

MINUTES

**MINE SAFETY AND HEALTH RESEARCH ADVISORY COMMITTEE (MSHRAC) MEETING
MAY 10, 2016, 9:00 AM – 5:30 PM
HILTON GARDEN INN PITTSBURGH / SOUTHPOINTE
1000 CORPORATE DRIVE
CANONSBURG, PA 15317**

COMMITTEE MEMBERS & ATTENDEES PRESENT

Dr. Priscilla Nelson, Department Head and Professor, Department of Mining Engineering, Colorado School of Mines, Chair of MSHRAC, called the meeting to order at 9:00 a.m.. The following members were present:

Mr. Jeffrey Welsh, NIOSH, Designated Federal Officer
Dr. Sukumar Bandopadhyay, Professor of Mining Engineering, University of Alaska Fairbanks
Dr. Jefferey Burgess, Director, Division of Community, Environmental and Policy, University of Arizona (Dr. Burgess departed the meeting at 3:00 pm)
Mr. Dale Drysdale, Vice President of Occupational & Environmental Health, National Stone, Sand & Gravel Association
Dr. Kramer Luxbacher, Associate Professor, Assistant Department Head, Mining and Minerals Engineering, Virginia Polytechnic Institute and State University
Mr. Bruce Watzman, Senior Vice President, National Mining Association
Mr. Michael Wright, Director of Health, Safety and Environment, United Steelworkers of America
Mr. Kyle Zimmer, Director of Health and Safety, International Union of Operating Engineers
Dr. Richard Fragaszy, Program Director, Division of Civil, Mechanical and Manufacturing Innovation, National Science Foundation
Dr. Jeffery Kravitz, Chief, Scientific Development, Mine Emergency Operations, Mine Safety and Health Administration

The following attendees were also present:

Gerald Finfinger, Pittsburgh, PA
Carl Sunderman, NIOSH-SMRD, Spokane, WA
Marie Chovanec, NIOSH, Pittsburgh, PA
Robert Randolph, NIOSH-PMRD, Pittsburgh, PA
Eric Lutz, NIOSH-SMRD, Spokane, WA
RJ Matetic, NIOSH-PMRD, Pittsburgh, PA
Michael Payton, UMWA
Jack Trackemas, NIOSH-PMRD, Pittsburgh, PA
Michael Peelish, Law Offices of Adele Abrams, Beltsville, MD
Jessica Kogel, NIOSH, Atlanta, GA
Patrick Dempsey, NIOSH-PMRD, Pittsburgh, PA
David Snyder, NIOSH, Pittsburgh, PA
John Burr, NIOSH, Pittsburgh, PA
Aleksandar Bugarski, NIOSH-PMRD, Pittsburgh, PA
Kelly Bailey, Vulcan Materials, Birmingham, AL
Chad McDougal, Vulcan Materials, Birmingham, AL
Dana Willmer, NIOSH-PMRD, Pittsburgh, PA
Dave Yantek, NIOSH-PMRD, Pittsburgh, PA
Eileen Storey, NIOSH-RHD, Morgantown, WV
Scott Laney, NIOSH-RHD, Morgantown, WV
David Blackley, NIOSH-RHD, Morgantown, WV
Jonisha Pollard, NIOSH-PMRD, Pittsburgh, PA
Cara Halldin, NIOSH-RHD, Morgantown, WV
Drew Potts, NIOSH-PMRD, Pittsburgh, PA
Sarah Felknor, NIOSH, Atlanta, GA
Pamela Drake, NIOSH-SMRD, Spokane, WA
Dan Wolff, Crowell & Moring, Washington, DC
Maryann D'Alessandro, NIOSH-NPPTL, Pittsburgh, PA

Peter Kovalchik, NIOSH-PMRD, Pittsburgh, PA
Miguel Reyes, NIOSH-PMRD, Pittsburgh, PA
Gerrit Goodman, NIOSH-PMRD, Pittsburgh, PA

Mr. Welsh explained that MSHRAC members participating in the meeting must be free from conflicts of interest. He asked members to declare conflicts of interest before the morning session and the afternoon session prior to the start of the session. There were no conflicts from members reported.

Dr. Nelson read the minutes from the last meeting and S. Bandopadhyay moved to approve the minutes as written. M. Wright seconded the motion, and after a brief discussion where a consensus was reached to circulate the draft minutes to the committee members as soon as they are prepared following the meeting, it was passed unanimously.

DR. JOHN HOWARD, TELEPHONIC REPORT FROM THE DIRECTOR, NIOSH

Dr. Howard welcomed the committee members and extended his appreciation for their participation and service. He stated that he was the Acting NIOSH Associate Director for Mining for a little over one year and is very happy to have Dr. Jessica Kogel as the permanent NIOSH Associate Director for Mining (ADM) as well as Dr. Eric Lutz as the permanent Director of the Spokane Mining Research Division (SMRD). He expressed his thanks to those who assisted the mining program while the search for the new permanent ADM and SMRD Director was underway. He specifically thanked Dr. Lewis Wade, Dr. Gerald Finfinger, Dr. RJ Matetic, and Ms. Pamela Drake.

DR. JESSICA KOGEL, REPORT FROM THE ASSOCIATE DIRECTOR FOR MINING SAFETY AND HEALTH, NIOSH

Dr. Kogel gave a report covering NIOSH Mining Program highlights including vision, organization, staffing, research portfolio, recent changes and future plans. The vision for the program is to be recognized as the world leader in mine worker health and safety research. Six priority areas must be addressed to achieve this vision including an evaluation of the current program's alignment with current and future stakeholder needs and priorities. Recognizing the fact that the industry is going through a transition, the ultimate goal is to reposition, if necessary, the research program to meet the changing landscape around mine worker health and safety. Dr. Kogel described recent changes in the organization including the creation of two geographically focused research centers: the Spokane Mining Research Division in Washington and the Pittsburgh Mining Research Division in Pennsylvania each with its own leadership and budget. Data were presented to illustrate the need for regionally focused efforts to better address the unique mine worker health and safety challenges in the eastern and western US. NIOSH Mining Program head count and vacancy statistics were also shared along with a commitment to implement a workforce readiness and sustainability program. An overview of the research program's strategic goals and funding allocation was presented. The top three areas in terms of funding for FY16 include ground control (36%), disaster prevention (30%) and respiratory disease (16%). Over 50% of funding in FY16 was directed towards research for the coal sector. Although coal fatalities in 2015 were at a historically low level, BLS data for 2014 show that coal injury rates are higher than the private industry baseline (3.8 per 100 FTE for coal versus 3.2 per 100 FTE for private industry).

Question from P. Nelson: Will actual budget allocations within the program and ways to develop more collaborative relationships be available at the next meeting? Response: We will share more details about funding to help MSHRAC meet their charter. Knowing how much is invested in a project or program is a reasonable request and can be provided to the committee. OMSHR is eager to develop collaborative relationships that go beyond the role of awarding contracts; however, this question needs to be more fully explored before we can commit to anything specific. The MINER Act program is under review and areas for improvement have been identified including expanding NIOSH's role throughout the entire technology development lifecycle including technology diffusion into the marketplace. This expanded role, if implemented, may provide the basis for more collaborative relationships with universities for example.

Question from B. Watzman: What is your sense of the support of the mining program from CDC? Previous committee's had to intervene with congress because of CDC's budget allocation decisions. Response: CDC fully supports the mining program and funding is expected to continue at current levels.

DR. RJ MATETIC, REPORT FROM THE PITTSBURGH MINING RESEARCH DIVISION, NIOSH

Dr. Matetic discussed: 1) PMRD overview, 2) Key program areas, 3) Program portfolio distribution by mining sectors, 4) Recent products and technology developments, and 5) Staffing, succession planning and workforce development plan.

The Pittsburgh Mining Research Division (PMRD) has the following seven goals for mine worker health and safety: 1) Eliminate respiratory diseases, 2) Reduce noise-induced hearing loss, 3) Reduce the risk of musculoskeletal disorders, 4) Reduce the risk of traumatic injuries, 5) Reduce the risk of mine disasters, 6) Eliminate ground failure fatalities and injuries, and 7) Reduce adverse health and safety consequences through effective interventions with new technology.

Key PMRD program areas are : 1) Reduce occupational illness – Diesel assessment & control, Respirable dust assessment & control, Hearing loss prevention, 2) Reduce injuries and fatalities – Health & safety management systems, Musculoskeletal disorder prevention, Training research & development, Illumination, ground control, Electrical machine safety, safety culture, Surveillance, and 3) Disaster prevention & response – Atmospheric monitoring & control, Refuge alternatives, Breathing air supplies, Communications & tracking, Emergency response & rescue, Explosion prevention, Fire prevention & control, and Ventilation.

Dr. Matetic explained that the PMRD FY2016 program has 27 projects in 7 branches distributed across mining subsectors. Overall, 21% of PMRD projects address Stone, Sand & Gravel H&S issues, 21 % Metal & Nonmetal, and 58 % Coal.

Products and technology developments from PMRD in the last 3 years include: LED lighting for roof bolting machines, Continuous personal dust monitor, ErgoMine mobile auditing app, Helmet-CAM & Evade 2.0 software, Coal dust explosibility meter, Diesel particulate matter monitor, VISLab simulated mine environment lab, and BG 4 benching trainer software.

Next Dr. Matetic discussed PMRD staffing. There are currently 157 employees at PMRD, and the new organizational structure has a total of 221 positions. Sixty-two employees can retire within 3 years. Dr. Matetic then discussed what is being done for succession planning and workforce development.

Question from M. Wright: If all of the unfilled positions are filled, then a 40% funding increase is needed. Will this be an issue?

Response: This is true if we are successful in filling all of the vacancies and it is not likely that we will be successful in filling all of them. We currently have an open continuous announcement for mining and mechanical engineers that we are hoping to capitalize on.

Comment from K. Luxbacher: NIOSH does an excellent job of communicating research findings and safety meetings and training modules would help to disseminate those findings to small mines.

Question from J. Kravitz: Is CDC pursuing a replacement for the Lake Lynn Laboratory?

Response: CDC is working to identify a Lake Lynn Laboratory replacement. The process is progressing and we should have a replacement facility purchased by the summer of 2017.

Question from M. Wright: Somebody needs to expand research findings to the oil and gas sector – is NIOSH mining planning to expand to this sector?

Response: Dr. Kogel and Dr. Matetic will be meeting in June with the NIOSH Western States Division to talk about collaborating on oil and gas research.

Question from J. Kravitz: NIOSH could coordinate with MSHA on the issue of disseminating research findings to small mines?

Response: In the past, NIOSH has worked with MSHA on the small mines initiative. A seminar was conducted in Logan, WV that was very successful.

DR. ERIC LUTZ, REPORT FROM THE SPOKANE MINING RESEARCH DIVISION, NIOSH

Dr. Lutz presented a summary of the Spokane Mining Research Division (SMRD). Western mining operations are experiencing unique health and safety challenges due to geographic isolation, challenging mining environments, and dynamic operational pressures due to commodity price fluctuation. In response, SMRD is experiencing a period of research portfolio expansion, organizational restructuring, and dynamic growth to support the needs of the western industry sectors. Within the next 24 months, the SMRD is adding an additional 25 staff, growing from 35 current employees to approximately 60. These recruitment efforts are also an attempt at mitigating challenges related to attrition, specifically that 31% of SMRD staff are eligible for retirement within the next year and 51% reach this stage within the next 5 years. With the additional staff, SMRD will re-organize the structure in two phases. Phase one will add a fourth team, so that the Division will include: Ground Control, Ground Stability, Ventilation, and Exposure and Health Surveillance Teams (new). Phase two will divide the four teams into two branches, to include the Miner Safety Branch, housing the Ground Control and Ground Stability Teams and the Miner Health Branch, with Ventilation and Exposure and Health Surveillance teams. This restructuring will also provide two additional senior leadership positions in the form of Branch Chiefs. In response to western mining health and safety burden and stakeholder needs, research efforts include: stability in underground and surface mining to minimize man-made and naturally-occurring catastrophic rock failures in metal/non-metal and coal mining (Ground Stability Team), improved mining methods in challenging underground environments (Ground Control Team), advancing technology to minimize respiratory exposures (Ventilation Team), and reducing safety and health risks like noise, thermal stress (hot and cold), chemical exposures, and improving miners fitness-for-duty (Exposure and Health Surveillance Team). SMRD is also developing additional surveillance capabilities toward understanding mining-related chronic disease risks and occurrence.

Question from S. Bandopadhyay: In the arctic there is cold stress for workers. Are you also considering that in addition to heat stress? University of Alaska offered to collaborate. Yes, the current project on heat stress is part of a broader new program initiated in SMRD on Thermal Stress, which will include cold stress. SMRD representatives are engaging with operations in Alaska in summer of 2016 through spring 2017 to clarify cold stress related health and safety burden and operational needs.

Question from J. Burgess: Expanded discussion on the health plan – important area is chronic disease. The Mining Program concurs that a lack of information exists related to chronic diseases across the mining sectors, especially in metal/non-metal mining. The SMRD is establishing a Miner Exposure and Health Surveillance Team, expanding our capacity to conduct chronic disease surveillance and thus, address the gap of defining burden in the mining industry.

Question from J. Kravitz: Mining seismicity research – is it both metal/nonmetal and coal?

Response: Yes to both. SMRD has active ground stability and seismic research projects in both coal and metal/nonmetal mining.

M. Wright commented that a lot of hazards in fracking in the oil and gas sector are similar. Recognizing that the historic and present Mining Program research portfolio includes many areas of overlap with the contemporary oil and gas health and safety needs, a Partnership in Oil and Gas Extraction Safety and Health Research meeting has been scheduled to occur in the summer of 2016 in Denver, CO. Invitees include representatives across NIOSH Divisions, industry, and regulators.

DR. SARAH FELKNOR, NATIONAL OCCUPATIONAL RESEARCH AGENDA – ASSESSING BNI, NIOSH

Dr. Sarah Felknor presented the plans for the third decade of the National Occupational Research Agenda (NORA) and the framework NIOSH has developed to identify research priorities and guide research investments over the next 10 years. She acknowledged the many thought leaders across NIOSH who have contributed to the development and launch of this initiative.

Some background and context was provided to help distinguish between NIOSH and NORA, which was a frequent question during the second decade. NIOSH is the U.S. federal health agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. NIOSH creates new knowledge in the field of OSH and transfers it globally into practice through a variety of scientific activities including: Research, Surveillance, Field Investigations; and Recommendations.

NORA was launched in 1995 by NIOSH as a public-private partnership designed to engage a diverse set of stakeholder interests and perspectives and to chart a research course in 10-year cycles. NORA was recognition that no one organization had the resources or capacity to completely address the research needs of the US working population and that partnerships were essential. NORA provided a framework for the entire occupational safety and health community and guided research for the nation. NORA responded to the NIOSH vision of "Delivering on the Nation's promise: safety and health at work for all people through research and prevention."

Dr. Felknor provided a brief overview of the evolution of NORA over the last 20 years. Each decade of NORA has been grounded in fundamental questions that characterized the challenges of the time and helped guide the structure and purpose of that 10-year cycle. In the first decade, the guiding questions were; "What will the workplace of 2006 look like? What research will be needed to ensure a safe and healthy workplace?" To respond to these challenges, the first decade of NORA was organized into 21 Focus Areas that prioritized OSH research for NIOSH and the nation. NORA became a map by which the OSH community could identify, generate, design and fund priority research efforts. By the time the first decade was launched, more than 500 individuals and organizations had contributed to the development of NORA. No previous occupational research agenda had captured such broad input.

In the second decade, NIOSH was challenged to understand how to better move research into practice in the workplace. The response was the development of Sector Programs that would serve as the conduit to the working population in the United States. These 10 Sector Programs were organized around the 20 business sectors defined by the NAICS codes and organized into groups (initially 8, then 10) based on their similarities with workplace safety and health issues. During this decade, NIOSH organized 24 intramural Cross-Sector Programs to support Sector Program goals and priorities.

The third decade of NORA is facing slightly different challenges that ask "What research should we be doing in 2020 and beyond? Can an efficient and effective structure be found to identify and integrate research priorities?" In the third decade of NORA, NIOSH will continue with the 10 Sector Programs whose aim is to prioritize OSH research by major areas of the US economy. In addition, there will be 7 Cross-Sector Programs whose aim is to identify national OSH research priorities according to the major issues affecting the US working population.

In the third decade NIOSH has defined Core & Specialty Programs that represent the core activities, mandates, special emphasis areas and methodological approaches to research. Many of these Core & Specialty Programs were organized as intramural Cross-Sector Programs in the second decade, and also reflect some of the Focus Areas of the first decade.

Dr. Felknor then reported on a new structure NIOSH has developed to identify and integrate research priorities in the third decade of NORA. The BNI method (Burden, Need and Impact) will be used to help identify and define research priorities. The central tenets of the BNI Method are that NIOSH must do the most important work to protect the workforce; must identify research priorities to guide the investment of scarce resources in a clear and transparent manner, and base these priorities on the evidence of Burden, Need and Impact.

Dr. Felknor then described the operational definitions for Burden, Need and Impact. Burden provides evidence of the health and safety and economic burden (or potential burden) of workplace risks and hazards. In considering these burden estimates, we will also consider how well the burden evidence is assessed. Emerging issues, which would not have established burden due to their emerging nature, would have potential burden that could be described by many of the same parameters of established burden – such as potential for injury, illness, disability and mortality. Need helps define the knowledge gap the proposed research will fill. It considers the comparative advantage NIOSH has over other funding agencies and the unique resources NIOSH might have to respond to research need. Need is where stakeholder needs are identified and addressed. Impact is where we consider how well the research is conceived and likely to address the need. Impact or potential for impact helps us consider if the proposed research can create new knowledge, lead others to act on findings, promote practical intervention, adopt a new technology, develop evidence-based guidance, aid in standard setting or promote other intermediate outcomes. Consideration of impact is where we look to see if the proposed research will likely lead to a decrease in worker injury, illness, disability or death, or enhance worker well-being. Together, and in sequence, the BNI method will help NIOSH select priority research to guide investments to ensure that we are doing the most impactful work to protect the workforce.

Dr. Felknor described the matrix-like structure by which NORA Programs will work together to identify and integrate priority goals for major sectors of the US economy and major OSH issues facing the US workforce. She also mentioned that this approach has been pilot tested internally with good results thus far.

Dr. Felknor mentioned that the formal announcement of plans for the third decade of NORA will be made late summer and the third decade of NORA will begin on October 1, 2016.

Question from P. Nelson: Various DOE tensions with labs and universities and intramural and extramural and only having a meeting once per year. Has NORA thought of this problem?

Response: Plans for the 3rd decade include more than annual meetings and we plan to pursue using web-based technologies to provide additional opportunities for councils and work groups to meet on a more frequent basis.

Question from P. Nelson: Will extractive industries be brought together to look at cross industry issues?

Response: The Mining and Oil and Gas Extraction Sectors Councils will be from a broad stakeholder base.

Question from J. Burgess: How do you assess burden?

Response: Burden is assessed through evidence of the health and safety and economic burden (or potential burden) of workplace risks and hazards, such as morbidity and mortality, disability and severity, economic costs and emerging issues.

Question from J. Kravitz: Will BNI be applied to the Mining Sector Council?

Response: NIOSH does not expect the councils to use the BNI method to generate their individual sector or cross-sector program agendas. NIOSH will use BNI to identify priorities for the work it then takes up from the sector and cross-sector agendas.

DRS. JESSICA KOGEL AND LISA STEINER, COMMITTEE DISCUSSION: MINING PROGRAM RESEARCH PORTFOLIO, NIOSH

NIOSH's Mining Division uses a systematic process to determine gaps and focus areas for new research areas and/or technology development. Influences from worker health data, mining injury/illness/fatality data, stakeholder input from mining associations, labor, and MSHRAC, and current and trending regulatory mandates are compared to the current research efforts and our established strategic plan to identify gaps for future research and funding commitments. These gaps are then identified to and reviewed by stakeholders for feedback as to importance and practicality. The final focus area list is used to establish guidance for both internal and external project concepts. Once a concept is submitted, it is critically scored as to its identification of burden, need and impact by the mining division lead team (and possibly MSHRAC going forward) and is reviewed for full proposal potential. The full proposals are written and submitted for external review by subject matter experts using specific review questions. The concept to full proposal process occurs from November through early September with a new project start date of October 1. Dr. Kogel shared with the committee a list of emerging areas and trends that she has identified as potential future research drivers and priorities. These include more underground mines, deeper mines (surface and underground), a higher proportion of coal sourced from Illinois and Powder River Basins compared to Appalachia, increasing automation, changing workforce demographics, alternative fuels and more battery powered equipment.

A committee member asked the question: In your mind, what is MSHRAC's role in assessing outcomes at the end of research? Response: NIOSH could use MSHRAC during 2 key phases in the research process. The first is to vet research/technology gaps and the second is to provide subject matter expertise which would include assessing research outcomes.

A committee member asked a question about the overlap of the NORA and NIOSH strategic plans? Response: The Mining Sector Council NORA Research Agenda is closely aligned with the NIOSH strategic goals.

A committee member commented that the 3 new strategic goals cover more and could be reduced to 1 strategic goal (Protect Mine Workers Safety and Health). Response: The idea is to reduce the number of goals without

losing specificity to the point where the goals are no longer meaningful. The comment is important and will be taken into account as we continue evaluating the 3 proposed goals. The strat plan will contain sub-goals.

Dr. Kogel asked the committee if they agree with the emerging trends that she presented:

S. Bandopadhyay: Climate change, big data

K. Luxbacher: Lower grade ore, moving more earth to get at reserves, smart mines, safety management tool

K. Zimmer: Social impact on cognitive issues, heat stress and hypothermia. Moving safety in another direction toward the human side.

J. Kravitz: Robotics – there is a need for a long distance explorer and drones in mines to address mine rescue issues in deeper and long distance remote areas

P. Nelson: International focus, consequences of deeper mines, overlap with construction and oil and gas. Lifecycle of a mine – some synergies that we aren't thinking about. Less mine closures. Concerned about academia – fewer viable programs. Look for new ways to support academic programs. Develop new types of partnerships with academia. Response: We aren't closing mines because they are being reworked. Reworking mines causes more challenges and issues. Agrees that mining program support is critical and that there are not a lot of funding opportunities for universities except for the Alpha Foundation. Bruce Watzman responded to Priscilla that do we really need the number of mining university programs due to the change in the mining industry.

J. Burgess: Oil and gas, tunneling, refineries and smelters. Mentioned that the Seattle tunnel rescue and response is close in proximity to Spokane. Add "and improve health" under occupational goals on the slide. Establish a burden estimate. Clarity between NORA and NIOSH. Collaboration between mining and oil and gas. Oil and gas exploration is applicable to mining.

B. Watzman: Change in philosophy, risk-based process to manage safety and health.

M. Wright: He believes that there is a lot of overlap between oil and gas and mining over land but not underground. A greater proportion of coal in Powder River instead of more coal. Increasing globalization of mining companies.

D. Drysdale: Consolidation of companies – larger companies typically have more resources. Increasing automation is really big and includes, for example, remote controlled heavy vehicles. Barriers to recruiting, most young people do not think about or understand mining and don't want to work in mines. Some operators have successfully recruited younger workers by educational outreach programs. Other barriers or opportunities exist for ex-military personnel who may be recruited to work in mines. Many of them have heavy-equipment experience, but there may be human factor issues for those whose injuries resulted, for example, in missing limbs, that require innovative accommodations.

R. Fragaszy: Funding for research, reduced demand for coal and closing of coal mines.

The additional emerging trends suggested by the committee will be added to the list.

The committee broke for lunch at 12:15 pm and reconvened at 1:15 pm.

DR. MARYANN D'ALESSANDRO, UPDATE FROM THE NATIONAL PERSONAL PROTECTIVE TECHNOLOGY LABORATORY – BREATHING AIR SUPPLY, NIOSH

The NIOSH National Personal Protective Technology Laboratory (NPPTL) supports the Mining Industry Sector by conducting personal protective technology and equipment research, standards development, and respiratory protective device conformity assessment to support mining occupational safety and health. A summary and status update of the presentation provided to MSHRAC follows.

1. Closed Circuit Escape Respirator Rule, 42 CFR 84, Subpart O and Respirator Approval Activities

In March 2012, the Department of Health and Human Services (HHS) published a final rule (42 CFR 84, Subpart O) establishing a new standard for the NIOSH certification of closed-circuit escape respirators (CCERs). The new standard was originally designed to take effect over a 3-year transition period.

HHS determined that extending the concluding date for the transition is necessary to allow sufficient time for respirator manufacturers to meet the demands of the mining, maritime, railroad and other industries. NIOSH extended the phase-in period until 1 year after the date that the first approval is granted to certain CCER models. The final rule to extend the transition period for respirator manufacturers was approved in August 12, 2015. The respirator approvals obtained since the rule was finalized were described:

- Two CAP 1 (~ 10 minute unit) non-mining approvals have been issued: one to Avon Corporation in May 2015 and one to Ocenco Corporation in October 2015.
- Two Cap 3 mining approvals were issued: one for Ocenco Corporation in January 2016 and one to CSE Corporation in March 2016.

NIOSH offers manufacturers the opportunity to have a product evaluated to the NIOSH requirements prior to submitting an application for approval to assess the product's likelihood to meet the NIOSH requirements. This activity is tracked and managed as Correlation Testing.

2. Escape Respirator Post Market Evaluation

As of March 2016, approximately 235,936 escape respirators are in the MSHA inventory. NIOSH evaluates certified respirators to demonstrate that the products continue to conform to NIOSH requirements. In the mining environment this activity is known as the Long Term Field Evaluation Program (LTFE).

NIOSH is exploring alternative approaches to (1) collecting products for evaluation and (2) disseminating the evaluation findings. NIOSH continues its development of a standardized reporting format for mining users and manufacturers to expedite the approval and dissemination process. The current LTFE respirator collection activity is a labor and time intensive process. One full-time employee travels to mines throughout the country to collect and replace the respirators prior to returning to Pittsburgh to test the units collected. Since MSHA requires mines to assess 1% of their units annually, NIOSH is exploring opportunities to leverage this MSHA requirement to facilitate respirator collection and evaluation for the LTFE. NIOSH is collaborating with MSHA to determine the best path forward for this evaluation.

Resources have been dedicated to the respirator approval and correlation activities, consequently, this effort has not received the attention needed to complete the draft reports.

3. Next Generation Escape Respirator for Mining

NIOSH contract program initiated in 2011 to advance breathing air supply technology and provide a variety of escape solutions. NPPTL took over the activity in January 2016. The focus of the effort is two-fold: 1) to develop switchover capability via docking/switch-over valves without exposure to an irrespirable atmosphere between equivalent SCSRs, between different SCSRs, and between SCSRs and self-contained breathing apparatus (SCBAs). Enable verbal communications by users through the use of hoods with inner masks; and to 2) Provide efficiency improvements through the exploration of alternative solutions to SCSRs including very high pressure cylinders and reducers, SCBAs with air refill stations, ergonomic SCSR designs to improve comfort and usability, and cryogenics technology. The research underway expects to generate products available for field evaluation in the mining environment in one year. The research will be peer reviewed in fall 2016 and the path forward determined at that time. MSHRAC is encouraged to recommend potential peer reviewers for this effort. In addition, MSHA would like to explore current technologies to assess if other alternatives currently used in other industries could be leveraged for the mining environment. MSHA is holding a Stakeholder Meeting at the NIOSH Pittsburgh facility June 3, 2016 to discuss this topic further.

Questions from MSHRAC:

1. How big is the SCSR industry?

We do not have data on the size of the industry, but manufacturers have informed us anecdotally that the maritime industry is the bulk of their market for the CAP I products, and mining is the bulk of the industry for CAP III products.

2. What products are used in other countries?

Other countries use similar products, but in some countries the products are approved to the standards used in that country.

3. Are other countries interested in switchover capability?

Not to our knowledge.

DR. EILEEN STOREY, UPDATE FROM THE RESPIRATORY HEALTH DIVISION, NIOSH

Dr. Eileen Storey provided an update from the Respiratory Health Division. A major focus of work in the Division has been the expansion of the Coal Workers' Health Surveillance Program (CWHSP) in response to the 2014 Coal Mine Dust Rule issued by MSHA. The rule added spirometry testing and a respiratory health questionnaire to the chest radiograph and occupational history obtained from miners participating in the program, and it expanded health surveillance to include all surface coal miners and contractors. In August, 2014, NIOSH issued an Interim final rule 42 CFR Part 37 to (1) establish standards for the approval of facilities that conduct spirometry examinations, (2) outline spirometry interpretation procedures, (3) describe the requirement of a respiratory health assessment form, and (4) include surface coal mine operators and contractors in the requirements to submit medical examination plans for the provision of employee examinations. Work is currently underway to finalize the rule. Coal operators have been working with NIOSH to establish medical examination plans. Since the rule was published, 584 contractor operators and 804 surface operators submitted plans and as of March, 2016, 79% of surface operators are in compliance with the rule. Since April 1, 2014, NIOSH has approved 74 facilities to take radiographs of coal miners. There are now 138 approved medical facilities providing health surveillance services in 22 of 26 states with coal mines. The four states without facilities have facilities in nearby states not far from their mines and are also served by mobile units. NIOSH is developing the infrastructure to evaluate spirometry conducted at facilities for miners. Work with spirometer manufacturers is ongoing to identify spirometers that will meet specifications provided in the rule. Facilities will be approved to provide spirometry in 2016. NIOSH will work with MSHA to roll out this part of the program, adding spirometry to medical examination plans for all coal mine operators.

The Enhanced CWHSP is a program in which NIOSH conducts direct outreach to coal operators and miners in mining communities throughout the country. This program has included spirometry since 2005. Dr. Storey briefly summarized recent work demonstrating a relationship between radiographic changes associated with coal workers' pneumoconiosis and lung function changes in miners evaluated through the Enhanced CWHSP (Blackley DJ, Laney AS, Halldin, CN, Cohen R. Profusion of Opacities in Simple Coal Worker's Pneumoconiosis is Associated with Reduced Lung Function. *Chest* 2015 Nov, 148(5):1293-9). The group has also evaluated the health of miners who have left the mining industry, finding higher rates of disease, particularly of chronic obstructive lung disease. (Halldin CN, Wolfe AL, Laney AS. Comparative Respiratory Morbidity of Former and Current US Coal Miners. *AJPH* 2015, 105(12):2576-7.) This was based on surveys conducted in eastern states in 2012-2013. Further analysis of former miners will be conducted, as NIOSH completed surveys in the western states in 2015.

Question from P. Nelson: Geology, have you looked into what changes/differences in geology make a difference?

There's been an increase in the prevalence and severity of coal workers' pneumoconiosis (CWP) in the U.S. since the late 1990s. Cases of CWP continue to be reported in coal-producing regions across the country, but 'hot spots' in central Appalachia (including KY, VA, and WV) have been hardest hit. Factors including inadequate dust control, increases in number of hours worked, and differences in the composition of mined material have been suggested as potential explanations for the resurgence of CWP. In recent years there's been a substantial increase in the prevalence of r-type opacities (radiographic abnormalities associated with silicosis lung pathology) in central Appalachian coal miners. The concurrent increase in the prevalence and severity of CWP is unlikely to be due to changes in the composition of mined coal, but is more likely attributable to the composition of the respirable coal mine dust that miners are inhaling while working. The increase in the proportion of miners with r-type opacities is consistent with excessive exposure to crystalline silica, which is often found in the rock bounding coal seams. Changes in mining practices, including increases in the practice of thin-seam mining, coupled with more powerful cutting equipment and improved coal cleaning technologies, could mean that mining outside-the-seam rock is becoming more common.

Question from M. Wright: Have you done work for workers in coking?

This issue has not been a focus of the Respiratory Health Division at NIOSH.

Question from J. Burgess: Have you been able to do anything with longitudinal data?

The CWHSP is a national surveillance system which does not provide data longitudinally by specific workplace. NIOSH has looked at longitudinal data among individual miners to identify individuals with rapidly progressive CWP and is beginning to look at longitudinal spirometry data to evaluate lung function among miners over time.

Question from B. Watzman: Is the data available by state and will it be published?

New cases of CWP continue to be observed in most states that produce coal, but based on data from the national surveillance program, states in the Appalachian coal fields have the highest prevalence of disease. NIOSH will continue to produce peer-reviewed research describing the distribution and trends of CWP in U.S. coal miners. Stakeholders can visit the public CWHSP Data Query System (<http://webappa.cdc.gov/ords/cwhsp-database.html>) for customizable searches, including reports broken down by state.

Comment from J. Burgess: Talk about success as far as productivity on research projects.

We encourage interested stakeholders to visit NIOSHTIC for a searchable database of publications describing NIOSH research projects relating to coal mining and coal miner health: <https://www2a.cdc.gov/nioshtic-2/advsearch2.asp>

MR. JOHN BURR, CAPACITY BUILDING PROGRAM UPDATE, NIOSH

Mr. Burr presented a review of the NIOSH-Mining Capacity Building Initiative. He discussed the objective of providing the mining industry with sufficient ventilation and ground control expertise by developing new postgraduate experts and ensuring an adequate number of professors. Mr. Burr described the competitive Broad Agency Announcement (BAA) funding mechanism and the NIOSH-Mining evaluation of the proposals. He stated that each proposal is centered in a research project that is to advance a topic important to the mining industry and is well suited to training graduate students. Each capacity building contract is funded at approximately \$250,000 per year for a maximum of five years. Student tuition and stipend, partial salary for the principal investigator, travel necessary for conducting or disseminating research are examples of permitted expenses. A NIOSH-Mining technical expert is assigned as the Contracting Officer Representative (COR) for each contract and monitors the performance of the contractor. An annual contract review meeting is held where students describe their work in detail. Mr. Burr stated that 14 ventilation contracts, seven in 2009 and seven in 2014, have been awarded. He further said that eight ground control contracts were awarded in 2011 and 17 proposals were being evaluated for possible award in 2016. Mr. Burr listed 37 graduate degrees (16 Ph.D. and 21 MS) in ventilation and 26 graduate degrees (11 Ph.D. and 16 MS) in ground control that have been produced by the Capacity Building Initiative. Mr. Burr presented a summary of employment for the graduates. The largest number of graduates (13) were employed by a mining company closely followed by consulting and NIOSH-Mining with nine each.

Following the presentation there was a discussion regarding the best methods of assessing the success of this program. Mr. Burr stated that NIOSH-Mining has had difficulty in establishing hard data to assess the program.

- K. Luxbacher stated that it would be good to track the graduates throughout their career and that their academic advisor would be able to help.
- P. Nelson suggested that NIOSH-Mining establish contact with the graduate's employer and obtain feedback regarding their academic preparation and general readiness for the workplace.
- J. Burgess suggested NIOSH-Mining grade the quality of the research projects as one measure of the program success.
- R. Fragaszy asked whether the funded graduate students are required to be US citizens. Mr. Burr answered that they are not required to be US citizens.

DR. GERRIT GOODMAN, ROCK DUST PARTNERSHIP UPDATE, NIOSH

Dr. Goodman updated the MSHRAC committee on activities of the Rock Dust Partnership. The original Partnership was formed with representatives of NIOSH, Mine Safety and Health Administration, and the carbonates industry after finding inconsistencies in rock dust particle sizing and dispersibility. Specifically, a number of rock dust samples collected by MSHA inspectors and analyzed by NIOSH showed a lack of compliance with the requirement of 70% of particles being less than 200 mesh (74 microns). More worrisome was that some of the samples that did meet the particle size requirement did not inert when tested in the 20-Liter explosion chamber, indicating a lack of inerting ability. Furthermore, no rock dust sample remained dispersible as required when exposed to moisture and dried. NIOSH, with Partnership assistance and support, defined test methodologies to quantify rock dust particle sizing and dispersibility. Changes to improve inerting effectiveness were suggested, including the removal of large, ineffective rock dust particles and the use of chemical treatments for maintaining rock dust dispersibility in the presence of moisture. The Partnership was later expanded to include industry and labor representatives and to address concerns regarding the potential health effects of exposure to rock dusts and the impacts of rock dust on respirable dust exposures measured with the Personal Dust Monitor (PDM). In response to an MSHRAC committee question, Dr. Goodman stated that the sensitivity and accuracy of the PDM was unaffected by the rock dust treatment.

Dr. Goodman reviewed the work of the NIOSH Health Effects Laboratory Division (HELD) to assess potential health effects of exposure to rock dusts. This group analyzed treated and untreated rock dusts, finding low levels of respirable silica in these dusts and no significant differences in cellular responses (membrane damage) to exposures to treated and untreated products. The MSHRAC committee recommended that long-term animal testing be considered to verify any health effects of exposure to treated and untreated rock dust. Furthermore, the committee suggested health assessments of rock dust treatments be conducted to ensure these additives are not harmful to human health. Dr. Goodman agreed on the value of such testing and offered that such assessments are currently being considered. He then briefed the committee on assessments of respirable dust generation made by dispersing treated and untreated rock dusts in underground mine entries. Although respirable dust levels were elevated when applying rock dust, little respirable dust was generated when tramming a scoop through floor accumulations of these products. He also discussed NIOSH efforts to reduce the fraction of respirable particles in rock dust to limit the potential for worker overexposure to respirable dust. As smaller particles are more effective for inerting, any reduction in the respirable fraction must be balanced against maintaining inerting effectiveness. The final topic was creation of foamed rock dust products that can be applied with little generation of respirable dust. Experiences with one-part and two-part foams were discussed, with the latter showing improved foam stability and dispersibility.

Question from P. Nelson: Do any treatments effect PDM?

Response: No it doesn't effect PDM but it may change the measurement. PDM samples mine dust which includes rock dust.

Comment from J. Burgess to address human testing – significant risk of having health effects. Pursue animal testing to make sure the treatments are not adding toxicity.

MR. DAVID YANTEK, REFUGE ALTERNATIVE PARTNERSHIP UPDATE, NIOSH

Mr. Yantek delivered a presentation to update the MSHRAC committee on activities related to the Refuge Alternative (RA) Partnership. The RA Partnership consists of underground coal mine stakeholders from labor, industry, mines, RA manufacturers, RA component suppliers, engineering firms, state government, federal government, and academia. The first RA Partnership meeting was held in February of 2015 at PMRD. Mr. Yantek provided a brief reminder of disasters that occurred at three mines in 2006—Sago Mine, Alma Mine, and Darby Mine—that led to the enactment of the Mine Improvement and New Emergency Response (MINER) Act in June of 2006, and the subsequent requirement of RAs in underground coal mines by the West Virginia Office of Mine Health, Safety, and Training in 2007, and later by the Mine Safety and Health Administration in 2009. Mr. Yantek detailed NIOSH PMRD's new research project on RAs that was developed using guidance from the RA Partnership. This new research project has multiple research areas including RA heat/humidity buildup, air delivery systems, contamination ingress, built-in-place RA stopping/door systems, and RA communication systems. Mr. Yantek provided an overview of the Refuge Alternative Laboratory Facility (RALF) that PMRD is developing in their underground Experimental Mine. Currently, RALF has a 60-person BIP RA and a 6-person mobile metal RA. PMRD is in the process of improving RALF by adding a dedicated BIP RA contamination ingress test area, modifying their 6-person mobile metal RA to increase its capacity to 10 people, and procuring a mobile tent-type RA. Upon completion, RALF will have test areas that represent all three types of RAs that are

used in underground US coal mines. Mr. Yantek outlined the RA heat/humidity research tasks including identification of the heat input to represent miners, determination of the apparent temperature limit that causes a body core temperature increase, heat buildup in mobile and BIP RAs, occupancy derating for warm mines, the effect of fires/explosions on mine temperatures, and RA heat mitigation strategies. Next, Mr. Yantek summarized planned research on RA air supply systems which involves research on contamination ingress, contamination ingress prevention strategies, effect of BIP RA ventilation system layout on purging, relief valves. Mr. Yantek also discussed planned PMRD research on BIP RA stopping/door systems. Finally, Mr. Yantek provided an overview of PMRD's planned research on RA communications, through which PMRD aims to ensure reliable post-disaster communications from an occupied underground RA to the surface. Mr. Yantek also discussed several external PMRD research contracts related to RA topics including contracts for the development of guidelines for protected compressed air lines (University of Kentucky), the development of a computer simulation tool to determine occupancy derating (University of Nevada, Reno), the determination of the appropriate heat input and miner size for RAs (University of South Florida), the identification of the critical apparent temperature which would cause heat stress for refuged miners (ThermoAnalytics, Inc.), and the development of example occupancy derating tables for RAs tested by PMRD (ThermoAnalytics, Inc.).

Two questions/comments were provided by MSHRAC members: (1) J. Kravitz from MSHA asked how and where PMRD plans to test BIP RA stopping/door systems for overpressure and (2) B. Watzman from NMA suggested that, with in-use RAs potentially reaching the end of their 10-year service life, there is a need to develop a method to prove the structural integrity of mobile RAs that have been in the field for 10 years. For their research on BIP RA stopping/door systems, PMRD plans to first begin by using finite element (FE) analysis to perform static linear structural analysis. Then PMRD will move forward with more advanced FE analyses, such as nonlinear static, linear dynamic, and nonlinear dynamic. PMRD plans to either develop their own test facility, or contract with an external party, for testing BIP RA door/stopping systems for blast and/or projectile (flying debris) resistance. With respect to ensuring the structural integrity of nearly 10-year-old, in-use RAs, PMRD will discuss this concern with members of MSHA's Approval and Certification Center.

MS. HEATHER LAWSON, DYNAMIC FAILURE, NIOSH

Heather Lawson presented a technical overview of the Detecting and Managing Dynamic Failure of Near-Seam Features Project. This project centers on better defining the role of geology, and particularly fluctuations in the character of near-seam stratigraphy, in the occurrence of dynamic failure events, or bumps, in underground coal mining. Dynamic failure can be defined as the unstable failure of ground in an underground mining scenario, and can manifest in several different ways, dependent upon mechanism of failure, such as pillar outbursting, massive collapse and dynamic floor heave events. These events occur as the result of a rare confluence of factors including mine layout, ground stress and geology. While these events are relatively rare, they are also extremely dangerous, resulting in worker injury up to and including fatality in greater than 60% of cases reported to MSHA. The Crandall Canyon Mine Disaster brought the problem of Dynamic Failure to the forefront of the mining community's consciousness. Significant progress has been made in this area since that time. However, the poorly defined role of geology has been a recurring theme in much of the published work.

The Detecting and Managing Dynamic Failure of Near-Seam Features Project works from the hypothesis that localized changes in geology affect dynamic failure potential. The project seeks to identify mechanically significant features, thereby enabling effective hazard identification and targeted preventative and mitigation practices. Examples of work-to-date were provided.

The first of these addresses the role of spatially discrete stiff units, such as paleochannels, within the context of the overburden character. It is commonly accepted that these discrete units are observed in connection with dynamic failure events. However, these are relatively widespread features and appear to be benign in many deposits. An initial empirical study indicates that, in fact, they occur with equal frequency in both bumping and non-bumping deposits, and that dynamic failure events appear to correlate more strongly with the ratio of stiff to compliant units in the overburden as a whole. A subsequent numerical modelling study finds that within a given lithology, a critical thickness and location of a discrete unit may exist at which dynamic failure risk due to collapse reaches a maximum. This finding suggests that through tracking of problematic discrete stiff features combined with numerical modelling using accurate and site-specific lithology, areas of elevated rupture risk may be anticipated in advance of mining. This would allow for mitigation techniques to be implemented prior to worker exposure.

The second example addresses the role of characteristics of the coal itself in the occurrence of dynamic failure events. This work summarizes the findings of a Primary Component Analysis of 528 coal sample records from the Pennsylvania State Coal Sample Databank which included compositional data. Primary Component Analysis, or PCA, is a statistical tool that uses multiple dimensional reductions to isolate those variables that most closely correlate with a given phenomenon in this case, a history of reportable bump activity. The results of the PCA analysis reveal a very strong correlation between positive bump history in a given seam and the seam's composition with regard to volatile matter and organic sulfur. The study found that 97.4% of bump positive samples fell above a volatile matter to organic sulfur ratio (VM/S) of 20. This delineation was less successful at accounting for bump negative cases at only 67%, emphasizing the need for both inherent susceptibility and adequate stress to facilitate bumping behavior.

The presentation concluded that through identification and quantification of risk associated with localized changes in geology, hazard identification becomes, in essence, an exploration problem. Through discovery of key geologic features, hazard mitigation can be tuned to local conditions during mine planning. Areas of elevated risk can be identified during the exploration phase of mining and solutions can be implemented long before any worker exposure or risk has occurred.

MR. CARL SUNDERMAN, THE INTERNET OF THINGS, NIOSH

Mr. Sunderman presented an overview of the Industrial Internet of Things (IIoT), an emerging trend in industrial automation. The IIoT is anticipated to become a common form of industrial communications and be the primary enabler of Big Data processing and machine learning. In a nutshell, the IIoT involves sensing the environment with ubiquitous and typically low-cost sensors, transferring that data through the internet to processing at the "edge" of a network and in the "cloud". The processing is intended to affect changes in a physical system, business, or strategy. This may be accomplished with the techniques of predictive analytics, allowing discovery of health and safety trends or alerting researchers to dangerous situations. NIOSH has two research efforts related to the IIoT that will allow the mining program to adapt-to and utilize IIoT techniques. The first is a pilot project, "Industrial Internet of Things Applications in Underground Coal Mines", the second is a project task under the "Durable Support for Western US Underground Metal Mines" project. The "Coal Mine" pilot project is involved in determining sensor technologies and communication systems applicable to IIoT in underground coal, site visits to established monitoring and control vendors to discuss inclusion of IIoT in communication products, and development of a demonstration system. The demonstration system is composed of a WiFi sensor attached to the door of a refuge alternative (RA). The status of the RA door is transferred over the internet to a "cloud" processing engine. When the RA door is opened the engine commands WiFi actuators to activate both a ventilation fan in the RA and a warning light in the mine office. In the "Metal Mine" project the IIoT is leveraged to demonstrate how mine geotechnical data can be delivered directly to the researcher's desktop in a convenient and secure way. A demonstration system was developed to demonstrate the technique. This system is composed of a wireless sensor network, bridge router, data server, and client computer. Wireless sensor network data is acquired by the bridge router, which in turn translates the data onto the internet. The data server, in the "cloud", then collects that data and relays sensor readings to a program running on a client computer. The client program gathers the data, stores the readings in a database, and updates an online real-time chart. While the server is currently cellular-based, work is progressing to host the server on the CDC network.

Question from P. Nelson: Does this include mobile sensors?

Response: The IOT is about collecting and aggregating sensory data so that it can be processed with analytics. As long as the data from the mobile sensor can be timely sent over the internet to the analytics system then it would be supported.

Question from D. Drysdale: Worry about over-reliance on this technology and it gets hacked?

Response: The sensitivity of the sensory data will drive the level of security required in the application. Common forms of logical security are encryption, authentication, and authorization.

MS. JONISHA POLLARD, ERGO APP, NIOSH

Ms. Pollard presented ErgoMine, an ergonomics audit tool for mining currently available for download in the Google Play Store for Android devices. She began her presentation by explaining the results of several injury and fatality analyses that characterized the burden associated with bagging, haul trucks and maintenance and repair

tasks at mining facilities. She explained that bagging and palletizing activities contribute to over 106 injuries per year, which is significant considering the small number of bagging and palletizing operations in mining. She also explained how there isn't much mining-specific guidance available for these activities. She highlighted the large proportion of nonfatal injuries when getting on and off of haul trucks and the large proportion of fatalities to haul truck operators due to loss of control. She also presented the mining activities associated with maintenance and repair injuries including the use of nonpowered hand tools and handling materials. She also noted the causes of the 17 fatalities per year including mechanical energy and falls. Ms. Pollard then explained the process used to develop the questions contained in ErgoMine that included field visits, laboratory studies, stakeholder input, and analyses of reportable injuries and fatality reports. She highlighted that although ErgoMine is an ergonomics audit, it also contains content in areas that wouldn't be considered ergonomics, but contribute to preventing injuries and fatalities such as lock out/tag out and design of roadways. Ms. Pollard then described the process for ErgoMine review by the Mine Safety and Health Administration, Certified Professional Ergonomists, Human Factors researchers, the United Steelworkers union, mine safety and health personnel, and other NIOSH researchers. She concluded her presentation by providing a demonstration of ErgoMine. She showed how to conduct an audit and provided examples of the types of guidance users will receive from the application.

Question from M. Wright: Get it beyond Android to iPhone.

Response: We are hoping to update the app in the future after it has been in use and we have received feedback from the industry. At that point, we will likely add iOS and Windows platforms.

Question from P. Nelson: Can you provide info to developers?

Response: Yes, we can provide assistance and guidance to developers. Please contact us at OMSHR@cdc.gov.

DR. ALEK BUGARSKI, DIESEL NANOTECHNOLOGY, NIOSH

Dr. Aleksandar Bugarski provided an overview of the NIOSH efforts to curtail exposures of underground miners to diesel aerosols. The emphasis was given to trends affecting physical, chemical and technological properties of diesel aerosols emitted in the underground mines, health end points associated with exposure to diesel aerosols, current exposure levels for underground mining industry in the States, and potential engineering and other solutions. Aleksandar discussed the concern over occupational exposure to traditional diesel exhaust that was previously linked to a variety of acute and chronic health problems, have been additionally heightened after, in 2012, the International Agency on Cancer Research (IARC) declared diesel engine exhaust as a carcinogen to humans (Group 1A). NIOSH PMRD researchers, in cooperation with distinct national and international stakeholders, are focusing on applied research addressing various aspects of a multifaceted and integrated approach toward reducing exposure of underground miners to diesel aerosols and gases. The MSHA compliance data indicate that introduction of diesel regulations limiting exposure of underground metal and nonmetal miners to diesel particulate matter (71 Fed. Reg. 28924, 2006), and to some extent diesel research at NIOSH, resulted in a substantial decrease in the average exposures of underground M/NM miners to diesel aerosols. The data indicate that over the past six years the industry-wide geometric mean exposures to total carbon (TC) have been around 125 $\mu\text{g}/\text{m}^3$, and that the majority of the operators have been in compliance with 160 $\mu\text{gTC}/\text{m}^3$ limit. However, for the same period, more than 24% of the samples were above the compliance limit and between 1 and 3% of the samples showed exposures in excess of 500 $\mu\text{gTC}/\text{m}^3$. These indicators warrant additional efforts and research to address this important issue. The ongoing diesel projects are focusing on evaluation of various control strategies including alternative fuels (FAME biodiesel, and hydrotreated vegetable oil renewable diesel), advanced engine technologies (EPA Tier 4 final), and providing solutions to unique situations and specific occupations in underground mining operations. NIOSH researchers are planning to continue to focus their research efforts on advanced diesel emissions control strategies and technologies, control strategies and technologies tailored to specific operations and occupations, alternative sources of energy, substitution of diesel-powered vehicles with battery powered vehicles, alternative metrics for monitoring exposure to diesel aerosols, and advance instrumentation for monitoring DPM concentrations and exposures to diesel aerosols.

Question from P. Nelson: What are the solutions to reduce exposure of underground miners to diesel aerosols?

Response: Addressing issue of exposure of underground miners to diesel particulate matter and gases requires multifaceted and integrated approach. Achieving this goal depends on concerted efforts throughout mine organizational structure and considerable support from mine management. Exposures to diesel aerosols and gases can be effectively reduced using combination of several strategies: (1) controlling pollutants after they become airborne, (2) controlling diesel emissions at their source, and (3) implementing administrative controls.

Question from B. Watzman: What are the hurdles to get an accurate real time monitor for DPM (like PDM)?

Response: Due to complex nature of diesel aerosols, real time monitoring of DPM is more technologically challenging than real time monitoring of dust. The instrumentation for continuous monitoring of diesel aerosols, equivalent to PDM, is currently too bulky to be wearable and used for real time monitoring of personal exposure to those aerosols. However, some recent development in miniaturization of such instrumentation indicate that such technology could become available in not so distant future.

Question from M. Wright: Some advanced engine technologies have lower particulate emissions but produce large concentrations of smaller diesel particles. What is significance?

Response: The high concentrations of nucleation aerosols characterized emissions of the older engines fueled with higher sulfur content (> 300 ppm) diesel and equipped with certain catalyzed control technologies. Over the past decade, improvements in fuel quality (< 15 ppm sulfur), and engine and exhaust aftertreatment technology reduced magnitude of that problem. In order to meet EPA (and other) regulation requirements, the contemporary diesel engines have to produce low particulate mass emissions. However, those engines that are integrated with diesel particulate filter systems might still produce relatively high particulate number emissions. The reductions particulate mass are achieved by more complete combustion of the fuel. That process produce particulates with significantly smaller size that consequently contribute less to the total mass. The effects of the size and other individual physical and chemical properties of diesel aerosols on health end points are still not well understood.

PUBLIC COMMENTS AND QUESTIONS

No comments or questions from the public.

FINDINGS AND RECOMMENDATIONS BY MSHRAC MEMBERS

There was general discussion of the issues among the members following each of the presentations. Specific findings, recommendations, comments, and requests include:

Minimize the number of presentations at future meetings to allow sufficient time for committee discussion after each presentation. Another option would be to conduct a webinar on a specific topic between meetings, which would make it easier for committee members to attend, would facilitate the dissemination of research information and would allow miners and mine companies the opportunity to also participate.

Provide presentations and background documents for the meeting well in advance of the meeting to allow the committee sufficient time for review before the meeting.

The committee recommended that the Interagency Work Group reconvene. The work group was created under the MINER Act and has not met in recent times.

MSHRAC ACTION ITEMS:

The committee discussed the timing and format for future meetings. It was decided that the Spring meeting, hopefully in March, will be a face-to-face meeting and then a 2nd meeting, hopefully in October, will be a webinar with a face-to-face capability optional.

The MSHRAC Chair will work with NIOSH to determine the date for the next meeting and will be in touch with the committee members with that information.

The MSHRAC Chair requested that the committee be educated about industry meetings so that the MSHRAC meeting could possibly piggyback off of industry meetings. B. Watzman invited the MSHRAC members to attend 2 NIOSH workshops at the MINExpo in Las Vegas on September 27-28, 2016. The 4 hour workshops will be held on Tuesday and Wednesday afternoon from 1:00 – 5:00 pm.

The MSHRAC Chair requested that the draft minutes be sent to the committee by June 10, 2016.

Topics for future meetings include:

Address international mining activities

Work organization – safety culture

Present new 3 goal strategic plan including specific goals

Additional topics, future agenda items or comments on today's presentations should be sent to J. Welsh, who will then send them out to the MSHRAC committee for comment.

The meeting was adjourned at 5:05 pm.

I hereby confirm these Summary Minutes are accurate to the best of my knowledge.

Priscilla P. Nelson, Chair

Date