MINUTES

MINE SAFETY AND HEALTH RESEARCH ADVISORY COMMITTEE (MSHRAC) MEETING
May 22 , 2018 – 8:30 AM – 4:00 PM and May 23, 2018 – 8:00 AM – 12:00 PM
PATRIOTS PLAZA 1
395 E STREET, S.W., ROOM 9000
WASHINGTON, DC 20201

COMMITTEE MEMBERS PRESENT:
Mr. Ronald Bowersox, United Mine Workers of America, MEMBER
Dr. Jefferey Burgess, University of Arizona, MEMBER
Mr. Dale T. Drysdale, National Stone, Sand & Gravel Association, MEMBER
Mr. William Francart, Mine Safety & Health Administration, MEMBER
Ms. Stacy Kramer, Freeport McMoRan, MEMBER
Dr. Kramer Luxbacher, Virginia Polytechnic Institute and State University, MEMBER
Dr. Aubrey Miller, National Institutes of Health, MEMBER
Dr. Priscilla Nelson, Colorado School of Mines, CHAIRPERSON
Mr. Michael Wright, United Steelworkers of America, MEMBER (By phone)
Mr. Kyle Zimmer, International Union of Operating Engineers, MEMBER

COMMITTEE MEMBERS ABSENT:
Dr. Richard Fragaszy, National Science Foundation, MEMBER
Mr. Bruce Watzman, National Mining Association, MEMBER

Mr. Jeffrey Welsh, NIOSH, Designated Federal Officer

NIOSH PARTICIPANTS
Hugo Camargo
Marie Chovanec (By phone)
Lauren Chubb
Maryann D'Alessandro
Patrick Dempsey (By phone)
Gerrit Goodman (By phone)
John Howard
Jessica Kogel
Anthony Laney
George Luxbacher
RJ Matetic
Steven Mischler
David Parks
Drew Potts (By phone)

Robert Randolph (By phone)
Todd Ruff
David Snyder (By phone)
Lisa Steiner
Dana Willmer (By phone)
Kristin Yeoman

OTHER PARTICIPANTS
Kelly Bailey, Kelly Bailey Consulting, LLC
Howard Berkes, NPR
Mark Ellis, IMA-NA
Ed Green, Crowell & Moring LLP
Jingnan Hiou, NPR

DAY 1, Tuesday, May 22, 2018

The meeting commenced at 8:30 am. Mr. Welsh welcomed MSHRAC members and attendees to the meeting. He explained that MSHRAC members participating in the meeting must be free from conflicts of interest. He asked members to self-declare any conflicts of interest that may arise during the meeting and recuse themselves from any discussion related to that conflict and abstain from voting for that particular matter. There were no conflicts from members reported. Mr. Welsh conducted a roll call to confirm a quorum. He turned the meeting over to the MSHRAC Chair, Dr. Priscilla Nelson, for the introduction, announcements and approval of minutes.

INTRODUCTION, ANNOUNCEMENTS AND APPROVAL OF MINUTES, DR. PRISCILLA NELSON, MSHRAC CHAIR

Dr. Nelson thanked the committee members for submitting their comments about the NIOSH Mining program's strategic plan. She announced that there will be a public comment period on the second day of the meeting at 11:00 am.

Dr. Nelson read the minutes from the November 15, 2017 meeting in Denver, Colorado. There were no changes to the minutes and they were approved unanimously.

REPORT FROM THE ASSOCIATE DIRECTOR FOR MINING, DR. JESSICA KOGEL

DR. KOGEL: Today I will cover four main topics including how the MSHRAC meeting agenda aligns with our strategic plan, research impact, human capital, and an overview of new initiatives.

The presentations given over the next day and a half will address each of our strategic goals, as well as several intermediate goals under each of the three strategic goals. Strategic goal 1, which is to reduce

occupational illnesses in the mining workforce, will be very well covered by this particular MSHRAC meeting.

Let's turn to the topic of research impact. It is very important that we invest our resources in a way that delivers the strongest impact in terms of worker health and safety, and we want to make sure that we are covering all sectors of the mining industry. Starting with the 2019 project portfolio, you can see how it compares to the previous two years in terms of numbers of projects broken out by percentage across the various mining subsectors.

We continue to see a trend towards fewer projects around coal, and increases in the number of projects for the metal mining sector as well as an increase in the number of stone, sand and gravel projects. We are approaching the point where the portfolio is closer to being balanced in the way that we would like to see it based on the surveillance data that we track, particularly the MSHA health and safety statistics. So far in FY 2018, we've produced 164 outputs. These outputs fall into one of two categories. They can be science outputs or they can be translational outputs. Approximately 40% of our outputs fall under the science category, which is where we show impact from a scholarly perspective. These outputs include peer-reviewed journal articles, proceedings papers, and presentations at science-based meetings. The science outputs also provide the pipeline for our translational outputs. Translational outputs are very important to the program because translational outputs can have impact on the actual mineworker. They are tangible outputs that are used at the mine site with the potential for direct impact on health and safety. Our outputs cover all sectors, and align with the number of projects that I showed for each sector.

Now I want to move onto our workforce, and present a program-level view into the profile of our workforce. Close to 35% of our workforce is retirement-eligible over the next three years. This is something that we have to continue to address because we are very interested in making sure that we have a sustainable program for the long term. Years in service is also interesting. I would characterize our workforce as somewhat bimodal in this regard. Almost 30% of our workforce has over 25 years of experience. Balanced against that, another large percentage of our workforce has 9 years or less of experience. Therefore, the workforce is fairly mixed in terms of experienced and less experienced workers. If we look at our age distribution, more than 50% of our workforce is over 50 years old. We do not have many young people in the workforce, but over the last couple of years through our hiring we have started to shift the age distribution towards younger workers. When thinking about sustainability of our workforce, it's very important that we have a good distribution across these age categories. We have a well-educated workforce and we're probably where we want to be in that regard. Approximately 68% of our workforce is male—I think that's pretty reflective of the mining industry as a whole. Over the last couple of years, the number of women has been changing in the industry and we see he same trend in the Mining Program at NIOSH. We lack diversity in terms of race and ethnicity which also reflects the industry that we serve.

Now I would like to turn to our future research directions and new horizons. As you are aware, we've started down the path of doing sector-specific assessments of our program. The goal is to see how well our program is currently serving each of the sectors and to assess how well we are prepared to serve the future needs of each sector. We have hired subject matter experts to help us with this. For example, Kelly Bailey was hired to assess our stone, sand and gravel research program. He will present his findings at this meeting. We have also kicked off phase two, which is industrial minerals, and Bob Glenn is helping us with that. He has completed his visits with both PMRD and SMRD. We are learning a lot

from these assessments and are very happy to share the results with MSHRAC and would like to hear your thoughts.

The next future research direction that I would like to discuss is miner health. In March, we had a facilitated stakeholder listening session in Washington DC at the National Academies of Science. Several of you on the MSHRAC Committee were at that event, and you will hear a presentation about it during this meeting. We continue to build capacity in terms of miner health. We are standing up a new program in Spokane that includes expanding the research portfolio into new areas. Another new research area that falls under miner health is EMP research. There will be a presentation later today that describes how we are taking the recommendations from the National Academies on the NIOSH Asbestos Roadmap and moving forward with some of them to advance the state of the science in this area.

NIOSH's activities in the area of automation and new technologies continue to expand and mature. We convened a team of experts within NIOSH who worked with external experts to do an assessment and come up with recommendations. We presented that at the last meeting. We have developed an action plan based on these recommendations, and now we are into the implementation phase, and we'll give you an update on exactly what that looks like. This is another important initiative that we would like to have the Committee's feedback on.

Then the last topic is improving research impact. We have already touched on research impact and some of the metrics that we use to measure this. Starting this month, we are going to begin a yearlong program review. We do these periodically at NIOSH to assess the impact that we are having on occupational health and safety in a very clear and quantitative way that is based on evidence. The last review that the Mining Program had was in 2008 and that was done by the National Academies. The upcoming review will be conducted by an external review committee using an evidence package that we will prepare using logic models and a contribution analysis framework. At the next MSHRAC meeting, we will provide more details about the process. The other thing that you will hear more about today with regard to improving research impact is our continued efforts towards aligning our intramural research, extramural research and the NORA sector council.

My last slide is about the workforce for the future. I have already mentioned that we have to think very carefully about the workforce of the future and we recognize that we have an opportunity to bring on new skills and competencies as we backfill positions that are vacant because of retirement. It is a challenge but it is also an opportunity to diversify the workforce to meet the challenges that are in front of us as the mining industry continues to evolve and change. We need to find ways to bring in more diversity, not just ethnic, racial or gender diversity but diversity in terms of how people think and the skills that they bring to the table so we can solve problems in a more out-of-the-box kind of way. I invite the Committee's thoughts on how we address some of these looming workforce opportunities and issues.

Questions and Comments:

DR. NELSON: Are these percentages based on projects or dollars?

DR. KOGEL: These are based on projects, there are many ways we can look at this, and I think last time I might have shown it based on both.

DR. NELSON: One comment overall—we bounce back and forth between numbers of projects and dollars, and it would be, I think, on a continuing basis, most helpful if both numbers were given at the same time so we know. However, for those three years—2017, 2018, 2019—how has the research budget been changing? Is it going up, flat, going down?

DR. KOGEL: It is relatively flat.

DR. NELSON: Is there a possibility of, I mean is the goal to change or is that the right number? The flat number that you are at.

DR. KOGEL: That is up to Congress. I have asked Dr. Howard to talk a little bit about budget when he makes his comments.

DR. NELSON: And you put the numbers up but you talk about the concept of balance. I do not necessarily know exactly what balance is. Does your group have in mind what would be more balanced than what you have right now?

DR. KOGEL: That's part of what we're trying to answer through these sector-specific assessments of the program, and actually when Kelly gives his presentation on the stone, sand and gravel sector analysis, he will present a recommendation for what he feels is the appropriate percentage, however you measure that, whether it's dollars or number of projects, and I'm not sure that we know exactly what that metric is. I think he looked at it in terms of dollars, and he used MSHA data to determine where the greatest needs are in terms of both injuries and fatalities and illness too, which is a much harder to quantify.

DR. NELSON: Okay, so for the sector external consultancies, are you going to—when are these going to be completed? Because you have finished or are finishing sand and gravel.

DR. KOGEL: We are starting the second one.

DR. NELSON: Sand and gravel, and you are starting industrial minerals.

DR. KOGEL: We have two more that we are going to do. We will do metal and coal. In addition, we will probably start coal later this year, and then metal. Therefore, I would think right now, we are on track to complete the process in three years.

DR. NELSON: Three years from now or?

DR. KOGEL: No, from the start. I think originally, we were looking at a longer timeline. I think we are now trying to compress it a bit.

MR. BOWERSOX: Hiring freeze is still on, I take it? Hiring freeze, this going on?

DR. KOGEL: There is no hiring freeze at this point. There are some limitations but there is no hiring freeze.

DR. BURGESS: Do you have, or do you that potential to have, summer internships for graduate students?

DR. KOGEL: Absolutely.

DR. BURGESS: And so what is the situation with that? Because that seems like it is a great way to bring in a diverse—in many different ways—workforce for the future.

DR. KOGEL: Yes, I agree that interns are potential new employees of the future for us. One of the issues is timing. When we advertise for these positions, it is often too late in the year and many students are already committed so we are working to get the announcement out much earlier in the year.

DR. NELSON: In follow-up to that, I think that is an interesting way to get some of the groups like the Native Americans engaged, because there is mining in American Indian territory, and I think they are not so connected in all cases to our university system. They may not even think about this kind of thing. I think though, if you focused on that, you could actually make some progress in that area.

DR. MILLER: I just had an add-on to that. I think you have 67 positions open, and obviously you have to prioritize that—going back to kind of what you were raising. How are you prioritizing that and what's kind of the process that you're thinking through, because obviously all that has to be administratively worked through as well, which is a lot of work.

DR. KOGEL: It is a lot of work, and both RJ and Todd, when they do their presentations, will talk about how they are addressing workforce issues for their divisions. To answer your question in general terms, priorities are research-driven and our goal is to make sure that we have the skillsets and the people onboard that are able to perform the priority research that we're engaged in.

DR. NELSON: In lack of any other conversation, let me ask a question about—and workforce is 24% is less than five years, but 10%—in service with NIOSH—but 10% is less than 30 years of age. Therefore, you have been pulling in people who are above 30 years in age.

DR. KOGEL: Yes.

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DR. NELSON: So those people are coming in from practice—where are they coming in from, because you're getting quite a number of midlevel people at least, maybe senior-level people that have joined you.

DR. KOGEL: That is a great observation and I have not really looked at that but I am just going to give you what I think the answer is without knowing the numbers. I think many of the people that we are pulling in are coming from industry. When industry has a downturn for example, people tend to look to government, and so we benefit from that situation. Probably some people come from academia too, but our main focus is on recruiting people that can bring the skillset and the talent that we need, and we'll take them from wherever they happen to be.

DR. NELSON: So the 10% less than 30 years old, is it difficult to recruit these young people? Are they not there?

DR. KOGEL: I think they are there, and I think there are many of them who want to come to NIOSH. I think our bigger hurdle or barrier is the slow hiring process, and because of the extended timeline, there are well-qualified candidates who cannot

wait around for a government or a NIOSH opportunity. So I think we have plenty of interest. NIOSH has a good reputation, and people do want to come work for us.

DR. NELSON: It will be interesting to keep track of those people who are coming in in midlife, if they go back out, exactly to what extent do they stay. Nobody has—always I have questions, so I will ask one more. On slide 5, the scholarly impacts, now outputs are not necessarily your measure of inputs.

DR. NELSON: So the sense of trying to get a handle on to what extent are those outputs used and valued would be interesting.

DR. KOGEL: And that is what this contribution analysis assessment is going to be about, exactly that and how do we quantify that. At the next MSHRAC meeting, we will address that and talk about the framework that NIOSH uses to measure impact.

DR. NELSON: Right, the standard scholarly thing of number of hits or number of times that people have referenced articles.

DR. KOGEL: That is one of the metrics. One of many.

DR. MILLER: So it would be the assessment of stakeholders and see how, kind of a post-evaluation, how things are being used.

DR. KOGEL: Yes.

DR. NELSON: Okay, then you know, and we are going to hear from Jeff later on today about the automation and new technologies.

MR. WELSH: Yes.

DR. NELSON: Automation and new technologies are of great interest. Is there a way of looking at this from the standpoint of trying to quantify potential impacts of automation and new technologies, big data? In what way, if implemented, would you start to think you'd see changes in injury rates or—I mean, if we could get a handle on, a guess, at least have it out there for discussion, that could be made into a compelling argument for additional resources.

DR. KOGEL: This is an emerging area with little data available so we are trying to answer these sorts of questions but they are very difficult to answer. But yes, if we could come up with some metrics, and we have some in the report that was prepared, we could have a better idea of impacts We presented those at the last meeting.

DR. KOGEL: Before we launch a new research program, we have to do our homework before we direct resources towards something. In addition, as you know, we're guided by BNI—burden, need and impact—and if we can't make the burden argument, then it's very difficult for us to justify the investment in it in terms of both people and other resources—because this is a big effort. And so that's why it was a year-long study that we conducted to convince ourselves that this is an area that we need to be involved in and that there were significant gains and that we are serving our constituency, which is the mineworker.

DR. NELSON: There are some experiments where people are implementing some aspect of big data, automation and granted, they are fairly short-term but there is some that have been longer like Rio Tinto and other things, to try to pull that data out to say what happened because of this.

MR. WELSH: Yes, and one of the things I presented at the last meeting was the Australian mining industry has a longer experience. They have been working with automation for a while and there is an Australian bulletin that lists some of the incidents and accidents that have happened, and I mentioned a few of those at the last meeting. So there is some data coming in, yes.

MINING RESEARCH PROGRAM UPDATE – SMRD, MR. TODD RUFF

MR. RUFF: I have a great job because I get to be on the ground level of how we build this division. The division is fairly young; it's around three years. The Spokane office has been around for a while but it's been its own division now for about three years. And so we're moving in new directions and building capacity in some of the stuff that we've been doing for a long time, and I'll give you an update on what's going on there.

In Spokane, we focus on these four mine safety and health program areas. Underground metal mining ground control focuses on developing recommendations and new technologies for monitoring ground stability in metal mines, and for supporting ground during the mining cycle. Mining-induced seismicity and stability is studying the unique challenges that we are seeing in western mines around mine design, especially underground coal, and it's mainly around the differences in depth and geology that we're seeing in the West. Emerging technologies is a new focus area. We're looking at health and safety implications, both positive and potentially negative, of advanced technologies in mining like you had mentioned, Priscilla, around automation. And miner health and chronic disease is a new focus area for Spokane. We need to improve our understanding and the research that's needed regarding the health status and disease burden in the mineworker population.

Dr. Kogel showed the overall mining strategic plan with all the strategic goals. In Spokane, our projects address all three of the goals, with a focus on occupational illness and traumatic injury, and this is shown, kind of the breakdown of where we focus by the number of people that we have working on it. Our first focus area for occupational illness looks at the following intermediate goals: airborne contaminants, noise, heat stress and chronic disease. For traumatic injury, strategic goal, we focus on: machine safety, global and local geologic instability, rockfalls between supports. For fitness for duty - specifically fatigue in that area. Our mine stability projects cross over into the third goal—you'll note there on the lower left those looking at eliminating catastrophic failure, mine disasters, we do cross over on the strategic goal three.

Currently, Spokane Mining Research Division is organized into four teams under my office, as shown here. We also receive support from the Health Communications Branch that's located in Pittsburgh. The four teams are organized around the four focus areas that I just presented: metal ground control, mining-induced seismicity and mine stability, automation and technology, and our health work is done under the health exposure assessment and monitoring team. We currently have 40-41 staff right now. It fluctuates, it seems, weekly. But we are looking to expand our expertise in these new teams - automation and technology, and our health program, but that's the way that the teams are kind of distributed right now,

and that will change over time.

Now I'll get into a little bit more detail on what each team is doing with a quick update on the current projects and some highlights of current activities just to give you a flavor of what we're doing currently. The metal ground control team has two projects. They both started in FY17 so they're in their second year, and both projects focus on underground metal mining and the challenges in either deep, highly stressed ground or in weak host rock conditions. The durable support project is developing new support technologies and recommendations, and right now we have strong partnerships with mines in Idaho, Montana and Nevada, and we'll talk a little bit more about our field sites and our partners later in the meeting.

The alternative mining methods project is looking at safety of new mining methods. It's updating recommendations for the use of backfill especially in new cut and fill mining methods that we're seeing around some of the new equipment and new mining methods that are coming out for deep metal mines. Just to highlight a few things that are going on in this team halfway through the year. I just wanted to give kind of a flavor of the type of things that we're working on. We're increasing our understanding around the conditions of corrosion, of supports, like mesh and rock bolts, and just to look and see if there's extra monitoring or remediation efforts that need to happen. There are instances where you cannot tell that you are walking under a roof bolt that is completely corroded through. We're also seeing some really extreme rates of corrosion on mesh in some mines, not all mines.

One of the examples is at Hecla's Green Creek mine, where we have corrosion coupons installed to understand corrosion rates and sources, and so if I can get my pointer to move over there, we're looking at mesh here and there's two corrosion coupons here for this test. One is against the rock to see if there's interaction going on between the host rock and the mesh, then we have one suspended out away to see if it's environmental, the atmosphere conditions.

So we're also conducting tests on cemented backfill, so you can see here we have some samples that we crush in our test machines in Spokane to determine strength characteristics, and this is around new requirements that the mines are coming to us, regarding the use of cemented backfill, the composition of it, and can they change their stope designs based on backfill strength characteristics. So that's what we're working with those mines, Barrick, Newmont and Stillwater.

Finally, we're seeing a need for new methods to obtain real-time data around ground stability. So we need to improve risk assessment for underground metal mines, especially as some of those mines consider new methods and going towards automation. So I'll talk about this effort a little bit more tomorrow when we talk about new projects that are coming up.

Next, our mining-induced seismicity and stability team. We have one project that started in FY16, detecting and managing dynamic failure. That's focused right now on some of the mine design challenges that are unique to western underground coal. Some of the highlights there, just one very important partnership with Chonbuk National University in South Korea, and this is looking at some of the same issues that we are for underground coal, so there's opportunity to share work in mine modelling and rock mechanics.

A previous project we had was to develop software to aid mine planners and designers in safer and more

productive drilling for blast hole patterns, and this helps minimize overbreakage and the risk of loose ground, and the software was released at SME in February, and it's available for download now.

Extensive modelling work has been completed to show the effects of near-seam features in coal such as cleats and small fissures, and that's something that's been lacking in previous models, and it shows the potential for dynamic failure, violent failure of pillars. We've published extensively on this so far this year, and we have more coming on the findings.

Our automation and technology team has two projects currently. We're working on new technology for portable and faster—hopefully someday real-time—monitoring of diesel particulates to improve exposure assessment and interventions. And we're in our second year of funding, through the CDC Innovation Awards, to develop an internet-enabled conveyor maintenance, planning and monitoring system. We're going to hear more on that today too.

Some highlights—this is the second year of funding through iFund for the conveyor maintenance monitoring system, and it's allowing us to expand our development and testing methods to improve situational awareness during maintenance activities. The main goal is to reduce the risk of unexpected start-up in this phase of the work, especially while personnel are in hazardous areas working on conveyors.

Additional partnerships are being formed. First, we have an ongoing relationship with Oldcastle Materials. We're now looking to expand the work there. We're also looking at other mining companies like Lafarge-Holcim. We're proposing to move this work under the mining program starting next year, and we'll hear more about that.

Powered haulage and machinery accident are still the leading cause of fatalities in metal and non-metal mines, and we plan to take a closer look at this with a deep dive into the accident statistics and the reports, fatality reports, to better understand where we should be targeting our efforts in this area. As Dr. Kogel and Jeff have mentioned, we're starting an initiative to better understand the status of advanced technologies in the US mining industry and where safety concerns may need further study, and we'll hear more about this too.

Dr. Miller has made progress in determining applicable technologies for smaller and faster DPM measurements, with FTIR for measuring both elemental and organic carbon showing promise.

For our last team, health exposure assessment and monitoring, which is one of our newest teams, they have one full project on predicting heat strain in miners, and they also have four one-year-long pilot projects on the effects of machine vibration on hearing loss, fatigue, data sources for miner health, and also collaboration with another NIOSH division to look at radon exposure in metal mines.

Some highlights for this team, as we already talked about, at the meeting that NAS conducted with stakeholders for the introduction and some feedback on the miner health program. That meeting went very well. It's receiving support to move forward, and Dr. Yeoman will be talking more about that.

The pilot study on heat stress in underground mining developed heat illness training materials and delivered the training for over 400 miners in Idaho in the Silver Valley, and this work will be a full—it's a

full project that started this year, moved out of the pilot phase. The study on fatigue in mining also started as a pilot project. It's continuing this year. Due to the interest we've seen from industry, we're proposing that that work also be moved into a full project next year.

I just wanted to highlight some of the more significant and the major conferences that we've been at this year where we've had a fairly large presence. At SME, we had five papers and our staff chaired two sessions that covered health and safety subjects around ground control, fatigue, diesel monitoring and communications. We'll have a very strong presence at the 52nd US Rock Mechanics Symposium in Seattle this June. We have nine papers accepted there. And then also, reaching out for international feedback with two papers on geomechanics and another one on photogrammetry at the Asian Rock Mechanics Symposium in Singapore this fall.

As we move forward in Spokane, we have plans to expand our research in miner health, ground control and emerging technologies. And the miner health program will be expanding efforts and searching out and analyzing new data sources. We'll increase our efforts in understanding and reducing miner fatigue with a full project. We plan to spend half a million to upgrade and renovate our industrial hygiene laboratory in Spokane. That's in cooperation with the other division there, Western States.

We also continue to increase our expertise in impacting ground control. We have many new staff in this program. We see a potential to make advances in risk assessment and real-time informatics for ground stress and movement, monitoring, and there's opportunities to look at potential needs for ground control technology as mines move towards automated equipment also.

We're also working to modernize our laboratories and our material test equipment as new technology comes available.

For automation and technology, we'll be looking at emerging technologies in mining, both for the safety implications that need to be understood, and for the benefits of advanced technology that could be applied to mining. And we'll be expanding our efforts in a very persistent Machine Safety Challenge—this is the conveyor operation and maintenance—so moving to a full project under the program is an important step there. We'll be looking to better understand machine-related issues on a larger scale by looking at accidents and stakeholder needs to help future areas—future research in areas of machine safety.

Just a quick look at some of the needs that we're going to see as we build the program, and as I talked about those future areas that we'd like to get into. This is just a few of the disciplines that we'll need, we have immediate need for in the next year or two, and there is data science, behavioral science, industrial hygiene, engineering, automation, system safety. So we do have some planned recruiting activities. One of the questions I have for the Committee is just looking at creative ways of bringing people on. As Jessica mentioned, we have just some challenges around our HR process. We have the ability—we don't have a hiring freeze—but it still takes more time than we would like to bring people on.

We're looking at a greater presence at university career fairs. We have done a good job in the past but we'd like to do even better at guest lecturer opportunities at the universities so that students get to know who we are and what opportunities might be available. We also have done a good job with student design projects where we will give local university engineering schools, will give them the opportunity to help us

solve a problem by having a student design team or another type of project, they'll do a very specific small-scale project for us. And we actually have brought on new people by doing that.

Then there's also the idea around a hackathon. I wasn't really familiar with this until recently.

Questions and Comments:

PARTICIPANT: A hackathon, and in fact, it does not have negative connotations.

MR. RUFF: Yes, if you look into them a little bit, they're really interesting little contests that you give, and they've mainly been around software but you can also do other things with them. But you get a team and you—well, several teams, and they're competing for it can be an award or something like that, but you give them a very specific problem and they get a weekend to work on it. So there's some potential there.

MR. WELSH: And I've seen those associated with conferences too as part of a conference that they do that type of thing. It's very interesting.

DR. NELSON: So Barrick has done several big hacks in Denver and in Las Vegas, and we sent teams. Students get very excited about it so if we have one problem, it is low enrollment coming into mining, and anything that increases the enrolment is important to consider.

MR. ZIMMER: Just a thought with hiring, do you think part of the problem is the perceived industry and prospective candidates are staying away from it because they don't know the longevity of it?

DR. NELSON: We can have that conversation. There's a lot of individual reasons, but I think overall, students that we have coming into engineering programs do not envision themselves having a career in mining, for whatever reason. So to change their minds by any surreptitious way.

DR. LUXBACHER: Well, I think when we talk about some of the specialists people that NIOSH is looking like graduate students, the long hiring process is a big problem because they are coming out with low salaries already, loans they have to take care of, and waiting three months on a job is very difficult for those people.

DR. KOGEL: Yes, and I think the pool is limited, and so I think that's also another thing as far as our specialized needs. We need to be thinking more broadly so that we can expand that pool in creative ways, because there aren't that many, like if we're looking at mining engineers and we want PhD mining engineers, there are just very few of them. So you can address it by fixing the pipeline problem at the beginning and getting more people into mining, or you can also look at do we expand our search and consider people that don't have necessarily the traditional mining and geotechnical engineering skills, which is often where we're hiring. And I think what Todd is showing here on the side, I don't know if you did it purposely, but you see a pretty diverse skillset here. We have all of these skillsets in NIOSH

already but I think when we're looking forward, especially with some of these new programs that we're implementing, we're going to shift that sort of, the profile I've showed, if I were to show it in terms of skillsets, it would be very different for that future mining or NIOSH workforce, and there's going to be more potentially around data science, and we're seeing an increase in our need for behavioral science and social scientists, and Priscilla has done some of that in her department on CSM. And so now we're having an opportunity to hire engineers that have some of that skillset as well. I think we're going to have just kind of change the way we think about the entire situation. So for us, it's hard for us to go out and bring in data scientists. I think we're a well-recognized kind of place for mining engineers, but how do we attract data scientists to the government, who have never heard of NIOSH or public health or occupational health or mining, and never thought of themselves—but that's the skillset that we're looking to.

DR. NELSON: That kind of connection. At mines, we have to do that because we don't have a medical school, we don't have the sociology. So we have to go out and find them and bring them in. But you have a big school like Virginia Tech or Arizona or other places, you've got the partners on campus that could actually provide that. Anything that NIOSH could do that actually encourages mining faculty, mining departments to develop that kind of connectivity on campus would be very interesting, and think about how that might be done. But NIOSH could be a force there. I think also one thing that's not—it's sort of in there in the student design project—but, in my perception, is what we would really benefit from if NIOSH wanted to do this, was having some kind of a mentoring activity where students who are working on projects, that may or may be your projects or ones that you provided but other projects that they come up with, if NIOSH staff could actually become a resource where students could ask questions. So you engage them in different ways and then you start really having an impact on the way they're thinking and you empower them at the same time. I think that kind of a mentoring role, regardless of whether you gave them the design project, would be useful for engineering projects.

MR. BOWERSOX: A question. I've heard it several times but what is the average process time towards hiring someone. When you say this is a long process. Is it weeks, months?

MR. RUFF: It's more than three months. It can be six months to a year.

DR. LUXBACHER: It was just the government's requirements on background checks or what slows it down?

DR. KOGEL: I think it's a lot of different things. That's a really difficult question to answer.

MR. RUFF: It is. It is.

DR. KOGEL: It can be many different things.

MR. RUFF: Yes.

DR. KOGEL: It's just we bring it up just because it's part of the reality and it's not something we really necessarily can change or have control over. But I think it's just important that we all understand that there's just a baked-in timeline that sometimes can put us at a disadvantage when it comes to hiring. And it's different across the government too. I mean, that's one of the things that I've learned coming to the government, is I think a lot of people have the idea that it's the same across the government and it's not. It's different. So it's just our reality.

DR. NELSON: I know at NSF when I was there, to have somebody temporary, or not permanent, was totally different from having somebody who becomes a federal employee. And we could hire in people from universities effectively but they were borrowed. They go back. They're not feds. And that's a huge threshold in hiring.

PARTICIPANT: Yes. Jessica, you mentioned interns. Does NIOSH have a co-op program where someone takes a year off of school and works and then goes back?

DR. KOGEL: I don't believe we do but maybe Jeff or some of the people who have been around longer than me could answer that.

MR. WELSH: Probably about five years ago we did do some co-ops. It's not common but I think it is still available. We just haven't utilized it that much.

DR. MATETIC: One of the hard things, too, is to get it through the school, given the process, the government process, to make that happen. We have done it in the past and it's just sometimes difficult to use the government process with the academic institution and kind of align it to make that happen. But it has been done and it's something that we always consider to utilize.

PARTICIPANT: And they don't have to go through the same hoops as if they were going to become a full-time employee, then. Right?

DR. KOGEL: No. I would assume so but I'm not experienced with it so I'll defer that to others.

DR. MILLER: I do think the intern is a good way to go too where people are going. I had a question, going back to the health exposure monitoring group. And you had mentioned that there was a chronic disease focus in that. And where is that kind of at? Where are they going with that?

MR. RUFF: Yes, so we're going to get extensive update from Dr. Yeoman but just to let you know that we're moving forward with the initial steps. The first thing is to establish the industry and the stakeholder partnerships in that work first to get their feedback on this and get their buy-in. We can't go forward without that. So that's the first step.

PARTICIPANT: So it's the scoping.

MR. RUFF: The scope. Then the second step is the strategic planning based on that. Then we'll move into a larger scale partnership or workshop with stakeholders to help for the exchange of information and direction. But we'll get more details on that from Kristin.

DR. BURGESS: So a comment and two questions. Did you consider building internships into

some of your programs? For example, your ventilation programs, it's designed to increase a number of doctoral students I think in that field. Could you expand that, for example, to have interns come to Spokane or Pittsburgh or some other location? This is a consideration for the long term. That way the money is already built in and that would be one of the deliverables, a fund.

DR. KOGEL: Yes. At this point that's not part of that…

DR. BURGESS: No. But I'm saying in the future.

DR. KOGEL: You're suggesting that we might do that.

DR. BURGESS: Could you—yes. Because that way you get around all these issues. You already have the money. It comes through the university. It's dedicated as a deliverable for that. A thought.

DR. KOGEL: Yes.

DR. BURGESS: So two questions. One, for the fatigue, so a lot of work has already come out of Australia and some other locations on that. I imagine you're already working somewhat collaborations there.

MR. RUFF: So that's part of the process, is finding out what's going on in other countries. But also what's going on in other industries because the over the road trucking industry also has a very good handle on that, especially mon… Well, they have a good handle on monitoring technology and we've seen a lot of that applied to mining. And one of the issues that we want to make sure is that is it the right approach. And it's just one part of a toolkit for mines. And that's what we're learning, is, I think there's a lot of different things that you can do depending on the mine and the situation. And we just want to make sure and understand what's available; what has worked in other countries and other industries and then bring those recommendations to mining.

DR. BURGESS: And along those lines for the DPM there was previously—and there still is—a real-time DPM monitor. And so what's up with the transition from that to this new approach? What is going on with the old one specifically?

MR. RUFF: So we're trying to come up with a system that measures total carbon. The other one measures elemental carbon. And then you have a ratio to kind of estimate total. So the idea is one instrument that measures total carbon, both elemental and organic, and does it in a small package. I mean, initially we're looking at something lunchbox size. Eventually as technology develops maybe it can be worn on the body. So that's the direction. This is a long term effort looking to take a very big step beyond what is currently available.

DR. BURGESS: So is NIOSH done with the old, the current monitor? Or is that a—are you continuing to collect data on its use? Where is that part?

MR. RUFF: Yes, so it's part of—we always keep an eye on what's going on with that and how it's being used and how well it's doing. But to take a step forward, it looks like we

need a different technology to do this.

MR. RUFF: One idea might be to do like a grand challenge in that space. We've done some of those with EPA and those are pretty interesting and for a low cost, you get some innovation out of that.

DR. NELSON: And in fact, a focused IP—that could be a hackathon where you actually get people from all across campuses coming in and completely reimagining what's going on. That would be a good exercise for students.

MR. RUFF: Yes. So we're in this phase now.

DR. NELSON: Yes. We already went there. So I found myself thinking about this when you have deeper and hotter and stressful situations. The same thing happens to robotics and technological fixes in the underground. So the basic sense of thinking about robotic health—I know it's not part of your mission yet, but the basic sense of it—you're going to understand how robotics can replace and automation can do things. You've got to understand the limitations of that. And they're also going to experience fatigue and heat stress and noise problems and everything you've got up there. The same thing is going to affect the electronics and the robotics. And so it would be interesting to think about that with… I don't think that you can quantify benefits unless you can get your handle on that. Because if you're rosy-eyed and saying that the robotics are never going to slow down, never going to do anything else, then they're going to come up with something that nobody quite expects. But that could be an interesting thing to think about.

MR. WELSH: Yes, one thing, Jeff Burgess and I were at the Resolution Mine a couple of month ago. Very hot, wet, 160 degrees; can't touch the walls. And that's a concern of protecting electronics and any of the electrical gear from that type of environment.

DR. NELSON: Yes. It's hot. Yes. And another thing I was thinking about was slide 5 and 6 when you talked about the problems with durability, which seems to be focused on corrosion predominantly. Is that true?

MR. RUFF: There's the durable roof support project looks at corrosion but it also looks at installation sequence and new technologies around support. So they're looking at—I have mines come to us and say do I do mesh and then shotcrete and then bolts over the top of that? Or do I do mesh and bolts? There's just a difference…

DR. NELSON: But are you looking at the durability of that?

MR. RUFF: We're looking at the durability in that we want those technologies to take a load. So durability from the standpoint of can it take a load? How far will it deform before?

DR. NELSON: But durability implies time. Okay. That deformation.

MR. RUFF: It's corrosion or deformation but corrosion works into the time component.

DR. NELSON: And I realizes that you're very responsive to if a mine has a problem you respond to it.

MR. RUFF: Yes.

DR. NELSON: But as we start thinking about mines becoming deeper and hotter and in a wider variety of different kind of materials, is it possible to maybe have a project that thinks in anticipation of what kinds of deeper, hotter rock masses would be most important to know about, ahead of time, you're going to run into this problem down the road? So whether you're talking about something that has asbestos in it, rock that has it, or some kind of particularly caustic water, or, I mean, is there some way of providing some kind of thinking or guidance to people who are thinking about going underground in deeper and hotter conditions and what problems they're going to anticipate?

DR. KOGEL: Absolutely. Yes. This is sort of behind this whole idea of understanding ore body geology because it really is going to come back to that. And if you understand the mineralogy and the geology in that ore body, then you can start predicting potential exposures and some of these ground control issues based on our understanding of the geology. And so I think that's the framework from which you would start really… Ask the question and start addressing it and build some sort of database. And we already have this and I think, Steve, when he talks about the EMP is going to talk about similar sort of approach to what we're doing with the elongate mineral particle research.

DR. NELSON: What kind of an application ? So certain material that's not causing a problem in shallow or surface excavations, if you went deeper you'd run into a problem and when it could be overstress driven, it could be whatever. But that's anticipating. But that's where mining is going to go.

DR. KOGEL: Exactly, something predictive.

DR. MILLER: As you were talking about ore body geology, how closely connected are you guys with like USGS and their divisions there that do a lot of that work?

DR. KOGEL: Right now we interact with USGS and certainly are interested in working across various federal agencies.

DR. MILLER: They have a new environmental health division there too, so that might worth exploring that relationship with them.

DR. NELSON: What I'm wondering is when you, as a federal agency, make a partnership like that where you're working on developing a new product or new methods, I wonder if it's possible to think about bringing US faculty in on that project so that they can actually learn along with you and develop academic ties that could be sustainable for the long term. Just as a general policy.

MINING RESEARCH PROGRAM UPDATE – PMRD, DR. RJ MATETIC

Dr. Matetic discussed: 1) Organizational Updates, 2) Research Portfolio Overview, and 3) Program Highlights since the last MSHRAC meeting (November, 2017) in the presentation.

Dr. Matetic discussed that PMRD is addressing staffing goals, and retirement and succession planning for the future of the program. There are currently 158 employees at PMRD. Sixty-three (63) employees can retire within three (3) years, which is approximately 40% of the workforce. Dr. Matetic mentioned, although the government hiring freeze has ended, there continues to be hiring restrictions mandated down from the Department. Dr. Matetic proceeded to mention utilizing several talent pools in an innovative and creative way to bring well-qualified candidates into the program, although the hiring restrictions continue. Such as, recruitment of the veteran population, visiting and promoting the program at technical schools, community colleges, universities, contacting industry personnel, along with personnel from other government agencies. Dr. Matetic also mentioned the use of more innovative and creative processes to bring people into the program. Such as, utilizing continuous announcements, internships, the pathways program, fellowships, along with using the Presidential Management Fellowship Program to recruit candidates.

Dr. Matetic explained that the PMRD FY2018 program has 25 projects in 7 branches distributed across differing mining sectors. Dr. Matetic also mentioned the consistency of sector distribution of projects related to previous FY17, current FY18 and future FY19. The average sector distribution related to the PMRD research portfolio over the three fiscal years relates to 41% coal, 22% stone, sand and gravel, 14% industrial minerals, 20% metals and 2% oil and gas.

Dr. Matetic also displayed a slide related to distribution of outputs (science and translational) since the last MSHRAC meeting in November, 2017. The PMRD produced a total of 111 outputs since the last MSHRAC meeting, 6 months ago. He also mentioned that 46% of the total outputs were related to science and 54% associated with translational outputs. Dr. Matetic also reiterated to the committee that science outputs are the supporting evidence of the research and translational outputs are designed to translate research to stakeholders who can implement changes. He also provided information on how the outputs were disseminated across all mining sectors. The dissemination of outputs were displayed as 47% coal, 29% stone, sand and gravel, 11% metals, 10% industrial minerals and 3% oil and gas. Dr. Matetic also mentioned the increase in stone, sand and gravel outputs since the last MSHRAC meeting. There was a 13% increase in outputs for the stone, sand and gravel sector. All other sectors remained neutral since the last meeting, 6 months ago.

Dr. Matetic wrapped up the PMRD overview by highlighting seven (7) areas of success, since the last MSHRAC meeting including: 1) SME presentations and awards – A total of 22 publications and presentations (6-dust control, 5-disaster prevention and response, 5-ground control, 4-machine safety, 1-human factors and 1-economics) were provided at the SME meeting in February, 2018. In addition, two major awards were also provided to PMRD and respective employees at the meeting. Jacob Carr received the J.W. Woomer Award for Young Engineer of the Year and the Dust, Ventilation and Toxic Substances branch received the Health and Safety Research and Educational Excellence Award for efforts associated with monitoring and control of respirable dust; 2) partnership meetings and stakeholder interaction – A rock dust partnership meeting and the underground stone seminar was conducted in December. Two webinars, sponsored by the NSSGA were conducted involving topics related to end-of-shift silica monitoring and hazard recognition and risks associated. A total of three (3) workshops were

conducted at the Agg1 conference in March, sponsored by the NSSGA. The workshop topics included, health and safety management systems, hazard recognition and associated risks, simple solutions to musculoskeletal disorders in mining; 3) guidance document on enclosures to prevent exposure to airborne hazards – The guidance document entitled, "Design, Testing and Modeling of Environmental Enclosures for Controlling Worker Exposures to Airborne Contaminants" has been reviewed and cleared for publication and will be released this summer and be available on the mining program's website. The guidance document will provide the industry and user with design considerations, testing and monitoring, and data analysis of performance and modeling of enclosure filtration systems; 4) release of the simple solutions guide to industry – The guide provides simple solutions for surface mine workers to reduce risk factors attributed to musculoskeletal disorders and slips, trips and falls. A total of seventeen (17) simple solutions are provided which include activities or tasks such as greasing, palletizing, equipment access, working around floor openings, transporting supplies on mobile equipment ladders, etc.; 5) Saturn and Jupiter II lights– commercialization next – the Saturn light is currently in MSHA approval and certification. Once approved J.H. Fletcher will commercialize the light and install on their roof bolting machines. The Saturn light was developed for improving hazard detection and reducing glare to roof bolting machine operators. The Jupiter II light was developed for wide area lighting. One such application would be as a machine headlight, other applications would include lighting of beltways, etc. J.H. Fletcher is interested in commercializing the Jupiter II light as well. The Jupiter II requires only 24W of power versus the 50W of power for a traditional machine headlight. In addition, the Jupiter II uses the same explosion-proof housing the Saturn light uses; 6) two recent interviews related to the resurgence of PMF in central Appalachia regarding monitoring and control of respirable silica dust – Two (2) recent interviews were conducted with BNA Bloomberg and NPR related to the resurgence of PMF in central Appalachia. Topics of discussion were monitoring and control of respirable crystalline silica. The end-of-shift silica monitoring method, utilizing the FAST (Field Analysis Software Tool) software was of major interest and 7) number of on-line users associated with the hazard recognition challenge – The hazard recognition challenge is a virtual workplace examination tool (surface operation). The tool is designed to increase the user's knowledge of hazards and awareness related to the identification of the hazards. Four areas (shop, pit, plant and roadways) are associated with the challenge. Since inception, the challenge has been used by over a thousand on-line users. EXAMiner is next. EXAMiner will not only give trainees the ability to perform a virtual workplace examination, but it will also allow the creation of custom training scenarios for their own purposes.

Questions and Comments:

MR. ZIMMER: How is the simple solutions for surface mineworkers publication being used in the field? is it being handed out to the worker?

DR. MATETIC: It's being handed out to the workers.

MR. ZIMMER: What's the response factor?

DR. MATETIC: It's in its infancy so it's a couple months old, so I'll tell you more, Kyle, when—

MR. ZIMMER: Is that available through NIOSH?

DR. MATETIC: Absolutely, yes.

MR. ZIMMER: I like it.

PARTICIPANT: I did distribute the booklet it at a lot of mine sites. That helped; that's a real good one.

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DR. NELSON: Great. Thank you very much. I'm struck by one thing that we have to go—I encourage you to go—the virtual reality realm. And we have a new professor at mine, and most schools have this, that are partnering over in Computer Science and we've exported laser scans from the Edgar Mine onto campus. And you can go and put on the glasses and you're sitting there in Edgar Mine. And people can be up at the mine and down on campus looking at the same thing because we have wideband up there. And it's phenomenal as a learning experience. So what I understand, this is great and people are responding to it. We've heard so much about it since I've been on the committee. Got to look towards virtual reality.

DR. KOGEL: Yes. I think that's a great comment, Priscilla. And those are conversations we're having. We're setting up to do some of that. It actually has come up at Spokane as we've interacted with our stakeholders. And so we're looking into that and we've got the research capability in Pittsburgh with a 360 degree but we need to bring it… We've been referring to it as "the Conference Room Scale," where you can do actually that. And the technology is so inexpensive now and I do think that's the way of the future. And we're certainly gearing up to incorporate that much more into our research.

DR. MILLER: RJ, you mentioned the reports about increased black lung and then talked about the silica. Wouldn't you also be looking at the carbon particulate as well?

DR. MATETIC: Yes.

DR. MILLER: Or is it just the silica?

DR. MATETIC: For those two interviews it was specifically related to silica exposure.

DR. MILLER: I see.

DR. MATETIC: So that's when the end-of-shift silica monitoring method was so…kind of rose to the top, regarding, "Oh, my. There's a method that might be released that you could determine percent silica at the end of a shift instead of waiting weeks for the sample to come back to the lab."

DR. NELSON: Any other comments or questions? Jeff?

DR. BURGESS: I was wondering, in terms of the silica and the B Reader stuff, about the potential for using machine learning to be able to read digital chest x-rays. So this is something that I thought about after a couple of recent presentations and meeting with the folks in Australia. And I know that they have a program where they're funding someone to do some parts of this. But I spoke with one of my colleagues who is a pulmonologist and an occupational physician, and he said that this is a really challenging problem that requires a lot of resources, smart people. But it seems to be very valuable to be able to have some type of machine learning

approach that could augment the reading of radiographs just by standard individuals in addition to B Readers because that's always been a limitation.

DR. MATETIC: Scott, I can defer that to Scott.

DR. LANEY: Yes, so there have been really great technological advances with tuberculosis and with breast cancer for this type of thing. There's been great challenges with this for pneumoconiosis because of the different presentations, because of the subtleties. And so there's been a tremendous amount of resources put into this by giants like Fuji and some other Japanese manufacturers, especially. They've been able to do some of the ribs, some traction stuff that's really important. But we're just not there.

I was contacted, probably five years ago now, about this type of thing being funded by the NIH. And they were interested in candidate images for the learning process and whether or not they could access some of the surveillance films from the Coal Workers Health Surveillance Program. And that never got funded or went anywhere.

There's a lot of suspicion, because of the amount of resources that have been dumped into this, that the sensitivity and specificity will probably never really be able to get dialed in with the digital radiography. And that we're going to have to go to things like CT or other technologies to actually get there. So that's really the current status.

MINING RESEARCH PROGRAM UPDATE – MINER ACT EXTRAMURAL RESEARCH, DR. GEORGE LUXBACHER

This presentation covered the extramural contracts and grants programs under the NIOSH Mining Program. There are currently 28 active contracts issued by the CDC Office of Acquisition Services (OAS) and managed from a technical perspective by Contract Officer's Representatives (COR) within the Mining Program. There are 3 active grants issued by the NIOSH Office of Extramural Programs (OEP); these grants are fiscally managed by a Grant Management Specialist (GMS) and administered by a Scientific Program Official (SPO). The Mining Program provides input through a Mining Program Project Scientist (PS).

An annual one-day workshop meeting is planned for the Miner Safety and Health Training Program - Western United States grantees: the University of Arizona and Colorado School of Mines. This meeting will be held in December 2018 following the SME Arizona Conference with the intent to review and share grantee information and products, discuss technical and coordination plans or issues, build partnership among the funded institutions, and coordinate partnership and/or training activities.

Synergies between completed grants and the intermural research program were discussed, using noise emissions and rescue rebreathers as examples. Several grants have been followed by contracts to further develop concepts.

Contract solicitation options were reviewed; Broad Agency Announcements (BAA) and Requests for

Proposals (RFP) are the two mechanisms most frequently used. The Mining Program currently has 14 BAA technology contracts and 1 RFP contract under our MINER Act program and 12 BAA capacity build contracts; these contracts are managed by 18 CORs from the Mining Program.

An Annual Report to Congress is prepared by the Mining Program as required by the MINER Act Amendments to the OSH Act; this report summarizes the status of all BAA technology and RFP contracts active during the preceding fiscal year. Several examples of contracts were reviewed as part of the presentation.

The results of the FY2018 BAA solicitation were briefly covered with reference to the focus areas discussed at the fall 2017 MSHRAC meeting. Limited details were provided as contracts are currently in negotiation. It was noted that the majority of the responses to the solicitation came from universities (31 of 44 total) however only one university is proposed for a contract (1 of 7). A lengthy Q&A discussion resulted.

The presentation then discussed the BAA capacity build program in some detail. To date this program has resulted in 27 contracts, supported 62 faculty (including the 27 principal investigators), and funded 87 masters students (68 degrees completed to date) and 58 doctoral students (41 degrees completed to date). The NIOSH Mining Program has hired 14 graduates from this program; 12 are still employed by NIOSH

Questions and Comments:

In response to the presentation on the annual grantee meeting under the Western Mining Training Center grants, which includes Colorado School of Mines and University of Arizona.

DR. NELSON: Who else will be there, just NIOSH plus the two? Or are you going to open it up to others or invite people?

DR. LUXBACHER: I think the intent right now is just NIOSH and the two universities. I would venture to guess both universities could invite stakeholders should they so choose. We'll talk about that internally. They have these annual meetings of grantees on most of the grants that NIOSH sponsors but this is the first one for us.

In response to the presentation on active contracts:

DR. NELSON: Does the word "contracts," imply specific deliverables? What does the word "contract" as opposed to "grant" mean to you?

DR. LUXBACHER: The contract means specific deliverables. The grants, depending on the type of grant, are researcher-initiated. And typically it's very difficult to hold those individuals to deliverables at the end of the grant. While they try and I have attempted to accumulate most of the grant reports, there are grants where the grantee has either chosen not to submit a report or submitted a very brief report. Contracts are held to very specific deliverables. The biggest problem on the

contracts is getting a 508 compliant report at the conclusion of the work. On contracts that include company-confidential information, two versions of a final report can be submitted: one for public distribution and one that includes with withheld confidential information. We've funded a number of research efforts into sensor technology, for example. We'll have a public report that's a very short public report and we'll get a very detailed report for to comply with the contract deliverables. With the contracts that are expiring this year and the contracts that we're going to award within this fiscal year, which will be awarded in August and September, we'll have 27 contracts in our portfolio next year that we're managing.

DR. NELSON: Do you make every one of these as standard contracts rather than continuing awards, fully funding them out of one fiscal year?

DR. LUXBACHER: With the exception of the capacity builds, we fully fund. You have severable and non-severable contracts under appropriations law. A non-severable contract means you get the delivery at the end of a multi-year period but you fund it out of that given fiscal year. So all the technology contracts are funded within one fiscal year. The capacity builds are renewed annually.

DR. NELSON: Do you have the option of not doing renewing?

DR. LUXBACHER: Yes, we do and we have exercised that option in the past. We've had situations where the principal investigator has left the country and no other principal investigator at the institution has stepped to the table and we have terminated. We've also terminated for poor performance.

DR. NELSON: Yes. And sometimes that money doesn't come back to you.

DR. LUXBACHER: That money doesn't come back. Well, the benefit on the capacity build BAAs is that money is funded out of that given fiscal year. So if we make that determination ahead then we can redirect that money. But the money on the technology contracts is lost to us if the contract is terminated prior to completion.

In response to the presentation on anticipated FY2019 contracts:

DR. NELSON: What's the one that is being considered for funding in the "other" category?

DR. LUXBACHER: The "other," whenever we submit a BAA you can submit a BAA under anything you care to submit a proposal related to health and safety on.

DR. NELSON: You're going to think about funding one. What is that one?

DR. LUXBACHER: We're thinking about funding one - it's related to an intramural program. It's an issue that came up but I can't really talk about it until a contract is awarded since it is outside the focus areas. It's related to an intramural program with regard to refuge alternatives where the Mining Program doesn't have the capabilities to address the issue. We have a submittal that can do some assessments and that's what we're considering funding.

In response to the presentation on the statistics for BAA solicitations for the last 5 years, including contracts anticipated to be awarded in FY2018:

DR. NELSON: Do the universities know the lack of success of their submittals for the current BAA solicitation?

DR. LUXBACHER: If a proposer has a question as to why their proposal wasn't selected, either the concept paper or the full proposal stage, we offer a debrief meeting upon request through the Contracts Office. We've had complaints because we are not responsive to requests for a debrief meeting but we're not allowed to talk to proposers individually but rather it has to go through the Contracting Office. The delay is in getting the Contracting Office to schedule the debrief meeting.

DR. NELSON: There's a huge level of effort for 31 concept papers and proposals coming in and only one of them (universities) to get funded.

DR. LUXBACHER: We had more responses from universities than companies but the university responses were more research oriented and not necessarily focused on implementation of technology which is what the BAA focuses on. A proposer can always submit under the "other" category. And we're not locked in to any particular topic, although we have definite interest in the identified focus areas. If we had an indefinite funding availability, the next level of chosen projects would have been primarily from the "other" category, not from the focus areas. So through our evaluation process it just happened to break out in this fashion for this fiscal year. We have to work this within the available funds which is something that's always difficult.

PARTICIPANT: I think it gets to what you want. Are you looking for new ideas and new areas or are you looking for specific solutions? If you're looking for very specific solutions then that's the way to do it.

DR. KOGEL: Correct. Looking for very specific solutions is an RFP. We have had internal discussions related to this.

In response to the presentation on the FY 2018 anticipated contracts:

PARTICIPANT: The small CPDM, are we close to something there?

DR. LUXBACHER: I can't talk in detail about what we're planning to fund out of the current BAA but I can tell you that I think what we're funding has great potential to give us a reduced sized PDM on a very rapid path.

PARTICIPANT: That will make the miners very happy.

DR. LUXBACHER: When you look at the form factor of the current CPDM it unfortunately was designed around the battery for a miner's cap lamp. And whenever they elected to take it away from the cap lamp they had to maintain the same form factor because of the way it went into production. What you have essentially is a partially empty case. If you actually dissect one you'll see that there's empty room

there. But they were forced to do it to move into production. And I think that—while, again, I can't talk about contracts that we haven't yet issued, I think that—there is some potential there. Plus we have some alternatives. This University of Illinois Chicago wearable device that both handles dust as well as silica I think has some potential. But I think it's quite a few years away. I think we have some quicker solutions that will make the miners much happier.

SMART MINE/INNOVATIONS INITIATIVE UPDATE, MR. JEFFREY WELSH

Mr. Welsh provided an update on the Smart Mine/Innovations Initiative. Technologies associated with automation robotics, wireless communications, smart sensors, wearable platforms, augmentation of reality, interconnectivity of devices and data analytics are being implemented in the mining industry, particularly in western metal mining. The introduction of these technologies in mining could affect worker health and safety, both positively and negatively. NIOSH wants to proactively address worker health and safety issues that may be associated with the implementation of the new technologies.

In the NIOSH "Mine of the Future" report, six key recommendations were listed. Progress has been made on each of those recommendations. One is to collaborate with the NIOSH Centers for Occupational Robotics Research and the Center for Motor Vehicle Safety, both coordinated out of the Division of Safety Research in Morgantown. Two mining program researchers are part of the steering committee and they attend the meetings, and actively participate. Two is to participate on standards committees addressing safety standards for mining automation. A global mining guidelines group recently had a workshop in Vancouver on the implementation of automation systems in mining. A mining program researcher attended that meeting and will also attend a June 22nd meeting in Denver. Three is to partner with universities and research organizations conducting automation and robotics research. Mining program researchers interact with the National Robotics Engineering Center in Pittsburgh, and they are using LIDAR to map a limestone mine, and determine how the technology could be used for determining control issues. Researchers have also met with faculty in the WVU Electrical-Computer and Mechanical Engineering Departments, where their robotics research is located. Four is to develop staff, gain in-house expertise. In Todd's presentation, he talked about the Emerging Technologies Initiative and the expertise that will be needed. It is part of the hiring plan. Five is to initiate a pilot project to gain knowledge, and develop contacts to better focus our direction. At the last MSHRAC meeting, Miguel Reyes talked about a proposed pilot project. The approach that will be used is to post a Request for Information in the Federal Register. It will take a broad look at what's going on in mining automation, covering all sectors, not just metal and non-metal, but coal, stone, sand and gravel. Input from the RFI will feed the direction of the pilot project. Six is to collaborate with mining companies implementing automation and smart mine technology. Three companies, Barrick Gold, Hecla Mining and Rio Tinto, have plans to implement automation technology at their mines, and have expressed interest in collaborating with NIOSH to identify potential health and safety issues and provide solutions to those issues. Initial meetings were held with

those companies. An Emerging Technologies Research Initiative was started to focus on western metal mining automation, with SMRD the lead. Plans were to convene a workshop to discuss research needs in this area, and to provide a forum to exchange information, experiences on implementing the advanced technology in metal mining, and to identify potential health and safety risks. The workshop would answer these questions: What extent will automation and smart technologies be implemented in metal mining? What are the emerging health and safety concerns? What gaps exist in occupational health and safety related to automation and smart technologies? Of these gaps, what are the priorities? Would the topic benefit from a mining multipartite partnership?

Initial thoughts were for NIOSH to put together the workshop. But with concerns related to FACA, an alternative approach is to initiate an MSHRAC workgroup to organize a workshop. The remainder of the session discussed this approach to establish an MSHRAC workgroup and they would be the ones who would organize that stakeholder meeting and provide information back to this full committee. The workgroup's charge would be to gather information on the potential health and safety issues related to implementing automation and smart technologies in metal mining. The workgroup would organize and facilitate a public mining stakeholder meeting for discussion around the questions above. The workgroup would draft a report based on the research activities and information gathered during that open stakeholder meeting and present it back to the full MSHRAC committee at a future meeting for discussion and potential recommendations to NIOSH to proactively address those worker health and safety issues. A proposed charge for the workgroup was mailed to committee members in advance of the meeting.

Questions and Comments:

DR. KOGEL: I want to mention the timeline. We want to move fairly quickly, and it's not going to be a long-term activity because we would like to, within the next three or four months, have the workshop and then at the next MSHRAC meeting in November, hopefully we would then have a report back to MSHRAC.

DR. NELSON: I think this workgroup activity then really engages the industry and the academics in both the mining industry and the supporting industries. That's the way to do it. So I think it needs to be done and if this is the mechanism that you've chosen.

DR. KOGEL: Yes and that isn't to say in the future we wouldn't want to use another approach in the future.

DR. NELSON: Is there anybody on MSHRAC that would not be interested volunteering for the workgroup?

MR. WELSH: Kyle, Kray, Mike, Ron, Jeff, Stacy, and Bruce (in advance of meeting) volunteered to be on the workgroup

MR. WRIGHT: Jeff, are you going to be the DFO?

MR. WELSH: It will either be myself or Todd.

DR. NELSON: Are you thinking that the workgroup workshop would happen during the summer?

MR. WELSH: The charge has the first meeting of the workgroup within 30 days of today and

then within six weeks after that, have the workshop.

DR. NELSON: The sooner the date is fixed and you start letting people know, the more likely you're going to get good attendance. But the concern to me is that you don't have the key people whose voices you want to hear.

DR. KOGEL: Tomorrow, as part of our wrap-up discussion, maybe we can come back to this after people have had some time to think about it, any additional questions that might come up and as Jeff mentioned that it wouldn't be completely starting from scratch necessarily. We have the Mine of the Future report that the committee would be able to work from, and we have put a lot of thought into the questions and some other materials that we've developed, that the committee could also use if they want to.

STONE, SAND & GRAVEL SECTOR RESEARCH PRIORITIES, MR. KELLY BAILEY

Kelly Bailey made a presentation on recommendations for NIOSH mining research for the stone, sand and gravel (SSG) construction aggregates mining sector. He began by describing some of the unique aspects of the construction aggregates industry demographics. An important fact about this industry is that 84% of the companies in the industry have 25 or fewer employees in their entire company. Sixty percent have 10 or fewer. The logistics of reaching these small companies is a major challenge. He next spoke about how different entities group different commodities under the SSG heading. This presents problems with injury, industrial hygiene, and other statistics when trying to identify areas of concern and possible research targets.

Mr. Bailey provided some basic injury data for the SSG sector and referred the Committee to the written report for a more comprehensive discussion of the injury and fatality data. There were six critical questions that NIOSH wanted addressed: 1.) Is NIOSH identifying and addressing the current SSG challenges; 2.) Focused on priority issues; 3.) Positioned to meet emerging challenges; 4.) Equipped to serve the SSG sector; 5.) Are there different challenges between East and West regions of the US; 6.) Is the level of investment appropriate to meet the needs?

Based upon inputs from numerous sources the following recommendations were offered:

Question 1 – Current Challenges

- Discuss with MSHA the errors in the commodity classifications of several mines.
- Establish a working partnership with MSHA to identify small companies that may benefit from NIOSH research participation.
- Examine MSHA data regarding flooding, roof falls and fires for potential research projects.
- Review MSHA IH data for aggregate mines. Review MSHA DPM data to identify which jobs are most frequently over the PEL.

Question 2 – Priority Issues

- Examine MSHA injury classifications to clarify exact causes especially for material handling and slip, trip and falls. Increase hazard recognition training in these areas.
- Identify QC measures that should be incorporated into audiometric testing software.
- Employ the end of shift silica analysis approach in the aggregate industry where mineral complexity does not present interferences.
- Develop effective welding health hazard training.
- Helmet Cam for DPM in underground mines and welding fume exposure assessments would benefit the industry.
- Assist safety and health professionals with making safety and personal value for their employees.

Question 3 – Emerging Challenges

- Establish the Elongated Mineral Particle research team
- Crystalline silica analysis capabilities of commercial labs
- Are heavy metals in mine dust a real hazard? At what level?

Question 4 – Equipped to Serve

- Develop a more strategic approach to research priority selection.
- Increase knowledge of the SSG industry by partnering with NSSGA
- Establish an SSG expert for PMRD and SMRD
- Need to obtain expertise in the emerging challenges areas.
- Mix different research expertise on projects to enhance more interaction between researchers

Question 5 – East versus West – Research should take the following into account:

- Most dredging is performed in the East so there is a higher risk of drowning.
- More wear and tear on equipment in granite and traprock operations means more welding in these types of operations.
- Most underground SSG mines are in the East. DPM work should focus there.
- Drilling and blasting occurs in quarries. The East has the most quarries.
- Most sandstone is in the East which will have higher silica content and be better candidates for the end of shift silica analyzer.

Question 6 – Funding

- Increase funding for SSG from 10-12% to 20% of the total research budget in order to adequately fund recommended projects.

<u>Questions and Comments:</u>

DR. NELSON: When you say that, are you talking dimension stone or can that actually be aggregate?

MR. BAILEY: I'm talking aggregates.

DR. NELSON: I think you talked about the cyclic nature of the industry, is characteristic of all mining industries but is there an extraordinary turnover in employment? How long do people stay working with the SS&G or is there higher turnover of employees in that sector than there is in typical other coal or hard metal?

MR. BAILEY: I think there is more turnover. I think it's primarily in the quarries that are located around large metropolitan areas.

DR. NELSON: Is there data on that?

MR. BAILEY: I'm sure there is.

MR. BOWERSOX: I can speak from the organized labor perspective and we represent the operators in the quarries and there is no turnover, in our case, because they're larger companies. The pay scale is good. The work conditions are decent. So historically, those guys stay in those quarries. But I agree to your point, the smaller companies, some of the smaller companies on the outlier, they tend to turnover a little bit quicker.

MR. BAILEY: Unless they're very small towns, where you have generations of families working. I mean, it's pretty remarkable. You get around Atlanta and you've got not only the mining sector that's competing for your welder, you've got all the other types of industries that are associated with that metropolitan area that may pay a little bit more. So the competition for the labor and the labor pool is not deep. It's not deep and that's one of the drivers of automation is that how do we keep the place running with fewer people because we can't get them to come work? And they drive a haul truck back and forth from the muck pile to the primary pressure for 16 hours a day. Not many people will say yes, sign me up.

MR. BOWERSOX: Sixteen hours a day, I wouldn't think.

MR. BAILEY: When an economy gets better. It's kind of interesting because you end up stretching those hours out to a point where it doesn't make any sense. You go to the second shift, then you have to have a third shift for maintenance. That's how it kind of happens. So we're coming out of this great recession. It's picked up considerably. It started picking up in '12, '13 and it's moving pretty fast. So they're trying to get people, hire people.

PARTICIPANT: Actually our partnership program is providing an awful lot of labor to our signatory contract with the miner. The kids are coming out, they're going into paving. They're going into cement plants. They're going into the asphalt plants. They're going into rock ports and they're doing good and a lot of them stay there. Some of them, to your point, do want to venture out and do other things and they do but that's a good learning place for them, get them into the quarry and get them into the good quarries with good safety program and things happen.

MR. BAILEY: If they're there for two years, three years, they'll easily stay. There's a lot of them that come in for a week and leave.

DR. NELSON: That's what I'm trying to understand, the differences between this sector and the

other ones.

DR. BURGESS: Just a couple of questions and comments. One, how about the trainers? I mean, they've got to still have MSHA training and so, it seems to me like that's a mechanism to get information out there, maybe something that can be tried. Like for example, we're working with Texas right now. They have this state-based program where they send folks out. Maybe that's a way of getting information out to them about things, because they're already going there. So let me put that as a question. Have you looked at that as a mechanism to get information out?

MR. BAILEY: It certainly is and it is a requirement that they're trained in it. It's not a requirement that they be of high quality. So you have that whole spectrum of training. You have a state grants program, like a community college, they usually are pretty good at what they're doing. I know training for other companies and so forth. But a lot of the smaller operations –I mean, they're all relatives, mom works the scale yard. Dad works the shovel and it's a different culture. But they've still got to do it, but the quality may be different. And I agree with you, those kind of tools that NIOSH has, make them available to those state grant trainers and it's every year they've got to do it.

DR. BURGESS: Exactly. It's a wonderful opportunity. And so the other question I had was how much have you been working with Spokane's new health program? In terms of you talked about the, for example, the welding fume exposure seems like a great opportunity for collaboration with the stuff you've been doing and what they've been thinking about, in terms of the health outcomes.

MR. BAILEY: I've been out there twice and I've talked to Jerry Poplin and tried to facilitate the signing up of folks for that, which is not an easy thing. There are some issues that companies have that involve legal issues and that kind of thing that they have to work through. And that Stone Association has been helping with that, too, as far as getting people to understand what it is and when it was originally started, it didn't go very far because. We just didn't really have a good appreciation or understanding of what it was within the industry and it kind of fell on its face. And I think it's being taken at a slower pace and with more collaboration and I hope it's more successful. But it needs to be done.

DR. BURGESS: Exactly. The last question was actually for the larger NIOSH group. Is there the potential for having extramurally-funded projects either through the MINER Act or through RFPs specific to stone, sand and gravel? Maybe you've already been doing that. That would seem like it would help to address some of these issues.

DR. KOGEL: Can I just go back to the welding? That's an opportunity for us to work more broadly across NIOSH because NIOSH has an active program in that research area. It just isn't within mining. So part of this is I think is for us internally within NIOSH to bring the mining program together with the folks who are doing that research and make sure that they understand what our particular research

interests are in that area. And we may have already addressed some of this, so then in that case it's just a matter of identifying what's already been published and making sure that we're disseminating it to this particular sector. So I think there's sort of an opportunity there. The short answer about the extramurally funded projects is no because even though the MINER Act doesn't specifically mention coal, pretty much everything is under the MINER Act is to push you in the direction of coal, if you're looking at the sectors. But that isn't to say that we couldn't somehow, where there's overlap, maybe start thinking about that as an opportunity. And certainly RFPs could be an opportunity, as well, for that sector. But I think a lot of the recommendations are things that we can accommodate in the existing program and we already are to some degree. I think Kelly made the point that it's maybe a matter of being more strategic about how we start incorporating some of these things, some of the gaps that he's identified that we're partially addressing, perhaps. So I think that's going to be kind of a first line of tackling this.

MR. BAILEY: Reaching all these small companies is the biggest challenge, it really is. It is very hard. We talked about it, they all get the industry magazines because they're free. You know you've got Aggregates Manager, Pit and Quarry and Rock Products and they go to practically everybody because Caterpillar is paying for it all and you get those stories in there, easily understood and they'll read them. Whether they do anything about it, I don't know. But they'll read them and get it that way and again, I would—your idea with using this annual refresher training and feeding those folks as much as you can and then really consider using MSHA as a conduit to those folks. But MSHA also could identify those small producers that have a problem that they have to abate, that NIOSH already has a research project on and you enlist them into your project as a candidate for participation in research.

DR. MILLER: One question "Is the fracking sand that they use for hydrofracking, is that under sand and gravel or is that under oil and gas?"

MR. BAILEY: Industrial oil, industrial sand.

DR. MILLER: Industrial sand, because there's lots of exposures associated with that. I'm just wondering if that's part of your industry's concern, as well.

MR. BAILEY: No. Mark's (Ellis) got that.

DR. MILLER: And my other question to you was along the lines of what you would like to see more, in terms of the elongated mineral particle issues. What's your kind of thought about where you'd like to see that go?

MR. BAILEY: Well, you know, I've been studying that for about 40 years and you know, really the issue comes down to how people define terms and I've read so many papers on that and by the time you read it, you really don't know what they define as a

fiber and if you're a microscopist, you're interpreting it one way and if you're a regulator, you're interpreting it one way and if you're a mineralogist you're interpreting it another way. And everybody is saying fiber but it's a different thing. And until that—it's like the Tower of Babel, you know, we talk right past each other and—

DR. NELSON: And not all fibers are equal.

MR. BAILEY: That's right, not all fibers are equal. And then how do you characterize it? What is the minimum that you should characterize EMP through polarized light, SEM, TEM? What should be the minimum that you should characterize an EMP before you publish it? A photomicrograph would help a lot because in this particular area, an image is very valuable. So, you know, one of the most important things I think can happen is an agreement that if you're going to publish a paper, you need to characterize an EMP with this set as a minimum. Because actually a lot of stuff is just…I mean, you don't even know the dimensions of these things. You read the paper and you say, "What do I know? I don't know much." And it's because the person writing the paper is not a mineralogist; they're a toxicologist. There was a conference in Monticello where we had all these different disciplines come and we kept them on top of a mountain. They couldn't get away. And it's the first time that a lot of these folks had ever been to a conference where they heard someone other than their profession talk and they learned a lot. The toxicologists learned a lot from the mineralogists, because they go to toxicology meetings. They don't go to mineralogy meetings. And so, when you had that cross-fertilization of all those different disciplines that are involved in this issue, it was pretty unique, pretty unique. I think everybody walked away with new knowledge and that's what makes this thing so difficult. You need a lot of players.

UPDATE FROM THE NATIONAL PERSONAL PROTECTIVE TECHNOLOGY LABORATORY, DR. MARYANN D'ALESSANDRO

DR. D'ALESSANDRO: Good afternoon and thank you for the opportunity to provide an update to MSHRAC. I always appreciate being here. Sometimes I don't have a lot of updates that you are enamored with but nevertheless, I have some updates today.

Just for those of you who don't know who NPPTL is, NPPTL is the division in Pittsburgh that's co-located with RJ's division and our role is to prevent work-related injury, illness and death by advancing the state of knowledge and the application of personal protective technologies. Respirator approval is our bread and butter, but we also have a research portfolio that encompasses three sectors: healthcare, public safety and some mining. The topics of interest today, of course, are the mining topics and we will first start talking about the Subpart H to Subpart O regulatory transition which is the rule that is used for our Respirator Approval Program. Followed by the Long-Term Field Evaluation Program and then Breathing

Air Supply Research. So, what I'd like to do to start to talk about Subpart O is first go back in history a little bit. So those of you who aren't familiar with how we got to where we are today. So if we go back in time to 1999, in 1999 NIOSH published an information circular that provided details regarding test requirements for a new respirator that would be a one-hour unit. That was '99 and then in 2001, the program came to NPPTL. That's when we were created. From 2001 to 2003, we had a series of public meetings, about 10 of them, where we asked stakeholders, including MSHA, UMWA, BCOA. We went to the training centers, all over the place, about 10 session to get their perspectives on those requirements and get some other insights into what should be incorporated in this new standard. Then it was just paused and put on the side after that, 2003. Then 2006 came along and that's when the Sago occurred and after that Sago disaster the lone survivor reported that he tried to open several SCSR units and he was unsuccessful. So that resulted in us going back to that Subpart O regulation and revisiting it and doing some more evaluation to see how we can move it forward. So that was 2006. So then by 2012 is when the rule was finally promulgated and that was a result of all the research over the years, input from the Long-Term Field Evaluation Program and a lot of input from stakeholders, as well. So, 2012 was when it was promulgated. And then in the rule, we made a decision that we would give manufacturers three years to provide products under this new rule and after that three-year timeframe, we would no longer be able to sell the units that were in the field prior to the rule which are Subpart H units. So it would have been by April 2015. We had indication that three years would be a good enough time, time enough for them to prepare units, develop units and get them fielded. Well, we come to April 2015 and what happened is we did not have enough units that were fielded. In fact, we only had one CAP I unit at the time and that CAP I unit was from a manufacturer that had just entered the business and their desire was more to go into the maritime industry rather than mining industry. So what we did then is we issued a Federal Register Notice indicating that we would allow Subpart H units to be manufactured, labeled and sold up to the point in time when—one year after the first unit was developed in that particular class. So that ended up being January 4, 2017 for one of our devices and May 13, 2017 for the 10-minute units in mining. And then, what happened, we were getting closer to those dates and what happened is MSHA and some UMWA came to us and said that we don't think that there are enough—even though these units have been approved, they are not belt wearable and what we really want is a belt wearable unit and if you do this, you're taking away the only belt wearable 60-minute unit that's out there, the SRLD. So what we decided to do is extend it once again to June 2019. So as of this point in time, manufacturers have until June 1, 2019 to manufacture, label and sell their Subpart H units in the mining industry. The other industries we're taking them out because we haven't heard any complaints in the other industries. The maritime industry has completely transitioned to the Subpart O units. So that's where we are today. There are a number of ways we can go. We can stay indefinitely, just saying these Subpart H units can be manufactured and sold indefinitely. We can again have another deadline and continue this process until there's a belt wearable out there. We're in discussions regarding what approach we're going to take. So where are we now with these devices? As of today, we have three devices that are currently approved under Subpart O: one CAP I, two CAP III. Just a reminder, the CAP I are what the old 10-minute units and CAP III are the 60-minute units. You see there are the same players that are out there today, Ocenco and CSE. Although we have had additional manufacturers who have never had approvals in this space

before come in, but they have not been successful to-date. We're hoping that eventually they are, but so far, we haven't had any luck in those areas. Just to give you a sense of the difference in these new units compared to the old units that were out there, in the CAP III approvals, you see on the left-hand side that's the Ocenco EBA-75. That's the EEB Subpart O approval. It is essentially identical to Ocenco's 6.5 unit that is a Subpart H unit and it weighs the same. So there's really no difference. You see their weights fluctuate between 8.2 and 9.4 pounds. They say it's depending on the material variance that they're using. But it's in that range for both the H and the O. When we get to the other CAP III that's been approved, that is the CSE SR2000 and that is 8.6 pounds and the belt-wearable unit, the SRLD is 5.9 pounds. So we're about 2.7 pounds greater than we would like to be because the miners would like to have the same size configuration as they've had in the past. But we are making progress that's getting closer to a belt-wearable and CSE does believe it is belt-wearable but right now, it hasn't gotten good reviews on being a belt-wearable unit. Okay and then for the CAP I approvals, they're generally 10-minute but by capacity, it's about 30 liters. And this is the Ocenco unit and it's the approved version of the old Ocenco unit. And it is a little bit heavier, about half-of-a-pound heavier and it includes this other case, this black case that you see there and they needed to include that case, in order to meet some of the durability requirements. So that case is always on when it's in its non-deployed configuration. Once the individual go to use it they have to get it out of the case. We have been hearing some anecdotal information that the zipper in the case is getting stuck in the mine. So I don't know if anybody else has been hearing that, but that's something we've been hearing. So, when you look at the inventory today and where things are, there are approximately 200,000 escape unit respirators deployed in the mines right now and about 1% of those are these Subpart O units, which is a good sign. Last time I reported on this, there were no Subpart O units in the mines. So it looks like Ocenco, the M-20.3, the CAP I unit is the most out there and that's what people are doing now who are carrying the M-20s and cashing out all the rest of the units. Now whether or not these SR2000s that are being purchased would be carried we don't know that yet. I think it's too early to say since they just came on the inventory now. But I think it's favorable, it's great that these units are getting out there and hopefully next year, we'll see even more. And we can see that some of the ones that are going down, the Draegers, have decreased and Draeger has already made a decision that they weren't going to get into this market. They were pushing the refill stations with the closed-circuit—open-circuit SCBAs, so the refill stations in the mines. That was what they were pushing for a while. I'm not sure if they're still out there pushing that. Then, Ocenco and CSE still the same players.

DR. NELSON: What's the relative cost of the Subpart H versus the Subpart Os?
DR. D'ALESSANDRO: I think they're a couple hundred dollars more. They are more expensive. The durability requirements has resulted in an increase in cost. Some of the requirements to have sensors on there, so you know if the chemical bed has been compromised and you know a moisture indicator. So if it's been exposed to too much heat…now those were not requirements before but CSE still had some of those sensors incorporated in their SRLD, because they were developing that SRLD right as we were working on the standards. We knew what the requirements were going to be, so it came out right before O came out. And then two of these Draeger units also were approved right before O came out because

they weren't sure they'd be able to meet the Subpart O requirements and they weren't able to. CSE had to redesign to that CSE SR2000. So, that's all I have on the Subpart H/O transition. Now I'll move on to the Long-Term Field Evaluation Program. And the Long-Term Field Evaluation Program is something that was brought to NPPTL in 2001 when we were created, got it initiated in the Bureau of Mines and it involves sampling a number of escape respirators in mines and then evaluating the units and then reporting on the performance. And because these devices are closed-circuit, you don't know if they're going to work until you open them, similar to a parachute. So it's good to evaluate a sample of them over time to make sure they continue to function as they were approved to function. This is a program that we do in conjunction with MSHA. From 1986 until 2008, there were eight LTFE Reports produced. So that was over a 22-year period eight reports produced and then in 2009, we decided to modify this strategy. So let me tell you what the strategy was. So what the strategy was up until 2000, we would go into mines, coal mines, tell them we would like to pick up some SCSRs and go around the country and drive until we picked up as many as we needed. The mines would give us the ones that they wanted to get rid of. So it wasn't a random sample, at all. It wasn't really statistically significant. We just said we're getting 100 of each. I don't know what the reasoning behind that was. It was just a 100 each and just collect them from wherever you can. So that's why in 2009, we just put a pause to the program and said, "Let's design a more statistically sound program or at least a randomly generated approach." So we started working with MSHA and getting MSHA's inventory on a regular basis. Then we randomize that inventory and over-sample a bit because sometimes we go to the mines and not all the units that you want to pick up are there. So you need to have a little more extra on your list. That's been going pretty well, but the issue is that it's very time-consuming. It's much more time-consuming than the old approach because sometimes the units aren't there when they're supposed to be there. Whereas before, they just gave us whatever. We didn't have to look for a particular unit. So, we've done this for three phases using this approach—and I think I'm getting ahead of myself. Okay, that's our current strategy. So, we did this for three phases where we would go in to randomly identify the units that we want to collect using the MSHA inventory, targeted more than we wanted to and we traveled to the selected mines across the country. Then at this mine, we conduct a visual inspection. If the unit does not meet a visual inspection, we do not take it back with us. And then when we return to our site, we also conduct another visual inspection and we also use an AM—acoustic modal, AMSD. I think it's a detector that tells you…it's a sound type of approach. If there's so much sound, then the unit is likely compromised. So we do that back at our site. Then we put a final report together. Right now, the difficulty has been in getting these reports out, because we collect so many units all across the units, even now with this random approach, it's a lot of data to gather, a lot of testing to do and now with the Subpart O testing going on, that always trumps the LTFE. So if we have somebody in to get a unit approved or correlation testing, that comes first because that's what's going to get new units into the field, LTFE comes last. So, it's been a struggle to get the reports out but we are working on it. Right now, the three reports that have been prepared using this new randomized approach are all completed. LTR 1 and LTR 2 have been published and LTR 3 is in clearance right now. There are a few issues with the LTR 3 collection where the breathing bag wouldn't open. So we went back and did some retesting to see if that was actually a real issue or if it was perhaps operator error. Because the testing was done at the time when we had just retrained somebody and it turned out to be operator error,

after we did 40 more tests. So that's not an issue. In the other units, when you look at what we collected and what we tested, that represents the amount that after we came back to our site, we did not test because we found other issues with them. I have a couple of the issues here I can just read you. So when you look at why things failed from a visual inspection standpoint, in LTR 1 in some cases the outer cases were cracked at the handle strap location. There were shifted cylinder bands with loose nuts, washers and brackets were not in place, serial numbers were scratched out, crimped breathing hoses and other signs of abuse and a cracked cap on the demand valves. That was for the Ocenco EBA-6.5s. But that was curious to me because those were—all of those things seemed to be things we would have picked up at the mine. So I'm still not clear why for this LTR 1 why those things didn't get picked up. And then for Ocenco, M-20 they were missing a ball in the yellow security latch, loose and missing bottom bumpers on the case, coal dust or a white powder inside the case indicating that the seal was breached and the invisible cracks on the lids. And on the Draeger, three were missing red plastic seals and two had cracked moisture indicator windows. So again, those seem to be all things we should have picked up at the mine. Then with LTR 2 these are things I think we wouldn't have picked up at the mine. There was internal damage to components, mine dust inside the case, the red security seal missing and damage to the case, the breathing bag was empty, no aspired O2 and higher breathing resistance on one. Then LTR 3, it failed portable ASMD test, the sound test I was mentioning. The red heat exposure indicator had damage and there was a broken seal. Then crimped hoses, coal dust or powder inside the case. So all of these things, these visual observations that we're making were something that we've never really done anything with. It isn't part of the report but it's something going forward we want to make part of the report because we think these findings are really important to get out to the mines. And that has led us to reconsider our current approach and look at maybe revising the approach that I'll talk about next. As I mentioned, these two reports are published LTR 1 and 2 and 3 is in the works. And then the future, then, where are we going with the future of LTFE? What we'd like to do is rather than collecting across the country all the units at once and then testing and then preparing one report, we're thinking is it possible to maybe just collect units from one mine? And not that we just do one mine a year. We do many mines a year but one mine and then report on that mine or perhaps from a district and we report on that district. Or if we could work with MSHA on identifying these regions, can we work on regions? So we thought that would enable us to get some information out faster, go to a focused area and probably get better information to particular mines on what the issues are at their mine location. That's just something that we're thinking right now but we'd like your input on that. And also, if I can just give you an example, what we're doing in healthcare, in stockpile—where respirators are stockpiled across the country in various state and local stockpile—we are going and sampling a sample of all of these stockpiled respirators and we're going to have one big report at the end, but we're also going to write a special report for each stockpile we evaluated, to give them particular information on their particular stockpile. And that's why I think it might be useful to do the same thing in mines. Okay, so the next topic is then breathing air supply research. The breathing air supply research was initiated in the Mining BAA program that George discussed earlier. And this research was initiated in 2011 with the first contracts awarded in 2012 and then the program was transitioned to NPPTL in 2016. Our first step when taking over the contract work was to conduct a peer review of the work and the philosophy we discussed was that the philosophy with all of these contracts

and interagency agreements were established, the idea was to develop component-based technologies for the next generation escape respirator called the CCMER in mining. And then to, at the end, integrate all of these components into a platform. Several platforms were investigated and the platform that seemed to be the most feasible ended up being the backpack platform. That was the platform that through the peer review, we had some—the scientists and engineers gave and the military staff gave great reviews. They thought it was fabulous and the military wants to collaborate on it. MSHA and UMWA didn't like it at all. They said a backpack would never go over. So where do we go from here? So a decision was made to no longer fund the completion of the entire backpack design but continue to fund the components that are being developed but they won't be integrated into the backpack design. So that's where we are now. So objective now is to complete developing the CCMER components that we started and I'm going to talk about the oxygen delivery system, the stocking and switchover value and the face piece and then we're also going to support PMRD in encouraging manufacturers to produce NIOSH-approved systems using these components and that's the RFI he was talking about earlier. Okay, so the first technology is the valve integrated pressure reducer and the oxygen cylinder. Under this contract with two cylinder manufacturers, one was Luxfer and one Carlton, two cylinders, two very high-pressure cylinders were developed. Carlton developed a 10,000-psi cylinder and Luxfer a 5,000-psi cylinder and there is no off-the-shelf valve integrated pressure reducer for these. So that had to be developed separately. So another company is developing the VIPR. So what both Carlton and Luxfer have done is to develop these cylinders and taken them both through some of the Department of Transportation tests. In order to get certified, they have to go through tests with DOT, both a bonfire test and a burst test. The 10,000-psi cylinder has completed both the burst and the bonfire test. They're all done. They passed all those. Now Carlton has put that application into DOT for approval. So hopefully that will be approved and they won't ask for any additional testing and then, after it's approved, manufacturers could be free to use that cylinder in their devices. And it's a much smaller cylinder than the ones that are being used. Similarly with the 5000-psi cylinder, it has gone through the burst test successfully and it has to still go through the bonfire test. They were a little delayed in their development. They had some other issues they had to work on and kind of redesigning it a little bit, so that's why the 10,000 came before the 5000. So the hope is that this one will also get completed and then both of these will be out there and manufacturers could use them if they desire to replace what they have, if it ties into the type of system that they were using. Okay, the next technology is the docking T-bit. So here again we have two designs, the design on the left is a simple design but the simplicity of the design results in the user having to hold their breath and not having it to continuously breathe. So it's not a desirable design. So the design on the right allows for the user to continuously breathe. So this is the one that we are continuing with and the intent is to integrate this with a face piece and then evaluate it with the breathing loop. Since we were not able to complete the whole backpack, we have the breathing loop still and we can integrate that with the breathing loop, just to test it out to see if it works. If we do that with human subjects, that would be an additional $80K that we have not accounted for yet, but that's a possibility. But again, I must say that one of the manufacturers who has an approval has expressed interest in this so that's good. They wanted to wait until they had a belt wearable unit so then they can be able to dock and switch over to their other units, to their own units. But they haven't picked this up yet but they're interested. Okay, the last topic is the CCMER facepiece

and as George mentioned, current SCSRs use mouth bits and talking isn't possible. And this is viewed as apriority in the MINER Act to address talkability and this is the third technology under development. The technologies have been tweaked along the way. The first one was a hood but there was a lot of CO2 buildup in the hood and a lot of heat and humidity so that didn't work. And then this seems to be the next feasible approach. And this is this half mask that will cover the nose and mouth and then that dockable valve in the front. And then the mask has a bite piece inside and then that bite pieces telescopes out, so if you press that valve—that green valve on the outside, it then can go into your mouth and if you press it again, it can pull out. So you don't have to be monkeying with it with your hand but be able to push in and out. And then that's when the user would then talk and then put it back in. what we haven't done is any—this has performed successfully on the simulator but we have not evaluated this on human subjects. It's something that we're out of funding to do that, too. So if there's interest in doing that step, that's a possibility, too. It's also important to know that this system was designed for the CCMER, the backpack, the closed circuit, the mining backpack. So it was meant to be incorporated into that platform. So all of the guts of that backpack would tie into this. Whether or not some of the units that are out there now, like the Ocenco and the CSE unit would be able to transition to this, I don't know. Okay and lastly, the future work being considered is just managing these contracts that are underway through 2019 and then George mentioned this earlier, also, this liquid oxygen storage module. We've been working with NASA on that. We've done some initial development with that and it would take about another $180k to continue that development. That could enable significantly or reduced size as well in a future device. So we look at this as high-risk, high-reward research. Now the questions I had are related to the LTFE and then also, thoughts about the liquid oxygen storage module.

Questions and Comments:

DR. NELSON: Thank you, now we received a document yesterday by email. It had to do with this?

DR. D'ALESSANDRO: That was the LTFE.

DR. NELSON: Okay. Are there any questions or responses to the questions that are posed here from MSHRAC members?

DR. BURGESS: I have a brief question. Maritime use for an hour or is this the 10-minute?

DR. D'ALESSANDRO: No, 10-minute.

DR. BURGESS: And is the refillable open circuit SCBA still an option to meet standards?

DR. D'ALESSANDRO: It's still an option but I think there was no interest from what I understand, is that right Bill?

MR. FRANCART: I don't know about the interest but it would be applicable to compliance.

DR. G. LUXBACHER: There's still two or three mines that use a similar system, a refillable system. San Juan still has theirs but if you look, San Juan also has M-20s and 6.5s, as I recall. So they've combined systems.

DR. BURGESS: I think I may have said this during the last meeting or a previous one about the

liquid oxygen storage module and this was about the IFF's efforts to work with manufacturers to have something that firefighters could use. I think it may have been the actual person that was using it but they had a lot of concerns, in terms of the high-temperature environment and the ruggedness etc. of it that I know that they went down that path and ultimately it didn't come out. They had something similar I think there they were looking for type of backpacks that have smaller profiles, the firefighter could fit through smaller holes, etc. That also kind of went away and then stopped. Are you familiar with either of these efforts, in terms of kind of the obstacles that developed?

DR. D'ALESSANDRO: Yes, I know that when it came to the IFF and bringing prior possibilities to them, they have so many standards underway right now that they didn't want to take on—that they just didn't feel it was time to take this on right now. I don't want to say they didn't think it was a good idea. They just thought it wasn't a priority for them because they think that the units that are out there now are good and continuously are evolving every five years with the NFPA standards. So, the low-profile unit, people are getting stuck using that right now. So I think that's just kind of—it has some merit, but I think it has a lot of issues, as well. But the military is interested in a backpack design.

DR. NELSON: Any other comments on that? Then the first two questions were related to the LTFE plan. Maybe they'll have a chance to read through the plan and can give you later some additional input.

DR. MILLER: I looked at the LTFE document briefly this morning. My questions kind of went to the statistical sampling and ensuring that you actually are getting a representative sample and how does that compare with what you were doing before? Earlier it sounds like you are getting some pretty satisfactory feel for that.

DR. D'ALESSANDRO: Yes, we have our statistician involved in that and his initial thinking was that if we go to one mine, then 20 units of the same per mine would be sufficient to make some claims about the units in that mine. But that's as far as we are right now. He's looking at all kinds of potential statistical ways to look at it.

DR. MILLER: I think it's probably a useful and thoughtful approach with geographical representation and continue to expedite your program, so it's a matter of just trying to work out those issues. But I think it is probably very helpful to go that route.

DR. NELSON: Also with the speed, if there is a problem at a mine, you're going to know it a lot faster than if you try to find some broad sampling and statistics rules.

UPDATE FROM THE RESPIRATORY HEALTH DIVISION, DR. ANTHONY LANEY

Dr. Laney presented an overview and update of the NIOSH Respiratory Health Division. As background, RHD has administered the Coal Workers' Health Surveillance Program (CWHSP) since it started providing services to coal miners in 1970. Historically the primary task of the CWHSP was to administer

the x-ray surveillance program where eligible miners are offered periodic chest x-rays throughout their careers. Screening services are offered in two ways. One way is through medical facilities that are approved to participate in CWHSP and specified in mine operators' surveillance plans. The other way is through targeted mobile outreach offered by NIOSH. Because screening is now offered to surface miners, RHD has provided services to more miners in FY-2017 than any time in recent history. The program is used to monitor disease patterns over time through ongoing surveillance activities and Dr. Laney provided updates on those trends. There was a decline in prevalence after implementation of the Federal Coal Mine Health and Safety Act to historic lows in the late 90s/early 2000s and an overall increase since that time (particularly in the longest tenured miners) however since around 2010 increases in prevalence of disease across all mining tenure categories is apparent at the national level. Dr. Laney described that looking solely at the national data can obscure important regional trends. If the data are restricted to Central Appalachian underground coal miners a much higher prevalence is apparent – particularly in long-tenured miners with over 1 in 5 actively working miners in this group with black lung.

Dr. Laney then went on to discuss the most severe form of coal workers' pneumoconiosis, progressive massive fibrosis (PMF). He noted a resurgence of progressive massive fibrosis in long-tenured miners in Appalachian underground coal mines where RHD surveillance data show 1 in 20 of these miners with this most severe form of black lung. Dr. Laney discussed enhancements to the CWHSP since 2014 which includes expanding x-ray surveillance to surface miners and the addition of spirometry testing and symptom assessment questionnaires. RHD has developed an approval process to assure that medical facilities approved to provide spirometry for CWHSP provide high quality tests. 30 facilities in fixed locations and 1 mobile facility able to reach a number of Western states are now approved. Part of the approval process was to assure that all facilities used equipment meeting accepted standards for use in spirometry testing and spirometer manufacturers are adopting NIOSH specifications for secure data transfer of spirometry tests.

The NIOSH B Reader program was then discussed. The B Reader program provides support to CWHSP by providing training opportunities to physicians to learn about using an international classification system to assess the presence and severity of changes of pneumoconiosis on chest radiographs. It also offers a certification examination to document their ability to use the system. Over the past several years RHD has amassed a repository of digitally-acquired chest radiographs demonstrating work-related lung diseases from domestic and international contributors. They have used this repository for several purposes. One being the development of new B Reader Training materials and an exam using solely digitally-acquired images through a partnership with the American College of Radiology. RHD plans on having a pilotable version of the new syllabus and exam by fall 2018 with full release of the exam once the performance of the pilot version is validated. The current version of the Guidelines for the use of the ILO Classification of Radiographs of Pneumoconiosis (2011) is a digitized version of the 2000 analog standard films. Another use of the image repository is the identification of candidate images for new digitally-acquired ILO standards through a long standing collaboration with the International Labour Office. Current candidate images have been classified by several expert B Readers to determine their suitability as a standard image. NIOSH is helping ILO to convene an international panel in September 2018. The panel will review and select new standards from the pool of candidate images, establishing the first fully digital version of the ILO standard images—bringing the classification of pneumoconioses into the 21st century.

The presentation concluded with a discussion of clinic-based investigations of retired miners seeking compensation benefits from federal black lung clinics including a report from 3 clinics in Southwest

Virginia. In total, 416 cases were identified with PMF representing the largest cluster ever reported in the scientific literature. Dr. Laney thanked the committee for the opportunity to share the findings of RHD.

Questions and Comments:

DR. BURGESS: Why was it that so many cases were discovered late in the process with very large opacities. Is it because those individuals never went in previously or was there any evidence that initial films that maybe it wasn't appreciated the extent of the disease that those folks had.

DR. LANEY: I've done a lot of work on the issue of progression and participation in the programs and what we find is in general, miners are likely to participate because it's by law, early in their career. And then there's a huge void of time where even though they're eligible for X-rays at five-year increments, they just don't take advantage of the program, showing up at the very end of their career for either a Part 90 transfer rights or for the beginning of a disability compensation claim. So when that last ,most severe disease one comes in and a miner of long tenure, we often don't see them and often, they don't even get their X-ray with us. They go straight to the black lung clinic and get it for compensation purposes. And so that falls outside of our purview. And so when we began to understand that this was what was going on, we began these clinic-based investigations that are in these black lung clinics with data that we wouldn't have otherwise seen.

DR. BURGESS: My question specifically was about those clinics. That were they seeing these guys previously or was it just as you said, that it had been many years since they'd had a previous film and they just came in with disease? Was there any evidence within this process, particularly with the spirometry, you're suggesting that maybe if we catch it early, we'll see perhaps some changes that would suggest that something else needed to be done. But you need a process where you could see that at regular enough intervals to be able to intervene. And so it wasn't clear to me why that isn't happening now, just from the chest X-ray perspective.

DR. LANEY: Particularly with the miners in the Kentucky and the Virginia case, most of them have never—they had basically evaded surveillance. They didn't want to know what their health status was until they were so severely impaired that they were seeking clinical care and compensation.

DR. BURGESS I guess kind of going back, in terms of thinking about was there changes in exposure or other risk factors that contributed to this big evolution in both exposures were behavioral?

DR. LANEY: Sure, so that's an active area of research for us. Because we've had the opportunity to do some of these clinic-based investigations, we've expanded the scope of what we would normally do to get detailed occupational histories. These guys are out of work now and so, they are much more free and open about what

actual exposures they encountered throughout their working career. And we do hear a pretty consistent story related to thinner seams of coal, removing more rock. For economic feasibility purposes and others that we have pretty good reason to believe and some of our preliminary pathology investigations are showing more pneumoconiosis and silicosis.

PARTICIPANT: So, do you have access to any of these historic radiographs that would show you whether the disease was progressing differently, in terms of the type of dust they're being exposed to, whether it's silica versus coal?

DR. LANEY: Sure, we have almost a million radiographs in our collection, going back to the late 1960's and we can look at the way that those X-rays look compared to the way that the X-rays look now and we have seen certain patterns of impairment that have increased pretty dramatically over time. One is the shape and size of these opacities. So we know based on correlation studies between pathology samples at autopsy and the person's X-ray that there are these large rounded opacities called r-type opacities. They're much more common now and they are indicators of silicotic nodules. And so, when you have these large, very well-defined margins swirled pattern in the pathology and then this large rounded nodules particularly in the upper lung zones, you feel pretty confident that—we know that that pattern has changed and it has been associated with silicosis. So we think that's probably a driver.

DR. LUXBACHER: I think another way to look at that—particularly where you have this cluster in Kentucky and Virginia—which I thought about doing they are very hard to get is to look at historic data and the recovery. Because you would expect they're mining that much more rock and that's where the exposure is coming from, that their recovery is going to be going down. And that's well-kept data by every company but it's very difficult to get your hands on is what I've found.

DR. LANEY: Yes, we've certainly given that consideration but haven't been able to make any in-roads in that aspect of it. But in talking to the miners themselves, you know, they're saying 20, 30 inches of rock being cut is not something that's particularly unusual.

DR. LUXBACHER: And It might be easier in a smaller area where you have this cluster to start getting that sort of data.

MR. BOWERSOX: This was a continuous mining operations or longwall?

DR. LANEY: Primarily in that portion of the country, most of it is continuous miner operators, particularly in these smaller seams that they're going for and you know, the geology of Kentucky is really interesting in that the sandstone that they have adjacent to the seam is characterized as greater than 98% crystalline silica. So you know, we don't have a whole lot of slam dunks right now but everything sort of seems to be pointing us in that direction. And as I mentioned, we have got some explanted lungs from miners who have undergone transplantation and

been able to do elemental analysis on those lungs and they're showing us that this is not just a carbon dust like we would expect in the past. We've had very detailed pathology studies done in the 1980s and the 1990s and that looks like black lung. I mean, you're looking at carbon and what we're seeing now is silica and silicates, certainly coal in there. There is more opportunity for other things like iron and other things that are outside of the seam. And so, that's what the few pathology studies that we've been able to do so far have done. And we have been sort of toying with the idea of getting more integrated in with some of the regional transplant centers to get more of these specimens. Because we had a paper that was just out a couple weeks ago that shows an increasing rate of transplants, threefold higher in the last five or 10 years than historically what's been done for this condition.

PARTICIPANT: What's the silica sampling data look like?

DR. LANEY: The silica sampling data that I've seen, it depends on how you look at it. NIOSH has historically put together this world report that looks at some of those. We use geometric means that are flat as a pancake from the beginning to the end. We don't see the sort of rapid increase in compliance sampling for silica but there's a lot of issues related to how to best interpret MSHA compliance sampling for silica. And I would think that the data itself would be internally consistent but what we see is there's been a decrease, a pretty constant decrease over time in the levels of silica in these mines. Though one area of interest that we're looking to pursue and looks like it may provide some fruit is that the percent silica looks to be on a trend up. But if you look at just the total composition of it, the proportion of it that's made up of silica now is higher than it has been in the past. But that's still very preliminary.

DR. NELSON: So I can see the thinning of the coal beds, so that you encounter more sandstone and material like that. But with the thinning, you can also have a change in the coal itself and is that being watched and separate from saying that the coal is just coal and it hasn't changed? In fact, coal could be higher silica, as well.

DR. LANEY: Right, so there certainly seems to be—this isn't my area of expertise, I'm a health guy but from what I've heard, there's more intrusions now into the coal. And so, the mix of what that pure seam is may be different now than what it has been in the past.

DR. NELSON: Is there good knowledge on how paleo-geomorphologically you can end up having quite significant changes like that?

DR. KOGEL: Yes and I think what's you're asking Priscilla is the quartz content of the coal bed itself changing or is there some other aspect of the coal that is changing.

DR. NELSON: It doesn't have to be just quartz. It could be some other stuff, too.

DR. KOGEL: Yes and I would say that this is something that we have identified as something that we need to know more about and we just don't right now. But it's certainly an

important consideration.

DR. LANEY: Yes I absolutely agree with that.

DR. MILLER: I'd like another USGS kind of partnership. I think it would be valuable.

DR. KOGEL: Exactly, yes.

DR. MILLER: Just going back, too, in terms of other surveillance, are you seeing any other change in patterns of disease in these communities in terms of cancer or other types of things that might be in Medicare usage or something that's…?

DR. LANEY: So there have been some studies done, some by West Virginia University that have looked at community effects in mountaintop removal immunities versus others and they've been able to look at reproductive outcomes. They've been able to look at cancer issues. Of course these ecological studies are met with a great deal of angst and skepticism but there's clearly something there and if you take the heat maps for cancer and you take the heat maps for reproductive health and you take the heat maps for opioid deaths and you take the heat maps for where this black lung outbreak is and you lay them all on top of each other, there's a complex community-based problem going on here.

MR. ZIMMER: The last thing they care about is their black lung.

PARTICIPANT: They've got too much going on.

DR. LANEY: I think there's competing risks and as far as black lung disease goes, when you're confronted with having a job and having cancer and having diabetes and all of the other millions of things that go into Appalachian life, this is another one in the mix. I mean, it's been really interesting to live here for the last 10 years and to be engaged so deeply in these communities with these health studies and there's a lot to what you're saying but it's a complex set of problems that people have to deal with who live there. Unfortunately, this is a major, major one and it's getting worse.

DR. NELSON: Well, people are getting older, too.

PARTICIPANT: At the same time, they're not using protective devices because they aren't as concerned or they've got other things that have a higher risk for them?

DR. LANEY: So anybody who wants to work underground certainly is afforded the opportunity to wear a respirator if they choose to do so. There's a large case, somewhere to the tune of 65 million that was just settled with dust mask companies—and so I don't really want to get into that but the issue of personal protective equipment probably is one of the least effective means for controlling coal mine dust. And that would really be the last result on the—

PARTICIPANT: It is the last result. Control the atmosphere.

DR. LUXBACHER: Well, anecdotally, when I talk to coal miners they say, "I wish I had worn it when I was young. I didn't think about it then and now my breathing is already impaired and it's harder to wear a mask."

DR. LANEY: Some of the stories that we've heard and you will—I mean, we are writing this up

now and I'll just give you a little bit of a preview—is that we've heard a number of stories where people were just simply overwhelmed by dust. They can't keep a respirator on because it impacts the filters or they're taking their mask off to get a breath because they're encased in so much dust are some of the stories that 'we've heard.

MR. ZIMMER: This is a little bit off-topic, but I think we can tie it in. Jeff, when you're doing firefighter studies, do you see that same culture with firefighters that come up in the 70s and 80s with their respiratory protection and now all of a sudden, the fire is out and you know, the protocol is to wear it. And oh, there's nothing in here, and they're not wearing them. So they're being exposed. Did you see that, you can tie those cultures.

DR. BURGESS: There's been a culture change in the fire service. In the past it was kind of a mark of being macho or whatever you want to call it, to take as much smoke as you could. And now they're even using it in periods where they can't see any smoke at all.

MR. ZIMMER: Right and you can probably make that same parallel to the coal miners and them protecting themselves.

DR. LANEY: But the way the current federal regulations are in place is that administrative and engineering controls should be able to effectively take care of this problem and that's what's required by the statute.

MR. BOWERSOX: That's fact. We should be able to control that dust. We should have mines set up right. you would be able to control that dust. You shouldn't have to take a respirator off because it's full of dust. There's something very wrong.

DR. LUXBACHER: Well, and it begs the question what's going on with the monitoring program? If the monitoring data saying that exposure's not that bad, well…

DR. LANEY: In the last report I saw, I'm sure people in the room know better than I but the last I saw, greater than 98 percent of the compliance sampling now is within compliance.

PARTICIPANT: Is that for coal or is that for silver? That's the issue.

DR. LANEY: This is for coal.

PARTICIPANT: So, coal is limited to one million…

DR. LANEY: 1.5

PARTICIPANT: 1.5, and the silica limit is 0.1, still basically at MSHA. So, you could in compliance with coal and silica because if you're just monitoring for coal, we have to know that.

DR. LANEY: And there's an interesting paper that was done a few years ago by Jerry Joy from the Pittsburgh group then that highlighted the very point.

MR. WRIGHT: I think we ought to be skeptical about the MSHA numbers that show so many mines are, quote, "in compliance" with the Coal Mine Dust regulations. The way regulations work is the operator knows who's wearing the device and can move

them to a safer less dusty location, you know. In talking to miners I know that happens, so it's a very easy standard to gain, you know, I'm sure folks don't like it when I say that, but I think it's true. So, the fact that MSHA's not able to issue a lot of citations doesn't mean that there's necessarily widespread compliance, at least not as widespread as the lack of citations would indicate, and calling that compliance is kind of like saying that if you got a situation where everybody drives 80 miles an hour in a 60-mile an hour zone, but the police only catch one percent of them it doesn't mean the other 99 percent are in compliance. And I just think that we have to be very careful about that word.

DR. LANEY: Yeah. I'll just wrap up with this, Mike, I think that we're speaking the same language. Given what we understand about the exposure-response relationship between coal mine dust and bad health outcomes, if these mines were within compliance, as it's written today, we wouldn't be seeing the amount of disease that we're seeing today. Now, if you want to argue that these exposures are historical and we're all since the year 2000 they've all occurred in this century, even given those compliance sample numbers that we see they don't jive with what we're seeing in ill health for coal miners.

MR. WRIGHT: Yeah, and I think we also have to remember that the new dust regs only lowered the permissible exposure level from 2 to 1.5, and there was supposedly widespread compliance with it, too. So, it's a little hard to believe that that much of a decrease or that little of a decrease would wipeout black lung disease. Now, in saying that I don't mean to be critical of the people who worked on the regulations because it was, you know, it was a long, hard effort and they worked very hard on it, and they did really terrific work, but I, you know, in terms of black lung we're not there yet.

DR. LANEY: No, and NIOSH's standing recommendation since 1994 remains regarding the recommended exposure limits for both coal mine dust and silica and neither of those are currently adopted.

END-OF-SHIFT SILICA MONITOR UPDATE, DR. LAUREN CHUBB

Dr. Chubb presented an update on field-based monitoring for respirable crystalline silica (RCS), specifically two independent methods that are currently in development. Field-based methods are necessary in order to decrease the largely unavoidable time delays that accompany traditional monitoring methods, which can hamper efforts to quickly detect and address high concentrations of RCS. Field-based methods take advantage of portable, user-friendly instrumentation to produce results quickly, helping to prevent exposure to RCS.

The first method presented is an infrared (FTIR) method and can be used by any mining sector, as well as by other industries where exposure to RCS is a concern. The field-based FTIR method produces exposure data within a few minutes of the sample being collected, allows the sample to be analyzed

directly in the cassette in which it has been collected, and is non-destructive so the sample may still be submitted to an external laboratory if desired. The major components of this effort are summarized below.

1) Quantification models are used to determine the mass of RCS present in a sample. First, sampler quantification models consider how different types of respirable sampler affect the deposition of respirable material on the sample filter. Models have been developed for common sampler types (such as the Dorr-Oliver nylon cyclone, the aluminum cyclone, and the GK2.69), and additional models are planned for additional types of samplers. Second, mineral confounders that can impact the accuracy of the FTIR estimation of RCS are also addressed through quantification models. When no mineral confounders are present, the field-based FTIR method compares favorably with the standard analysis for RCS. In general, the mineral composition of samples can be quite complex, and can vary according to a number of factors. Specific mineral confounders such as kaolin and microcline have been identified and successfully addressed to improve the accuracy of the FTIR estimation (relative to the standard method) when these confounders are present. Future research is planned to identify additional mineral confounders and the types of samples in which they are likely to occur. It is also possible to adjust FTIR estimates of RCS based on knowledge of how accurate the field-based method has been (relative to the standard method) for previous samples at a specific site; this is called the *site-specific quantification model*.
2) The respirable dust sampling cassette interacts with the portable FTIR instrument to facilitate field-based analysis. Modifications to the traditional sampling cassette allow the sample to be inserted directly into the FTIR instrument without removing it from the cassette. This simplifies and accelerates the overall analysis process, and protects the sample filter from damage.
3) The raw data from the FTIR instrument is translated into information that is easily used for exposure monitoring. NIOSH has developed a software program, the Field Analysis of Silica Tool (FAST), which will be freely available online. FAST incorporates raw FTIR data (from the FTIR instrument) and field sampling data (entered by the user), then calculates exposure information. Future versions will include additional quantification models and refinements to the existing models.
4) The numerous components of the method are being consolidated into written documentation that will promote acceptance of the method by the mining industry. These include a planned NIOSH-numbered publication that will be designed to guide both new and experienced users through the field-based monitoring process, and will support the collection of reliable data using the method. Also planned is a submission to the NIOSH Manual of Analytic Methods, which will help to formalize the method and promote its acceptance within the mining industry.

The second field-based method presented in this update uses a portable X-ray fluorescence (XRF) instrument to analyze samples collected in coal mining operations using the Continuous Personal Dust Monitor (CPDM). The XRF method is well suited to the relatively simple composition of respirable coal mine dust samples, which are composed primarily of coal, RCS, and kaolin. XRF is an elemental analysis and quantifies RCS indirectly by measuring the silicon signal of the sample (correlating to both RCS and kaolin) and then correcting that signal for kaolin by measuring the aluminum signal (correlating to kaolin alone). This method is currently in the proof-of-concept stage of development: the ability to detect silicon in RCS samples and respirable kaolin samples, the ability to detect aluminum in respirable kaolin samples, and the ability to predict how much of the silicon signal originates from respirable kaolin rather than from RCS have all been demonstrated. These results can be used to predict the mass of RCS present in a sample, although at this stage the accuracy of these predictions leaves room for improvement. Future development of this method may focus on refining the filter material to decrease

measurement variability, and using newer XRF instrumentation to improve the measurement sensitivity for aluminum and silicon.

Questions and Comments:

DR. LUXBACHER: What were the blue bullets versus the black?

DR. CHUBB: The black ones are the ones that have been completed and the blue are the planned.

DR. NELSON: You talked a lot about kaolin and, granted, I don't usually think about kaolin. So, you've got kaolin and potassium feldspar, the microcline. There's other kinds of silicates in there, but why focus in on just kaolin which is a minor constituent, for the most part, in granite?

DR. CHUBB: We saw that in about half of the samples. We saw an opportunity to correct for something that we already knew how to correct for, so we kept it in the model. In the future, I agree, if we're not seeing it in a high proportion of the samples that we collect in the future we may remove it from the model.

DR. KOGEL: So, these are probably weathered granites. That's the only way you can be getting kaolin.

DR. NELSON: Well, they might be, but if they're too weathered then you don't want it for aggregate. I guess I'm just wondering, it seems like if you know how to correct for kaolin, so you do so, but meanwhile there's a couple of other 800-pound gorillas in the granite that you might also need to correct for.

DR. CHUBB: I agree. We identified a number of minerals that we weren't yet able to develop a correction strategy for. And, again, we're still working toward that and hope to incorporate that in the future.

DR. BURGESS: I think NIOSH and you are to be commended for a fantastic product. This is NIOSH at its best, I really think. So, incredibly useful, particularly timely now with some of the issues that we're dealing with. That 25 microgram limit of detection for the FTIR technology assuming, let's say, an 8-hour shift, where does that put you relative to the standard for silica?

DR. CHUBB: So, we've been using a combination of tools to help us kind of get around the… not really get around, but work to overcome the limit of detection.

PARTICIPANT: I meant, sorry, limit of quantification.

DR. CHUBB: Right. So, this technique is particularly well-suited to high-volume samplers and non-traditional samplers. Actually, that was one of the reasons why we included the GK269 in our initial models, even though we're not seeing a ton of mines using it right now, but we really hope that they will be in the future, because you can collect more material you're better able to detect the lower samples. We've also been playing around with ideas to incorporate it with real-time

instrumentation like helmet-CAM where we found if you actually… we 3D printed what amounts to a mask to concentrate that sample instead of being spread over 37 millimeters it's spread over about 8, and so we can overcome that issue in that way, too

PARTICIPANT: So, in other words, you're saying it is an issue if you use standard non-high flow sampling into in terms of where you are on the standard and the limit of quantification.

DR. CHUBB: Yeah. But I think we're at the same place is the standard methods.

MR. DRYSDALE: Does the device recognize the interfering minerals automatically and then cancel them out or do you have to kind of program that what kind of rock you're dealing with?

DR. CHUBB: The device itself does not recognize them. That's what we've been building into the software. Right now it's most helpful if you tell the software where you are. If it knows that you're in a coal mine it knows that it should be looking for kaolin. That basically amounts to these sector-specific quantification models, so that capability will increase. As that goes on we're able to complete more research.

DR. NELSON: That's all based on the area under the curves.

DR. CHUBB: Yes.

PARTICIPANT: Have you considered transflectance for your CPDM filters?

DR. CHUBB: We have not.

PARTICIPANT: We have a similar issue because supports fiber filters are too thick.

DR. CHUBB: Yeah. I know that Art had tried… he actually kind of began the work with the CPDM and he explored a number of different methods years ago. The XRF was what we had the best success with.

PARTICIPANT: I don't think he tried that, transflectance.

DR. CHUBB: Yeah, I don't think he did either.

PARTICIPANT: And we just discovered that one. And your last slide, and good job, by the way…

PARTICIPANT: Your presentation was great.

DR. CHUBB: Thank you.

PARTICIPANT: I've seen products available in 2018-2019, where can we buy them?

DR. CHUBB: So, we're talking about that FTIR?

PARTICIPANT: Yes.

DR. CHUBB: Okay. The FTIR instruments, the four that you see here, are commercially available off-the-shelf. The software program that will do all the translational stuff should be available later this year. I'm not sure when the NIOSH numbered publication will be available. We're definitely trying to get it out as soon as

possible.

PARTICIPANT: Thank you.

MR. WRIGHT: No questions, but this is really terrific work.

DR. CHUBB: Thank you.

ILOTO IFUND PROJECT, DR. DAVID PARKS

DR. PARKS :My name is David Parks. I'm a mechanical engineer, Spokane Mining Research Division. We're going to talk about our Internet-Enabled Machine Maintenance Monitoring And Reporting system for improving safety particularly around stationary powered haulage. So this is a project that's in its second year currently, but it's consisted of two separate one-year iFund funding periods, and we're hoping to make it a mining project next year.

The problem that we're trying to address is the persistent issue with workers getting entangled in conveyors and stationary haulage. Some work that Todd did a few years back showed that on surface mines of the 41 fatalities there were, 83 percent of those reported maintenance or cleanup as the leading activity involved, and then a further reading of the narratives showed that 29 percent of the time lockout/tagout was performed incorrectly or not at all, and conveyors where the machine that was the biggest issue on surface mines.

Some more recent data that I grabbed shows the same trend. There are quite a few things here but the things that I'm most interested in are at the bottom of the graph here, and we still see that maintenance and repair is by far the most conspicuous activity and conveyors have the highest combined permanent disability and fatalities, although the ore haulage trucks result in more fatalities.

The problem that we see with LOTO is that the current procedures are outdated and often times it'll involves a walk to an office where you fill out a paper form, you grab a padlock and a lock hasp, and you lock the machinery out and in some cases there are many locks on the hasp as shown here. Each one of those represents a worker, so that's a little bit tedious. And this is required even for minor maintenance, as I've witnessed firsthand trying to install our system. I just wanted to stand on the conveyor for a minute to check the number on my sensor and we had to lock the whole thing out. There's also a lack of perimeter control at gates and critical access points and machine guards are not monitored. So, all these things we think come together to encourage circumvention. Basically people will try to avoid LOTO if they feel like they can get away with It. And our solution is to start monitoring LOTO and also to make LOTO easier and to monitor machinery so that we know when failures are likely to occur, thus maintenance can be planned in advance as opposed to being reactive and rushed.

The things that we're going to monitor are machine guarding, first off, and access points, gates and doors. It's fairly straightforward, a switch is open or closed. We also want to look at proximity and the status of conveyors and the attached equipment, in terms of whether it's powered on or not when the machine guard is removed, for example. And then this would also be compared on the back end with planned maintenance which would be on mobile devices or conveniently located tablets, portals where workers can plan out the maintenance procedure, and then that will go to a database, a machine guard would be

removed, but then the system would check to see that the conveyor is powered off and that there has been a plan put in place for the maintenance.

A general structure for industrial IoT is a local network of sensors that can operate without the cloud, but we would also like to have cloud connectivity so that remote viewing is possible for people that are concerned with the safety of the workers while they're not on site.

Generally there's a trade-off when we're talking about wireless sensor networks. Wireless is the way that we think we're most likely going to go because on a typical site we anticipate that we'll have several hundred sensors and stringing wires all over the place it's not really going to go over too well but, of course, neither is having batteries that need replaced every so often. So, that's a bit of a conundrum and you end up with a trade-off between bandwidth power range and duration of autonomy. Basically what I'm trying to say with the slide is things like Wi-Fi are really not compatible with this. There are other protocols that are low data rate and more efficient for our purposes. We have a prototype system in Spokane where there is a cement batch plant which is pictured here.

There's a cement mixer at this batch plant and there's a worker climbing into it here and this occurs every day that they operate, and here's a conveyor that feeds the cement mixer. So, you really wouldn't want to be in there when that gets turned on and the way they lock it out is with this bar here on these four safety disconnects. And here we see a gate, that's one of the critical access points that we mentioned. So, what we did is we put simple dry contact switches with wireless sensors, sensor nodes, on these four switches and a similar device here with a magnetic reed switch.

And here's the graphical display of our prototype, kind of a cartoon here. Here's the gate and you can see the last date that that gate… time and date the gate was open. And then here are the four switches. They're all red indicating that they're all currently on. The door has time and date as well. And then we have temperature. Temperature is a good indicator of bearing health, so we're monitoring that in order to make a maintenance plan as opposed to reactive. And then one last thing that we monitor is the batch temperature itself so the worker doesn't have to go out there and stand near the mixer and monitor that with a heat gun.

I have some web pages which I'll try to link to. That's the webpage now and this is real-time data that's being streamed right now. So, someone at home, for example, a foreman or manager could be looking at this, or a safety officer, and seeing what's going on with the batch plant. So, we can see they open the door of the batch plant this morning at 9:17 a.m. They opened the gate last night when they cleaned the mixer at 4:35 and all the switches are on. So, we also added the temperature measurements. So, I'll show you those.

The format that the stakeholders had told us that they liked the best was rather than having fancy graphs just have a basic table where the highest temperatures obtained are shown and when they were obtained, then also the current temperatures here. And this is Pacific time, so it's 12 o'clock over there right now. you can reload it. And then there's one last webpage which works best in Microsoft Edge because it has some widgets and that's the plan maintenance form. So, we plan to use that to make the actual planning of LOTO a lot easier. So, there would be something like this which is this is an exact replica of their current paper form and a lot of these would be auto populated, and then you'd be able to submit it to a database and it would also go to a printer because for the time being paper records are still

required by MSHA and OSHA as far as I know. We do want to eventually get to the point where our electronic records are acceptable. So, there's the form again, and the idea is, of course, it would be on a tablet.

Our next steps are to expand the system at Oldcastle and then we're also intending to deploy at a Lafarge-Holcim site with our partner SRS, Safe Reliable Systems, with whom we will have a CRADA. So, that will happen hopefully in the next year. We want to continue to work on R2P. We're going to make this a four-year project.

Things to consider, definitely everyone that hears something about IoT often hears about security issues, so that means that's something we need to think about which means updating firmware regularly on all components, that's definitely necessary. We need to ensure the networks are very healthy so that our batteries last as long as possible, and potentially look at energy harvesting solutions.

Questions and Comments:

DR. NELSON: Yeah, you don't want to go and tangle with them.

DR. PARKS: Yeah. This is limited to surface mine data. so what our planned solution is, is basically to improve LOTO among a few other things.

MS. KRAMER: So, if the lockout… it's instead of putting their own lock on or how… I'm not sure I'm following.

DR. PARKS: At this point would be supplemental. So, what we would add is instead of going back and filling out the paper form they would have the electronic form and we'd also monitor the lockout procedure to make sure it was being performed, and then there are Bluetooths. Well, there are different options for connected locks as well. so we hope to make the lock part of the system so that we know where it is and how it's being used.

MS. KRAMER: So, you know they've locked it. You put something on each of those lock points so you know whether they've locked it or not?

DR. PARKS: Yeah.

DR. KOGEL: But if they open the gate that would also de-energize the system, is that correct?

DR. PARKS: We're not putting in the ability to be de-energize it at this point. That may be something we get to later, but from what I hear they don't go over very well because that would trip it so many times. Interlocks are not popular, but I mean interlocks are readily available already. We just want to be able to monitor the lockout/tagout procedure, and basically use that to make sure that it's falling.

MS. KRAMER: How has this company used that work then? I mean have they found that they weren't being followed and they could then intervene?

DR. PARKS: Yeah, they're adopting this. We're working with them. We have an MOU that I needs to be signed. So, far it's been our demo site and they're very cooperative

and on-board with it, but they haven't replaced their system yet. They're still going with their current lockout/tagout system. So, when we expand it we're going to add several things including a portal where they can easily plan their lockout/tagout. Currently our system is autonomous from their SCADA. It's not integrated within it and that's the way we kind of have to stay because they don't really want anybody getting into their SCADA, so we have to provide our own hardware and our own monitor, and then under the MOU they would use the system regularly and continue to give us feedback.

MS. KRAMER: How long has the system been there now? I guess I'm not clear on what impact…

DR. PARKS: It's been there about a year. The reason why they wanted us to monitor this, in particular, is there's a sister site where what happened is somebody, a worker, locked the machine out, put this bar in here and locked it, but these were all still in the on position. So, that's one thing they wanted to monitor. And not only that, they have suggested that we extend our system to monitor the soft-start which is the test-out portion of lockout/tagout/test-out so that they know that the operator is not only locking it out, but he's doing the test-out as well, so we need to put a relay into a J box for that. That's been something that they've suggested.

MS. KRAMER: That's actually some of our latest near misses and high energy events have been where somebody didn't try it out or didn't, you know, that the tryout wasn't effective in some way, whether they didn't do it right or something failed.

DR. PARKS: There are companies that can do this for a lot of money. We're going to try to make it so that the small operations in stone sand and gravel can afford it.

PARTICIPANT: Well, I noticed at the beginning, this is all really good stuff, but you just call it lockout/tagout and not a tryout, and from an administrative standpoint that's part of the mental thing we try to encourage with our processes and company I work at now and others, that that is the process. It's lockout/tagout and then tryout. So, it may be worthwhile and further advertising of this is having the three-step part in there. I mean that's a critical component, like Stacy just said, a few issues we've had recently. So, just a suggestion.

DR. NELSON: So, you're going to do this all on Bluetooth?

DR. PARKS No.

DR. NELSON: What were you going to do?

DR. PARKS: Well, Bluetooth 5 is actually promising.

DR. NELSON: But what are you going to do?

DR. PARKS: We're using SmartMesh right now which is 802 15.4 IEEE, Bluetooth 5 is promising, that's also a 802 15.4, but it's got a slightly different network protocol and that's… the ones that I'm interested in. Although my lab mate is looking at the Monnit sensors which are 900 megahertz long range sensors so they can go a

	kilometer and they have long battery life, and then we're also looking at (LoRaWAN) sensors.
DR. NELSON:	What is that?
DR. PARKS:	Low rate. They chirp, they're spreading is done by chirping.
PARTICIPANT:	Is that the way that looks or are those breakers all on?
DR. PARKS:	They're on.
MS. KRAMER	That's what he's saying, they did it wrong. That's why the company wanted to do something.
PARTICIPANT:	That's real wrong. That's basic error.
DR. PARKS:	Yeah. Well, the bar is not fixed. It would pop out real easy. When they lock it out they put a lock on it so it doesn't.
PARTICIPANT:	Yeah. Because the way it looks like you turn the breaker off the way it looks, but that's just the way it looks.
DR. PARKS:	Yeah, I mean, it seems like they shouldn't be storing it there.
DR. MATETIC:	Or designed to where the only way to apply it is where it fits through it.
PARTICIPANT:	A flat bar or something.
DR. PARKS:	Yeah, I mean, definitely.
PARTICIPANT:	I can see why they called you.
MR. WRIGHT:	I had a couple of questions. One is, what sort of work have you done to make the sensor systems failsafe?
DR. PARKS:	Sensor systems?
MR. WRIGHT:	Yeah, that's the question.
DR. PARKS:	Okay. The first thing that we're doing is to not actually have the lockout/tagout procedure be reliant on the sensors, they're supplemental. And as sensors become more reliable then, you know, maybe we'll think about replacing some more portions of the current lockout/tagout procedure with our augmented ones, but at this moment it's just supplemental. So, we failsafe, and to not avoid the question, we monitor the sensors regularly because one thing that sensors can sense is their own operation. So, we're getting that data on a regular basis and when the sensor is getting ready to fail we'll know it.
MR. WRIGHT:	Yeah, we had one fatality, that's not at a mine, but in a tire plant, actually, where they were dependent on a kind of a pad that sensed weight in order to make a machine that was actually robot safe, and the pad failed and the worker did everything right, but was killed because, you know, the sensor wasn't sensing… well, the sensor wasn't passing on the fact that it was sensing his way to the to the robot arm. So, we've been, you know, we've been real interested in all this stuff that could ultimately either replace or, at least, supplement lockout/tagout. But one of the things we've really been concerned about is making sure that if it fails, it fails to a safe mode. The other question is going back to your very first slide, and let me find it on my computer. It was the one where you have some

numbers about the fatalities. Yeah. Okay. Maintenance or clean-up was the leading activity in 83 percent of the 41 fatalities. And lockout/tagout was a contributing factor in 29 percent of those. I would think that… so one of the characteristics of the other 71 percent which were fairly maintenance or clean-up, but where the lockout was done was barely done correctly and was in place and somebody still was killed.

DR. PARKS: Yeah, that's a good question.

DR. KOGEL: Those accidents would've been in a situation where there was maybe not lockout/tagout required. So, maybe a clean-up activity next to a moving conveyor or something like that. So, I think it's maybe just within how you read that statistic.

DR. PARKS: Yeah, it's I guess not all clean-up requires LOTO.

MR. WRIGHT: Yeah. No, that's true. But were both of those where people were caught in machinery or where they were, for example, hit by mobile equipment or any…

PARTICIPANT: Those were all severe… sorry, those were all fatalities in surface mines involving stationary equipment. So, it's not mobile.

MR. WRIGHT: All stationary equipment. Okay. So, maybe a lockout should've been required on some those. Okay. Well, anyway, thank you.

EMP RESEARCH AT NIOSH: ACTUALIZING THE EMP ROADMAP, DR. STEVEN MISCHLER

This presentation outlined the proposed elongate mineral particle (EMP) research program at NIOSH. The focus of this research program will be to actualize the NIOSH Asbestos and EMP Roadmap (roadmap) which was published in 2011. The presentation started with a slide of definitions, to ensure that all MSHRAC members were aware of the definitions to be used for the presentation. The presentation continued with a slide outlining the strategic goals as stated in the roadmap and then reviewed the National Academy of Sciences (NAS) recommendations based on a review of the roadmap. The ensuing slides identified the several avenues that will be developed within NIOSH to pursue this research program including, 1) creating a centralized home for this research at the Pittsburgh Mining Research Division, 2) establishing relationships with key research partners and 3) developing research projects to answer specific questions from the roadmap. The remainder of the presentation was a review of the current research proposal for the project, “Understanding Elongate Mineral Particle Exposure in Mining”. These slides included a summary of the burden, need and impact driving this research, a description of past NIOSH research projects which laid the groundwork for this future research. Finally the presentation finished with four slides giving a detailed description of each of the three specific aims (SA) for the proposed research project and these include; 1) SA 1: To understand miners’ potential exposure to asbestos and other EMPs by analyzing bulk material samples previously collected from copper, granite, gold, iron, limestone, and sand and gravel, coal, etc. mines across the country, 2) SA 2: To further elucidate the toxicology of the EMPs by creating new EMP separation methods to allow both in vitro and in vivo toxicity tests on EMP’s of specific lengths, widths, mineralogy and other characteristics of concern, and 3) SA 3: To investigate an application of qualitative and quantitative analysis of EMPs for end-of-shift measurement using newly developed and novel techniques for EMP analysis.

Questions and Comments:

DR. NELSON: When you say "improved," do you mean statistically consistent or correct, or more decimal points? What do you mean by "improved?"

DR. MISCHLER: Well, I think what the point now is a lot of the work has been done up to this point and each area or each group has sort of recognized different parts of these fibers or they looked at different things and they haven't really included the entire characterization that maybe we can say. And so I think when I say improved in this particular case I would like to… we're planning on improving the techniques so that we can encourage or that we can envelop all of the terms that people have used in the past and sort of make that one individual nomenclature or combined nomenclature. So, there are some improved techniques that we have. I mean, we'll talk about all of this a little later, but like end-of-shift techniques, sort of like Lauren was talking about, with crystalline silica, we're going to be looking at that, improved techniques for separating fibers.

DR. NELSON: Can you just educate me? Is this a physical reaction or issue or a chemical? I mean when you talk about shape that sounds like physical. When you talk about surface area it sounds more like chemicals. So, what do you think's happening?

DR. MISCHLER: Well, I think that's to be found out.

DR. NELSON: You don't know yet.

DR. MISCHLER: That's part of the toxicity. Everybody thinks it's a different thing. It depends on what the active toxicity is, a lot of people say, it's chemistry, right? A lot of people say it's active sites on the fibers. Other people say it's purely physical, it's purely a fiber.

DR. NELSON: So, when you go after it you have to go after it if you think it might be chemical, something that's not just looking at the shape of the fibers. Right?

DR. MISCHLER: Right.

DR. NELSON: You have to have a very complex experimental plan.

DR. MISCHLER: Absolutely. But we can also eliminate things. If we know… by this if we can separate particles that are, let's say, 1 micron in width, you know, but they meet the 3-to-1 ratio, we can we can have a bunch of particles like that and if it doesn't show any biological activity then maybe we can eliminate the idea of particles that are that wide. They're not causing any biology or any harm. So, we can do it stepwise, but, yes, you're right, we'll have to incorporate the chemistry at some point in active sites on these fibers are probably a certain thing. Also, bio persistence. I mean, a lot of these fibers… some fibers persist longer than others.

DR. NELSON: Well, there's a scale effect as well, because if they're of a certain shape, because they interfere with a certain organelle in life or something, so there's got to be a

scale effect that has to be monitored as well.

DR. MISCHLER: Yeah, and I think this is a very tricky area, and so we're going to be working with all of our stakeholders and we need that help because this work has been going on, people have been trying to solve this issue for many, many years. And so we think by bringing everybody together hopefully that will help to really move this, push this forward.

PARTICIPANT: Well, this is great, and I'm glad to see energy put in this space and the fact that it has kind of a home now, it looks like, at NIOSH, so and there's a lot of interested partners, you know, here and elsewhere there's a group that we've had with USGS and EPA and others for several years. It's Brad Van Gosen's group, they've been working on these issues. So, I look forward to picking up with you about some of this. I'm really interested in hearing a little bit more about the new kind of elutriation device. I mean, part of the issue has always been being able to generate enough fiber or the specific classes, you know, based on physical properties that you could actually do something beyond just this small in vitro experimenting, you know, being able to generate some real fiber would be amazing, you know, and it could certainly set us well ahead of where we are.

DR. MISCHLER: Right. And so we're excited about that, too. The work is still very at the beginning stages. The bearing classifier that we were showing that, you know, you could separate things beautifully, but you separate the very, very tiny fraction so you can't do anything. I think we had estimated that if we got a couple of those the size of a… a laboratory the size of this room it would take maybe a year or two to actually collect enough to run a toxicity experiment. So, you know, that that just isn't feasible, but there are some techniques that we've been using, you know, using different types of electrifying… or electrifying fibers where you can actually grab them and point them in a different direction. And, again, they're doing some of that working in South Korea, too. It's a different laboratory, but they're doing some of that work, too, where you can really grab the fibers that you want and it seems like they may be able to amp that up to a usable level. There's three or four techniques that we're going to be looking at.

PARTICIPANT: It'll be real interesting. (Venkat @ 03:34:16) did a lot of work on this.

DR. MISCHLER: Yeah, he did a lot of work on that, that whole realm.

DR. MILLER: And then it crosses over into the area linear nanoparticle toxicology and carbon nanofibers and materials. So, I think there's a real interesting opportunity here to explore linear particle toxicology, whether it's mineral-based or other, but I mean, I think it's exciting. The National Toxicology program, obviously, would be really interested as well, and others.

DR. MILLER: Is there a plan to have a meeting with other partners or how are you guys going

to proceed forward or what's your kind of trajectory and timeline?

DR. MISCHLER: Yeah, I mean, we've been working on having a meeting for a while.

DR. MILLER: I know the National Academy one never happened.

DR. MISCHLER: Right. Yeah. And so we've been having trouble, actually, just organizing and getting the right people to be involved. But, yeah, ultimately in the next couple of years that'll be something that we'll be able to put together.

DR. BURGESS: So, most of the projects that NIOSH are based on the idea of burden of disease. So, when I think about asbestos or asbestos like fibers I think of asbestosis which is really high level exposure and probably not going to see that, at least, nowadays I wouldn't think except perhaps maybe in an asbestos mine, but even then probably not. Then the other thing is mesothelioma. I'm not sure how often that actually occurs in any of the surveillance you've seen, but beyond that are there particular endpoints of disease that you think might be associated with this? I mean, how did you develop the burden statement in terms of supporting this particular effort?

DR. MISCHLER: We developed the burden based purely on the asbestosis and mesothelioma because when you look at the number… the disease percentage it's much, much higher for mesothelioma and for, well, obviously, and for asbestosis, but miners have a higher burden. So, that's kind of how we develop that. But, yeah, I mean, I think that… we do certainly need to do some more work along those lines.

PARTICIPANT: So, I think just in terms of presentation I would suggest that perhaps you start with that so that the audience can understand that there is, you know, there's a significant amount of disease that you're addressing here. I just I think it frames it better.

DR. MISCHLER: Yeah. I mean, and it's hard with any chronic long-term disease. I mean, you know, 40-year activation life, right? So, it takes a long, long time, and it's hard to really start defining that.

DR. BURGESS: But, no, I mean, at the beginning of your presentation is you talk about the, you know, the endpoint of disease, and it allows the viewer to understand kind of where you're going and that there's a specific disease you're trying to prevent.

PARTICIPANT: And, you know, you could look at the IARC listings and in other listings now about other cancers, you know, burden of cancer beyond just mesothelioma and (MUGCA @ 03:37:34), and then pleural disease as EPA has picked up. So, if think about the range of physiological ramifications across the spectrum, both environmentally occupationally, because we're seeing it in both domains.

DR. NELSON: And you may find more than one thing going on, I mean, where you have… I mean, like you have ever had asbestos in coal, which you don't particularly have asbestos in coal. But if you did something like that then you'd have more than one effect and they would tend to compound. And maybe silicosis, that kind of thing

can do that.

DR. MISCHLER: Well, and that's part of the initial understanding, right, is that we're going to look at all of these different commodities. So, we will be looking at coal. We'll be looking at the coal samples to see is there any potential exposure for those things. And, I mean, part of that, too, is the exposure isn't… you know, you have bulk sample and it's not really easy to correlate that bulk sample with the actual exposures because we don't really know what that exposure looks like. So, we actually need air samples also, and we've just been talking to some of the stakeholders. We think there are areas where we can actually have a bulk sample with air samples and that would be the most valuable data that we can really use.

DR. MISCHLER: Because then we can actually create those. We can create those exposures ourselves and do more work on it, and I think that's the important thing.

DR. KOGEL: And I guess I'll just kind of say a few words about burden and, you know, we do operate from this BNI kind of perspective, but some of the issues that we work on that isn't necessarily the reason it's so much under our radar and, certainly, I think there's a good burden justification here, but also this is something that goes back to the asbestos roadmap, the National Academies, NIOSH has been doing work in this area for a long time and actually our stakeholders and NSSGA, and others have also come to us saying this is an important issue that we need to address. So, those things combined are also what put it on our radar, and as long as there's burden there to justify pulling the resources towards it then we move forward with that.

DR. LUXBACHER: In terms of burden do you think this work might have some broader impacts on characterizing all respirable particle geometry? I mean, I'm not that knowledgeable about it, but I understand that characterizing geometry is difficult. We're getting to where we're doing a good job of characterizing what the particles are made of, but not necessarily their shape and how that's impacting health.

DR. MISCHLER: I think that would be the idea. Yeah, we would be able to come up with a set, sort of analytical technique to work with every other particles as well.

DR. LUXBACHER: And that might be a nice piece of burden, too.

DR. MILLER: There's been some work that's looked at the particles shape, size, dimensions, you know, all transitional chemistry is evaluated. But, again, as what you were mentoring earlier, there's not a lot of that being done, so the characterization of a lot of the science and experiments, the epidemiology that went with does not relate back to understanding of the exposure very well, that level of characterization.

DR. NELSON: You just said solution, what is going on?

DR. KOGEL: Yes. I think there's some big science questions here that we at least have an

answer in.

MR. WRIGHT: If we go back to the first slide after the title. I want to make sure I'm reading this right. Is this about the definition of an elongated mineral particle?

DR. MISCHLER: This is really just the definition that I'm using for this presentation, just to put everybody on the same page.

MR. WRIGHT: What I question is why would chemical composition be part of that? I can see why we would want to know a lot about chemical composition to characterize the particle, but to define it wouldn't that only be based on fiber dimensions?

DR. NELSON: It's not part of EMP. It's part of active EMP.

DR. MISCHLER: Right. But as a particle we haven't actually eliminated the chemical composition of those particles as far as toxicity's involved.

MR. WRIGHT: Yeah, and would certainly want to study that, but this seems to indicate that we would eliminate some particles as being EMPs even before we do that research because of their chemical composition.

DR. MISCHLER: We don't plan on them.

MR. WRIGHT: Because we decide that that particular chemical composition doesn't qualify them to be an elongated particle. Do you see what I'm getting at?

DR. KOGEL: I see what you're getting at, Mike. If we're going to talk about elongate mineral particles that's dimensional, it could be any chemistry, but I think maybe you're including that because that's just part of the characterization aspect of it, which I think it was your point, Mike.

MR. WRIGHT: Yeah.

DR. KOGEL: It's not really about the definition.

MR. WRIGHT: We would want to characterize it.

DR. KOGEL: So, probably with that comment maybe, you're right, we would take chemical composition out of that because that infers that we are using that as one of the dimensions of the definition.

DR. BURGESS: Oh, but it might be, though, because you'd actually be thinking about persistence of the particles, so the toxicity is things that don't break down. So, if you had something with soluble with water and break down and wouldn't stay that way then that may be a function of the chemical composition.

DR. NELSON: But whether you're an EMP or not there's nothing… it doesn't bear upon whether you're toxic or not..

DR. KOGEL: And this is why this is such a tricky thing. But, I mean, you bring up a good point.

MR. WRIGHT: The reason I'm a little sensitive about this is we went through a big fight with the Asbestos Institute back 20 years ago which started them doing some bizarre chemical thing to basically rock, chrysotile and claiming that it was no longer asbestos because they coated it with some kind of other material even though it was the same, you know, the morphology was the same. So, you know, we see these claims by people who were not our friends, but that just because they

changed the chemical composition of a particle they removed it from the asbestos category.

DR. MISCHLER: Mike, I'm hoping for this project we're all going to be friends.

MR. WRIGHT: Yeah, right. Well, we don't exist anymore, so move on.

DR. MISCHLER: Yeah, that's the idea.

MR. WRIGHT: So, we kind of won that fight.

DR. MILLER: You know, part of the problem is, is there's particles that don't fit in these definitions that are causing health effects in the area now which is not, in part, asbestos mineral, but yet workers are exposed to it in different locations and they have very profound effects, seemingly high rates mesothelioma. So, you know, what is it about these particles and which ones, and what should be concerned about so we can actually think about what are we doing for testing and which particular exposures do we need to be protected from.

DR. MISCHLER: That's the bottom line.

MR. WRIGHT: Yeah, of course. I mean, we are the union that represents Iron Miners, so we know that issue well.

MINING PROGRAM COLLABORATIONS – PMRD, DR. RJ MATETIC

Dr. Matetic provided a brief overview related to the domestic and international collaborations associated with the PMRD. Dr. Matetic mentioned the PMRD is tracking over 420 domestic and 15 international collaborations. He also mentioned the collaborations only involve carrying out the current research portfolio, in which, consists of 25 research projects. Dr. Matetic mentioned the PMRD tracks collaborations based on stakeholder type and sector. Stakeholder types would include mining companies, mines, manufacturers, academia, federal and state government offices and associations. The differing mining sectors would include coal, metal, stone, sand and gravel, industrial minerals and oil and gas.

Dr. Matetic mentioned the distribution of domestic collaborations related to stakeholder type involved the following: 251-mines, 90-manufacturers, 32-mining companies, 22-academic institutions, 11-federal government offices, 11-associations and 5-state government offices. The distribution of the collaborations by sector included: 246-coal, 55-stone, sand and gravel, 46-industrial minerals, 42-metal, 28-all mining and 5-oil and gas.

Dr. Matetic also delivered the distribution of international collaborations, in which, involved 6-manufacturers, 3-mining companies,3-academic institutions, 1-federal and 1-state government office and 1-association. The 15 international collaborations were associated with 9 different countries including 4-Germany, 3-Australia, 2-Canada, 1-Belgium, 1-Columbia, 1-Finland, 1-Norway, 1-Poland and 1-Sweden.

Dr. Matetic also stated all of the collaborations have specific data associated with them. The specific data includes a Mine ID number if relevant, a mine or company name, city of activity, state of activity, the intermediate goal (of the strategic plan) associated with the research effort, commodity type, stakeholder type, the specific activity performed and the work unit-branch, division, etc.

Dr. Matetic also provided two slides demonstrating examples of domestic collaborations by stakeholder type and activity, along with a slide that displayed examples of international collaborations by stakeholder and activity.

Questions and Comments:

DR. NELSON: Is the work with the Cundinamarca government in Colombia a contract?
DR. MATETIC: No.
DR. KOGEL: No. Can I just add one other thing about that that I think is important, is we're putting this together for the Colombian government, however we're going to make it available to anybody that would like these training modules in Spanish. So that's really the idea behind that. We will probably have copies of the training modules at the NIOSH booth at the next SME meeting because we will have already delivered the modules to the Colombian government. We will also have them on our website for distribution as well.

DR. NELSON: No collaborations with China?
DR. MATETIC: Numerous contingencies come from China to the lab to visit or discuss specific topics, but nothing like forming specific collaborations at this time.

DR. NELSON: Is this an area that your office wants to grow, the international collaboration?
DR. KOGEL: The international collaborations are very important to us. If we do grow we have to be strategic and how we do that because we're limited in terms of our resources to manage these things. So, I think Todd has already mentioned the MOU with South Korea. Where there are opportunities for us to expand our research and to exchange information then we do it, but we can't do all of them that are out there that either come to us or we may be interested in. Perhaps not expanding it because we already are managing a lot of them, but just making sure that what we're doing is really supporting our mission is a good kind of exchange. It's how we prioritized them.
DR. MATETIC: If you're able to leverage ongoing research across the international community that'll be great because then it'll energize and support a lot of work that could be done,

MINING PROGRAM COLLABORATIONS – SMRD, MR. TODD RUFF

MR. RUFF: Thanks again for the opportunity to share information about what's going on in Spokane. As RJ mentioned, our collaborations with industry, universities and the international organizations are really critical. I'll cover field sites, mining schools and other universities, and then our international partners. First of all, let's take a look at the field site partners. Because of our Western focus our mining

partnerships are primarily in western states. What I'm going to talk about here are basically mine sites and collaborations with organizations specifically our mining projects. Let me just highlight some of these by team. First of all, for the metal mine ground control team, historically, we've been very active in the Silver Valley in Idaho, and our partnerships with Hecla and U.S. silver are important and they continue, and we see those continuing for the future. The main work there is for ground support technology, backfill design, seismology, and all this around reducing risk when mining in high stress deep mines, and reducing the risk of rock bursts especially in that area.

Our involvement in Nevada underground mines, that's increased over the last few years and as we see the surface mines moving into underground mining and the challenges that they see in mining through weak rock mass. We have partners in Montana, and I've talked about Greens Creek in Alaska. They're assisting with development evaluation of Internet of Things-based sensors to monitor corrosion and ground movement.

Next is the mining induced seismicity and mine stability team working with Western underground coal mines and one surface copper operation. The main work there is around seismic and stability monitoring, providing input to improve the understanding of the issues related to what I had mentioned earlier today about the differences in geology in western coal and improving the use of seismic events in risk assessment. That's the main work going on there.

The automation and technology team is fairly new, but they formed some critical partnerships already with stone, sand and gravel operations and mines in the Silver Valley. We're starting to define a partnership with the metal mines in Idaho and Nevada. They're considering automation. That's part of that group's work. Mines in the Silver Valley are providing diesel emission samples for our diesel project and our work to characterize radio frequency propagation for voice and data communications through tunnels is wrapping up now, but that was aided by some mines in the western underground coal mines and a hydroelectric facility in Washington State. It turns out that the nice smooth walls inside of a dam are a good way of testing radio propagation and establishing baseline data. That's kind of an interesting spin on that.

Finally, for the miner health team, we have strong partnerships in Idaho. Galena was the first site where our heat stress pilot study occurred and Hecla is also involved in the heat stress work. We're working with two state clinics for evaluating miner health data sources, that's in Wyoming and New Mexico. Our collaboration with Rio Tinto is providing access to miner health data and providing input to the miner fatigue study.

Those green states are areas where we are not working at, but as opportunities come up I'm sure that we'll be expanding, especially as we move more into stone, sand and gravel and surface mines.

I wanted to talk a little bit about some of the work we have going on with universities. I'll highlight for each of these. First these are in our own backyard, many of these are actually in Spokane. We have work going on with Gonzaga University and Eastern Washington University. These are projects I talked about earlier about the senior design or the engineering design projects. We're working with student design teams on accelerometer design for vibration, interface designs for the IoT, Internet of Things-based mine maintenance systems. Another important collaboration with the Washington State University's Sleep Research Center is allowing us to exchange information on cognitive testing for fatigue and for heat

stress. Seattle University is working with us on the diesel monitoring technology. They're looking at the LIBS or the laser-induced breakdown spectroscopy part of this while we are concentrating in Spokane on the FTIR side of that.

A little further away, Montana Tech has the experimental mine. They're providing a test bed for a couple of our projects, IoT, a vibration and hearing study, photogrammetry, corrosion studies and the seismic data analysis. University of Utah has projects with us in big data, risk modeling and mine stress modeling, also helping with seismic data analysis. Colorado School of Mines, they worked with us on that blasting software that I showed earlier today, the Drift software, and then also we have projects in ground control and diesel monitoring technologies at the experimental mine. University of Arizona is working with us in the areas of heat stress and then also through a contract with the analysis of miner health data. Finally, on the other side of the country there, Virginia Tech has asked for assistance in using ground-penetrating radar in their underground stone mine void detection project. That's the kind of things that we do at the universities.

The last slide here moves to the international collaborations. I already mentioned the MOU with Chonbuk University in South Korea around the mine stability and mine design. We also have some more going on with Victoria University, New Zealand around seismic processing. For the metal mine ground control team, collaboration with the Western Australian School of Mines. We were invited to give five or six papers in Australia around deep high-stress mining, and we met with the university faculty and students to discuss our research in this area and where we can collaborate. That's under development now. These last two for the metal mine ground control team are examples where we work with industries that are international, so we have new concept mining. South Africa, they have a new roof bolt design and this is where mining companies in the U.S. are considering using these new technologies and they've come to us to verify tests and strength characteristics. There's a new roof bolt design that we've tested in our machines at the lab there. Also, the wire mesh testing from Geobrugg and then, finally, for the miner health team they're working with Rio Tinto in Australia and Mongolia on heat stress and fatigue.

Questions and Comments:

DR. NELSON: So, you actually went out to Kalgoorlie?
MR. RUFF: Yes. I think they did. I'll have to check on that.
DR. NELSON: So, it's the Rio Tinto in Mongolia.
MR. RUFF: Yes.

DR. NELSON: Are there opportunities that occurred as a committee that maybe could be those win-win ones, that you probably already have, but we don't know because we can't be told?
PARTICIPANT: Well, this was my only thought when I was looking at it, the earlier part of the discussion today where the oil and gas in extracted industries seems to be a large growth in the United States, and especially with the fracking area and the use of proppants in sand and other things. So, I guess, I would just make a point about thinking about that and about NIOSH program thinks about that, and can

express itself in terms of the research programs as that begins to... continues to grow and what are the health-related issues associated with that broadly. Because I don't of anybody else is really working in that space, you know. We funded some research from NIH, but there's really no end of thought for construction of how do we approach it from a worker health paradigm.

DR. MATETIC: I'll just offer that NIOSH does have an interdivisional working group on oil and gas, and that's out of Spokane Western States in the oil and gas program office, and so there's ongoing research primarily on the exposure side that's being conducted. There have been discussions and I've been involved as the group are related to how to get at the health issues. So, if there is some activity it's mostly outside of the mining group in another division.

PARTICIPANT: Yeah, I was just kind of wondering what's the home for that. NIOSH did some really nice work on silica exposures related to that, and I was wondering where does that sit exactly and it's a of crossover to mining and oil and gas, but there seems to be an overlap here.

DR. MATETIC: The workgroup does involve people from mining as well.

DR. KOGEL: SMRD has been involved in that project and we do have an extractive industry's working group that Jeff has talked about at previous MSHRAC meetings to try to make sure that we're connecting the dots across all of NIOSH. This is probably a common theme you've noticed. You know, we are distributed into different divisions, and so I think we're doing a much better job of looking at where we can work collaboratively, but, the question does come up, where is the home and who is the keeper of that particular area of research? But we've worked very closely with Western States, but there's been some changes there with people retiring and I'm not sure if Spokane is directly involved in the research now, but they're still interacting through this group that Scott was mentioning. I think the mining program needs to stay engaged, and so I appreciate you mentioning that because there are a lot of questions and issues that we need to be involved in and I think we can bring some things to bear.

DR. NELSON: What I noticed was you didn't say anything particularly about Canada. I know that there is an international group. I went to one of their meetings.

DR. KOGEL: Yes. What RJ and Todd presented is for current research. What hasn't been presented are there are other things that aren't necessarily related to one of the two mining research divisions. There is this group that the overall mining program has been involved in that I don't remember the name of it.

DR. NELSON: NRGO or something.

DR. KOGEL: And there's another one, too, in the past…

DR. NELSON: There's several up in Canada.

DR. KOGEL: …that involved NIOSH, so the U.S. So, the major mining countries. So, U.S.,

Canada, Australia, South Africa. Who am I leaving out? There seems like there's somebody I'm leaving out. Anyway, so at one time there was a group that was meeting on some frequency.

DR. NELSON: Like every other year or something on mine safety and health.

DR. KOGEL: Yeah, and that I think right now is not happening. That hasn't happened since I've been at NIOSH. I don't know the last time that group met.

DR. NELSON: It was right about the time that you came in because I went up to Canada to the meeting, that last meeting. I don't know where it was. But they were looking to have the next meeting and they thought that you would be able to host in Pittsburgh. I told them to call you.

DR. KOGEL: You told us they haven't. Yeah.

DR. MATETIC: We also, in Canada, are for the diesel project, to monitoring control of TPM, Canada has been a major player with us as well on it. But there's no formal meetings or something like that happening that involves specific mines and monitor and control.

Day 1 meeting adjourned at 4:00 pm.

DAY 2, Wednesday, May 23, 2018

The meeting commenced at 8:00 am. Mr. Welsh conducted a roll call to confirm a quorum. He asked members to self-declare any conflicts of interest that may arise during the meeting and recuse themselves from any discussion related to that conflict.

NIOSH MINING PROGRAM FY19 NEW PROJECTS

PROPOSED PROJECTS FOR FY19: SPOKANE MINING RESEARCH DIVISION, MR. TODD RUFF

MR. RUFF: We're going to talk about new projects proposed for FY19. And we have five of them in Spokane, new project proposals we feel are addressing important needs in mining health and safety and will move us forward in achieving our strategic goals. I wanted to give you an idea of where we are in the process right now.

In November/December 2017 timeframe we put out a call for concepts and that's an opportunity for researchers to propose areas of research. It's guided and we try to provide some focus on the areas that we want to look at and receive proposals. It's really a time for researchers to give ideas and we try not to be too limiting on that. Then we go through those, we vet those, and through a review process we pick those ideas that we want to see full proposals developed. That's the stage we're in right now, so we're in internal review and the draft proposals have been written. We review those internally and then next month they go out for external peer review. So that's where we are in the process.

This is a similar slide to what I showed on my overview yesterday. But I wanted to highlight where I see

the Spokane Division going. This is really driven by burden, need and impact, the BNI that we talked about. We get a lot of feedback from our stakeholders too. I mentioned yesterday our ground control and our mine design efforts have historically been the foundation of our work in Spokane and we'll continue to grow that area. Our main focus areas will be around ground support needed as mines go to new mining methods and different equipment types. We have expertise in ground stress monitoring, seismicity, and mine modeling. For the future we see a need to improve the analytics and the visualization of the data around those. This is to improve risk assessment and we're seeing a push towards automated mining equipment in the U.S. and so we need to look at the change in ground control methods and the data analytics needed around that.

We're in the process of building up the miner health program. We'll be working hard to establish the partnerships that are critical to the success of that program. Dr. Yeoman will be giving more information on that. There are other areas that will be expanded in the next year. For example a study of miner health data sources. I'll talk about in a minute, and also increased effort in fatigue interventions.

We talked a lot about emerging technologies yesterday. This is really looking at the safety implications and benefits of new technology. We know that we have an area that we can focus on in bringing emerging technology now – that is to improve conveyor safety, especially around maintenance. Also we will be looking at machine safety priorities for metal and nonmetal and stone, sand, and gravel. So I'll give you a few details on where we're going with those.

Here are the five projects. They're in the proposal stage. Developing a ground stability informatics system, will be led by Shawn Boltz. Building an evidence-based framework for improving miners' health, by Aaron Sussell. Mining applications of novel interventions for fatigue, Tim Bauerle. Developing and evaluating emerging technologies to improve conveyor safety, we've heard from Dr. Parks, and Identification of key factors affecting machine-related fatalities and injuries in metal/nonmetal mines, Dr. Vaibhav Raj will be leading that project.

First, the project entitled Developing a Ground Stability and Informatics System. That's a four-year project. The objective is to improve the access and the interpretation of ground stability data and other sources of information to aid in risk assessment. So new technologies and new data analytic methods are available and they're needed to start the move away from a siloed approach to looking at ground stability data and to start to look at all the data sources that can come in on that in an integrated approach. Especially as we move towards automation, we have less people in the stopes and in the haulage ways keeping an eye on ground movement. So this data's going to be critical. We have a mining company that's on board to partner with us in this research and the need for improved situational awareness is a top priority of the mine-of-the-future report recommendations developed by us. So there's been advances in sensors and informatics and they can be leveraged to improve safety in this area.

So for impacts - the recommendations for improved risk assessment using the latest technology is one of the goals of this project. And at the end, we want to have a prototype system demonstrated in a mine and hand that off to a technology manufacturer or a mining company to take off with this and get it out for wider use.

We've done some work around this already really by necessity; our ground control projects we're dealing with a lot of data and especially around seismicity, geology, fault locations, and the mining process itself.

There is a 3D model of the Lucky Friday Mine and the spheres that you see distributed out here and there are the seismic events. Geology is also shown here along with the mine workings. We needed to have some way of visualizing the seismic activity, so this was developed using a gaming engine. It's called Unity and provides the initial thoughts around how we see this working. You can also virtually fly around this model and you can even enter into the mine and travel through the mine workings, as you can see on the top-left there. You can enter in and see the events and the geology as you travel through the stope virtually.

The second proposed project will be a five-year effort to identify and evaluate miner health data sources to define the research focus and establish some baseline data. This project is critical to the foundation of the miner health program. It's a little different in that it's an ongoing effort to inform the miner health program in future research, so it'll likely extend for the life of the program in some form. As we target areas of health-related research or chronic disease in mining, we'll provide periodic updates to our stakeholders and identify where we'll focus and also the effectiveness of the interventions that are developed. We have a pilot project this year that's looking to evaluate some of the date sources that'll be used in this project. There's four main data sources that we're targeting now: clinical, national surveys, data from mining companies, and from government agencies like MSHA.

The third new project is looking at the problems associated with fatigue in mining and possible interventions. We have a pilot project this year that's leading to this multi-year effort. Around need, I think we're all aware fatigue's a major concern for most mining companies and the problem really is serious when considering the operation of large equipment. We have several partners that will be collaborating in this research including Kennecott, Rio Tinto. I know we've talked to Freeport. So there's support here and our stakeholders regard this as a high priority. We also have Washington State University sleep research center in Spokane which will be an important partner. Final products from this project will be in the form of recommendations for preventing fatigue and the translation of effective toolkits that might consist of fatigue management tools, shiftwork recommendations, and even the effectiveness of monitoring technology. The pilot project that's going on has conducted a systematic review of fatigue in mining and identified some possible models and interventions that could be targeted. A preliminary model for fatigue management will guide the development of the full project.

Our fourth proposed project will develop and evaluate new technologies for improving conveyor safety you heard about yesterday. As Dr. Parks mentioned, we'd like to move this work under the mining program and continue to develop and refine the system so that it can be handed off to industry. One thing we tried to point out yesterday but I wanted to highlight here is lockout/tagout isn't the only issue with conveyors, of course. We see a need for improved training, better methods for maintenance and cleanup, and there's challenges that are unique to small mines that need to be addressed too. We have strong partnerships right now for developing and testing new technology: Oldcastle and Lafarge-Holcim are on board. The final products include the licensing and marketing of a new internet-enabled maintenance monitoring and reporting system, training materials around maintenance, and new technologies that are developed and interventions targeted toward the smaller operations. We covered this in detail yesterday, but the main goal here for the maintenance part of the project is to improve situational awareness in maintenance activities. An unexpected startup, we mentioned yesterday, is one of the most common factors in severe injuries related to maintenance. Status of maintenance activities, the status of guards and access points, the location of personnel prior to startup, really with new technology now can be at the fingertips of the mine personnel and management. It shows on the bottom-

right there that you can bring that same interface that David brought up—showed yesterday, you can bring that up on your phone. That's where we want to move with that. There's new technology available to do this type of thing and we want to get that to industry.

Our final proposal is for a one-year pilot project that will take a closer look at machinery and power haulage accidents in metal/nonmetal and stone, sand, and gravel. Accidents involving equipment, both stationary and mobile, consistently come up as one of the top fatality classifications for these sectors. We need to understand the root causes and use the burden data and feedback from stakeholders to help guide future research in this area. That is the focus of this. We know that conveyors, of course, stand out. As RJ is going to point out, haul trucks also stand out as the top types of equipment involved in these types of incidents. But we really need to dig a little deeper, understand what exactly is going on and where we should focus our research efforts.

Questions and Comments:

PARTICIPANT: So these are all events that have occurred, not predicted?
MR. RUFF: These are past events, correct.

MS. KRAMER: Can we go back to the seismic stuff? Are you creating this model that shows what's occurred, but is it in order to be predictive?
MR. RUFF: In order to do risk assessment—yes. I don't like to use predictive. We're not there yet, but in order to aid in the risk assessment, absolutely. We will have historic data. Hopefully be able to say these if conditions that we're mining through look a lot similar, we're getting a lot of the same reaction in the rock mass, as we've seen before, we need to be paying attention. This is one of the challenges that our partners have brought up is as they move towards automation, they're not going to have their eyes and ears in the stope as much so this is critical. The other part of this is the visualization of the data. I think there can be improvements made in how we present the data, the data analytics behind how it's presented, what's presented, and the predictive or the risk assessment functions can be built in so that it draws attention to those problem areas. We're hoping that this looks something like in the VR or augmented reality technology.
PARTICIPANT: So I would think I mean every mine'll be different.
MR. RUFF: Yes, so creating the 3D models is fairly straightforward because, with this technology, you can now import the mine maps in whatever format the mine is using. And these models are created—it's not quite there yet, but it's getting there where they are created—basically a 3D model is created from 2D drawings.

DR. NELSON: What do the colors mean on that?
MR. RUFF: That has to do with size, it has to do with intensity, and the color has to do with

how recent.

DR. NELSON: So what is the legend? Because time is really important in trying to understand what's happening here.

MR. RUFF: And I don't know on this particular graph what the timeframe is on the bottom-right. You know, it's probably over the course of a year.

MR. RUFF: So you'd be concerned about a grouping of red spheres because they happened more recently.

MR. RUFF: I can get you more details.

DR. NELSON: It'd just be really interesting to see and it may be difficult to do, but to show more of that sequence of what was related to what. And I know you can't put everything on.

MR. RUFF: If it was a video I could show the sequencing where we bring up data in time.

MR. BOWERSOX: On the fatigue part, are you going to compare the number of hours people are forced to work now versus what the old used to be a standard and then (longer/rotating) shifts versus working a steady shift?

MR. RUFF: Yes, so the shiftwork and the miners that are asked to do repeated shifts, all of that is data that needs to be fit into monitoring the person.

DR. NELSON: I know from disaster response that there's a lot of work going on right now, not particularly—I don't know in mining, but in general disaster response, getting and having the equipment that's being used be a part of the sensor so that the equipment may identify fatigue or whatever state of mind the person's in. So are you planning—is that part of this where you make the equipment smart and so the equipment can actually tell you whether this person should be running the equipment?

MR. RUFF: Well, there are monitoring technologies, of course, that can detect if the person is getting sleepy, to me, that's kind of the last resort. We want to prevent fatigued drivers from getting on the equipment in the first place. Monitoring after they're having microsleep events is kind of too late. But it happens and there's that human factor. So we know that the technologies can wake that person back up and it can also alert management saying, "Hey, this person's having issues, maybe we should give them a break." So that's how that is working currently.

MR. RUFF: Yes, the equipment itself is not here yet doing it. It's an add-on, it's a retrofit of something that's monitoring the operator.

MS. KRAMER: And the stuff that comes before that keeps them from getting on the equipment, we were talking about this the other day when we met, it's starting to feel a little snake-oil-ish. Like I don't know if we can really believe it'll do what they say it will do. So I think some of this work he's going to be doing will help us as companies to know is this really something that's valuable that will help us and isn't just the

next-best thing that we're going to go out and buy.

MS. KRAMER: The stuff that's on the equipment, you can see it working. The other it's a little bit more ambiguous.

PARTICIPANT: Question on the belt conveyor maintenance issue. Are you going to focus on surface equipment or you include underground belts?

MR. RUFF: I think it applies to both, really. Now, our initial testing has been on surface but really I don't see why it wouldn't have applied to both underground and surface.

PARTICIPANT: Do you see any possibility using proximity detection technology to keep people away from hazards?

MR. RUFF: Absolutely. That's part of that whole package where we know where people are during the maintenance phase and that can be extended to just regular operation too. But one of the ideas is if we know that a person has entered a restricted area, or even if they're still there, we need to know if they're still there before you turn that piece of equipment back on. That's one of the goals.

MR. RUFF: Doing it in a cost-effective manner is something that we really need to look into because that's challenging.

DR NELSON: What goes on in terms of measurement while drilling or exploration in this? Because there used to be quite a bit of work done out of that, like measurement while drilling, putting in rock bolts. Is that something that's done all the time?

MR. RUFF: It's something that we're proposing especially for the continuous miner—like for the automation plan.

DR. NELSON: Like press, torque, etc.?

MR. RUFF: Exactly, they can look at it and get an idea of where the faults are. They do that all the time. We could build that into this too. But that is one thing about the roof bolting that they are going to instrument in this particular example, behind continuous hard rock miner. And that data has come to be part of this risk assessment.

NIOSH DIRECTOR'S REMARKS, DR. JOHN HOWARD

Welcome, everybody. Thanks for taking the time out of your busy schedules to be here.
MSHRAC is a vital channel of communication that we rely on to give us advice about our programs. Today, I will briefly discuss several items. First, the NIOSH budget. The FY 2018 budget, which they have passed, is flat—it is $335.2 million. But the budget came out late, and we soon have to close the books on the FY 2018 year, so that creates a fairly rapid type of expenditure. That's fine if you have capital equipment you want to buy, but it's harder for grantees and others to spend money quickly. So that's a big challenge, which also impacts planning. The proposed FY 2019 budget is more complicated than the FY 2018 budget. The proposed budget for NIOSH is $200 million, which would be a 40% reduction from FY

2017, 2018. In addition, the budget proposes that NIOSH should realign from CDC to NIH. That is the FY 2019 budget proposal as it stands today.

The other item I wanted to mention, in addition to all the other mining issues, because I think it does at least geographically affect a lot of states that have high mining activities, is the opioid crisis that is affecting the US. In 2016 there were, according to the National Center for Health Statistics, about 64,000 who overdosed and died from opioids. And that is probably an underestimate. Those statistics are rather alarming, it's a significant problem. So the issue about the use of opioids in the workplace, last year about 12 million people in the US are estimated to have misused opioids to result in some type of ill effect and we have to assume, even though we don't have data, that of those 12 million people there are workers involved. So it is an occupational issue, certainly in the case of first responders that respond to opioid events, they're affected. And then the issue about what kind of treatment you offer to somebody who may be in the workforce that needs help. So I think it is an issue for all of us. And I do think Kentucky and West Virginia, New Hampshire, Ohio, other states that have a significant effect, it is I think a mining workforce issue too.

I again would like to thank committee members for your service on MSHRAC.

Questions and Comments:

MR. ZIMMER: Dr. Howard, along with that, I'm with the Operating Engineers in North American Building Trades and we're addressing that same problem. Actually we had this conversation this morning at breakfast—and with the opiate crisis, a lot of it's anecdotal evidence. The data isn't there. How do we find that data or whatever? What I'd like to do is a conversation between you, myself, and Jessica, maybe others, to find out how we can work with the Building Trades also. Something needs to be done to get to the workers, to the workforce. We know what the problem is. We know that there's some resources out there. We need to make it deliverable to the workforce so that the stigma gets taken away from this issue, that people get healthy, they get the support from the employers and from the labor leaders that they need to get back to work. That has become my priority and my passion and I think with these discussions that we're having at this level we can translate that into something that's going to benefit the workforce and the employers.

DR. HOWARD: Well, I think our role, we're at the upstream part of it, the antecedents to opioid use in the first place which often is work itself, hard physical labor, or an injury that comes from work. So that's really the upstream issues that I don't hear anybody else talking about. So I think that's something that labor unions would obviously be very interested in pursuing. So I think that end of the continuum of this opioid problem is something that we all can spend some time on in

occupational safety and health.

DR. NELSON: So the opioid—I used to live in New Jersey and work from New Jersey and the emergent chemical contamination in the groundwater systems, I don't think, at that point certainly, it had included opioids, as I recall. Is that being looked at to see whether there are opioids getting into the groundwater?

DR. HOWARD: I have never heard anybody talk about that, pharmaceuticals in the ground—

DR. NELSON: Yes, pharmaceutical emerging contamination—

DR. HOWARD: Okay, it sounds like an environmental problem too.

DR. NELSON: That's it, it's environmental, I don't even know whether they check and treat to remove from the wastewater stream.

PROPOSED PROJECTS FOR FY19: PITTSBURGH MINING RESEARCH DIVISION, DR. RJ MATETIC

Dr. Matetic provided an overview of the six proposed full research projects and one pilot project. The projects presented were:

- Electromagnetic interference & electromagnetic compatibility considerations in underground mines
- Exploring miner experience as a contributor to workplace injury
- Understanding elongate mineral particle exposure in mining
- Improving float dust controls in underground coal mines
- Mitigate fire and explosion hazards of lithium ion batteries
- Prevention of manual materials handling injuries in mining
- Identification of health and safety Issues related to haul trucks (pilot)

The relationship between each proposed project and the NIOSH mining strategic plan was shown. The projects relate to all 3 strategic goals and are represented in 6 intermediate goals. A summary overview of each project was then presented by Dr. Matetic.

The first project presented was on Electromagnetic interference in underground mines. EMI can disrupt electronic systems in close proximity to one another. The CPDM and the Person-Wearable-Device (PWD) for proximity detection systems was given as an example. This project will recommend effective design practices, develop administrative and engineering controls and promote standards for compatibility of electronic devices to eliminate EMI related to electronic systems used in underground mines.

The next project addressed miner experience and how it actually contributes to workplace injury. A recent review of MSHA fatality reports show there has been a disproportionate number of fatalities related to miners' inexperience at their current job. For example, 95 metal/non-metal fatalities were reported during 2013-2017 (5-yr. period). During that time, 21% of the fatalities had less than one year of mining experience. This project will provide guidance on risk reduction to inexperienced miners, take a look at improving "onboarding" strategies for inexperienced miners and look at providing improved training

products and then test those for validation.

The elongate mineral project was briefly reviewed. There was an in-depth discussion on this research topic the previous day. This project will create a database of differing mine geologies associated with EMP, develop techniques for improved monitoring and analysis of EMP exposure and also develop control technologies in reducing EMP exposure.

The Improving float dust controls project is a continuation of a previous project related to monitoring and controlling float coal dust. The project will focus on the development, evaluation and implementation of controls in reducing or eliminating float coal dust. Three specific control technologies will be examined and tested: the use of surfactants to reduce emissions, the installation of a water curtain in the longwall return, and the use of a water-powered longwall shearer scrubber.

Emerging Li-ion battery technologies offer a solution to the burden of diesel exposure in confined underground mines. However, large format Li-ion batteries in mobile underground mining equipment can pose a threat to potential fire and explosion due to battery thermal runaway. An evaluation of large format (e.g. 240 V) Li-ion batteries used by powered vehicles in underground mines has been requested in recent years due to the concern for a potential pressurized explosion within the XP enclosure. This project will develop evaluation criteria and test methods to assess Li-ion batteries in explosion proof enclosures. In addition, this project will also provide guidelines to emergency responders in dealing with Li-ion battery fires.

Handling supplies and materials accounts for nearly 25% of all work-related musculoskeletal disorders in the mining industry. Each year materials handling results in 70,000 days lost from work. The project will provide guidance on effective materials handling for the mining industry and attribute to the prevention of manual materials handling injuries in this mining workforce. The project will also provide a focus on finger and hand injury prevention. Severe hand and finger injuries are prevalent in the industry. In addition, while materials handling technologies and mechanical assist devices are being accepted and used in many industries, mining is still plagued by significant materials handling injuries. This project will explore and introduce new or emerging technologies to reduce the burden of materials handling injuries.
Finally, the pilot project on identification of health and safety Issues related to haul trucks was presented. Despite the development of new technologies, little has been done in understanding operator situational awareness and to provide more directed strategies to improve hazard recognition. The pilot will investigate accident causes in greater depth and analyze the perceptual and situational awareness requirements for operating haul trucks safely. It will then provide a roadmap for targeted research and interventions for future efforts.

<u>Questions and Comments:</u>

PARTICIPANT: Are you working with MFPA on guidelines for emergency responders ?

DR. MATETIC: Yes. We have worked with them in the past with the fires team. We're just in the planning stages of the proposal writing.

DR. NELSON: So several of these things, it seemed like there might be some technology

transfer like out of the military side of things? Have you found that to be the case?

DR. MATETIC: That's what we will explore. There is technology—in like a materials handling piece.

DR. NELSON: The handling on the exoskeleton and I think the driving as well.

DR. MATETIC: Yes, and those—especially the exoskeleton we know they're being used in other industries. Is there limitations in the mining for those to be used? Because materials handling injuries, obviously back issues are there, other industries are using mechanical-assisted devices to relieve that. Is there something that we can develop or implement from another industry to actually promote and use in our own industry? So that was definitely a thought.

DR. NELSON: Right. And DARPA is getting really involved in the underground, so we'll stay on top of what they're doing there because there could be some direct implications possible of the DARPA projects.

DR. KOGEL: Yes, and we're getting more plugged in with DARPA. George has spent some time with them and so we're actively engaged looking for exactly these sorts of crossovers.

UPDATES TO NIOSH MINING STRATEGIC PLAN, DR. LISA STEINER

DR. STEINER: We've come a little bit further since the last time that we talked to this committee and sent out this plan. We listened to the feedback that we received from you, so I want to take you through this and then we'll go through an interactive version of this plan. This might be a little more of a fun presentation.

So where are we now? We have now made the design to be more user-friendly, more interactive, and hopefully useful. I hope when I show you this that you'll see the benefits of that but we've also further developed our content based on some of the interactions that we had with you previously. We've provided for a living document approach. I know there was a question of how long until things are updated, things like that. We're working on a protocol for that, but we know that it's going to be at least yearly but as things happen you're going to see on our website that there's the new content and what it will be. There will be an actual attention-getter to the plan. Also, we have backed up each intermediate goal with burden, need, and impact. You saw some of that in the previous version but now what you'll see is a more interactive version, as well, as links to where we get this information and how do we interpret it? There'll be consistency with that, as well, and we also know that the burden it places on us in terms of making sure that we update our statistics each year and such.

We've added a lot of definitions because some of you had questions mapping to projects, mapping to intermediate goals, mapping over to the bigger NIOSH plan. We've added more specific content and then what I think you're going to like is the projects links that tie our stakeholder needs with the research goals, something that we have not done so clearly in the past. We also gained your feedback in—and some of what we didn't expect-- was some of you had said that you viewed the plan as a research map and that you were able to pull out of there and talk about different things to employees or to other people about

small segments of this and be able to use it. We were very happy about that. You also thought that the living plan was a good approach and allowed us to address emerging issues. As for the content, you thought that we covered the main concerns, the issues you expected to see but there were some missing or weak topics.

Before I go any further I want to thank Jessica for the direction on developing this plan and having a new approach that we've not had before in mining and also to Todd and RJ for letting me pick their brains and their people's brains to try to make this more interactive and useful Also a big thank you to Joe Shall and the J Team—which is the team that made this interactive, they made it come to life so that it works and it works very well—for their help. Also I want to thank Jonisha Pollard who had given the once-over on this about ten times, so just for somebody on the outside looking in.

So what did we learn? The intermediate goals were a snapshot, a five-year timeline of where we're at and update them as we move forward. The interactive mapping table, which Jessica had put together for another MSHRAC talk a while back, turned out to be a good pivoting table for us to use and also let you know which projects are contributing to those particular goals and intermediate goals. We also think that we need to add final reports for our projects with a list of outputs so that users can easily go there, find the project, find out where we stopped with our research, results, what is contributing to those answers and finally what gaps are still remaining. In the meantime we have developed a template for the researchers to use after they finish a project. We also heard that the worker experience issues wasn't included and it's a problem in the industry. Neither was slips, trips, and falls or fitness for duty. The radar issues that are not part of our plan yet, like cement plant issues or seat belt safety, that really aren't a research project yet, but we had to find a place to fit those emerging topics. Also, risk assessment approaches and miner health programs were not easily identified. Those topics will change and grow as problems arise. Additionally from your feedback, we heard that you like us bringing the practical solutions and we're not going to lose sight of that.

This is the pivoting or mapping table. And again, this is in the plan, it's interactive. You'll see down here where it attaches to the NIOSH plan. I will tell you that some of you might see a couple slight changes to this table and to the plan since the last time you saw it as we have worked through it with NIOSH OD. This table is going to be the map and you'll find it inside of the plan as you did when you reviewed it. I just want to talk for a minute about how all of this works together. We have a program level and a project level. A lot of times in the strategic plan in the past we've only gone from strategic goals to intermediate goals and it was kind of left up to the people to figure out which projects fall where. We're trying to be more transparent and useful about how our research fits into the bigger plan. We show how the intermediate outcomes from a project and the intermediate goals relate.

This is how these two come together. The intermediate outcomes are established each time a new project is funded. You might have two or three intermediate outcomes for a project or you might have one or you might have several projects that contribute to the same intermediate outcome. That will be transparent here and I'll show you in a little bit. The outputs are what you're used to seeing which are publications, interventions and tools, training programs. There are activities that contribute to the intermediate outcomes. On the program side we have intermediate goals which support the strategic goals and then we have activities which are broken down even further to address the intermediate goals and produce outcomes. Since these traditionally had not been in our plan, you didn't have a lot of detail about what we were doing. When we listened to your feedback, we thought we needed to add in these

activity goals because it will show you exactly what we're doing to accomplish the intermediate and the strategic goals as well and the intermediate outcomes so that's the point of bringing in the activity goal level to our plan.

Activity goals model the NIOSH strategic plan as well so you can toggle back and forth from our links there between the NIOSH plan and the NIOSH Mining program plan. They each have these same four types of research. I highlighted intervention research here because that's pretty much everything that we do. That's probably 85 to 90% of what we do. Now, the basic etiologic research is what you'll find us doing in laboratory studies and the translation research can be interpreted a couple different ways. You might look at this and think, well, they're not planning on translating their intervention but for a lot of our work we use tried-and-true methods that have been in existence for a long time so these are just part of our intervention approach. There are times, though, whenever we are trying to figure out a novel approach for translation. We've heard some feedback and we know we need to do that. That will involve some translation research but, for the most part, most of our stuff will fall into the intervention and we do surveillance research as well.

I know this font is small, but it's just to give you an overview of what you're going to see. We have added these activity goals which hopefully what you'll see in them, they're a little bit broad but if you go down to the table—which you have not seen this part of it yet -- the table will show you the exact health and safety concern we're looking at, what the research focus area is, what sectors we think it will address, the type of research that I just went over, and then a link to the projects (project pages) that have to do with this. You can see in this first one situational awareness, slip, trips, and falls and hazard recognition are three different projects that address this particular health and safety concern. So if you want to look at something that you're having problems with, you can see where we're going with that particular topic and that'll take you straight to the topic page for that particular project, which will also give you all the outputs that are associated with it. We'll take a little ride on that in a minute.

Looking down here, this is one that we don't have a page for yet because it's fairly new out of the Spokane work that Todd talked about a couple of times We are going to have a page developed for the conveyor maintenance as that develops you'll see that. You might see some black ones in here every so often that do not have a blue link yet and of course we have the BNI to support the IG.

We may link there if you think it's helpful. I guess we could associate the specific ones with that but I'll show you how we did it. When you get on here, this is what it will look like. And just notice these two first links, I'll go to the next slide just because it points out some things. There's a downloadable version of the entire plan and then that mapping strategic goals segment too and you could just press on that mapping and get to pretty much everything, as well, if you just want to start from that level or you can have the entire plan with all the interactive links. There are 75 references to data analysis, things like that, that might be helpful for you and there's 100 hyperlinks inside of here that take you to different places with associated materials with the topic that you're on. Again, down here you can link right through here to a strategic goal if you're interested in everything going on with occupational illness. You can also link to the NIOSH plan to see what are they doing? What are the other people in NIOSH doing in this area? Now, they had these blue tables that we talk about, but they did not add the last column that we added which are specific to the projects so maybe they'll catch our lead and want to do that as well. It's a lot bigger for them.

So in your slides that you have, too, these will not work for you yet. The reason being they'll need 24 to 48 hours and, honestly, Jessica and I wanted to find out what you're thinking about this because maybe we'll make a few updates and then get it out. We have not announced this to the program yet. This is being announced to you here so this is still unpublished intentionally to see what you're thinking so let's take a little ride, hopefully this works.

I know this will be a little bit of a lag. I'm not going to hit these, but just know that this takes you to that map you've already seen. This takes you to a downloadable, which you can store on your computer and it has all the same hyperlinks that being on here has so if you want to take it somewhere that you don't have access, you can do that and it'll take you back out. I did make a few notes about some things I wanted to take you to. One area is in the introduction here—and this came up yesterday and it came up working with Kelly on some things, too, is defining the mining subsectors. Now, even as a new researcher comes on board, it's very confusing for them what's dimensional stone, what's this sector, what's that? It's tough for them to know where things belong because not all of our researchers have mining backgrounds. And now we have plans for this table, but this will give you what the MSHA code is and what the SIC code is.

You can see that our analysis will—any analysis that we do-- you'll see, they'll tell you what they use and how they parse their data. Also, it just gives you every type of mined material that's out there. Hopefully this will be helpful for you guys, too, to see how we categorize whenever we do our data analysis. My hope in the future is that what we would also do is go out here and attach particular processes to these different materials so that when a researcher is doing something and they're working on a particular type of mining process they'll know that it also applies to other processes as well, and they'll be able to apply their research more broadly and get their information out to the right people so that's one area I wanted to take you.

If I go to any one of these strategic goals, I'm just going to pick traumatic injuries here, and you'll see a little bit of a background and some of the data that goes with it. You can click on this and get the data itself, how the analysis was done. What's interesting is, say for instance I want to look at Strategic Goal 2, now it brings up what all the activity goals under this Intermediate Goal 2.1, everything that's going on there. You'll recognize some of the words in here as things that you asked questions about before and, in your mind, it was missing from the plan. For instance, let's just use this one. This is the one we brought up in the presentation. If you click on the situational awareness it will take you out to this page and it will show you the topic areas that are there, the summary of the research, what's currently going on, we're doing lighted lifelines, escapeway marker signage, roof bolter illumination systems and feedback systems and then these are related topics. Now, you'll be able to get to the outputs, as well, for this particular area. So is this helpful to have this like this?

I just had one last part. So we have ideas and we like to capture them so you know what we're thinking about and where we're going. So for instance, the work that Todd and RJ just talked about with the new projects, those are not in here yet because they've not been approved, they've not gone through their vetting process. What you'll find is this area called ongoing challenges and emergent issues. You'll see hints to our new projects in this section where it talks about the problems that still need to be solved out there. Then once those become projects they will populate back into the strategic plan and they'll have activity goals and everything that are associated with them so you'll clearly see those changes. When those new projects start in about October, give us till maybe November and you'll see that change and so

you should see that for your next meeting, all that work.

So that's how that works. Mentioning what Priscilla just said, developing the performance measures for the AGs are the next thing to put those out there. We have some measures for these activities already. Some of them are obvious. They're yes or no, you either did it or not. Then trying to project how it's going to impact the industry so we know that we have to put annual updates out there. We're working on a protocol for that. It may be more than annual. The new projects will all have new activities. New content will be flagged for the public, for you and we'll align with the health and safety data releases. We usually around July have the new data that's been parsed through for MSHA and then we start redoing our moving average type of analysis so you'll see those updates sometime early Fall after we get that data. I don't think we linked in here to the actual MHSA data. We will have a link to that as well. Hopefully you can go there for a one-stop shop, but the rest of our website is certainly out there for you.

Questions and Comments:

PARTICIPANT: Is this just internal projects?

DR. STEINER: These are internal projects, but I will show you how we've helped to go to the external as well.

DR. NELSON: I would like to request that you're going to have to number the last column.

DR. STEINER: That's a good idea. You can see the work that we're doing here on slips, trips, and falls with the boot study and hazard recognition type of things. And then any type of related work - some of the things that were in your packet that you got, if you wanted some of the infographics you'll be able to download those and display them at your worksite. So hopefully this is helping you in another way navigate through our website in a way that you might think this way

DR. NELSON: And you are planning on putting the extramural studies in there?

DR. STEINER: Yes, so let me show you that. I'll go specifically to that. This is under strategic research goals. Some of these might not make sense to you, so that might be another thing that we can do is bring this up. So this is the extramural research program, and then you can go over what the MINER Act is. It'll take you straight out to there. The service goals of the bigger NIOSH plan is where a lot of the MINER Act work falls under. And then if you wanted to go out to find out what's going on in OEP, here's those reports, the annual reports that mention some of the extramural work. The Broad Agency Announcement, if you want to see that, and that will automatically get updated with the new one when it occurs. The extramural contracts, so this is a description of those and then down here are all the contracts. So if you want to see what's related—now, Jeff, if you think that it's helpful for us to relate those back inside of those blue tables, we can see what happens. That doesn't always fall within the project work, but a lot of times it does

align.

DR. G. LUXBACHER: There's no place where you can find the grants information like the contracts information. To the best of my knowledge, OEP does not make that information public on all the grants.

DR. STEINER: That's a problem.

DR. BURGESS: I know that a lot of extramural folks don't do the reporting back historically very well in terms of formats that are useful for putting up. So there's the part of the issue, again, getting information that's useful because all you have is an abstract, and they have the full thing and then it doesn't actually fit in there. But I think just to the extent that you can identify what things have been funded, even from a title and then who the PI is, it would be useful information to have.

DR. STEINER: Can we do that?

DR. G. LUXBACHER: Yes, we could probably create a webpage where we would identify those and then refer people to NIH RePORTER because if you go to NIH RePORTER, you can get detail on each one. So we need to provide a link to NIH RePORTER. I hadn't thought about doing that, but we've got to create a webpage and summarize the grants that have been funded that pertain it mining. We may not be the funding agency or the funding portion of NIOSH, but we can identify those that have been tagged for mining so that you can find those and then we'll take you to NIH RePORTER for the detail.

DR. BURGESS: I think that would be very helpful to know.

PARTICIPANT: So they're in NIH RePORTER?

DR. G. LUXBACHER: Every grant that OEP does—and not even just OEP, but NIH actually used grants that are mining, too, and everything goes into NIH RePORTER. So NIH RePORTER is the ultimate repository for all of that information. It's not up to date because NIH RePORTER for final reports, you won't find a single final report in there.

DR. BURGESS: But that's not to say that no one submits a report

DR. G. LUXBACHER: No, no, that's not the grantee's fault. That's because it's not utilized for that purpose. So right now the repository for all the OEP reports, all the grant reports, actually just with OEP. And while we publish summaries of these for the contracts, they don't do that for the grants. But that's a good point. Maybe if we need to add a grants page, ours would say these grants pertain to mining and do the same thing. It would be very easy for us to do. I just need to make sure that we talk to OEP…

DR. NELSON: I think it would be good to have your extramural grants mapped into to the extent that they can.

DR. STEINER: Yes, into our strategic plan?

DR. NELSON: Yes.

DR. NELSON: Now, what are you doing about metrics associated with the goals?

DR. STEINER: Yes, we need to do that yet.

DR. NELSON: Do you have metrics goals that actually are identified?

DR. STEINER: We do have metrics and actually some of those show up in those activity goals, but we also have some performance measures that we don't have in this plan right now because they need refinement. At some point, those may end up in here. We're just not ready to put them in it at this stage and that kind of comes back to the idea of this is a living plan. So in general, I think you know what our metrics are and I talked a little bit about the contribution analysis, activity that we'll be going through starting this month. Some of that actually might show up in this plan as we develop logic models and things and we haven't even talked about that. I can see a lot of metrics coming in through some of those avenues as well but certainly that's an important part of that plan. If we can't measure it, then we don't know what our performance is. A lot of what we do, there's a point at which NIOSH has control up through our outputs basically. We control that but after that and once it's out in the public domain, we don't control how things are used so then we have this cause-and-effect question that's very difficult to really know whether or not our research was responsible for the change in the MSHA statistics. We see fatalities have gone down or injury rate is going down, we can try to attribute (contribution analyses) it to what we do but we don't have a really strong cause and effect so we have to use some other ways of looking and that might be things where MSHA, for example, might adopt some of our research into some of their regulation.

DR. NELSON: Right, or a certain number of companies may choose to actually implement something that's been recommended.

DR. STEINER: Exactly. Yes, and if we commercialize—let's say we're working with Fletcher or another manufacturer or supplier and we commercialize some type of widget and we know what the sales are and how many companies are using that device.

DR. NELSON: Or you can go on Facebook and count your Likes.

DR. NELSON: So we are going to be able to play with this at some point in the future?

DR. STEINER: Yes. You should be able to play with it within 48 hours as long as our website developers are able to make the website live.

DR. NELSON: I was talking to NSF about this about if you release it, have a certain openness where people who are doing projects that are not funded by NIOSH where they could self-enter to increase the findability of their work. So I mean the opportunity for someone to put in a project that they've got is something to think about. So this becomes a repository

DR. STEINER: Yes, makes this a repository?

DR. NELSON: Not just a NIOSH thing, but a mining thing where people could put their projects in.

DR. STEINER: It's an interesting thought. We hadn't thought about that. I'm not sure it would go in our strategic plan, but maybe that concept could be a separate part of our website that is not necessarily our strategic plan but could be linked to it.

DR. G. LUXBACHER: That may align better with the NORA National Mining Agenda because that's one of the issues within the NORA mining agenda because it does not talk about who's doing what. It involves work outside of NIOSH and that may be a good proposal.

DR. KOGEL: Yes, I think that's actually an interesting idea, too, because this plan does link into the NORA sector council as well. So that would be a way to create sort of that repository that's separate from the strategic plan.

DR. NELSON: And just claim the one-stop shop where you want to know what's going on, you come to NIOSH and it's there.

DR. STEINER: And it's important because I think a lot of times that people don't recognize NIOSH and so when that happens, if we can do something like this I think it'll clear it up.

DR. BURGESS: I'd just caution on that because, again, by having it up there even though you'll make a disclaimer that you're not stating the quality or anything, it is up on kind of a government website as a project even though someone else may be putting there, you don't know the quality of it or any of those other issues. Then there's the curation of it and then someone has go in there and manage it and that's extra resources too. I'd be very concerned about those issues should you think about actually creating a larger repository.

DR. KOGEL: Yes, and those are great comments, noting that this comes back to the idea about a NORA sector council where it wouldn't be NIOSH. It might be housed on the NIOSH website, but it would be something that would be under the purview of the NORA sector council and people would have to submit and the sector council could vet, I mean that sort of thing. I agree, you don't want to just have this kind of wiki sort of activity going on the NIOSH website. We'd have to have some sort of review or vetting control over that.

DR. NELSON: Yes, but I still think it's worth it to try because I think that anything that elevates the importance of NIOSH as a resource. But to try to find out what's going on with Alpha grants and who's doing what. There's a lot of things going on that are harder to find.

MS. KRAMER: I think once we play with it, maybe we might have ideas too.

DR. KOGEL: We have two options here. We can go ahead and do a simultaneous release to you all as well as the general public or we could hold off the public release until

you all have had a week or so to play with it and then provide back any feedback. We will continually ask for your input as you do spend time working with it, so if we were to just go ahead and do the public release now it doesn't mean your comments wouldn't be something that we'd be interested and later address. I don't know what the kind of sense of the committee is here on that.

DR. NELSON: Why—I mean on the basis that you'd be taking input in that whenever it comes as a living document, then I mean I don't know why we would delay.

PARTICIPANT: I don't either.

DR. STEINER: If you do have comments, if you don't mind sending them to Jeff. He's been good at bringing them in and then sending them out. He's been really helpful on this plan.

MINER HEALTH PROGRAM UPDATE, DR. KRISTIN YEOMAN

Kristin Yeoman presented an overview and update of the Miner Health Program. The Miner Health Program is a long-term initiative that will use a multidisplinary team to establish a systematic, collaborative, and proactive approach to improve our understanding of the health status and disease burden of the mine worker population. Facilitating regular engagement with stakeholders in the mining community is a priority with this initiative in order to ensure that the research that is performed benefits miners through maximizing worker protection, minimizing exposures and preventing disease, and improving functional wellbeing. The core components of the program are similar to the public health model, which defines a problem, identifies risk and protective factors, develops and tests prevention strategies, and disseminates those strategies. The Miner Health Program will focus on primary and secondary data sources that will be used to inform what is and is not known about miner health, allowing NIOSH to prioritize research and resources to the areas of greatest need. Data on exposures and health will be analyzed, interpreted, and used to develop innovative strategies to control risk, and the effectiveness of these strategies will be evaluated. Underneath all of these components is a foundation of communication and collaboration.

Short-term goals are currently to continue stakeholder engagement and increase capacity for health-related research by increasing personnel and forming collaborations internal and external to NIOSH. The long-term goal is to establish a versatile, flexible health program that informs us about the health status of miners and is scalable to each mining sector. As part of the short-term goal of stakeholder engagement, information on the program was presented at an informal conversation with stakeholders across industry, academia, labor, and the trade associations hosted by the National Academy of Sciences. Some of the major themes discussed at the NAS meeting were as follows: barriers to collaboration on health-related research (i.e. litigation and liability, mistrust of research intent, and communication); data needs (i.e. gaps in data availability, lack of systematic approach to using available health data, identification of health programs that work well and dissemination of best practices, and use of current reporting systems for collection of health data); and elicitation of feedback on emerging needs (i.e. aging workforce, chronic disease, MSDs, obesity, opioids, interaction of work and health). The need to incentivize participation in

NIOSH research was also discussed.

Finally, we provided information on next steps, including formulating a more formal strategic plan and developing a two-day workshop led by the National Academy of Sciences to discuss plans and issues more in depth.

Questions and Comments:

DR. NELSON: Did they give you a letter report or any formal feedback?
DR. YEOMAN: No, because this was considered just an informal conversation.

DR. NELSON: That National Academy thing, I'm trying to understand because the different levels of formality require different lengths of time and imply different costs. So out of this workshop, what will you get that says the National Academy—will you get a letter report that summarizes what came out or what is it?
DR. KOGEL: No. This one was purposely set up to be a listening session, I think you used similar kinds of wording when you described it—just to bring in a fairly small group of interested stakeholders to start in helping inform what it is that we're attempting to do and to make sure that we hear the questions and the concerns and then to think about what is the best mechanism for doing more formalized effort. This was facilitated by NAS to give us sort of a safe neutral space to have this conversation. In 2019 the idea is that we will have this more formalized effort through the National Academies.

DR. NELSON: Because they usually have a letter report that can be much faster, but a document goes through peer review.
DR. YEOMAN: Yes, and this wasn't one of those. This was sort of the pre into to that

DR. LUXBACHER: I have a question. A couple of years ago I was chatting with a colleague about opioid use in the military and he felt like there was a lot of overlap—this was a medical colleague—with mining, particularly the type of sort of long-term musculoskeletal injuries that you see and that kind of thing and how they're treated with opioids. I just wondered if you were considering collaboration with some of the health people in the military to look at how they're intervening with those populations.
DR. YEOMAN: Yes, we haven't gotten to that point of considering all of the different collaborations that are out there, but that's a really good point and I'll make a note of that.
DR. LUXBACHER: He even felt that some of the traumatic injuries were similar and that there might be a good opportunity there.

DR. YEOMAN: Yes, it makes a lot of sense.

DR. BURGESS: Kristin, how do you plan to work the stakeholder involvement going forward? Actually that's a broader question for other parts of NIOSH as well. I'm not sure how they organize stakeholders. I mean obviously MSHRAC has a particular purpose, but beyond that for different programs, is that something that's going to be invited, is going to be open? How will it work?

DR. YEOMAN: I think that's going to be part of the strategic plan is how are we going to do it.

DR. KOGEL: One of our mechanisms that's sort of a tried-and-true one that we use across the program currently is our partnerships. We have five active partnerships now and some of those partnerships have 100 members and they're open so that could be one mechanism that we use. These National Academy meetings is another. I think we have a lot of different ways of doing it and it's the beginning of the project plan for how we're going to bring stakeholder interaction into the program systematically so that we're always engaging that way. Our partnerships do that but this may look a little bit different. It may take the partnership model and tweak it a little, but we have a lot of different ways we could do it and so as they go through the strategic planning, we'll make some choices about how we might incorporate it more formally into the program.

DR. MILLER: I totally applaud the long-term view of stakeholder engagement to build those models and trust but at the same time, you're trying to also balance your research agenda based on issues that are coming in. How do you intertwine those elements of both what's being generated through NIOSH, other programs, or what's happening in the public view of what's being identified as problems at the same time you're trying to develop this ongoing relationship of stakeholder input? It is a lot of demands for a small group.

DR. YEOMAN: Yes, and I think one of the things with engaging with stakeholders is that we're going to need to use many different data sources in order to figure out what our priorities should be. Some of those data sources we believe will come from the some stakeholders. It will come from companies that want to work with us and are willing to assist us with our research and it is a balancing act, but because we're going to have so many—or we hope to have different data sources coming in, looking at all of the different data sources will be how we focus our priorities. We'll have to, by engaging with the stakeholders to have access to some of the data but also to describe to them what else we're seeing, it'll be a fine line but we'll have to do a good job of communicating what we're seeing and from various different data sources and why we feel like these are priorities that we need to focus on.

DR. NELSON: So it seems to me there could be potentially a significant impact of the culture of

the workforce which may have gender and language connotations as well. But the issue of culture, different cultures will respond differently to different situations. Are you going to try to keep your eye open for that? If you're going to get all this data it'd be interesting if you can grab data that might inform on that at the same time.

DR. YEOMAN: One of the projects that Todd talked about with looking at specifically for different data sources—and this is managed by Aaron Sussell—one of the aims of that project is to look at vulnerable populations and subpopulations within mining. So that is something that we would be looking for and we're not sure where the data are right now.

DR. NELSON: Yes, we're going at a study, it's more related to heatwaves but something like this and the way different communities with different cultures will respond differently to heatwaves and if you're in a very intimate neighborhood you have a lot of people that you can go to if you lose power, but if you're in a high-rise project and you lose power what do you do? And so there's totally different response in different cultures and I wondered—I think that may well play into what goes on in mining because there are cultural biases to the workforce in different places. "Bias" is not the right word, but...

DR. YEOMAN: Implications?

DR. NELSON: Yes,

RESEARCH AND PRACTICE TO PROTECT MINERS' HEARING HEALTH, DR. HUGO CAMARGO

In this presentation I am going to talk about some of the research that we have been conducting at NIOSH in order to prevent hearing loss in the mining industry. Despite over 30 years of regulation, hearing loss continues to be one of the most prevalent illnesses in the mining industry. According to a NIOSH study in which over one million audiograms from workers in 40 different industries were analyzed, mining has the highest prevalence of hearing loss with about 27% when compared to the average prevalence in all other industries which was around 18%. Another study also conducted by NIOSH shows that by age 64 approximately 8% of the miners have some type of hearing loss in contrast to only 10% of those workers in other industries that were not overexposed to occupational noise. In this context, the NIOSH mining program has been conducting research that is aimed at reducing the incidence of hearing loss in the mining industry. As a result, we have developed noise controls for various types of mining machines including continuous miners, roof bolters, longwall shearers, jumbo drills, LHDs, and haul trucks. We have also developed some hearing loss interventions in the form of software, infographic pages, and we have conducted evaluations of current technologies.

Let me start with a brief description of our facilities, which include a large hemi-anechoic chamber that is use for noise source identification purposes. We also have an auditory research lab and a hearing loss prevention unit. In addition, we have a large reverberation chamber, NVLAP accredited, used for

precision measurements of total sound power.

As mentioned earlier, some of the hearing loss interventions that we have developed include the hearing loss simulator which is a software that allows the user to set and, most importantly, to experience different types and levels of hearing loss. The DOSES software was developed to make it easier to analyze the data from time-motion studies of noise exposure measurements. Inquiring Ears Want to Know is an infographic page that provides information on audiograms and, most importantly, shows you how to read and interpret the results of an audiogram. Simplified Roll-Pull-Hold is another infographic page that describes how to properly insert an earplug in three easy steps. We have conducted an evaluation of the potential benefits of level-dependent HPDs in the mining industry and we have also evaluated the performance of a NIOSH-developed Sound Level Meter app for mobile devices.

Moving onto the two projects that we have just completed. One of these projects involved load haul dumps and haul trucks. The objective of this project was to develop, evaluate, and implement noise controls to reduce the overexposure of the operators. Noise source identification, which is the first step in the development of noise controls, was conducted using some techniques including Source Path Contribution analysis and microphone phased array measurements. From these analysis and measurements, we found that the dominant noise source in a haul truck was the engine ventilation fan. The approach used to develop noise controls in this project was mainly experimental, by building a test fixture to simulate airflow over the engine compartment of a haul truck. The solution that came out from this project was a new type of fan that has redesigned blades and smaller dimensions. This technology provides a two to seven-decibel reduction at the operator's location and the partners that were involved in this project include Stillwater Mining Company that gave us access to the mine to evaluate this noise control; MTI Equipment is a manufacturer of haul trucks; and Multi-Wing is the manufacturer of the fan.

Another project that we have recently completed involves longwall mining systems. The objective of this project was to develop noise controls for longwall systems to reduce the operator's overexposure to noise. Noise source identification was conducted using panel contribution analysis with a model that was developed throughout the course of the project. From this analysis, we were able to identify the outer vanes of the shearer cutting drums as the dominant sound-radiating components. The approach used to develop noise controls for this project was mainly through the use of numerical models of the most critical components, which in this case are the two cutting drums. The solutions that came out from this project are in the form of structural modifications of the cutting drums. These modifications include the addition of gussets behind each bit holder, thickening of the outer vane plates, and the insertion of ribs on the face ring. These noise controls provide a three-decibel reduction at the operator's location. The partners that we have worked with throughout this project are BHP Billiton who provided us access to the San Juan Mine in New Mexico to develop and, most importantly, to evaluate these noise controls. Michigan Tech and Kennametal worked with us in the development of an instrumented bit that we used to measure operational coal cutting forces on an actual longwall shearer drum. Joy Global, now Komatsu, is the manufacturer of the actual cutting drums. Because of the good response that we obtained from this

project, a joint patent was filed between NIOSH and Joy Global both in the United States and also in some other coal-producing countries.

We are currently conducting two projects. One of these projects involves jumbo drill machines. The objective is to reduce the risk of noise-induced hearing loss of the operators by developing and implementing noise controls for a jumbo drill in operation. We conducted noise source identification using microphone phased array measurements. From these measurements, we identified noise sources in various locations including the bit/rock interaction, along the drill string itself, at the drill guide/drill string interaction location, at the coupler, and at the drifter. These noise sources were ranked based on their contribution to the noise levels at the operator location using Source Path Contribution analysis. It was found that the vibration of the actual drill string is the noise source that contributes the most to the noise at the operator's location. In this context, the solutions that we are currently working for this project involve a vibration isolator and coated drill strings. Currently we are building prototypes of these noise controls that we are going to test in our labs and in the field. We anticipate that these noise controls will provide a three- to five-decibel reduction at the operator's location. The other solution, that is the coated drill strings, will increase the damping to reduce the vibration levels and therefore to reduce the sound radiated by these drill strings. We are building four different prototypes that will be tested in our labs and in the field. We also anticipate that this solution will provide a three- to five-decibel reduction at the operator's location. The partners that we have been working on with this project involve Corry Rubber Corporation that is building the prototype vibration isolators. Michigan Tech helped us build an instrumented drill string to measure drilling forces. Pleiger Plastics is the company that is coating the drill strings. Stillwater Mining Company provides us access to their mine to evaluate the performance of these noise controls.

The other project that we are currently conducting involves stone, sand, and gravel mines and we have actually just started this project this fiscal year. The idea of this project is to identify and remediate barriers to effective implementation of hearing loss prevention programs at stone, sand, and gravel mines. This project also has four specific aims and we have just started working on the first one which is to develop sound contour maps that characterize the spatial distribution of sound levels at the stone, sand, and gravel facilities. We have conducted an initial assessment at a collaborating mine where we have focused on five different areas: automatic bagging, manual bagging, palletizer, rotary dryer, and the screen building. In addition to collect Sound Level Meter data, we have also taken our microphone phased array and we have collected some data at the automatic bagging machine and at the manual bagging machine. In total, over 460 data samples were collected. From the phased array measurements it was determined that at frequencies below 1250 Hz, most of the noise comes from an area adjacent to the automatic bagging machine. Whereas frequencies of 1250 Hz and above, most of the noise comes from the actual bagging machine itself. Area noise maps were also obtained from this survey. The idea with these maps is to use them to change the travel paths of the operators that walk through these areas and also the location of some operators in order to reduce their noise overexposure.

Finally, I am going to talk about our future directions. We are planning to investigate the viability of implementing a quiet-by-design approach in the mining industry. Up to this point we have developed noise controls for various types of mining machines. Most of these noise controls have the form of retrofits and some of them require additional training and maintenance. Most importantly, these controls only attack the dominant noise source. Therefore, there is a need for a more holistic approach where noise controls for various sources are developed simultaneously at the design stage.

We are also planning on developing methods and guidelines for effectively integrating HPD fit testing into hearing conservations programs. Although there is a variety of HPD fit testing systems that are commercially available, there are no guidance or best practices for their implementation. Thus, we want to come up with some recommendations to integrate this technology to improve the use of HPDs, reduce shifts in hearing, and comply with the requirements. We are also going to develop and disseminate simple solutions to reduce noise exposure in miners. Finally, we are going to investigate what can be done to improve the quality control of audiometric data.

Questions and Comments:

PARTICIPANT: Is that unusual for NIOSH to have a patent on technology or is that something that's happened a lot in the past?

DR. CAMARGO: I think not all projects but, yes, various noise controls that we have developed have some patent but not all of them.

PARTICIPANT: And then are those sold to industry afterwards, generally?

PARTICIPANT: Well, we have licensing agreements sometimes with industry. Is that what you mean by sold to industry?

PARTICIPANT: Yes. The idea is not to profit. But the inventors get royalties back and part of it goes to the government too.

PARTICIPANT: Very impressive, thank you.

MR. ZIMMER: I just liked the comment that you made towards the end there about being proactive rather than reactive in the retrofit. I like that approach that let's get it into design and through your efforts in the patents, it's evident in the work that you're doing. That's awesome.

DR. CAMARGO: Yes, probably the most challenging part will be to find an equipment manufacturer that is willing to work with us because that will involve a lot of changes on their product and somebody that is willing to do all those changes is a little bit hard to find. When we work on the cutting drum, we in some way had to convince Joy that those modifications were not going to affect the cutting performance of the drum because that's their main goal. They don't want to do anything that can damage the performance of the drums.

DR. NELSON: Does the noise change when you run into sandstone in the roof of the rock?
DR. CAMARGO: Yes.
DR. NELSON: And does it change with the modification that you developed for the cutting drum?
DR. CAMARGO: No, I think they mainly use it to cut coal. Sometimes they run into rock, but that's not very often. When we were working with San Juan, they had done a lot of work in automation of their longwall system and one of the things they were implementing was an infrared camera that allowed them to detect when they were cutting in rock and when they were cutting in coal so that, as much as possible, they were only cutting coal.
DR. NELSON: But it changes the noise?
DR. CAMARGO: Yes, and, again, that's why in most of our lab tests we use granite because over the years we found that granite provides more consistent results as opposed to, for instance, concrete. Probably it's because of the density of the constitution of the rock. We get all the rocks from our same provider in order to keep this variation as low as possible. But it changes when you go from different material to different materials.

PARTICIPANT: Are you able to share further details on the fan blade project you did to change the diameter of engine ventilation fan that you can share with us?
DR. CAMARGO: Yes, I can send you some of the papers that we have written on this project.

DR. NELSON: So you said you were using the US Bureau of Mines' measurements?
DR. CAMARGO: Yes.
DR. NELSON: So that was 20 years ago.
DR. CAMARGO: Basically what they did is they had determined that the cutting drums were radiating most of the noise. And that's what we used from them but then we asked the question "What part of the cutting drums are radiating most of the noise?" That's when we did this panel contribution analysis using a boundary element model of the cutting drum that allowed us to separate how much noise each part radiates.
DR. NELSON: That was computational?
DR. CAMARGO: Yes.
DR. NELSON: You didn't go back down and make additional measurements?
DR. CAMARGO: No. We found that the outer vanes radiate a little bit more than half of the noise.
DR. NELSON: You didn't want to go back down there and make additional measurements 20 years later?
DR. CAMARGO: Oh, we did. We did some measurements at San Juan but unlike the other project, what was challenging here is that we couldn't take longwall system into our labs to get some measurement. Whereas, when we were working with roof bolters or continuous miners, we were able to take those machines in our lab and

actually drill or make them work to make some measurements. This one it was very challenging. That's why we have to use a different approach and that's why we used numerical models of the cutting drums.

MR. BOWERSOX: When you were testing that longwall, did it make a big difference as at what speed they were cutting, they were testing? Because I know they can adjust the cutting speed.

DR. CAMARGO: Probably it ,makes a difference, but we didn't look at that variable because I think they had a set speed that we didn't want to interfere with their production.

PARTICIPANT: It's all about the production. Trust me, if you slow that down, the noise is going to come down.

UNDERGROUND RESEARCH FACILITY UPDATE, MR. JEFFREY WELSH

Mr. Welsh provided an update on the efforts of CDC/NIOSH to find an underground safety research facility to replace the Lake Lynn Experimental Mine. Two "Requests for Expressions of Interest" were published in the Federal Business Opportunities in 2016. The first one was in June, and there were no proposals received that met specifications. The second one was published in October. From that posting, one expression of interest was received that met specifications, and is currently being evaluated. The General Services Administration is facilitating the process. This Expression of Interest is in West Virginia. It is in the Greenbrier Limestone Formation, which is nearly 300 feet thick. The property has 461 acres, and has never been surface or deep mined. The listed use is managed woodland. Two preliminary test borings indicates that the strata meets or exceeds all the minimum requirements in the specification.

Status: An initial site visit was made last October. The Lake Lynn Experimental Mine entry layout was fit-tested to the property. Discussions were held with Green Bank Observatory, which has large radio telescopes, related to the quiet zone around their facility. No issues are expected. A contract was awarded in April for an Environmental Impact Statement under the Environmental Policy Act and the Historic Preservation Act. A second site visit was conducted in May. The land owners plan to drill additional test holes to make sure that the strata is consistent throughout the property, and to use that information for the valuation of the property, to determine the asking price.

Questions and Comments:

DR. NELSON: Do you already have the facility, other than the underground all done, the surface facility designed and done?

MR. WELSH: No, the surface facilities have not been designed yet. I anticipate something similar to what was at Lake Lynn Experimental Mine. Several buildings that contain offices for staff, a small conference room for training, a control room

where the sensor data would be collected and computers to analyze the data, maintenance area, etc.

MR. BOWERSOX: Is this close to Charleston or Beckley?

MR. WELSH: It is close to Snowshoe.

DR. MILLER: Green Bank Observatory is a radio-silent area. So that's not an issue?

MR. WELSH: Green Bank Observatory is over 10 miles away. We have had discussions with personnel at Green Bank Observatory, and there should not be any issues for either of us.

MR. DRYSDALE: Will this be a slope opening or a drift?

MR. WELSH: It will be a drift opening.

MR. BOWERSOX: Limestone, right?

MR. WELSH: Yes, it is limestone.

DR. NELSON: The limestone in West Virginia can be very karstic, a lot of caves. Has that area been found to have caves?

MR. WELSH: We have walked the property, and nothing is obvious from the surface. But we cannot be completely sure what is underground other than where we core sample.

DR. NELSON: You might check with the cave people since you may not always see it from the surface.

MR. WELSH: Yes.

DR. NELSON: So we are coming up on the public comments period, but maybe just before that, what I might suggest is that after our discussion regarding the workgroup that everybody's seen, the charge, so this is to be a workgroup of this committee, okay? So I suggested that we all actually ought to create this workgroup since it is ours, under our committee. So I propose that we consider a motion to establish an ad hoc workgroup of MSHRAC on metal mining automation and advanced technologies with a chair to be identified as a member of MSHRAC. We haven't identified anybody yet, right? And that this workgroup is formed to organize a workshop. The schedule is to be the workgroup meets within 30 days of this meeting today. Within six weeks after that the workshop is convened, a report is written from the workshop and the report will be presented at the Fall MSHRAC meeting which is typically in November. So that's it. So we just caused that to happen. So I offer that as a motion. Does anyone want to second it?

MR. BOWERSOX: I'll second that.

DR. NELSON: You second it, okay. And so any discussion about the motion?

DR. LUXBACHER: I had one point of discussion. The tight schedule is appropriate, but I think as we begin planning and we see that people that are really critical for attending the workshop can't attend, I think just allow for some play in the schedule is all.

DR. NELSON: Right.

DR. LUXBACHER: In that motion.
DR. NELSON: So we could say 30 days to organize, set the date, but—
DR. LUXBACHER: With a goal of six weeks after the 30 days—
DR. NELSON: —shoot for within six weeks to have the workshop convened. But that's the target window.
PARTICIPANT: Yes, I think the way that Kray ordered that is good, yes.
DR. NELSON: Good. Any other discussion? Okay. So shall we vote? All those in favor of MSHRAC creating this workgroup say aye.
PARTICIPANTS: Aye.
DR. NELSON: Those opposed? Great, unanimous, thank you. So we charted that.

PUBLIC COMMENTS

DR. NELSON: Is there anyone present that wishes to make a public comment to the committee?
MR. GREEN: First of all, I think this meeting was among the best of the MSHRAC meetings that I've attended in the past many decades. Congratulations to all of you for what I thought were excellent sessions by and large. Something that I want to call to your attention—and particularly to Bill Francart —having had a chance now to have listened to Assistant Secretary Zatezalo at some public meetings and having shared some private time with him and his brain trust in the past week or so, he has an agenda which I think is very consistently stated, among which particularly I think important for MSHRAC is his powered haulage initiative which I think probably everybody knows. I'm not going to try to describe it. But I want to make a point that MSHRAC proceedings and NIOSH activities, to the extent that NIOSH agrees with the Assistant Secretary's initiative, you all ought to try and dovetail what you're doing as much as possible with what he wants to do so that the advisory council at MSHRAC and NIOSH will be plugged into that initiative. I think what he's considering doing is publishing a Request for Information later this year, early next, as I understand it, and that'll be an opportunity I believe for NIOSH activities to be plugged into MSHA's thinking. I would urge NIOSH, your shop, Jessica, to attempt to meet with him prior to that to familiarize him with what you're doing and listen to what he wants to say about getting his initiative done. It's an important one. The two agencies ought to be marching in lock step as consistently as possible to give each other the advice and counsel that both agencies have information about it and expertise about it, number one.

Number two, I think the notion of having an MSHRAC working group, as you're calling it, is wonderful. Great step forward. In my opinion, anything that can be done to have MSHRAC be more vital than it is—and this meeting was an

important step—more power to the committee and working group on the initiative that you've identified is a wonderful step in the right direction. And as an elder statesman of the industry I'll be happy to help in any way I can.

And number three, in terms of that initiatives going back to what Jessica commented about, I want to just make sure that the committee understands how vitally important the various partnerships that NIOSH has underway are to the mining community, they really deal with difficult problems that are not truly solvable in the context of the normal rulemaking that MHSA gets into and that NIOSH assists from time to time. And the opportunity for these partnerships—and Mark Ellis is a vital cog in the wheel—to have these informal discussions in a place where trust and confidence is being built between stakeholders. After doing this work for almost 48 years, it's frankly a miracle that this stuff is happening. And God bless NIOSH and MSHA for going into it. And I think it's an opportunity to move forward in the right direction and try to untie some of the Gordian Knots that deal with proximity detection systems, refuge alternatives, diesel exhaust, health effects, et cetera, et cetera. So I just want congratulate Jessica and your team for supporting this kind of stuff. My clients and I support it. Though we are participants, I trust we think we're leaders in it. And it's fun to work with the committee and NIOSH as much as we can. And the miner health program, I participated in the academy discussion. It's lots of meetings in my life, many of which are forgettable and many of which are not forgettable for all the wrong reasons. But this meeting, this discussion was absolutely one of the best meetings I've participated in. Dale, you were there and other; I think you were there, Professor. It was a superb discussion. The academy did a great job of facilitating with it. I've had some follow-up discussions with Elizabeth Eide. She's anxious and interested to continue the cooperation. I think this workshop is a splendid idea. And there's all sorts of exciting opportunities and I salute and endorse this happening. Great work.

And that leads me into the presentation by Scott Laney yesterday. Frankly, I've never met Scott before. But I know who he is and I've seen his work, I've read most of it. The thing that I thought was remarkable before this meeting was the Morgantown meeting of the National Academy of Science's respirable dust committee. That meeting was remarkable for one particular reason in that presentation painted a picture of frankly a hellish situation in the segments of coal mining industry that was analyzed. And I couldn't help think as I was listening to that meeting, I couldn't drive to it, but I couldn't help think about in juxtaposition to the picture that MSHA painted at the first meeting with regard to essentially in excess of 99% of the samples taken in underground coal mines were in

accordance with the standard, those two ideas simply don't compute. But something is going on that has to be addressed and I think Scott addressed it passionately yesterday, I'm frankly always suspicious of people who are passionate advocates that worry about their balance, but Scott had important points to make. There is a real problem in that part of the world with regard to respiratory diseases among the younger coalminers. And all of us in the mining community need to find a way to address it. We've talked about it off and on for a number of years now and I think at this stage, the time, clock still goes on but we need to develop an action plan. And I'm speaking personally as a passionate advocate of mine health and safety too. So I would urge the committee at NIOSH to begin to consider what can be done, and there are things that can be done and we'd like to get that moving.

And with that, again, I congratulate you. Thank you for what you're doing and I've still got some tread on the tires and I hope to participate as long I can.

DR. NELSON: Wonderful, thank you very much. Are there any other public comments? Hearing none, we will close the public comment period and move right into a discussion of feedback in overall from the meeting and identification of potential topics for the agenda in the future.

WRAP-UP AND COMMITTEE DISCUSSION ON FUTURE AGENDA TOPICS AND DATES

DR. NELSON: So I made a couple of notes. I think at the next agenda we're going to have the workgroup report which could be more than 30 minutes, so we'll have to see exactly how that comes out. The internal projects should be decided, research projects, by then. What about extramural research projects?

DR. KOGEL: The November meeting will have a similar kind of update - let's have that as a standing agenda item, an update on the extramural program.

DR. G. LUXBACHER: The BAA solicitation may be out by that time, so we might be able to include that as well.

DR. NELSON: And we could have—the National Academy follow-up activities in 2019, I don't know if there's going to be any—

DR. KOGEL: The only thing we could potentially report is if we've gotten done half of planning and a report, something about dates. I can make that as part of my report. So I'll put it as at least a topic to include.

DR. NELSON: We left a couple of questions open, I think, in terms of what you might want to do regarding internships or mentoring. There were some—the interactions between your staff and people out in academia and the possibility of postdocs. So there may be an update that could be part of your report as well. I think there were two

topics that we really didn't talk on—one topic that we didn't talk on all that much about and it was on cemented backfill. I'd be interested in hearing something more about that and about health concerns associated with that. I'm not sure what they are but—and then we could hear about EMP again now that we know what it is. But if there's any additional work on it. But those were—this meeting sort of tied up a whole lot of loose ends from before. So does anyone have other topics derived from this meeting or perhaps topics that were not addressed at this meeting that you wanted to have considered for agenda?

DR. KOGEL: I'm wondering about the opioid discussion, which has come up several times, if there might be somewhere in the agenda—we're not going to have a research project on it, obviously, but maybe there's a place.

MR. ZIMMER: Maybe what I would recommend with that is I'm going to have conversations with Dr. Howard in conjunction with the North American Building Trades, there's a lot of moving parts with it right now from labor management's side. So maybe let's leave it kind of a loose-ended agenda item and see where it goes. I just think we have to bring the construction world, the mining world together because there's so many common areas that it's affecting and there's no reason for each entity to go off on their own. There really isn't. There's just so much overlap. So let's pursue that. We'll be in conversation with everybody—

DR. BURGESS: So I'm just wondering in that line, is there some other part of NIOSH that is really addressing this issue where you could have that person come and speak? That would be helpful to know what's crosscutting.

DR. KOGEL: I was just thinking that as well. I think we could have a presentation, and actually Kyle mentioned the construction industries, and we're working closely with CPWR through our construction group. There's a lot of activities happening around this in NIOSH, so I think we could do a briefing of what are those activities—within NIOSH, that overview.

DR. NELSON: I was wondering about—there was a very interesting meeting. It must have been more than a year ago—with MCS, Colorado School of Mines group that has the NIOSH grant. And really interesting conversations with OSHA and the idea of looking for the common ground. Well, I mean it was clear that there was common ground. So I support the idea, but beyond the opioid question, I think there's more. I mean the rate of injuries is higher in construction than it is in mining. So I'd be interested in exploring something like that, but... Any other ideas?

DR. KOGEL: I had another agenda item I had planned to update you on and that is our program review, which by the time we meet in November, we should be well into it. If the committee would be interested in hearing about that review, of the process, and that sort of thing, I could certainly update—

DR. NELSON: We do have the time. Yes?

DR. LUXBACHER: I just had one piece of feedback. When researchers give their presentations, I

certainly feel welcome to comment on any aspect which is good. But I really like the ones where the researcher posed one or two questions to the committee at the end. I thought that was really helpful because it gave us a sense of where they're really looking for our advice. So I think going forward that's a good practice.

DR. KOGEL: Is there anything that we have been presenting at meetings that maybe isn't that helpful? We talked about what we want to make sure that we include and we've added some things, but are there things that we're presenting that really don't have a lot of value to this committee we could do differently? That's very important feedback to have as well. There's no reason to do something that's not effective. And we're not shy to hear if there is anything.

MR. ZIMMER: I just think that we have such a good cross-section—and, Jeff, you and I kind of got in that conversation yesterday a little bit last night just briefly—we have such a cross-section where I think it's pretty well-represented and each presenter, whether I get lost on it or whatever, somebody in here is taking a value away from it. So I think the balance that you have of the members that are on this committee and the researchers that you have come in here that are explaining everything, I just think it's a great balance. And we can't get everything; I mean we each have our own little areas where it makes it work, I guess. That's my feeling.

DR. NELSON: Yes. I mean I appreciated Kelly's report back and to see what you are going to do with that report. And when will the industrial minerals be done?

DR. KOGEL: I was just writing it down. I think it's unlikely because it takes about a year. But if it is done, we should put it on the agenda. It may not be a written report, but we may be at the point where something could be reported back to the committee. If not, it will certainly be in our Spring meeting. So let's see if we can have a report even if it's not a written report yet.

DR. NELSON: Yes. And I think it would be really interesting maybe to think about going back to Spokane. But because there's things going on, there's broadening of the effort and that might be a good reason to go there. But I would love to have a field trip associated with that too. Be nice to go over to the Silver Valley if we could do that.

DR. KOGEL: Another question I have to the committee about how we've organized this—and I really appreciate Ed's feedback about the engagement of the committee because I felt that the committee was very engaged. And I know since I've been in this position we've tried different things to bring us to the point where we are today. And so I think certainly feedback on what is and isn't working in terms of the time that we're giving for discussion. And this meeting was different than previous meetings because we gave longer periods for presentations and more time for discussion immediately following those presentations, which we had not quite dialed that in correctly in previous meetings. And I think you always felt there was

a lot of information and not enough time for feedback, so—

DR. NELSON: Well, that's why we kept postponing some things—because we couldn't get to them.

DR. KOGEL: So do you all agree that this is good—the 30-minute timeslot?

DR. NELSON: Yes.

OTHERS: Yes.

DR. KOGEL: What that leads to, what I think we had envisioned is that the Fall meeting would be a day meeting and the Spring meeting a day and a half. Which means when we go to the Fall meeting, if we're going to keep those 30-minute timeslots you're going to hear fewer presentations. And I just want the committee to be aware of that. Unless of course everyone says, let's go for a day and a half in the November meeting. So that's always an option if the committee wanted to do that.

MR. ZIMMER: If we're going to travel to the West Coast, let's do that.

DR. KOGEL: Yes. For people who are traveling to Spokane, they may say yes because from the East Coast, it's a day to get there.

MR. ZIMMER: Yes, I've been there about five times and I've never had good luck getting there—

DR. KOGEL: The other thing I want to say to the committee is, again, thank you for all of your feedback. We do have a diverse committee that represents all of our various stakeholder groups. Each of you have different priorities and different perspectives and we need to hear those. And so I really appreciate the—I think we have very honest, open discussion. I appreciate that. And I appreciate of course, as I said when we kicked this meeting off, the time you spend because I know everybody's very busy. And I just want you to know that we find your input extremely valuable and I hope that you see that demonstrated in how we try to be responsive to what you suggest to us and hopefully you can see that showing up in our research, in the strategic plan, in a number of different initiatives that we ask you to advise us on. And we do take that very seriously. So thank you.

DR. NELSON: Did you want to give a briefing on program review?

DR. KOGEL: At the next meeting.

DR. NELSON: Good. Okay, any final comments?

MR. WELSH: I just want to mention one thing as far as the workgroup, that either Todd or I will be the DFO for that. And that person will be calling Kyle, Kray, Ron, Bruce, Mike, Stacy, and Jeff about the first workgroup meeting.

DR. NELSON: But keep us all informed because if it's possible, I would love to go to the meeting.

DR. NELSON: We are adjourned.

Meeting adjourned at 11:45 AM

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

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Priscilla P. Nelson, Chair

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