts. The node-based system serves a dual purpose of communications and tracking. Both leaky-feeder and node-based systems have been installed, tested, and demonstrated in underground mines and are now MSHA-approved and commercially available.

Primary Systems require an in-mine infrastructure that is inherently vulnerable, so their survival after a catastrophic event depends on redundant communications paths. In non-production areas of a mine, direct paths to the surface are accessible only via shafts and boreholes. These alternative paths are not readily available within working sections; therefore, in-mine redundancy of communications pathways, although less effective, must be used.

Secondary Systems include medium-frequency systems, which use the metallic structures within the mine to transmit signal, and through-the-earth systems, which exploit wireless options. These systems require minimal infrastructure and thus have better chances for survival after an emergency event. A NIOSH contract awarded to Kutta/U.S. Army produced a medium-frequency system, while contracts awarded to Lockheed Martin, E-Spectrum, Alertek, Teledyne Brown Engineering, Stolar, and Ultra Electronics are directed toward the development of through-the-earth systems.

A Secondary System cannot support routine mine communications because of limited throughput. Though it does not provide wide-area coverage, it provides an alternative communications path out of the mine (i.e., it substitutes for a borehole in a working section). Ideally, a Secondary System provides a backup, emergency channel for a Primary Communications System.

The medium-frequency system has been successfully tested and is in the MSHA approval process. Through-the-earth systems are still in the development stage. Although successful preliminary testing has occurred, the principal challenge is designing a system that can support two-way communications at power levels that are low enough to meet MSHA approval requirements. Despite the technological obstacles, NIOSH will continue to support advances in these critical technology areas.

NIOSH is planning to perform long-term, targeted research to address information gaps in communications and tracking. Identified gap areas include the safety issues of distributed and isolated batteries in communication and tracking systems, performance measurement and estimation techniques, compatibility considerations, and electromagnetic signal propagation in mining environments.

Refuge Alternatives: In response to MINER Act mandates, NIOSH has successfully conducted extensive research into the utility, practicality, survivability, and cost of various refuge alternatives in an underground coal environment. This research, through both in-house and contract efforts, included field tests of approved and commercially available refuge chambers. Sharing information is an important part of the response to the MINER Act; thus a NIOSH-MSHA Working Group was established to facilitate the flow of information and to enhance NIOSH research efforts. NIOSH prepared a report detailing the results of this research and providing specific recommendations that could inform the regulatory process on refuge alternatives. In December 2007 NIOSH delivered the report to the Secretary of Labor, the Secretary of Health and Human Services, the Senate Committee on Health, Education, Labor, and Pensions, and the House Committee on Education and the Workforce.

NIOSH has also addressed the training issues associated with refuge alternatives and has developed individual training products on topics such as the decision-making process of when to use a refuge chamber, operational guidelines for instructional materials, and how to use a refuge chamber. Significant work is needed in the area of expectations training, and NIOSH has a first module nearly completed in this area.

State and federal efforts resulted in the introduction of refuge chambers throughout the underground coal industry. However, alternatives to chambers such as an in-place shelter were left largely untouched and a range of chamber operational questions remain unknown. As a result, mineworker confidence in these chambers is low, and the value of this potentially lifesaving technology remains undetermined.

NIOSH has evaluated international best practices in self-escape and mine rescue operations to identify opportunities to improve U.S. mine preparedness. NIOSH researchers identified the value of introducing improved realism in mine rescue training and the importance of behavioral health issues in preparing miners and rescuers for response to an emergency. Researchers identified the need to improve training facilities and to use more standardized training and procedures in order to improve the ability of teams from different mines to work together during emergencies. NIOSH has communicated these findings at a number of industry events and worked directly with mine rescue teams to initiate change.

Self-Contained Self-Rescuers: The NIOSH research and evaluation program for self-contained self-rescuers (SCSRs) addresses new technology, standards for certification, training, and testing of mine-deployed SCSR.

New Escape Respirator Technology. NIOSH awarded a contract to Technical Products, Inc. (TPI) in February 2007 to design and fabricate an oxygen-supplying SCSR with “piggy-back” technology to allow a trapped or escaping miner to replenish his oxygen supply while underground. The new SCSR design includes a docking port mechanism that allows the user to plug in additional oxygen units without opening the breathing circuit to the potentially poisonous

atmosphere. The docking port requires that a second oxygen unit be plugged in before the valve can be repositioned to the alternate port. In addition to this docking capability, the escape respirator employs a new chemical technology for removing carbon dioxide from the exhaled breath. This new chemical technology will facilitate lower breathing effort by the user and be more capable of withstanding the rigors (shock, vibration, and rough handling) encountered in daily use. Other innovative materials and design features make the new escape respirator easier to manufacture and more comfortable to wear and use.

Under the same contract, TPI also developed a new technology filter self-rescue respirator for use in carbon monoxide atmospheres. The new filter self-rescue technology uses a catalytic process to remove carbon monoxide, resulting in longer protection from a smaller filter than current filter self-rescue technology. The new filter self-rescue respirator can be docked with the escape respirator to provide protection in atmospheres where the only hazard is carbon monoxide.

The designer and manufacturer of the new respirator technologies is expected to apply for NIOSH certification. In addition to the contract work on the docking escape respirator system, NIOSH has been working to increase awareness of other escape respirator technologies commercially available and used in other countries.

Standards for Certification Evaluation and Testing. On December 10, 2008, NIOSH published in the Federal Register a proposed regulation for certification, evaluation, and testing of closed-circuit escape respirators. The proposed regulation would replace current certification evaluation and test requirements identified in 42 Code of Federal Regulations, Part 84. The proposed regulation would enable state-of-the-art technology for both test and performance of escape respirators. In 2009, NIOSH held two public meetings to discuss the proposed regulation and opened a docket to enable interested parties to provide comment. NIOSH is currently reviewing the comments submitted to the docket and expects to submit a final rule this fiscal year.

User Training for SCSRs. NIOSH conducted a research project to evaluate the effectiveness of SCSR user training programs developed by NIOSH in collaboration with MSHA. In 2009, NIOSH worked with 11 mines and two mine training centers to conduct the training effectiveness evaluation on 461 miners. NIOSH and MSHA are now analyzing the training effectiveness evaluation and expect to complete the analysis this year.

Testing of SCSRs. In 2007, NIOSH redesigned the Long-Term Field Evaluation (LTFE) Program for SCSRs to change the focus from a research program to a respirator certification audit program. The LTFE Program redesign includes a valid sampling strategy to select SCSRs from mines for testing, uses defined evaluation performance criteria with a documented test protocol, and incorporates a procedure for conducting follow-through actions based on evaluation results. The redesigned protocol was peer-reviewed and discussed at two public meetings prior to implementation. NIOSH also established an open comment docket for stakeholder comments.

In May 2009 NIOSH launched the redesigned LTFE, starting with the collection of SCSRs from mines following a random sampling plan using the MSHA SCSR inventory. As of March 2010, NIOSH had collected 259 SCSRs from 153 mines, and had tested 173 SCSRs following the redesigned protocol. Collected and tested SCSRs represent respirators from each of the four

models currently used in mining operations. Following the new protocol and performance criteria, one respirator model exhibited the same test failure on two respirators. The failures are under investigation to identify the cause and to determine corrective actions.

Although this hearing is focusing on disaster prevention, everyday mine workers face a risk of injury or occupational illness. Advances in engineering and training interventions, developed in partnership with labor, industry, and government, have made significant reductions to nonfatal and fatal traumatic injuries. Yet more still needs to be done to approach a zero harm goal. NIOSH has a balanced research portfolio to address injuries in areas including ground control, electrical safety, and materials handling. In addition to developing solutions to specific problems, NIOSH is examining the advantages and limitations of additional approaches such as improving the safety culture and employing risk assessment methods.

Occupational exposures to noise and respirable dusts can result in unacceptable health outcomes for workers. For example, over 70,000 coal miners have died with black lung disease over the past 40 years. NIOSH has a major research focus on the development of engineering controls to reduce exposures to dusts and noise, and has successfully developed and introduced many of these into the mines. Perhaps the most significant event, however, is the successful implementation of the personal dust monitor – a technology that will, for the first time ever, allow mineworkers to know their exposure to coal dust in real time, then enabling operators to make changes to the engineering controls that can reduce miners' exposure. I would like to conclude by summarizing our work on this life-saving technology.

Personal Dust Monitor (PDM): In 2006, NIOSH published an influential document entitled, “Laboratory and Field Performance of a Continuously Measuring Personal Respirable Dust Monitor.” This document proves the personal dust monitor (PDM) to be a mine-worthy, accurate, and reliable real-time dust monitor that can provide miners and mine management with a powerful tool to prevent the overexposure of underground coal miners to respirable dust. The dust monitor is built into the miner's cap lamp system and provides real-time dust exposure data. The PDM has the potential to be used for compliance respirable dust sampling and as an engineering control tool. Significant progress has been made on advancing PDM technology into underground coal mines in the United States. Key developments are as follows:

- NIOSH and MSHA jointly developed 30 CFR Part 74 – Certification of Continuous Personal Dust Monitors. This regulation enables NIOSH and MSHA to certify PDMs for use as a compliance sampler in underground coal mines. The effective date of this regulation is June 7, 2010. NIOSH and MSHA expect to receive soon a request from the manufacturer to certify the PDM for U.S. mine compliance sampling.
- MSHA is modifying how coal mine dust is sampled under 30 CFR Parts 70, 71, and 90, covering, respectively, dust sampling procedures, dust control plans, and special sampling for miners with evidence of black lung. NIOSH has been providing significant technical assistance on the appropriate application of the new PDM technology in underground coal mines.
- The Personal Dust Monitor Management System (PDMMS) software package was recently developed and tested. A June 2010 release is anticipated. This software

collects, secures, and stores PDM data in an easily accessible data base and can produce reports in a variety of formats based on the needs of the end user.

In July 2009, the PDM commercial manufacturer, Thermo Scientific, began commercial sale of the PDM. From an initial production run of 122 units, 81 were sold to mining companies and are currently in use. Thermo Scientific has received orders for an additional 100 units from mining companies and is building the units. NIOSH researchers are also tracking the performance of these units around the United States.

Conclusion

In closing, NIOSH continues to work diligently to protect the safety and health of mine workers. The most recent mine disaster underscores the relevance of past NIOSH work and continued need for further safety and health research. NIOSH has made significant improvements in the areas of communication and tracking, oxygen supply, and refuge alternatives. Moreover, NIOSH's safety and health research program is addressing the critical areas identified by our customers and stakeholders, and through research, development, demonstration, and diffusion activities, NIOSH is enabling a shift to a prospective harm reduction culture in the mining industry. I appreciate the opportunity to present NIOSH's work to you and thank you for your continued support. I am pleased to answer any questions you may have.

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Dr. Howard received his Doctor of Medicine from Loyola University of Chicago in 1974, his Master of Public Health from the Harvard School of Public Health in 1982, his Doctor of Law from the University of California at Los Angeles in 1986, and his Master of Law in Administrative Law from the George Washington University in Washington, D.C. in 1987.

Dr. Howard is board-certified in internal medicine and occupational medicine. He is admitted to the practice of medicine and law in the State of California and in the District of Columbia, and he is a member U.S. Supreme Court bar. He has written numerous articles on occupational health law and policy.